Taking it to the extremes: understanding the role of assets in older people's vulnerability, resilience and adaptation to extreme temperatures

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Abstract

The emerging risks and impacts of climate change and extreme weather are an increasingly important threat to human health. This poses many challenges and opportunities for individuals and wider society on how to adapt. In response to the presently limited understanding of what shapes human adaptation to extreme temperatures, this thesis critically reviews current literature on vulnerability, resilience and adaptation. It does so, by drawing upon and bringing together the health, environmental science, climate science and sociology literatures to develop a framework for understanding the role of assets in shaping vulnerability, resilience and adaptation, as well as the interactions between these concepts. This thesis contributes to these emerging bodies of research by offering an interdisciplinary exploration and analysis of the factors shaping both general (i.e. daily life circumstances) and specified (i.e. extremely hot and cold temperatures) vulnerability (Brooks, 2003) and resilience (Folke et al., 2010; Miller et al., 2010), as well as adaptation to extreme temperatures.

To address this, empirical data was collected at the individual level using a multimethodological approach. Structured and semi-structured interviews were used to quantitatively and qualitatively implement general and specified measures of vulnerability and resilience. An asset-based approach is used to assess vulnerability and the 'Sense of Coherence' scale is used to explore resilience. The findings derive from an inter-seasonal study (heat in summer, cold in winter) with a diversity of older people living independently in the city of Lisbon (Portugal).

The results indicate that: (1) both general asset portfolio and general vulnerability are threatened by extreme temperatures, which erode specified assets and increase specified vulnerability (older people manifested slightly higher vulnerability to heat than cold); (2) resilience to extreme temperatures was found to be lower than general resilience, with resilience to cold being lower than resilience to heat; (3) adaptation to both heat and cold events is occurring to different degrees, with inequalities, lack of agency and powerlessness constraining and limiting adaptation. Overall, assets were found to be a key determinant of vulnerability, resilience and adaptation. Vulnerability was found not to be a key determinant of resilience, and both vulnerability and resilience were found to be key determinants of adaptation. These findings raise important policy and practice implications, emphasizing opportunities for reducing the health impacts of temperature extremes amongst older people.

Resumo

Introdução

A forma como respondemos às alterações climáticas e aos fenómenos de temperaturas extremas, à escala global, nacional e local é de crucial importância. Grande parte da investigação realizada na área da saúde respeitante a este tópico tem-se restringido ao estudo da mortalidade e morbilidade humana associada à ocorrência de temperaturas extremas. No entanto, começa a existir um interesse crescente em perceber as razões pelas quais estes impactos afetam certos indivíduos mais do que outros. Esta investigação nasceu da constatação dos efeitos nefastos das temperaturas extremas para a saúde humana em Portugal, e em especial para a população idosa do país. Este resumo apresenta conceitos, métodos, resultados e conclusões de uma investigação realizada em Portugal sobre os fatores de vulnerabilidade, resiliência e adaptação às temperaturas extremas e examina oportunidades para a prevenção e redução dos efeitos nefastos das temperaturas extremas para a saúde humana.

O desafio das temperaturas extremas para a saúde humana

De acordo com o Painel Intergovernamental para as Alterações Climáticas (IPCC, sigla em inglês), as alterações climáticas estão já a ocorrer e apresentam riscos para os sistemas humanos e naturais. A frequência, intensidade e duração destes eventos está também a aumentar a nível mundial com diferentes regiões do globo a serem afetadas de forma diferente. Estima-se que a probabilidade de eventos extremos aumentará em cerca de 25% no caso de calor extremo e de 5% no caso de frio extremo, com a região do Mediterrâneo especialmente vulnerável a estas mudanças.

As alterações climáticas, eventos extremos e temperaturas extremas

Nos últimos anos, os impactos do clima e da temperatura na saúde humana e no bem-estar têm recebido crescente atenção. O Quinto Relatório de Avaliação (AR5, sigla em inglês) do IPCC e a Organização Mundial da Saúde (OMS) reafirmaram que o clima e a variabilidade climática afetam negativamente a saúde humana. As temperaturas extremas (calor e frio) são exemplos de alterações climáticas que têm impactos diretos sobre a saúde humana, tanto em termos de mortalidade como de morbilidade, assim como outros efeitos físicos e mentais que afetam o bem-estar geral.

Apesar do seu clima temperado, Portugal tem vindo a ser afetado nos últimos anos por ondas de calor e vagas de frio com elevados impactos para a saúde da população. No entanto, apesar dos impactos de ambos os extremos de temperaturas verifica-se que as ondas de calor tem vindo a ser mais documentadas e investigadas do que as vagas de frio.

Justificação e contribuição desta investigação

Alguns autores argumentam que uma visão global da complexidade das interações entre a ocorrência de temperaturas extremas e os seus efeitos na saúde é fundamental para compreender os conceitos de vulnerabilidade, resiliência e adaptação às alterações climáticas e temperaturas extremas para proteger os indivíduos mais vulneráveis (por exemplo, os mais idosos), mas somente uma abordagem interdisciplinar irá permitir explorar e compreender os vários fatores (físicos, psicológicos, sociais, e ambientais) que contribuem para os seus efeitos na saúde humana. Como tal, entende-se que o papel da sociedade e comunidade não estão ainda suficientemente estudados e que as envolventes ambientais e sociais devem ser melhor investigadas. Neste sentido, esta investigação vem colmatar esta falha e dedica-se a estudar os fatores que influenciam a vulnerabilidade humana, resiliência e adaptação às temperaturas extremas usando uma abordagem holística e interdisciplinar (saúde pública, ciências do ambiente, sociologia do ambiente, psicologia, entre outras).

Apesar do vasto conhecimento sobre os impactos das temperaturas extremas na saúde humana, pouco ainda se sabe sobre os fatores que influenciam a vulnerabilidade dos indivíduos. A resiliência humana é também considerada crucial para compreender como os indivíduos são capazes de responder quando confrontados com temperaturas extremas, assim como a adaptação a estes eventos. A motivação inicial para esta investigação surgiu da vontade de entender: 'Porque alguns indivíduos enfrentam temperaturas extremas e mantêm os seus níveis de saúde e outros não?'. Assim sendo, este estudo explora os fatores e características que tornam os indivíduos vulneráveis e resilientes ao calor e frio extremos e os seus impactos sobre a adaptação aos mesmos. Os objetivos desta investigação incluem, compreender os fatores que influenciam a vulnerabilidade, resiliência e adaptação, assim como ajudar na formulação políticas e ações para reduzir a vulnerabilidade, aumentar a resiliência e melhorar a adaptação às temperaturas extremas.

Métodos

Esta investigação usa uma abordagem multimetodológica integrando métodos provenientes das ciências naturais e humanas para uma melhor compreensão dos fatores que influenciam a vulnerabilidade, resiliência e adaptação a temperaturas extremas. Trata-se de um projeto de investigação exploratória que combina uma perspetiva holística, ecológica e social para explorar as relações entre os três conceitos (vulnerabilidade, resiliência e adaptação). A investigação decorreu em três fases distintas onde se usaram entrevistas estruturadas e semiestruturadas com adultos com 65 ou mais anos de idade a viverem de forma independente na cidade de Lisboa, Portugal. Procedeu-se à recolha de informação sobre os participantes que incluiu: Fase 1 - informação sociodemográfica, saúde e qualidade de vida, habitação, capital social, ambiente; Fases 2 e 3 - experiências, comportamentos quotidianos e as respostas ao calor/frio extremos, obstáculos à adaptação, perceções de vulnerabilidade ao calor/frio extremos, conhecimento dos grupos afetados, perceção de riscos, perturbações diárias durante o calor/frio extremos, capital social, características das habitações durante o calor/frio extremos.

A análise dos dados foi realizada em duas etapas. Durante a primeira etapa da análise, os dados descritivos foram analisados para todas as variáveis incluídas nos protocolos de entrevista, e a segunda etapa consistiu na elaboração de dois índices: o Índice de Vulnerabilidade Geral (IVG) e o Índice de Resiliência Geral (IRG) e na elaboração de matrizes de vulnerabilidade e resiliência ao calor e frio extremos.

Resultados

1) <u>Vulnerabilidade humana a temperaturas extremas:</u>

- Níveis de vulnerabilidade geral moderados;
- Níveis de vulnerabilidade ao frio superiores aos níveis de vulnerabilidade ao calor;
- Reduzida perceção de vulnerabilidade às temperaturas extremas;
- Baixos rendimentos, baixa qualidade das habitações, falta de equipamentos para refrigeração ou aquecimento, e falta de oportunidades para tirar proveito de ações locais;
- Problemas de saúde, níveis de alfabetização baixos, capital social dependente de laços familiares;
- Ser parte de um determinado grupo (idosos) não é um fator determinante para a vulnerabilidade ao calor e frio extremos;
- O calor e frio extremos aumentam a vulnerabilidade geral dos indivíduos, pois aumentam a pressão sobre a disponibilidade e diversidade de recursos (humanos, financeiros, físicos, de base local e sociais) à disposição dos indivíduos para responder a estes fenómenos extremos.

2) <u>Resiliência humana e suas dimensões:</u>

- Resiliência ao calor e frio extremos inferiores à resiliência geral;
- Resiliência ao calor está relacionada com a previsibilidade do calor, a perceção de recursos disponíveis prontos a serem utilizados para responder ao calor extremo investindo em ações disponíveis;

- Resiliência ao frio está associada a apatia e ansiedade relativas ao frio;
- Os idosos acharam difícil estar motivado para lidar com o frio, principalmente devido à falta de recursos disponíveis, nomeadamente financeiros (falta de refrigeração e aquecimento a preços acessíveis), físicos (falta de isolamento térmico das habitações) e recursos sociais (falta de relações e contatos sociais).

<u>Adaptação ao calor e frio extremos:</u>

- Os idosos revelaram diversidade nas estratégias de adaptação implementadas para responder ao calor e ao frio;
- Foram também encontradas restrições e limites à adaptação, bem como oportunidades para melhorar a adaptação dos idosos ao calor e ao frio;
- Adaptar-se a ambos os eventos de calor e frio extremos foi considerado um desafio por parte dos idosos;
- Adaptação ao frio extremo foi considerada mais difícil que a adaptação ao calor extremo, principalmente devido ao estado de saúde dos indivíduos (por exemplo, doença crónica), ou a sua perceção de incapacidade de se adaptar de forma eficaz através das opções que lhes estão disponíveis (acesso a recursos humanos, financeiros, físicos, de base local e sociais);
- Os idosos sentiram que não poderiam fazer mais do que aquilo já faziam para lidar com o calor e frio extremos - embora não fosse suficiente para mantê-los frescos ou quentes, respetivamente – uma vez que existem limites à adaptação;
- A maioria das adaptações implementadas pelos participantes foram consideradas não-tecnológicas e não envolveram o uso de equipamentos elétricos (ventoínhas, aquecimentos). O uso de adaptações tecnológicas não foi generalizada, tanto devido à indisponibilidade de tais equipamentos, como também devido aos custos associados à sua utilização.

<u>Interações entre vulnerabilidade, resiliência e adaptação:</u>

- Os participantes revelaram diversas combinações de vulnerabilidade, resiliência e adaptação;
- Os participantes que revelam níveis relativamente mais baixos de vulnerabilidade e níveis mais elevados de resiliência apresentaram melhores formas de responder ao calor e ao frio extremos (adaptação);
- Os participantes que demonstraram níveis relativamente mais elevados de vulnerabilidade e níveis mais baixos de resiliência eram mais propensos a revelar estratégias e respostas mais limitadas para responder ao calor e frio extremos;

- Os participantes que revelaram maior vulnerabilidade e resiliência tinham esperança de que seriam capazes de responder ativamente ao calor e ao frio, apesar de não terem todos os recursos necessários para isso;
- Os participantes que demonstram relativamente baixa vulnerabilidade e resiliência foram incomuns neste estudo, e eram mais propensos à ansiedade e ao mesmo tempo mostrar apatia para agir;
- Constatou-se uma relação entre vulnerabilidade, resiliência e adaptação com tópicos como, justiça social, equidade e austeridade.

Discussão e conclusões

- <u>Contribuições para a compreensão da vulnerabilidade, resiliência e adaptação humanas às temperaturas extremas</u>

Esta investigação:

1) Faz conexões entre os conceitos de vulnerabilidade, resiliência e adaptação, e os fatores que os influenciam;

2) Oferece uma perspetiva interdisciplinar, multimetodológica e abrangente sobre a vulnerabilidade para a compreensão de como a vulnerabilidade humana é influenciada. A análise realizada neste estudo demonstra que a vulnerabilidade geral é influenciada principalmente por recursos financeiros, seguida de recursos físicos, sociais, humanos e de base local em ordem decrescente. Os principais fatores que influenciam a vulnerabilidade ao calor e ao frio extremos, incluem os recursos financeiros e físicos; e os recursos menos mencionados incluíram os recursos sociais, humanos e de base local.

3) Implementação de uma abordagem para operacionalizar a resiliência humana com o objetivo de compreender como esta é influenciada. A resiliência ao calor é mais frequente do que a resiliência ao frio.

4) Esta investigação sugere que a adaptação a temperaturas extremas é fortemente influenciada pelo contexto e diversidade dos recursos disponíveis e acessíveis aos indivíduos. Adaptações baseadas em recursos humanos foram influenciadas, principalmente, pelo nível de escolaridade e estado de saúde dos indivíduos, enquanto adaptações baseadas em recursos financeiros foram determinadas pelo rendimento disponível e os custos da utilização de equipamentos para refrigeração e aquecimento, bem como a situação financeira passada e atual. Por outro lado, este estudo também revelou que as adaptações com base em recursos físicos traduzidos em melhorias na qualidade da habitação e isolamento térmico, influenciou a capacidade e a habilidade de resposta dos indivíduos. Adaptações baseadas em recursos de base local foram fortemente influenciados pela disponibilidade e vontade de participar nas atividades disponibilizadas pelas Juntas de Freguesia, bem como o custo dos transportes e distância até

infraestruturas públicas (por exemplo, piscinas, jardins, parques). E, adaptações com base em recursos sociais foram surpreendentemente baixas, principalmente devido à falta de amigos e vizinhos próximos, bem como à falta de um sentimento de bairro e de comunidade.

5) A relação entre vulnerabilidade e resiliência não é simples, pois os resultados mostram que os indivíduos podem apresentar alta vulnerabilidade e alta resiliência, assim como baixa vulnerabilidade e baixa resiliência. A vulnerabilidade mostrou-se determinante na adaptação, e os resultados da influência da resiliência na adaptação a temperaturas extremas sugere que a resiliência tem também um papel determinante na adaptação.

6) Proporciona um quadro concetual e analítico, bem como uma abordagem metodológica que pode ser replicada a nível nacional, regional e local, pelas autoridades locais, ONGs, entre outras, para melhor compreender as necessidades, restrições, limites e oportunidades que os idosos possuem em responder a temperaturas extremas, de forma a reduzir a vulnerabilidade, aumentar a resiliência e melhorar a adaptação a temperaturas extremas.

<u>- Contribuições para reduzir os impactos das temperaturas extremas na saúde humana</u>

Os resultados desta investigação, conforme discutido acima fornecem uma gama de contribuições para o desenvolvimento e implementação de políticas e práticas com vista a reduzir os impactos das temperaturas extremas na saúde humana. Estes podem ser alcançados através do planeamento, desenvolvimento e implementação de políticas e ações destinadas a: a) redução da vulnerabilidade; b) aumento da resiliência e; c) melhoria da adaptação. A fim de alcançar estes objetivos, o foco central deverá ser em aumentar os recursos (humanos, financeiros, físicos, de base local e sociais), tanto ao nível do acesso e disponibilidade bem como da qualidade e quantidade de cada tipo de recursos e portfólio de recursos. Uma implicação importante é que estas políticas e ações podem ser sobrepostas e implementadas simultaneamente, mas necessitam de ser centradas em aumentar os recursos à disposição dos mais idosos para reduzir a sua vulnerabilidade, aumentar a sua resiliência e melhorar a sua adaptação a temperaturas extremas.

Recomendações

Em suma, e apesar de se viver numa época de austeridade, o governo, órgãos e entidades de saúde pública e autoridades de assistência social devem trabalhar em conjunto com outras organizações e instituições, incluindo organizações comunitárias e voluntárias para desenvolver prioridades viáveis e garantir que um sistema integrado e uma abordagem centrada nas pessoas é posto em prática para o benefício dos cidadãos mais velhos. Estas políticas e ações devem visar um trabalho conjunto na análise de aspetos e características da vida das pessoas mais velhas que são cruciais para responder a temperaturas extremas, tais como o estado de saúde, a capacidade do indivíduo para saber o que fazer no caso de temperaturas extremas e ser pró-ativo. O conhecimento dos fatores de vulnerabilidade e resiliência pelas equipas médicas e redes sociais em torno dos indivíduos idosos é fundamental neste exercício. O papel dos recursos sociais (por exemplo, o capital social) deve ser mais explorado como uma abordagem viável, eficaz e sem custos para reduzir a vulnerabilidade e aumentar a resiliência para uma melhor adaptação das pessoas idosas às temperaturas extremas. As pessoas idosas devem ser vistas como parte de uma série de redes de: saúde, assistência social, religiosa, vizinhos, família, etc. Além disso, as instituições acima devem também trabalhar em conjunto com o setor privado para enfrentar os desafios do aumento dos custos de energia, falta de qualidade e isolamento das habitações, falta de transporte, entre outros, que os idosos enfrentam nas suas vidas diárias com impactos para a sua saúde, bem-estar e qualidade de vida. Exemplos de recomendações específicas decorrentes dos dados empíricos, com base em exemplos fornecidos pelos participantes nesta investigação sobre as oportunidades para melhorar a sua adaptação a temperaturas extremas podem ser traduzidos para o desenvolvimento de políticas e ações voltadas para a redução da vulnerabilidade, aumentando a resiliência e melhorar a adaptação, são apresentadas de seguida:

• <u>Recursos Humanos:</u>

Educação, competências, conhecimentos: oportunidades decorrentes de educação ao longo da vida, da partilha de conhecimentos e de aprendizagem (por exemplo, Universidade da 3 ª Idade), da comunicação através de diferentes meios de comunicação para uma melhor compreensão dos riscos para a saúde das temperaturas extremas.

Saúde e estado nutricional: oportunidades decorrentes de cuidados de saúde e medicamentos gratuitos para idosos com baixos rendimentos. Desde 2011, com a implementação de medidas de austeridade a atribuição de cuidados de saúde gratuitos a pessoas idosas em Portugal passou a ser decidida tendo em conta não apenas o valor das pensões, mas também das poupanças, existência de casa própria, bem como os rendimentos de outros membros família a viverem na mesma morada que o idoso. Como tal, muitos idosos têm agora de pagar taxas moderadoras o que de acordo com os participantes neste estudo tem levado muitos idosos a ir com menos frequência ao seu médico de família. Como consequência, em vez de servirem como recursos de promoção da saúde e prevenção de doenças, bem como uma forma de operacionalizar o aconselhamento personalizado para os idosos sobre os impactos das temperaturas extremas na saúde, os cuidados de saúde são agora somente usados quando estritamente necessários, e muitas das vezes quando o estado de saúde dos idosos é já bastante precário. Oportunidades adicionais podem também advir de acordos com redes de supermercados para a entrega de alimentos a organizações e instituições que trabalhem com idosos o que contribuiria para a redução da vulnerabilidade financeira dos mesmos.

Trabalho e profissão: oportunidades decorrentes de trabalho voluntário (por exemplo, com outros idosos e intergeracional) na freguesia de residência e comunidade em geral; de cultivar os seus próprios legumes, frutas e ervas em hortas da cidade para consumo próprio, troca ou venda, que poderia aumentar os recursos humanos, financeiros e sociais dos idosos.

• <u>Recursos financeiros:</u>

Rendimentos e pensões: oportunidades para o aumento das pensões mais baixas (259,40 euros/mês) e reduzir as medidas de austeridade para os idosos com pensões baixas.

Despesas: oportunidades para aconselhamento sobre redução de despesas de habitação (por exemplo, água, gás e eletricidade) e de redução dos custos com aquecimento e refrigeração; subsídios por parte de empresas fornecedoras de eletricidade para reduzir as faturas de eletricidade (ou seja, refrigeração e aquecimento a preços acessíveis para os idosos com rendimentos mais baixos).

• <u>Recursos físicos:</u>

Qualidade da habitação e isolamento térmico: oportunidades de incentivos ou subsídios para melhorar a qualidade da habitação e isolamento térmico, instalar aparelhos de ar condicionado e aquecimento. As pessoas idosas têm direito a uma habitação digna e segura, não muito quente ou muito fria durante condições de calor e frio extremos, respetivamente. Como tal, existe uma necessidade de aumentar a qualidade das habitações.

Proprietário ou arrendatário: oportunidades para impor responsabilidades e obrigações aos proprietários para a renovação/reparação de habitações antigas; fazer cumprir as leis e regulamentos de planeamento urbano para melhorar os padrões de construção (por exemplo, isolamento térmico).

Equipamentos e bens: oportunidades para aconselhamento por fontes fidedignas acerca de refrigeração e aquecimento da habitação, para a aquisição e uso generalizado de equipamentos de refrigeração e aquecimento, o que também aumentaria os recursos sociais e humanos dos idosos.

• <u>Recursos de base local:</u>

Acesso a instalações públicas (transporte, infraestruturas públicas): oportunidades decorrentes de transporte gratuito para idosos com baixos rendimentos aumentaria os recursos humanos e sociais.

Acesso a espaços verdes: oportunidades para criar e manter jardins limpos e seguros e parques com sombra, bancos e casas de banho, como uma estratégia de adaptação às ondas de calor, e forma de aumentar a socialização de idosos, garantindo também um aumento dos recursos humanos e sociais.

Qualidade dos serviços e programas públicos: oportunidades decorrentes dos Planos de Contingência para as Ondas de Calor e Vagas de Frio, sistemas de alerta e ações locais para apoiar as pessoas idosas, proporcionando atividades na Junta de Freguesia da área de residência e na comunidade em geral, criando melhores redes de segurança social e proteção social, bancos de alimentos e distribuição de excedentes de alimentos com benefícios para o aumento recursos humanos, financeiros e sociais da população idosa.

Acesso a terra para cultivo: oportunidades para incentivar os idosos a cultivar os seus próprios vegetais, frutas, ervas e aves nos seus jardins e hortas da cidade para consumo próprio, troca ou venda trará aumentos dos recursos humanos, financeiros, bem como dos recursos sociais.

• <u>Recursos sociais:</u>

Relações sociais, redes sociais e de suporte: oportunidades decorrentes do desenvolvimento e fornecimento de sistemas de apoio ao nível da vizinhança e comunidade na freguesia de residência, de receber conselhos de profissionais de saúde e assistência social e dar conselhos aos familiares, vizinhos e amigos, com resultados positivos para os recursos humanos das pessoas idosas.

Participação social e atividades: oportunidades decorrentes de atividades comunitárias durante todo o ano (incluindo os meses mais quentes e meses mais frios) para pessoas idosas e participação intergeracional, também oferecem oportunidades para aumentar os recursos físicos.

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List of Acronyms

AR5	Assessment Report Five from the IPCC (2014)
CCC	Committee on Climate Change
CO	Comprehensibility
CRR	Cold-Related Resilience
CRV	Cold-Related Vulnerability
CSDH	Commission on Social Determinants of Health
CSVM	Coefficients of Seasonal Variation in Mortality
DFID	Department for International Development
DoH	Department of Health
DROP	Disaster Resilience Of Place
EC	European Commission
EU	European Union
EUSILC	European Union Statistics on Income and Living Conditions
EWM	Excess Winter Mortality
EWDs	Excess Winter Deaths
FA	Financial assets
GIS	Geographic Information Systems
GP	General Practitioner
GRI	General Resilience Index
GRRs	Generalized Resistance Resources
GVI	General Vulnerability Index
HA	Human assets
HIV	Human Immunodeficiency Virus
HRR	Heat-Related Resilience
HRV	Heat-Related Vulnerability
IMF	International Monetary Fund
INE	Instituto Nacional de Estatística
IPCC	Intergovernmental Panel on Climate Change
IPPR	Institute for Public Policy Research
MA	Manageability
ME	Meaningfulness
NHS	National Health Service
NGO	Non-Governmental Organization
OECD	Organisation for Economic Cooperation and Development
OPSS	Observatório Português dos Sistemas de Saúde
PA	Physical assets
PBA	Place-based assets

SA	Social assets
SLA	Sustainable Livelihoods Approach
SOC	Sense Of Coherence
SREX	Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation of the IPCC (2012)
UK	United Kingdom
UKCIP	UK Climate Impacts Programme
UNISDR	United Nations Office for Disaster Risk Reduction
USSR	Union of Soviet Socialist Republics
WHO	World Health Organization
WMO	World Meteorological Organization

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‘When the winds of change blow,

some people build walls and others build windmills’.

(Chinese proverb)

Chapter 1 - The challenge of extreme temperatures for human health

1.1 Climate change, extreme events and extreme temperatures

According to the Intergovernmental Panel on Climate Change (IPCC, 2014a), climate change is occurring and posing risks to both human and natural systems. Furthermore, the Royal Society (2014) asserts that demographic changes such as an ageing population are likely to increase the exposure to and impacts of extreme weather (i.e. heatwaves) on older people (aged 65 and over). As a result, it calls for policies and actions focusing on protecting people and their assets from extreme events (Royal Society, 2014). It has been estimated that the effect of increases in temperature means and variability has impacts on the likelihood of extreme temperature events (Keim, 2008; IPCC, 2014a) by nearly 25% increase in the case of extremely hot days and by 5% increase in the case of extremly cold days (McMichael et al., 2006), with the Mediterranean region being especially vulnerable to these changes (Giorgi and Lionello, 2008).

The IPCC defines a heatwave or extreme heat event as 'a period of abnormally hot weather.' (IPCC, 2012: 560), for which the frequency, intensity and duration is increasing globally (Menne and Ebi, 2006; Santos and Miranda 2006; Goodess, 2013; IPCC, 2014a). Regions of the globe are affected differently by extreme heat, but the Tropic and Mediterranean regions have been the most affected by increases in the frequency and intensity of these events and more increases are projected for the near future (Coumou and Robinson, 2013). The vulnerability of the European Continent to the health impacts from heatwaves is high (WHO, 2004), with examples spanning the prolonged heat of summer 2003 (Schar et al., 2004; Stott et al., 2004; Trigo et al., 2005; Trigo et al., 2006), summer 2006 (Rebetez et al., 2009), summer 2007 in Greece (Founda and Giannakopoulos, 2009) and summer 2010 in Russia (Trenberth and Fasullo, 2012). In addition, Southern European and Mediterranean coastal regions are projected to be more severely affected by the health impacts of extreme heat (Fischer and Schar, 2010). Furthermore, the western region of the Mediterranean has witnessed more pronounced shifts since the middle of the 1970s (Efthymiadis et al., 2011) with warming temperatures in the Mediterranean region of between +1.1°C and +6.4°C (Magnan, et al., 2009). As such, Fischer and Schar (2010) projected an increase of heatwave days in this region from around 2 days every summer between 1961-1990 to about 13 days between 2021-2050 and for the period 2071-2100 of 40 days.

The IPCC (2012; 2014b) does not offer a definition of cold spell or extreme cold events. Despite this, following the IPCC definition of heatwave or extreme heat event provided above (IPCC, 2012), in this research cold spell or extreme cold event is defined as a period of abnormally cold weather. Notwithstanding evidence of the increase of global and regional temperatures (Giannakopoulos and McCarthy, 2008; IPCC, 2014a) cold spells still occur and constitute a particular issue in the Northern Hemisphere (Confalonieri et al., 2007; Mori et al., 2014). Even though cold spells are usually more frequent in countries in higher latitudes, they also occur in countries in mid-latitudes with milder winters, were the population is less acclimatised to cold weather (Eurowinter, 1997; Healy, 2003; Gascoigne et al., 2010). As an example, high and mid-latitude countries experienced cold spells during the 2003, 2006, 2010 and 2012 winters (Petoukhov and Semenov, 2010; Mazick et al., 2012; Semenov, 2012) with increased mortality in the older adult population (Mazick et al., 2012). Observational analysis undertaken by Francis and Vavrus (2012) on the recent heatwaves and cold spells, found that an increase of frequency and intensity of both extremes (heat and cold) could be due to Arctic amplification,

> 'the observed enhanced warming in high northern latitudes relative to the northern hemisphere' (Francis and Vavrus, 2012: 1).

The relationship between the reduction of Arctic sea ice and these extremely cold winters was found in Europe and other parts of the Northern Hemisphere (e.g. Asia), suggesting that according to climate projections, additional reductions in Arctic sea ice may be linked to changes in the North Atlantic circulation patterns, increasing the probability of more frequent extreme cold events in the future (Liu et al., 2012; Mori et al., 2014). As such, projections of warming temperatures by the IPCC (2014a) are thought to lead to decreased frequency of extreme cold events with moderate decrease in both morbidity and mortality related to cold.

1.2 The health impacts of extreme temperatures

In recent years the impacts of climate and temperature on human health and wellbeing have been receiving increased attention. Both the Fifth Assessment Report (AR5) of the IPCC and the World Health Organization (WHO) have reaffirmed that weather, climate and climate variability negatively affect human health (WHO, 2012a; IPCC, 2014a). Significant human vulnerability and exposure to extreme events has thus resulted in increased impacts on mortality and morbidity, as well as effects on mental health and well-being (WHO, 2012a; IPCC, 2014a). In Europe alone, extreme temperatures are responsible for 94% of all deaths due to climatic, hydrologic and meteorological extremes, despite not being the most frequent events (17%) (WMO, 2014).

Extreme temperatures (extreme heat and cold) are an example of a changing climate that is increasing risks to human health (Romero-Lankao et al., 2012) due to thermal stress (e.g. illness, injury, death) (McMichael et al., 2006). Extreme temperatures have direct impacts on human health both in terms of mortality and morbidity (WHO, 2004; Confalonieri et al., 2007; CSDH, 2008; Giannakopoulos et al., 2008; Falagas et al., 2009), as well as other physical and mental effects, affecting overall wellbeing. Furthermore, human health is affected by the exposure (direct and/or indirect) to climate change as well as through social and economic disturbances occurring on environmental, social and health system characteristics (Confalonieri et al., 2007). Older people, children, pregnant women, individuals with chronic diseases, individuals with low income are those most vulnerable to climate change generally and extreme temperatures specifically (Balbus and Malina, 2009; CCC, 2014). A study conducted in the UK by Hajat and colleagues (2007) investigating the population groups most at risk from extreme temperatures (both heat and cold) confirmed that individuals aged 65 years or older are the most at risk from suffering health effects (morbidity and mortality). Within this age group, health status (chronic disease), sex (menopause), marital status, living arrangements (nursing homes, care home, independent living) and social factors are some of the key determinants of risk (Kovats and Ebi, 2006; Belmin et al., 2007; Bouchama et al., 2007; Hajat et al., 2007).

1.2.1 Extreme heat impacts on health

Extreme heat is posing increasing threats to human health (Kovats and Ebi, 2006; Menne and Ebi, 2006; Kovats and Hajat, 2008; Hajat et al., 2010; IPCC, 2012; WHO, 2012a). Heatwaves result in excess of deaths (Calado et al., 2004; Yohe and Ebi 2005; VandenTorren et al., 2006) and changes in the patterns of morbidity, often measured in terms of increased numbers of hospital admissions especially in the older population (e.g. Nogueira et al., 2009), mainly related to heatstroke, heat exhaustion, dehydration, cardiovascular diseases, respiratory diseases and cancer (Calado et al., 2004; Nogueira et al., 2005a; Kjellstrom and McMichael, 2013; DoH, 2014a). Physiologically, when faced with extreme heat the human body reacts by an increase blood circulation towards the skin in order to keep to cool, resulting in more strain on the heart which can result in heart failure in individuals such as older people and those with chronic illness (DoH, 2014a). An array of factors have been linked to increased risk of illness and death during extreme heat, namely old age, chronic illness, children, homelessness, people with alcohol and drug problems, among others (DoH, 2014a). It is important, however, to acknowledge that for example in the case of the older population they do not constitute a homogeneous group, and individual and social factors contribute differentially to their vulnerability (Hajat et al., 2007).

Despite the impacts of heat being very well documented in the literature, Yardley and colleagues (2011) argue that an overview of the complexity of the interactions of the effects on health from extreme temperatures is needed through an interdisciplinary approach to allow the opportunity to explore and understand the multiple factors (e.g. physical, psychological, social, environmental) contributing to health outcomes. As such, these authors state that the role of society and community is still inadequately understood and that individual and social environments should be further researched as they can be both protective and harmful influences on health (Yardley et al., 2011). Additionally, the Royal Society (2014) has urged for more interdisciplinary research aimed at better understanding how individuals are impacted by extremes in order to protect them and their assets. This research addresses this issue by exploring the factors that shape human vulnerability and resilience to extreme heat using an interdisciplinary and holistic approach.

Moreover, many authors have called for more research on the range of behavioural responses to heat implemented by individuals to understand their effects in reducing the impacts of extreme heat and support effective climate change interventions (Adger, 2001; Menne et al., 2006; Vandentorren et al., 2006; Abrahamson et al., 2008; Wolf et al., 2010). Understanding the factors shaping adaptation to extreme heat is also explored here. Taking into account projections of warming temperatures, determining strategies and actions for reducing the risks and impacts from heatwaves should be used as prevention and adaptation measures (Kjellstrom and McMichael, 2013). This is crucial, as extreme heat impacts on health (i.e. morbidity and mortality) are preventable and avoidable through actions aiming at reducing the most prominent health risks (Conlon et al., 2011; DoH, 2014b). As an example, the Heatwave Plan for England 2014 (DoH, 2014b) considers three main heat-health key messages and corresponding actions to reduce health risks. Such actions focus on the individual level and include staying out of the heat, cooling oneself and keeping the indoor environment cool, through staying indoor during the hottest hours of the day, walk in the shade, wear light clothing, drink cool water and eat cold food, have a shower, close windows during the day if hotter outside, stay in a cool room, among others (DoH, 2014b).

Other authors have also considered other measures which could include warning systems, improving indoor ventilation, education and information, and the use of air conditioning (O'Neill et al., 2009). In addition, Astrom and colleagues (2011) also suggest that research is needed to address the underlying factors responsible for the effects of heat, such as the effects of housing and the urban environment in heat associated illnesses and deaths in older adults which according to them are not having the necessary attention, which this research aims to address. On the other hand, authors like Wisner and colleagues (2004) consider that health at the individual level is very much related to the capacity to deal with stresses in daily living and that is an essential measure of individual resilience when facing disruptions like heat and cold stress. Thus, resilience in the face of disruptions and threats is then thought to be dependent on the availability of skills to deal with that situation by using individual physical and psychological resources and attributes (Bankoff et al., 2004) enabling individuals to adapt. As such, this research will also explore the factors shaping heat-related vulnerability, resilience and adaptation, and the links between these concepts.

This research makes contributions to theory, policy and practice. It offers a conceptual and analytical framework for understanding the role assets play in shaping human vulnerability, resilience and adaptation, as well as a broad range of opportunities for reducing the human impacts of extreme temperatures through a focus on increasing assets, for reductions in vulnerability, increases in resilience and improvements in adaptation to extreme temperatures.

1.2.2 Extreme cold impacts on health

In the past, extreme cold and its impacts on health had generally been lacking equal attention from the scientific community when compared with those of extreme heat, as cold was not considered to be an important risk factor for health impacts in terms of both mortality and morbidity (Mercer, 2003). This was due to the fact that heatwaves have become more frequent (Menne and Ebi, 2006; Santos and Miranda, 2006; Goodess, 2013; IPCC, 2014a) and have thus received more attention from both governments and scientists, but culturally in many countries extreme cold has been an important issue (e.g. Healy, 2003; Analitis et al., 2008). As an example, in 2010 the Department of Health in England started issuing cold weather guidance acknowledging that winter mortality in England was much higher (45% higher) than in colder countries like Finland (DoH, 2010). Evidence has also shown that extreme cold mortality is higher than extreme heat mortality, for example, in the United States of all deaths caused by weather-related events between 2006 and 2010, about 31% were attributed to extreme heat and 63% were attributed to extreme cold (Berko et al., 2014). Another example is a study from the Netherlands in which, excess mortality between 1979 and 1997 due to extreme heat was 12.1% and excess mortality due to extreme cold was 12.8% (Huynen et al., 2001). In Portugal, excess mortality due to extreme heat in the aftermath of the 2003 heatwave reached 43% with older people being the most affected with excess mortality of 89% (Calado et al., 2004). Despite this, researchers in Portugal have not yet established the impacts of cold in excess deaths, making excess winter deaths (EWDs) a generally ignored health problem (Casimiro et al., 2006; Vasconcelos et al., 2011). As a result, this study aims to combine research on human vulnerability, resilience and adaptation to both extreme heat and extreme cold.

Furthermore, European countries with milder winters (e.g. Portugal, Spain, Malta, United Kingdom and Ireland) are the ones with higher excess mortality compared with countries experiencing colder winters (e.g. Germany and Finland) (Eurowinter, 1997; Healy, 2003; Falagas et al., 2009; DoH, 2010; Gascoigne et al., 2010; Fowler et al., 2014), suggesting that individuals are less capable to adapt and less able to engage in protective behaviours when faced with extreme cold (Mercer, 2003; Hajat et al., 2007; DoH, 2011). The phenomenon of higher excess winter mortality in countries with warmer winters is called the paradox of winter mortality (Healy, 2003) and brings attention to the importance of other factors besides temperature in the excess of deaths, such as cultural factors (DoH, 2010). Many factors are thus deemed to be related to an increase of cold-related diseases and deaths. Population and individual characteristics, housing, behavioural, inequalities, deprivation, income and health factors are presented as some of the most important (Healy, 2003; Davie et al., 2007; DoH, 2011; Hales et al., 2013). It has also been found that some regions and countries have specific housing characteristics (i.e. thermal inefficiency, age of property, tenure) that provide poor protection against the cold, which is associated with higher winter mortality (Eurowinter, 1997; Keatinge et al., 2000).

Moreover, thermally inefficient housing is considered to increase cold-related risks. In this matter, the World Health Organization (2007) in a review report on housing, energy and thermal comfort recommended a minimum indoor temperature of 21°C in living rooms and 18 °C in other rooms. The most at risk from cold homes include older people aged 65 years or older but not all are affected in the same way, given the differences in the determinants of risk within this heterogeneous group (Hajat et al., 2007) and in their coping abilities and strategies (Hassi et al. 2005). According to the Cold Weather Plan for England 2013 extreme cold has a direct impact on health translated into increased probability of respiratory and cardiovascular diseases, falls and injuries, as well as hypothermia with older people, those chronically ill, children and homeless as those more at risk from feeling the impacts of extreme cold (DoH, 2013).

In addition, beside individual factors, other characteristics influence how cold-health risks are distributed for example, housing and economic factors (e.g. fuel poverty, lack of housing insulation), as well as behavioural factors (e.g. inability to stay warm) (DoH, 2013). As a result, in order to reduce the health impacts of extreme cold, actions focusing on improving the wider determinants of health (e.g. fuel poverty, social isolation), making health improvements (e.g. diet, well-being, fall and injuries in old age), and reducing premature deaths have been implemented (DoH, 2013). Furthermore, Fowler and colleagues (2014) call for more research on the personal, social and environmental factors deemed to contribute to such excess of winter deaths, and argue that more research is needed in understanding the differences within and between countries.

Indoor and outdoor temperatures have different effects on health and need to be dealt with in different ways (Rudge and Gilchrist, 2005; Wilkinson et al., 2007). The relationship between outdoor temperature conditions and excess winter deaths is broadly accepted (e.g. Rudge and Gilchrist, 2005) and some authors have even advanced that cold-related mortality can be as or more strongly related with indoor than with outdoor conditions (e.g. Wilkinson et al., 2007). Despite this, there is still lack of acknowledgment of the relationship between morbidity and mortality with cold homes and fuel poverty (Rudge and Gilchrist, 2005). According to the UK's Department of Health (2010) it is extremely important to stay warm both in outdoor and indoor environments, as protective behaviours and the use of adequate clothing are known to reduce the impacts of cold weather. Notwithstanding, there is a lack of research on how individuals most at risk like older people protect themselves from very cold weather (Gascoigne et al., 2010). In addition, Healy (2003) and Fowler et al. (2014) call for more research in countries with milder winters but high excess winter mortality (EWM) to tackle the lack of awareness by individuals and public authorities of the risks of cold weather associated with housing quality and insulation, deprivation and fuel poverty (Healy, 2003).

As seen above, climate change, extreme events and extreme temperatures pose serious risks to human health that need to be tackled in order to reduce its impacts to human health. Older people are considered to be particularly vulnerable to extreme temperatures (Semenza et al., 1996; Naughton et al., 2002; Haines et al., 2006; Kovats and Kristie, 2006; Vandentorren et al., 2006; Bouchama et al., 2007; Hajat et al., 2007; Astrom et al., 2011; Mazick et al., 2012) but most research on vulnerability has been mainly done by epidemiologists in the field of health through research into morbidity and mortality (Astrom et al., 2011). On the other hand, in the climate change literature, research on vulnerability has predominantly focused on exploring the factors that contribute for the observed impacts of extreme temperatures (e.g. Kelly and Adger, 2000).

As a result, vulnerability assessments have since in some instances started to measure the availability of assets and acknowledge access to assets as important factors in understanding vulnerability (Birkmann et al., 2010). Notwithstanding, few have been interdisciplinary approaches developed to understand the role of assets in shaping vulnerability (Fussel, 2007a), despite the use of asset-based approaches in disciplines such as the health sciences, economics and sociology (Alwang et al., 2001). As such, shortfalls of current approaches and disciplinary boundaries (Astrom et al., 2011) need to be addressed through comprehensive and interdisciplinary investigations in order to increase our understanding of what shapes vulnerability to extreme temperatures, which is what this research aims to achieve.

In addition, extreme temperatures change the resilience of individuals with impacts to their capacity to adapt and consequences for their vulnerability (IPCC, 2012). Issues of human resilience have been brought to light calling for an increase in the resilience of individuals as a way of reducing the impacts of climate change (IPCC, 2012). A variety of tools and measures to assess resilience have been developed (Leichenko, 2011; Martin-Breen and Anderies, 2011) in various disciplinary fields, with the field of human health being particularly interested in the resilience of individuals (Brown and Westaway, 2011). The salutogenic approach and the 'Sense of Coherence scale' have been used within the public health arena as quantitative measures of resilience in contexts other than climate change and extreme temperatures (Almedom, 2008; Glandon et al., 2008; Kimhi et al., 2010). Again, disciplinary boundaries result in different conceptualizations of resilience with few attempts to provide interdisciplinary insights on how human resilience is shaped (IPCC, 2014c) which correspond to a great opportunity for improving current knowledge which this research also embraces.

Furthermore, knowledge on older people's adaptation to extreme temperatures is also incomplete regarding the factors shaping adaptation behaviours and strategies (Fuller and Bulkeley, 2013) which links with shortcomings mentioned above regarding vulnerability and resilience. Additionally, the concepts of vulnerability, resilience and adaptation have emerged and evolved from different disciplinary perspectives with a growing number of studies having explored the theoretical linkages between these concepts (Nelson et al., 2007; Vogel et al., 2007; Miller et al., 2010; Turner, 2010). Despite this, studies investigating the operational and analytical relationship between vulnerability, resilience and adaptation are still few. Through this thesis it becomes clear that there is a need for better understanding how vulnerability, resilience and adaptation are shaped. It is thus argued here that an opportunity exists for empirical research exploring the role of assets in shaping vulnerability, resilience and adaptation, as well as the interactions between these concepts through a novel theoretical and analytical multiconceptual framework rooted in an interdisciplinary perspective, which this research undertakes.

1.3 Thesis justification and contribution

Research focusing on understanding the concepts of human vulnerability, resilience and adaptation to climate change and extreme temperatures has seen a growing interest in recent decades with the aim of reducing its health impacts on individuals, especially regarding the most vulnerable (e.g. older people). Even though broad knowledge on impacts exists, less is known about the factors that shape individual vulnerability to extreme temperatures (e.g. Astrom et al., 2011). Resilience is also deemed important in understanding how individuals are able to act when faced with extreme temperatures (e.g. Kjellstrom and McMichael, 2013), and adaptation to such events will be essential for individuals to reduce impacts and keep healthy (e.g. IPCC, 2014d). Despite this, research on the factors involved in adaptation, its constraints and limits, as well as opportunities is scarce (e.g. IPCC, 2014d). As such, exploring human vulnerability, resilience and adaptation is key in shaping individual responses to extreme temperatures and may help develop and implement policies and actions to reduce vulnerability, increase resilience and improve adaptation, which are aims of this research.

The aim of this thesis is thus to offer an interdisciplinary approach and advance knowledge on what shapes individual vulnerability, resilience and adaptation to extreme temperatures (heat and cold). This thesis also aims to contribute to improve understanding of human general and specified (extreme heat and cold) vulnerability and resilience, as well as adaptation to extreme temperatures, the factors that help shape them and the linkages between these three concepts. It examines the factors and characteristics that make individuals vulnerable and resilient to both extreme heat and cold temperatures and the impacts on adaptation by drawing upon and bringing together different literatures.

1.4 Research themes and research questions

The overall aim of this thesis is to offer an interdisciplinary approach for exploring what shapes general and specified (i.e. extreme heat and extreme cold) vulnerability and resilience, as well as adaptation to extreme temperatures and understand the linkages between these concepts. It does so, by exploring four research themes (vulnerability, resilience, adaptation and the interactions between the three concepts) expressed through respective research questions, which are detailed below:

- *Research Theme 1 and research questions: Vulnerability*

The first research theme relates to general and specified (i.e. heat- and cold-related) vulnerability. This theme focuses on the factors that shape vulnerability (whole sample and individual participants) by considering different types of assets (i.e. human, financial, physical, place-based and social assets). It also considers ways in which human vulnerability can be reduced to mitigate the health impacts of extreme temperatures.

1. Do different assets affect general, extreme heat and extreme cold vulnerability of older people? If so, what are their effects and how do they occur?

1a) How and why do levels of vulnerability differ between older people?

1b) How is vulnerability expressed?

1c) What types of assets are available to older people? How diverse are the assets?

1d) Why and how do assets contribute to and shape vulnerability?

- *Research Theme 2 and research questions: Resilience*

The second research theme focuses on general and specified (i.e. heat- and cold-related) resilience. It seeks to develop a framework for understanding what shapes human resilience and for considering ways to increase the resilience of individuals to extreme temperatures.

2. How are general, extreme heat and extreme cold resilience of older people shaped?

2a) To what extent do cognitive, instrumental or behavioural and motivational dimensions of resilience contribute to the resilience of older people?

2b) Do levels of resilience differ between older people, and if so who is resilient, and why?

- *Research Theme 3 and research questions: Adaptation*

The third research theme assesses the adaptation strategies and behaviours implemented by individuals in responding to extreme temperatures. It also considers constraints and limits as well as opportunities to increase adaptation to extreme temperatures by exploring older people's views on what can be done to improve how they deal with extreme heat and extreme cold.

3. What does adaptation to extreme heat and extreme cold look like in practice?

3a) What strategies do older people use to respond to extreme temperatures, and what can be done to help older people respond better to them?

3b) How do older people use assets for adaptation to extreme temperatures? What types of assets are important?

3c) What is the role of vulnerability and resilience in responding to extreme temperatures?

3d) How do adaptations differ between older people?

- *Research Theme 4 and research questions: Interactions between vulnerability, resilience and adaptation*

The fourth and final research theme offers a framework for exploring the linkages between vulnerability, resilience and adaptation. It assesses the relationships between these three concepts and the overall role of assets.

4. How do vulnerability and resilience interplay with adaptation to extreme temperatures and what is the nature of these relationships?

4a) How and why do levels of combined vulnerability and resilience differ between older people?

4b) To what extent do lower vulnerability and higher resilience contribute to increasing adaptation?

1.5 Methodological approach

The research questions above are answered through an interdisciplinary and multimethodological case study with older people in the city of Lisbon, Portugal. The first research question is investigated through the exploration of assets, the second through the implementation of the 'Sense of Coherence' approach, the third question is answered by exploring the actions and responses individuals implement during extreme heat and cold temperatures, while the fourth question is answered by integrating the findings regarding general and specified (extreme heat and cold) vulnerability and resilience, as well as adaptation to extreme temperatures.

This thesis' originality and contribution to knowledge and research lie at three levels:

1) at the theoretical level it rests in the interdisciplinary links regarding the concepts of vulnerability, resilience and adaptation; it offers a novel perspective in terms of the literature it draws upon and combines (i.e. health sciences, environmental sciences, sociology and development);
2) at the methodological level its interdisciplinarity allows the development and implementation of a novel multimethodological approach for assessing human general and specified (i.e. extreme heat and extreme cold) vulnerability and resilience; it offers a novel approach in terms of the methods used to assess vulnerability and resilience through the development of indices, which in the case of resilience has been attempted for the first time using the Sense of Coherence scale, and;
3) at the empirical level it explores human vulnerability, resilience and adaptation in the city of Lisbon, Portugal, where impacts of extreme temperatures on older people are widespread yet

there is a lack of research regarding these aspects; it offers novel empirical findings and ability for comparing and contrasting general, extreme heat and extreme cold vulnerability and resilience findings, and adaptation to both extreme heat and extreme cold. This thesis also explores opportunities for the design of health and social strategies arising from older people's views that if implemented could reduce vulnerability, increase their resilience and improve their adaptation to extreme temperatures.

The subsequent section defines the structure and content of the thesis.

1.6 Thesis overview

An overview of the remaining seven chapters that comprise this thesis is provided here. **Chapter 2** provides details on the theoretical component of the thesis by focusing on the conceptualisation and meaning of the key concepts relevant to this thesis (i.e. assets, vulnerability, resilience and adaptation), explores and critically reviews the human health, climate and sociology literatures regarding such concepts. The rationale for the use of an interdisciplinary and multimethodological approach to assets, vulnerability, resilience and adaptation to extreme temperatures in then justified. The concept of vulnerability is explored through an asset-based approach, were assets are introduced as ways to measure vulnerability. The concept of resilience is discussed and the Sense of Coherence approach is introduced to assess resilience. Adaptation to extreme heat and cold temperatures is investigated through the strategies and behaviours individuals implement in response to temperature extremes. In addition, constraints, limits, as well as opportunities for improving adaptation are uncovered by exploring older people's perspectives. From the literature review, four key research questions are advanced. This chapter especially focuses on laying the foundations for the development of a conceptual and analytical framework linking assets, vulnerability, resilience and adaptation in this research (Figure 1.1).

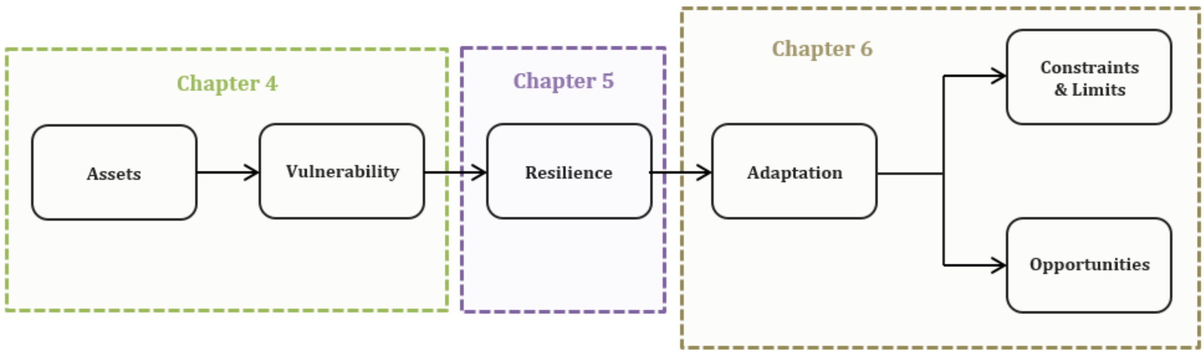


Figure 1.1 Chapter structure linking assets, vulnerability, resilience and adaptation in this thesis.

Chapter 3 introduces and outlines the development of the research design and methods implemented in this study. It presents the rationale for the multimethodological approach used, providing details on the practical aspects of the implementation of the research context, location, sample, as well as data collection and analysis procedures. The chapter finishes by providing a reflection on ethical considerations of doing research with older people, and research limitations.

Chapter 4 presents the results regarding the first research question. In this chapter, the characteristics of older people and their surrounding environments are explored to better understand what shapes their vulnerability, both general and specified (extreme heat and cold). It does so by investigating overall sample and individual participants' vulnerability. Assets are used to assess vulnerability and understand the specificities and links between general and specified vulnerability. Vulnerability assessments include the development of a quantitative General Vulnerability Index (GVI) and of qualitative Heat- and Cold-Related Vulnerability (HRV and CRV, respectively).

Chapter 5 addresses the second research question and explores general and specified (extreme heat and cold) resilience by investigating overall sample and individual participants' resilience. It does so through the use of the 'Sense of Coherence' approach to assess resilience. The Sense of Coherence scale is used to quantitatively assess general resilience (GRI) and a qualitative approach is used to assess specified (extreme heat and cold) resilience (HRR and CRR, respectively).

Chapter 6 presents the findings related to the third research question through the identification of adaptation responses older people use to deal with both extreme heat and extreme cold, exploring the dynamics of these adaptations and the factors that constrain and limit their actions. A focus is given to the determinants of adaptation and opportunities for enhancing adaptation through the eyes of older people. Parallels between adaptations to extreme heat and cold temperatures are also presented through overall sample and individual participants' perspectives.

As the penultimate chapter of this thesis, **Chapter 7** draws on the data from Chapters 4 to 6 to integrate and present a synthesis of the thesis findings on general and specified (extreme heat and cold) vulnerability, resilience and adaptation to extreme temperatures through a combined outlook looking at the interactions between the three concepts both at the overall sample and individual participants' levels.

Finally in **Chapter 8** the main findings presented in Chapters 4 to 7 are discussed as four key findings of this research. The limitations and implications to theory and research, future research directions and implications for policy and practice are also drawn. This chapter also presents final concluding remarks advanced by this thesis.

Chapter 2 - A conceptual framework for vulnerability, resilience and adaptation

2.1 Introduction

This chapter reviews the research carried out to date on human vulnerability, resilience and adaptation to extreme temperatures. Section 2.2 investigates the vulnerability literature exploring the relevance of assets and the livelihoods approach for assessing vulnerability. Section 2.3 then reviews the literature on resilience and examines the sense of coherence approach for assessing human resilience. This is followed in Section 2.4 by a review of the concept of adaptation and in Section 2.5 by the relationships between vulnerability, resilience and adaptation, with regard to the strategies and actions individuals use to respond to extreme temperatures. In Section 2.5 a conceptual framework linking vulnerability, resilience and adaptation is developed and presented, which will be the thread that binds this thesis together.

Throughout this chapter knowledge gaps are identified as it lays the foundations for developing a multiconceptual and multimethodological approach for combining the concepts of vulnerability, resilience and adaptation in a novel way. This approach is outlined in Chapter 3.

2.2 Vulnerability

This section first examines different uses of the concept of vulnerability (Section 2.2.1), followed by a review and critique of existing literature on vulnerability to extreme temperatures amongst older people (Section 2.2.2). Tools and measures to assess vulnerability are examined in Section 2.2.3. Then the concept of assets is documented as a framework that brings together different perspectives on, and bridges the gaps found in this review in vulnerability assessment (see Section 2.2.4).

2.2.1 Definitions and interpretations of vulnerability

The origins of the word vulnerability can be traced to Latin, firstly to the word *vulnus* (wound), then to the word *vulnerabilis* (to be wounded) (Kelly and Adger, 2000) and later in 1767 to the word *vulnerable* (Online Etymology Dictionary, 2014). Since then, the concept of vulnerability has been widely used across different disciplines: in psychology, economics, engineering, sociology, anthropology, disaster management, environment and health/nutrition literatures, among others (Alwang et al., 2001; Adger, 2006; Gaillard, 2010). Unsurprisingly, there are many ways in which vulnerability is understood and used. This multiplicity of considerations has allowed vulnerability to become a highly contested concept where no single definition exists, leading it to mean different things when used in a variety of contexts. As a result, different meanings of vulnerability have implications for the interpretation of the resulting outputs or outcomes of vulnerability assessments (discussed in Section 2.2.3). The purpose of this section is thus to explore the various conceptualisations of vulnerability in order to define how and why it will be used in this thesis.

In the climate change literature, vulnerability is viewed either as the extent of (potential) damage a system faces due to a particular event, or as an inherent state of a system before any given event (i.e. Brooks, 2003; Adger, 2006; IPCC, 2014a). Recently, the concept of vulnerability has been defined as

> 'the propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts including sensitivity or susceptibility to harm and lack of capacity to cope and adapt' (IPCC, 2014a: 28).

On the other hand, in the disaster literature, the concept of vulnerability has been defined as

> 'the conditions determined by physical, social, economic, and environmental factors or processes, which increase the susceptibility of a community to the impact of hazards.' (UNISDR, 2004: 16).

In their review paper, Alwang and colleagues (2001) explore the different conceptualisations of vulnerability in a number of disciplines. According to these authors, in the economics literature vulnerability is conceptualised as the outcome of a process of responses, measured as the variability in outcomes helped by insights from poverty dynamics, asset-based approaches, sustainable livelihoods and food security literatures (Alwang et al., 2001). On the other hand, Alwang et al. (2001) assert that the sociology/anthropology literature on vulnerability argues that factors such as capabilities are involved in poverty and thus they are mostly interested in identifying the poor, understanding the causes of social vulnerability and identifying vulnerable groups (Alwang et al., 2001). Table 2.1 presents selected definitions of vulnerability according to disciplinary fields. A critical insight in this matter is given by Chambers (2006). He argues that the use of the concept of vulnerability is in many cases equivocal; the term is used as a substitute for other concepts such as poverty, but asserts that vulnerability 'is not the same as poverty' and additionally makes links between vulnerability and assets (Chambers, 2006: 33). Asset approaches are those that consider assets as resources or capital that individuals have available to them in responding to daily life circumstances (see Section 2.2.4.1 for further details) In the health literature, the concept of vulnerability has been mostly used in epidemiology as an outcome of climate change and extreme temperatures, measured through mortality and morbidity rates (e.g. Hajat et al., 2007). The WHO has taken a very similar approach to the IPCC's and defined vulnerability as

> 'the susceptibility of a population or region to harm' (WHO, 2011: 2) and as 'the degree to which individuals and systems are susceptible to or unable to cope with the adverse effects of climate change.' (WHO, 2003: 28).

Additionally, according to the WHO vulnerability

> 'results from exclusionary processes related to inequities in power, money and resources, and the opportunities of life' (WHO, 2012a: 11).

Table 2.1 Selected definitions of vulnerability and disciplines

Selected definitions	Disciplines
'The propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts including sensitivity or susceptibility to harm and lack of capacity to cope and adapt' (IPCC, 2014a: 28)	Interdisciplinary
'Vulnerability is the state of susceptibility to harm from exposure to stresses associated with environmental and social change and from the absence of capacity to adapt.' (Adger, 2006: 268)	Environmental science
'The conditions determined by physical, social, economic, and environmental factors or processes, which increase the susceptibility of a community to the impact of hazards.' (UNISDR, 2004: 16)	Disaster science
'Social vulnerability is a measure of both the sensitivity of a population to natural hazards and its ability to respond to and recover from the impacts of hazards. It is a multidimensional construct, one not easily captured with a single variable.' (Cutter and Finch, 2008: 2301)	Disaster science
'Social vulnerability [...] is shaped by individual people's resources and behaviour as well as by broader societal processes [...]' (Few, 2007: 284)	Sociology
'Vulnerability: the susceptibility of a system to disturbances by exposure to perturbations, sensitivity to perturbations, and the capacity to adapt.' (Nelson et al., 2007: 396)	Environmental science
'Social vulnerability encompasses all those properties of a system independent of the hazard(s) to which it is exposed, that mediate the outcome of a hazard event.' (Brooks, 2003: 5)	Climate science
'Vulnerability is a broad concept, encompassing not only income vulnerability but also such risks as those related to health, those resulting from violence, and those resulting from social exclusion - all of which can have dramatic effects on households.' (Coudouel and Hentschel, 2000: 34, in Alwang et al., 2001)	Economics
'The susceptibility of a population or region to harm' (WHO, 2011: 2)	Health sciences
'Results from exclusionary processes related to inequities in power, money and resources, and the opportunities of life' (WHO, 2012a: 11).	Health sciences

Table 2.1 presented selected definitions of vulnerability according to disciplinary fields, gathered from the literature. These are complex definitions that contain other concepts within them that also need to be understood. The analysis allowed the identification of common basic structures and elements to all the vulnerability definitions presented and related to different levels of specificity, focus and factor of interest. This translates into some definitions being more general or specific than others. In addition to this, differences resulting from disciplinary focus were also found.

These different and often competing conceptualisations of vulnerability have begged the question: why has this happened? For instance, O'Brien and colleagues (2004) suggest this stems from conceptualising vulnerability as a starting point (e.g. an inherent characteristic impacted by climate change) or an end point (e.g. an outcome of climate change). Following these concerns, Adger (2006) argues that current conceptualisations of vulnerability have stemmed from two main different disciplinary traditions, one that is based on entitlements failure (i.e. assets) aiming at understanding the causes of impacts, and another based on hazards/disasters aiming at uncovering commonalities between hazards. The entitlements approach is one that recognises the role of assets in shaping vulnerability (see Section 2.2.4).

Most of the conceptualisations and uses of vulnerability refer to a general, rather than to a specified, event or situation, but Books (2003) emphasises that

> 'it is essential to stress that we can only talk meaningfully about the vulnerability of a specified system to a specified hazard or range of hazards.' (Brooks, 2003: 3).

On the other hand, Cutter and colleagues (2008) outline three conceptualisations that may help explain these differences, stemming from disciplinary differences: (1) vulnerability resulting from rooted social characteristics where research focuses on access to assets and different levels of susceptibility, as exposure is always assumed; (2) vulnerability viewed as resulting from different levels of exposure, and; (3) vulnerability as place-dependent and dependent on both biophysical and social components.

As a result of such diverse conceptualisations, Wisner and colleagues (2004) have expressed apprehension regarding the indiscriminate use of the concept of vulnerability, whilst Adger (2006) and Moser (2011) state that one of the advantages of these numerous conceptualizations is that vulnerability can be used in many different ways, settings and fields. Nevertheless, these examples have helped advance current understandings of vulnerability and explain the reasons why vulnerability conceptualisations vary so much. In addition, Susan Cutter has also on several occasions asserted that there is also a lack of attempt to bring together these different perspectives, both conceptually and analytically (Cutter et al., 2003; Cutter et al., 2008). As a result, some authors have even called for improvement and agreement on both definitions and assessments (e.g. Alwang et al., 2001; O'Brien et al., 2004) with clear statement of the approach(es) aiming at reducing the misuse of the concept,

> 'of treating the symptoms of vulnerability instead of its causes' (O'Brien et al., 2004: 13).

2.2.2 Human vulnerability to extreme temperatures

As mentioned in Chapter 1, older people (i.e. aged 65 years or more) are considered to be particularly vulnerable to temperature extremes (Semenza et al., 1996; Naughton et al., 2002; Haines et al., 2006; Kovats and Kristie, 2006; Vandentorren et al., 2006; Bouchama et al., 2007; Hajat et al., 2007; Astrom et al., 2011; Mazick et al., 2012). In addition, it is crucial to note that both extreme heat and cold temperature impacts on human health (i.e. mortality and morbidity) are preventable and avoidable in this age group (e.g. Conlon et al., 2011) through vulnerability reduction actions. Despite this, most research on vulnerability has been mainly done by epidemiologists in the field of health where vulnerability is seen as an outcome, translated into the quantification of increased mortality and morbidity. Moreover, the impacts of extreme heat and cold temperatures on mortality have been more frequently investigated than the impacts on morbidity (Astrom et al., 2011). Epidemiological research in the field of human health into vulnerability represents a very different way of conceptualising vulnerability when compared to other literature in the field of climate change, where vulnerability is investigated to understand the factors contributing to the impacts observed (e.g. Kelly and Adger, 2000). This highlights that in different disciplinary fields the research on the vulnerability of older people has advanced in different ways. As such, this represents a gap in knowledge that this thesis aims to tackle through the implementation of an interdisciplinary approach to vulnerability.

In recent years several authors outside the field of human health have become interested in investigating the root causes of vulnerability as a result of extreme heat events resulting in excess mortality and morbidity. For example, the work by Klinenberg (2002) on the 1995 Chicago heatwave is one of the first to go beyond the identification of vulnerable groups, the approach taken by epidemiologists, and implement a qualitative study to understand and identify several factors (e.g. living alone, health status, owning an air conditioning, access to transport, education, public infrastructure) as contributing to vulnerability. In his endeavour, Klinenberg (2002) enquired how other approaches beside epidemiology in the health sciences, such as interviewing and ethnography in sociology could help in identifying how vulnerability is constructed. Since then, other studies on extreme heat and cold have identified further factors influencing vulnerability. These factors and sources referring to these are presented in Tables 2.2 and 2.3 to illustrate the advance in knowledge on the factors contributing to heat and cold vulnerability and summarises the diversity of factors as well as shows where this factors have been mentioned in the literature, respectively.

In their work, Vandertorren and colleagues (2006) conducted a case control study with older people in France after the August 2003 heatwave focusing on both individual (e.g. behaviours, health status) and environmental (e.g. housing insulation) risk factors associated with health impacts. For example, in the case of older adults living independently, lack of mobility, poor health and housing characteristics (i.e. lack of thermal insulation, living on the top floor) were found to be factors contributing to higher heat-related risks (Vandentorren et al., 2006). Findings of a recent study in Portugal have highlighted the reduced housing quality as one of the factors increasing vulnerability to heat, as houses were considered as 'unsuited to the climate' (Schmidt et al., 2014: 185) with older people being those living in houses with lower quality levels (Villaverde Cabral et al., 2011).

Moreover, Klinenberg's (2002) work emphasized the role of social isolation in heat-related mortality. In a study with older adults living independently in the UK by Wolf and colleagues (2010) social capital and social support were also found to reduce self-perception of vulnerability to heat. Additionally, older people did not perceive extreme heat as a risk to their health (Wolf et al., 2010). Wistow and colleagues (2013) also found that informal (e.g. family, neighbours) and formal (e.g. care providers) networks play a crucial role in supporing older people during extreme weather events, such as extreme temperatures.

In North America, a study found that older people were aware of the Heatwave Plan in their city mainly due to the media and asserted they avoided the hot temperatures outdoors (Sheridan, 2007). Despite this, the ownership of air conditioning was found to only reduce exposure to heat if older people felt able to afford using it (e.g. Sheridan, 2007). Poumadere and colleagues' (2005) research also found that the combination of both natural and social factors had implications regarding heat-risks and impacts on mortality and morbidity. Furthermore, the combination of both socioeconomic factors (i.e. poverty, social isolation) and physiological factors (i.e. age and poor health) were found to be linked with rise in mortality due to heat in the aftermath of the 2003 heatwave in France (Poumadere et al., 2005). Such issues have also been considered critical in Portugal, where the economic crisis has lead to changes in electricity consumption (Schmidt, et al., 2014).

Table 2.2 Factors increasing vulnerability to heat and sources referring to these

Factors	Sources referring to these
Age (i.e. 65 +)	Benzie, 2014; Wilhelmi and Hayden, 2010; O'Neill et al., 2009; Balbus and Malina, 2009; Fouillet et al., 2008; Sheridan, 2007; Cutter et al., 2003; Basu and Samet, 2002; Keatinge et al., 2000
Sex: Female	Fouillet et al., 2008; Hajat et al., 2007; Michelozzi et al., 2004
Chronic health conditions (e.g. asthma; diabetes; cardiovascular, respiratory and cardiovascular diseases)	Benzie et al., 2011; Wilhelmi and Hayden, 2010; O'Neill et al., 2009; Bouchama et al., 2007; McGregor et al., 2007; Vandentorren et al., 2006; Schwartz, 2005; Cutter et al., 2003; Basu and Samet, 2002
Lack of mobility and being confined to bed	Bouchama et al., 2007; Vandentorren et al., 2006; Klinenberg, 2002; Semenza et al., 1996
Low level of education	Benzie et al., 2011; Wilhelmi and Hayden, 2010; Huisman et al., 2005; Cutter et al., 2003; Curriero et al., 2002
Low income	Wilhelmi and Hayden, 2010; Balbus and Malina, 2009; Confalonieri et al., 2007; Cutter et al., 2003; Curriero et al., 2002; Klinenberg, 2002
Poor housing (e.g. lack of insulation)	Benzie et al., 2011; Confalonieri et al., 2007; Vandentorren et al., 2006; Semenza et al., 1996; Kalkstein, 1993
Living on the top floor of a building	Vandentorren et al., 2006; Semenza et al., 1996
Tenant	Benzie et al., 2011; Huisman et al., 2005
No air conditioning	Vandentorren et al., 2006; Semenza et al., 1996
Living alone	Wilhelmi and Hayden, 2010; Bouchama et al., 2007; Cutter et al., 2003
Social capital and networks	Benzie et al., 2011
Social isolation	Klinenberg, 2002; Semenza et al., 1996
Not leaving home daily	Bouchama et al., 2007; Semenza et al., 1996
No access to transport	Semenza et al., 1996
Urban location and characteristics	Benzie et al., 2011; O'Neill et al., 2009; Hajat et al., 2007
Lack of green spaces	Benzie et al., 2011; Vandentorren et al.,2006

In the case of extreme cold, a cold and damp house with poor thermal efficiency, lack of insulation and lack of heating can increase the risk of death, when associated with factors such as health status, age and socioeconomic factors (e.g. fuel poverty) (DoH, 2010; Mercer, 2003; Healy, 2003). A report by the Marmot Review Team has estimated that in the UK between 1986-1996, EWDs in the coldest homes were approximately three times higher than in the warmest homes (Geddes et al., 2011). As a result, cold homes are one of the foci when trying to understand excess winter deaths. Regarding the health impacts of cold homes and fuel poverty, Geddes and colleagues state that regarding direct health impacts of cold housing and fuel poverty,

> 'there is a relationship between EWDs, low thermal efficiency of housing and low indoor temperature' (Geddes et al., 2011: 9).

In terms of indirect health impacts, associations with diet, accidents and injuries are also important contributors to vulnerability (Geddes et al., 2011). Furthermore, improvements in housing conditions and poverty alleviation have also been mentioned as factors that would reduce winter mortality (Healy, 2003). As an example, Portugal is the EU country with the highest prevalence of inability to keep the home warm by relative poverty level and by household type (WHO, 2012b). Moreover, the inability to keep the home warm in Portugal is much higher among households with one adult older than 65 years, which constitutes an exception among the other EU15 countries. More recently, the economic crisis and the austerity measures imposed to the population in Portugal have meant greater restrictions in the use of electricity to keep warm (Schmidt et al., 2014). This shows that older people in Portugal are at most risk of living in cold homes.

Older adults are thus put at increased risk of being vulnerable to extreme temperatures due to their asset portfolio (e.g. housing, income, health status). The notion of asset portfolio has been used in the literature to define the access, availability and accumulation of a diverse and complex range of assets individuals manage in their daily lives (Moser, 1998; Bebbington, 1999; Alwang et al., 2001). As a result of higher excess winter mortality among older people than in other age groups, understanding how older people cope with extreme cold is needed and of great importance when addressing policies and actions aiming at addressing issues such as fuel poverty (Hitchings and Day, 2011).

Table 2.3 Factors increasing vulnerability to cold and sources referring to these

Factors	Sources
Age (i.e. 65+)	Geddes et al., 2011; Conlon et al., 2011; Monacelli et al., 2010; Analitis et al., 2008; Hajat et al., 2007; Rudge and Gilchrist, 2005; Hassi et al., 2005; Curriero et al., 2002; Danet et al., 1999; Eurowinter, 1997
Sex: Female	Davie et al., 2007; Schwartz, 2005; Rudge and Gilchrist, 2005; Wilkinson et al., 2001; Eurowinter, 1997
Chronic health conditions (e.g. asthma; diabetes; cardiovascular, respiratory and cardiovascular diseases)	Ebi and Mills, 2013; Geddes et al., 2011; Analitis et al., 2008; Davie et al., 2007; Hajat et al., 2007; Schwartz, 2005; Hassi et al., 2005; Mercer, 2003; Curriero et al., 2002; Wilkinson et al., 2001; Aylin et al., 2001; Eurowinter, 1997
Low level of education	Curriero et al., 2002
Low income	Hales et al., 2012; O'Sullivan et al., 2011; Healy, 2003; Curriero et al., 2002; Wilkinson et al., 2001
Fuel poverty₸	El Ansari and El-Silimy, 2008 Rudge and Gilchrist, 2005; Healy, 2003
Poor housing (e.g. lack of insulation)	Geddes et al., 2011; Hajat et al., 2007; El Ansari and El-Silimy, 2008; Rudge and Gilchrist, 2005; Healy, 2003; Aylin et al., 2001
Tenant (i.e. living in rented accommodation)	Hales et al., 2012
Urban location and characteristics	Gerber et al., 2006; Barnett et al., 2005; Curriero et al., 2002; Eurowinter, 1997

₸ 'the inability to afford energy for adequate heating' (Rudge and Gilchrist, 2005)

Another important factor contributing to the vulnerability of older people to extreme cold is the evidence that older people do not perceive themselves at risk or vulnerable (e.g. Wolf et al., 2009; Tod et al., 2013). In addition, each factor presented in Table 2.3 may act independently or together with other factors, both resulting in increases in inequalities and aggravated vulnerability. An example is a study on older people and extreme weather events (e.g. extreme temperatures) by Dominelli (2013) where she argues that factors increasing vulnerability, such as low income and lack of social assets have impacts on older people's access to and availability of financial and physical assets. In relation to climate change, the IPCC (2014b) asserts that population growth and the age structure of the population (ageing) have impacts on vulnerability, but other broader factors such as individual characteristics (e.g. sex, income, health status, education) and the physical environment (e.g. geographic location, health and other public infrastructure) also play an important role. Furthermore, in the Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation (SREX Report), environmental (e.g. physical dimensions, geography, location, place, urban/rural), social (e.g. demography, education, health and well-being, cultural dimensions) and economic dimensions (IPCC, 2012) were also considered as vulnerability factors.

The factors contributing to vulnerability presented here are crucial to understanding vulnerability (Romero-Lankao et al., 2012) and, it is the combination of such factors and not only their isolated occurrence that can further exacerbate vulnerability (Weber and Messias, 2012). Notwithstanding the advances in the understanding of factors contributing to vulnerability, Astrom and colleagues (2011) assert that there is still a lack of studies investigating social, health and environmental factors associated with vulnerability and call for more research. These gaps in knowledge will be addressed in this study.

In summary, deeper exploration and understanding of a broader range of factors and interactions between factors is needed, coupled with an understanding of the linkages between such factors in shaping human vulnerability to extreme temperatures. This thesis will address this gap by implementing an interdisciplinary and holistic approach to identify different types of factors and categories of factors contributing to both general and specified (extreme heat and cold) vulnerability at the individual level in order to measure vulnerability.

2.2.3 Vulnerability assessments

The different conceptualisations of vulnerability discussed in Section 2.2.1 have enabled the development of various methods to measure vulnerability (Alwang et al., 2001; Adger, 2006; Hahn et al., 2009; Gaillard, 2010). For instance, in reflecting on the climate change literature, Kelly and Adger (2000) distinguish between three types of vulnerability assessments: end point (i.e. where vulnerability is assessed as an outcome); focal point (i.e. vulnerability is used as an overarching concept for the assessment) such as applied by the food insecurity and natural hazards, and; starting point (i.e. vulnerability is used for identifying the sensitivity of the system) adopted by some authors in the hazards/disasters literature (e.g. Wisner et al., 2004).

According to Gaillard (2010) some examples of vulnerability assessments have been developed from different literatures. These include, the Pressure and Release (PAR) model in which Wisner and colleagues (2004) show that different factors contribute to inequitable levels of vulnerability, the Space of Vulnerability model by Watts and Bohle (1993) and the 'Hazardousness of a Place' approach by Hewitt and Burton (1971). Additionally, several authors have identified Amartya Sen's entitlement approach as useful for vulnerability assessments (Ribot, 1996; Kelly and Adger, 2000). In his approach, Sen (1981) highlights inequitable access to education, health, food and services as sources of vulnerability. What is notable about this approach is that it incorporates access to assets into vulnerability assessments. In doing so, Sen (1981) has linked the concepts of assets and vulnerability which has been used by other authors in the development of vulnerability assessments, an approach that is also taken in this thesis (e.g. Hahn et al., 2009).

Alwang and colleagues (2001) found a growing interest in the development of quantitative measures of vulnerability in different literatures. Indeed, both the economics and sociological literatures have used the sustainable livelihoods and asset-based approaches to achieve this measurement (Alwang et al., 2001). Interdisciplinary approaches have also been developed, such as the Social Vulnerability Index by Susan Cutter (e.g. Cutter et al., 2003) in the disaster literature which according to Fussel (2007a) is also widely applied in the context of climate change. A development since then has been for vulnerability assessments to measure the availability of assets aiming at minimizing the impact of threats (Birkmann et al., 2010).

Vulnerability assessments are thus varied: some are mainly actor-centred (Nelson et al., 2007); context and purpose dependent (Fussel, 2007a; Romero-Lankao et al., 2012), and methodologically/output quantitative to enable the findings to be translated into indices and GIS maps (Kelly and Adger, 2000; Cutter et al., 2003). In addition, according to Brooks (2003) vulnerability assessments should also take into account timescale issues of specified events to develop adequate vulnerability assessments. This is crucial to understand specified vulnerability for the implementation of adequate adaptation measures and strategies. As a result, he identified three categories of hazards: 'discrete recurrent' (e.g. extreme temperatures); 'continuous' (e.g. increases in mean temperatures), and; 'discrete singular' (e.g. shift in climatic regimes) (Brooks, 2003:9). Furthermore, Brooks (2003) has also considered an additional way of taking into account timescale in vulnerability assessments which include distinguishing current from future vulnerability (Brooks, 2003). Current vulnerability represents a snapshot of the baseline degree of susceptibility a human system (e.g. individual) exhibits, which can therefore influence its future vulnerability (Brooks, 2003). Most of these measures take into account timescale issues and assess current vulnerability but others assess future vulnerability to climate change, which is considered to be a very difficult task as it deals with high levels of uncertainties (Benzie, 2014). The assessments of future vulnerability mainly use quantitative approaches focusing on climate scenario projections and relying on secondary data (Hahn et al., 2009; Zaidi and Pelling, 2013) in a top-down approach (Dessai and Hulme, 2004; Benzie, 2014).

One of the approaches to quantitatively measure current vulnerability is the development of indices using a composite index approach. These are based on the collection of quantitative multidimensional indicators from either primary or secondary data, incorporating for example the sustainable livelihoods approach (SLA) and investigating different types of assets to which individuals or communities have access to (Hahn et al., 2009; Shah et al., 2013). According to Morse and colleagues (2009), the SLA constitutes a collective approach on assets in which sustainability is defined as availability of assets in a vulnerability framework. Most composite indices use secondary data at the national and regional levels (e.g. Census data) instead of primary data at the household or individual levels but there are many limitations (Hahn et al., 2009). The use of primary data is considered an advantage as indices based on primary data do not rely on available data from other sources overcoming the disadvantages of missing data, as well as issues with data collection procedures (Hahn et al., 2009). In addition to the use of quantitative data for the development of vulnerability indices, qualitative data has also been used to assess vulnerability. Qualitative assessments of current vulnerability have mainly focused on the dimensions contributing to vulnerability (social, physical, cultural and institutional) which impact on the adaptation options available to individuals (Brown and Walker, 2008) (see Section 2.4). These are considered to be bottom-up approaches (Dessai and Hulme, 2004; Benzie, 2014), aiming to understand the root causes of current vulnerability and the impacts caused by climate events. Despite this, they are not exempt of limitations. As such, they can only be applied to small areas (e.g. neighbourhood, city and regional levels) and require large resources (Dessai and Hulme, 2004; Benzie, 2014).

Moreover, Dominelli (2013) asserts that assessing the vulnerability of older people to extreme weather events should comprise more than the usual approaches on exposure and also include the formal and informal characteristics of the places where individuals live (e.g. physical and social infrastructures for care and support). In addition, Balbus and Malina (2009) go even further and call for vulnerability assessments that combine both epidemiological data and context-specific dimensions. As most of the assessments of older people vulnerability to extreme weather to date have been mainly qualitative, there also needs to be an increase interest in developing quantitative indices. These indices with a focus on primary data collection would allow a better understanding of the causes of vulnerability at the individual level and could help the development of public health and social measures to be implemented to reduce vulnerability (Balbus and Malina, 2009).

In summary, the focus of this thesis will be on current vulnerability, assessed through the use of primary data and both quantitative (i.e. index development) and qualitative approaches to assess general and specified (heat and cold) vulnerability, respectively. In order to achieve this, strategies for operationalising vulnerability are considered below.

2.2.4 Using assets to assess human vulnerability

This section explores the concept of assets and its use in a range of disciplines for understanding how they relate to vulnerability, bringing together different insights using assets to assess vulnerability.

2.2.4.1 Defining assets

The notion of assets has been used in the sociology literature as means to understand livelihood strategies in poverty and deprivation contexts in the Global South (Rakodi, 1999). Furthermore, the use of assets has also been associated with the concept of capabilities (Sen, 1999) in both the sociology and health literatures which represents an additional argument of the particularly significant role of assets for understanding vulnerability. Accordingly, Ellis (2000) sees them as

> 'stocks of capital that can be utilised directly, or indirectly, to generate the means of survival of the household or to sustain its material well-being at differing levels above survival.' (Ellis 2000: 31).

In addition, Ellis (2000) asserts that assets are essential for understanding livelihoods but outlines disagreement on the types of capitals that are part of assets. As such, within the literature, there are many ways in which assets can be defined and interpreted. According to Bebbington (1999) assets or capitals

> 'are not simply resources that people use in building livelihoods: they are assets that give them the capability to be and to act.' (Bebbington, 1999: 2022).

Others like the Ford Foundation (2002) define assets as

> 'a broad array of resources that enable people and communities to exert control over their lives and to participate in their societies in meaningful and effective ways' (Ford Foundation, 2002: 4).

These different interpretations of the concept of assets have thus operationalised assets in various ways (Ellis, 2000). For example, Bebbington (1999) operationalises assets as human, produced, social, natural, and cultural. Additionally, a 'five-capitals' model has been developed that differentiates financial, human, social, natural and manufactured or physical capitals (Rakodi and Lloyd-Jones, 2002; Porritt, 2005; Manzi et al., 2010) which can be applied in an array of perspectives, such as social and economic (Manzi et al., 2010). On the other hand, one of the oldest and most used categorisations of assets are the ones by authors such as Chambers and Conway (1992) and Scoones (1998) which have identified five types of capital assets, which include human, financial, physical, natural and social capital.

Nonetheless these different categorisations of assets have many commonalities. The five types of assets can according to Ellis (2000) supplement and substitute each other, allowing for transformation of one type of asset into another which is considered to be a common strategy used by individuals and households to compensate the lack of one type of asset (e.g. financial assets can be transformed into human assets if investment is made in education). Despite its broad use, critics of the five assets model are few but generally point out feasibility issues and lack of ability to change livelihoods (Morse et al., 2009). Additionally, Morse and colleagues (2009) outline particular issues related to the fact that individuals or households are absent from the livelihoods approach as it focuses on different types of assets and not on individuals, and that it is not made clear how to empirically assess and measure assets. Others like Rakodi (1999) argue for the inclusion of political capital that despite being similar to social capital is grounded on the access to decision-making networks and institutions. Notwithstanding the previous criticisms, Gutierrez-Montes and colleagues (2009) assert that the assets focus in the sustainable livelihoods approach is an analytical tool that focuses on individuals, their resources and capacities. According to the livelihoods approach, researchers' focus on assets is one that allows a better understanding of the relationships between individuals and their environment, as well as the interactions between different types of assets in order to increase opportunities to improve the capabilities of individuals, which has been neglected in other disciplines (e.g. Rakodi, 1999; Rakodi and Lloyd-Jones, 2002; Porritt, 2005; Manzi, 2010)

Despite not being as widely considered or used, assets are defined in the health literature as

> 'any factor (or resource) which enhances the ability of individuals, groups, communities, populations, social systems and/or institutions to maintain and sustain health and wellbeing and to help to reduce health inequities. These assets can operate at the level of the individual, group, community, and/or population as protective (promoting) factors to buffer against life's stresses' (Morgan and Ziglio, 2007: 18).

Moreover, Harrison and colleagues (2004) assert that assets can be divided into physical, financial, human, social and environmental (in Morgan and Ziglio, 2007), which portrays many commonalities with the categorisations of assets within the sociology literature. The links between assets as used in the health, sociological and anthropology literatures are explored further in the research undertaken in this thesis. Table 2.4 presents examples of types of assets in different literatures with relevant sources. In this thesis, assets are defined as human, financial, physical, social, place-based factors, or characteristics directly or indirectly available to individuals in anticipating or responding to threats. This definition was developed for this research taking into account these various definitions and the context of this research.

Table 2.4 Summary of categories of assets, types of assets, relevant sources and disciplines

Assets	Examples	Relevant sources	Disciplines
Human	Education level, skills, knowledge, good health, ability to labour, living arrangements, occupation, nutrition status, marital status	IPCC, 2012; IPPR North, 2011; May et al., 2009; Moser and Dani, 2008; Dahlgren and Whitehead, 2007; Wisner, 2006; OECD, 2006; Barton and Grant, 2006; Vatsa, 2004; Ellis, 2000; DFID, 1999; Rakodi, 1999; Scoones, 1998; Carney, 1998	Sociology; Health; Environmental science; Economics
Financial	Income, savings, access to credit, pensions, informal economy, expenses	Ford and Berrang-Ford, 2011; IPPR, North, 2011; Moss et al., 2010; May et al., 2009; Moser and Dani, 2008; Dahlgren and Whitehead, 2007; OECD, 2006; Barton and Grant, 2006; Vatsa, 2004; Ellis, 2000; DFID, 1999; Rakodi, 1999; Scoones, 1998; Carney, 1998	Sociology; Health; Enviromental science; Economics; Public Policy
Physical	Buildings, type of housing, housing tenure, roads, tools, appliances, machines, terraces, irrigation canals, power lines, affordable energy, water supply, sanitation, telecommunication facilities, transport	IPPR, North, 2011; May et al., 2009; Moser and Dani, 2008; Cutter and Finch, 2008; Dahlgren and Whitehead, 2007; Barton and Grant, 2006; Vatsa, 2004; Ellis, 2000; DFID, 1999; Rakodi, 1999; Scoones, 1998; Carney, 1998	Sociology; Health; Enviromental science; Public Policy
Natural, Public or Place-based	Land, atmosphere, water, trees, wild vegetable, wild animals, fisheries stocks, biodiversity, metals, oil and other environmental resources, access to public amenities and services	IPCC, 2012; IPPR North, 2011; Riva et al. 2010; May et al., 2009; Moser and Dani, 2008; Dahlgren and Whitehead, 2007; OECD, 2006; Barton and Grant, 2006; Vatsa, 2004; Ellis, 2000; Rakodi, 1999; DFID, 1999; Scoones, 1998; Carney, 1998	Sociology; Health; Enviromental science; Economics; Public Policy
Social	Networks, connectedness, membership of groups and associations, relationships of trust, support, reciprocity and exchanges	IPPR North, 2011; May et al., 2009; Moser and Dani, 2008; Dahlgren and Whitehead, 2007; OECD, 2006; Barton and Grant, 2006; Vatsa, 2004; Ellis, 2000; DFID, 1999; Rakodi, 1999; Scoones, 1998; Carney, 1998	Sociology; Health; Enviromental science; Economics; Public Policy

Table 2.4 presented examples of types of assets in different literatures with relevant sources, gathered from the literature. The five types of assets were found to be broadly used within different research fields and only one type of assets was found to have different designations (i.e. natural, public or place-based assets). Several elements are common to the types of assets and the

examples considering the wide range of research fields. As a result, assets are used broadly in diverse disciplines.

As seen so far, the concept of assets and the five asset model allow linkages between both the health and sociology literatures and play an important role in the process of operationalising human vulnerability. Access to assets can thus be seen as the root causes of vulnerability (Moser, 2011). Moreover, Moser (2011) argues that vulnerability is associated to lack of assets in the sense that the bigger and the more diverse the asset portfolio the less vulnerable individuals and households are. Despite this, the role of assets in reducing vulnerability still needs to be further understood (Alwang et al., 2001) through exploring the relationships with resilience (Romero-Lankao et al., 2012) and adaptation (Brooks, 2003; Romero-Lankao et al., 2012) (see Sections 2.3 and 2.4).

In summary, the use of assets and asset approaches offer a framework that can be considered through the combination of both health and sociology perspectives for operationalising vulnerability. The approach taken in this thesis is one that integrates the need to understand the root causes of vulnerability by looking at the different types of assets individuals have access to, which is developed by using the concepts of human, physical, financial, social and place-based assets.

2.2.4.2 The relationship between assets and vulnerability to climate change

Amartya Sen's seminal work (1999) on the freedoms (e.g. assets) individuals' command allowing them to live a meaningful life has also called for the 'expansion of the capabilities' of persons to lead the kind of life they value and have reason to value' (Sen, 1999: 18). According to Sen (1999)

> 'capability is thus a kind of freedom: the substantive freedom to achieve alternative functioning combinations (or, less formally put, the freedom to achieve various lifestyles).' (Sen, 1999: 75).

As a result, they are influenced by at least five different elements, 'personal heterogeneities' in physical aspects such as age, sex, illness; 'environmental diversities' on climate such as temperature and rainfall; 'variations in social climate' such as education provision, public amenities and social capital; 'differences in relational perspectives' according to community specifies; and income 'distributions within the family' (Sen, 1999: 70-71). Each of these elements and/or combinations of elements create different conditions for individuals and will determine what capabilities are used. In the health literature, Mel Bartley (2006) makes connections between the concepts of capability, assets and resilience. The concept of capability relates to the concept of assets in the sense that capabilities and functionings can only exist if there are available assets. This has also connections with some of the literature on vulnerability to disasters through exploring how assets help understand the construction of risk and inequalities and its impacts on individual health and wellbeing (e.g. Weber and Messias, 2012). The emphasis on assets in this research thus relates to Sen's approach as assets determine capability, which in turn relates to resilience (see Section 2.3) and adaptation (see Section 2.4).

Furthermore, Carney (1998) asserts that when addressing the concept of assets one should also take into account associated dimensions,

> 'first, there is a need to understand the vulnerability context in which assets exist (the trends, shocks and local cultural practices which affect livelihoods). Second, it is vital to understand the structures (organisations, from layers of government through to the private sector in all its guises) and processes (policies, laws, rules of the game and incentives) which define people's livelihood options.' (Carney, 1998: 8).

Access to assets is a critical issue to achieve better outcomes in life, according to Ellis (2000). In assisting the argument for using an asset approach, Moser (2009) asserts that the empowerment and agency of individuals to achieve better lives is only accomplished through access, availability and accumulation of assets (e.g. financial, place-based) and argues that assets are the roots of empowerment and agency.

The five assets approach by Chambers and Conway (1992) and Scoones (1998) was used by the Department for International Development (DFID) for the development of the sustainable livelihoods framework (DFID, 1999) which has since been widely used by agencies and NGOs in developing countries (DFID, 1999; Allison, 2004). It has been used for assessing poverty levels and designing interventions for poverty reduction (Allison, 2004; Moser and Dani, 2008) focusing on the assets individuals and households possess that enables them to sustain their livelihoods (Gutierrez-Montes et al., 2009; Allison, 2004).

Despite being widely used in the development context, there have been few attempts to implement the assets approach in the developed world having only been applied to the context of poverty (e.g. Canadian Women's Foundation, 2001; Oxfam, 2009; IPPR North, 2011; Oxfam, 2013). To illustrate, in developed countries, such as Canada and the UK the five assets model has been implemented with some changes comprising the classification of assets, shaped to better reflect the different challenges individuals face in developed countries. As such, natural assets were renamed to place-based assets (IPPR North, 2011), public assets (Oxfam, 2009; Oxfam, 2013), and personal assets (Canadian Women's Foundation, 2001). Place-based or public assets are related to the geographic location where people live and work and include public infrastructures and services (i.e. medical centre, library, community centre, parks) (IPPR North, 2011; Oxfam, 2009; Oxfam, 2013), whilst personal assets are related to 'internal' characteristics of an individual (i.e.

beliefs, self-esteem, values) (Canadian Women's Foundation, 2001). The use of asset approaches in developed countries has been scarce but useful to test its applicability to a different development context. The cases mentioned above represent examples of how an issue crosses disciplinary boundaries (i.e. international development) allowing interdisciplinarity, but there is still reticence in applying an assets approach to the developed world.

The occurrence of extreme temperatures is one of many factors affecting human health (IPCC, 2012) and according to Moser (2011) health related impacts of climate change in urban areas are more pronounced in more deprived populations and individuals as they generate pressure and loss on different types of assets, such as health and wellbeing (human assets), housing (physical assets), income (financial assets), social relationships (social assets) and, health and care infrastructures (place-based assets). The IPCC (2014c) considers the characteristics of individuals, populations and their surrounding environment (i.e. health status, age, sex, socioeconomic status, public health and other infrastructure, geographic location) to be generic causes of vulnerability to the health effects of climate change and variability. Despite each of the causes occurring and being assessed separately, in practical terms they mostly occur in combination. In the case of extreme temperatures, the geographic location is an important factor influencing the impacts individuals may suffer and those living in cities are most at risk due to exposure to urban heat islands associated with socioeconomic vulnerability and characteristics of the city and neighbourhood (Uejio et al., 2011).

2.2.4.3 Exploring the links between assets and determinants of health

The health literature has addressed the operationalisation of assets through the use of determinants of health. This is mainly a difference in language, which has in turn framed the concepts that are most frequently used. One of the reasons for this may be due to the loose understanding of the different types of assets shaping health and contributing to vulnerability (Morgan and Ziglio, 2007). Sen's work (1999) on capability has been more recently re-evaluated as crucial for health in addressing assets (Marmot, 2013). As such, there has been increasing interest in the notion of assets and asset approaches in health focusing on positive characteristics and capacities of individuals (Morgan and Ziglio, 2007) which according to Huber and colleagues (2011) has resulted from an evolution of the definition and conceptualization of health within a positive/optimistic perspective. The concept of assets has been associated with that of determinants of health which are

> 'the range of personal, social, economic and environmental factors which determine the health status of individuals or populations.' (Nutbeam, 1998: 6).

The WHO (2013a) argues that the determinants of health comprise the social, economic and physical environments, and the characteristics and behaviours of each individual, with additional factors playing a crucial role. As such, there is a gap in understanding the links between assets and determinants of health. Despite this, some authors have focused their work in understanding the social determinants of health and have asserted that health inequalities and disadvantages include reduced or lack of assets (e.g. family assets, education, income, housing quality) (e.g. Wilkinson and Marmot, 2003; Marmot and Wilkinson, 2005). In this research both assets and determinants of health are considered to have connections with the factors increasing vulnerability discussed in Section 2.2.2, regarding extreme temperatures, and are thus used to assess vulnerability. This constitutes a novel approach and there is strong justification for making connections between assets and determinants of health with the factors increasing vulnerability based on the literature.

Unequal distributions of the determinants of health found among individuals, communities, regions and countries has led to the development of the concept of health inequality. The WHO has defined it as differences in the distribution of the determinants of health and the health status of individuals (WHO, 2013b). Additionally, Marmot (2010) asserts that health inequalities result from wider societal inequalities and due to the characteristics of the places where individuals live (CSDH, 2008; Marmot, 2010), which in turn are determined by the social, political and economic spheres of society (CSDH, 2008). Ultimately, Marmot (2010) argues that

> 'reducing health inequalities is a matter of fairness and social justice.' (Marmot, 2010: 15).

Issues of social justice have also been associated with health, as it shapes people's ways of living, their quality of life and the probabilities for morbidity and mortality (CSDH, 2008). The debate on individual freedoms from Amartya Sen's seminal work (1999) has also recently been combined with the debates of health as a human right and with the determinants of health (Marmot, 2013).

In addition, according to Steimann (2005) the sustainable livelihoods approach offers a salutogenic (i.e. origins of health) perspective within the development literature. This link between assets and salutogenesis has been identified in both the health and development literatures (Steimann, 2005; Marmot, 2013) (more details in Section 2.3.4). There is a requirement for protecting health by reducing the risks and impacts from threats/disturbances through assets (Marmot, 2013). As a result, Curtis and Oven (2012)

> 'argue for research that considers complex processes operating at various geographical scales, linking arguments about 'global health' with the more local and individual processes that contribute to health determinants' (Curtis and Oven, 2012: 654),

which is developed in this thesis.

In summary, this section has discussed the vulnerability literature and identified several gaps in knowledge presented throughout the section. These knowledge gaps will be addressed by the first research question: 1. Do different assets affect general, extreme heat and extreme cold vulnerability of older people? If so, what are their effects and how do they occur?.

2.3 Resilience

The concept of resilience will be explored in four subsections. First, definitions and understandings of resilience are reviewed, in Section 2.3.1. Second, the concept of resilience is discussed in the context of extreme temperatures in Section 2.3.2. Third, different types of resilience assessments and measurements are outlined, in Section 2.3.3. Fourth, the use of the sense of coherence to operationalize human resilience is examined in Section 2.3.4.

2.3.1 Definitions and interpretations of resilience

Defining resilience is not a simple or straightforward undertaking. It is thought that it was first used in the 1620s and derives from the Latin word 'resiliens' meaning 'the act of rebounding', evolving to 'elasticity' from 1824 (Online Etymology Dictionary, 2014). Currently, resilience is broadly defined as

> 'the ability of a substance or object to spring back into shape; elasticity'; and 'the capacity to recover quickly from difficulties; toughness' (Oxford Dictionary, 2014).

In the last four decades the concept of resilience has been vastly applied and researched in a breath of disciplines, such as climate, disaster, child psychology, ecology, engineering, health and sociology literatures, among others (Gaillard, 2010). Resilience has a prominent history in both ecology and psychology, but is most well developed in the systems and ecosystems arenas (Berkes and Ross, 2013; Doring et al., 2013). In addition, a controversy on the origins of the use of the term is also disputed, e.g. introduced in ecology by Holling in 1973 (e.g. Cutter et al., 2008; Berkes et al., 2012), while authors like Norris and colleagues (2008) suggest resilience had its origins in physics and mathematics. Others such as Gaillard (2010) assert it emerged in the climate and disaster literatures, and Lorenz (2010) argues it was firstly used in medical science by Pfeiffer in 1929 and afterwards by Werner in 1971 in the field of psychology.

These diverse disciplinary roots of resilience have resulted in many different definitions, which can be categorised based on four main questions: (1) what does resilience refer to?; (2) resilience of what?; (3) resilience to what?, and; (4) what is the ultimate goal of resilience? (Table 2.5.1 to 2.5.3, respectively). This helps exhibit and highlight the commonalities and differences between definitions. However, for the purpose of this thesis special attention will be given to the health and psychology literatures as they are the ones that better help to understand human resilience as they focus on the individual and have attempted to measure it, which is also one of the aims of this thesis.

Table 2.5.1 Selected definitions of 'what resilience refers to', sources and disciplines

Definitions	Sources	Disciplines
'A measure'	Holling, 1973	Ecology
'A capacity'	Rockefeller Foundation, 2014; Dominelli, 2013; WHO, 2011; Edwards, 2009; Keim, 2008; Almedom and Tumwine, 2008; Gunderson et al., 2006; Manyena, 2006; Walker et al., 2004; UNISDR, 2004; Bonanno, 2004; Glantz and Sloboda, 1999; Cederblad et al., 1994	Sociology; Human development; Health; Disaster Science; Enviromental science
'An ability'	Resilience Alliance, 2014; Marmot, 2013; IPCC, 2012; Resnick and Inguito, 2011; WHO, 2011; Lamond et al., 2009; Cutter et al., 2008; IPCC, 2007; Jackson et al., 2007; Bartley, 2006; Tompkins and Adger, 2004; Bonnano, 2004; UKCIP, 2004; Friborg et al., 2003; Pelling, 2003; Adger et al., 2002	Enviromental science; Ecology; Disaster science; Health; Psychology
'An internal property'	Davydov et al., 2010; Gallopin, 2006	Environmental science; Psychology
'A characteristic'	Wagnild and Young, 1993	Psychology
'A process'	Windle, 2011; Almedom, 2008; Norris et al., 2008; Luthar et al., 2000; Masten et al., 1990	Human development; Psychology; Health
'An outcome', 'good outcomes'	Netuveli et al., 2008; Masten et al., 1990	Human development; Health
'A product'	Pelling, 2003	Disaster science
'Relationships'	Folke, 2006; Luthar, 2006	Ecology; Human development
'An amount of change'	Nelson et al., 2007	Environmental science

Table 2.5.2 Selected definitions of ‘what is resilient’, sources and disciplines

Definitions	Sources	Disciplines
‘A system’	Rockefeller Foundation, 2014; IPCC, 2012; Edwards, 2009; Almedom and Tumwine, 2008; Nelson et al., 2007; Gallopin, 2006; Folke, 2006; Gunderson et al. 2006; Manyena, 2006; Walker et al., 2004; UNISDR, 2004; UKCIP, 2004; IPCC, 2001; Holling, 1973	Ecology, Disaster science; Enviromental science; Health
‘A social or ecological system’, ‘social-ecological system’	IPCC, 2014b; IPCC, 2007; UNISDR, 2004	Climate science; Disaster science
‘A social system’, ‘society’	Cutter et al., 2008	Disaster science
‘Human’, ‘institutional’, and ‘ecological systems’	Dominelli, 2013; WHO, 2011; Almedom, 2008	Health; Sociology
‘Groups’, ‘communities’, ‘institutions’ and ‘other social entities’, families’	Rockefeller Foundation, 2014; Marmot, 2013; Edwards, 2009; Almedom and Tumwine, 2008; Almedom and Tumwine, 2008; UNISDR, 2004; Adger et al., 2002; Adger, 2000	Climate science; Disaster science; Health
‘People’, ‘individuals’, ‘actors’	Rockefeller Foundation, 2014; Marmot, 2013; Windle, 2011; Davydov et al., 2010; Edwards, 2009; Almedom and Tumwine, 2008; Jackson et al., 2007; Bartley, 2006; Pelling, 2003	Psychology; Health; Disaster science

Table 2.5.3 Selected definitions of 'resilience to what', sources and disciplines

Definitions	Sources	Disciplines
'Change', 'external change', 'future uncertain change', 'disturbance', 'perturbation', 'adverse and/or turbulent changes'	IPCC, 2014b; WHO, 2011; Resilience Alliance, 2014; Almedom, 2008; Norris et al., 2008; Nelson et al., 2007; Gallopin, 2006; Gunderson et al., 2006; IPCC, 2007; Tompkins and Adger, 2004; Walker et al., 2004; Adger et al., 2002; Holling, 1973	Interdisciplinary; Ecology; Environmental science; Health
'Hardship', 'adversity'	Marmot, 2013; Davydov et al., 2010; Lamond et al., 2009; Netuveli et al., 2008; Jackson et al., 2007; Masten and Obradovic, 2006; Luthar et al., 2000; Glantz and Sloboda, 1999	Psychology; Human development; Health; Environmental science
'Stress', 'external stresses', 'significant sources of stress or trauma'	Rockefeller Foundation, 2014; Windle, 2011; WHO, 2011; Manyena, 2006; Adger et al., 2002; Adger, 2000	Environmental science; Disaster science; Health
'Disaster', 'hazard', 'potential hazard', 'hazard stress', 'hazardous event'	IPCC, 2014b; IPCC, 2012; Cutter et al., 2008; Keim, 2008; UNISDR, 2004; Pelling, 2003	Interdisciplinary; Disaster science; Environmental science; Health
'Extreme load'	UKCIP, 2004	Climate science
'Threats', 'shock', 'challenging or threatening circumstances'	Rockefeller Foundation, 2014; Marmot, 2013; Dominelli, 2013; Manyena, 2006; Masten et al., 1990	Disaster science; Health; Human development; Sociology
'Catastrophic events and/or experiences'	Almedom and Tumwine, 2008	Health
'Illness or loss'	Resnick and Inguito, 2011	Health
'Crisis'	Marmot, 2013	Health
'Risk'	Netuveli et al., 2008	Health

Definitions of resilience vary according to focus (system, individual) and scale (temporal and spatial). The ecology, climate change and disaster fields are more prone to consider a temporal scale (present, future) (e.g. Nelson et al., 2007; Pelling, 2003) and to consider resilience to external events (e.g. Adger, 2000; Adger et al., 2002). In the climate change literature, resilience is system-oriented (Nelson et al., 2007) whilst the psychology and public health fields are generally interested in internal (individual) responses to either internal or external events (e.g. Masten et al., 1990; Bartley, 2006; Almedom and Tumwine, 2008).

Another perspective sees individual resilience as a

> 'dynamic process wherein individuals display positive adaptation despite experiences of significant adversity or trauma' (Luthar et al., 2000: 543)

has been found to be associated with individuals and the characteristics where they live (Brown and Westaway, 2011). This includes assets (i.e. skills, educations, access and quality of public amenities) which are considered to influence the impacts of threats and stressors.

Recurrent elements in the definitions of resilience can be identified as all definitions follow a basic structure (see Table 2.5.1-2.5.3). Despite this, levels of specificity ranging from more general to more specific definitions were also found among the definitions of resilience. The one element that is common to all definitions is the different attribute resilience refers to (i.e. capacity, ability), factor of interest (i.e. change, stress, threat) and focus (i.e. system, people). The definitions found from this review (Tables 2.5.1 - 2.5.3) are not conflicting but present some notable differences, as was found regarding the concept of vulnerability (see Section 2.2.1). Nonetheless, within related disciplines such as human health, human development and psychology, approaches to resilience present a great diversity.

All these various meanings mentioned above suggest that resilience is considered to be mainly an ability, capacity, characteristic or process a system uses to positively respond or adapt to threats, stresses or events. As such, resilience exists in every system and is put to test in certain circumstances (e.g. disaster, shock). Additionally, according to Dominelli (2013)

> 'resilience has nonlinear and fractured characteristics that can result in a system becoming resilient along one dimension, but not in another. And resilience can vary over time as the context changes' (Dominelli, 2013: 208).

This is a significant development in how resilience can be conceptualised and consequently assessed. The answers to the question 'resilience to what?' is thus one that according to Folke et al. (2010) allows the distinction between general resilience (e.g. to a wide range of disturbances, shocks or threats) and specified resilience (e.g. to individual disturbances, shocks or threats). Therefore, Folke and colleagues (2010) define general resilience and specified resilience, respectively as

> 'The resilience of any and all parts of a system to all kinds of shocks, including novel ones.' (Folke et al., 2010: 3)

> 'The resilience "of what, to what"; resilience of some particular part of a system, related to a particular control variable, to one or more identified kinds of shocks.' (Folke et al., 2010: 3)

The Royal Society (2014) has also conceptualised resilience as general resilience and specific resilience, following Folke et al. (2010) definitions.

These distinctions, have been coined with a focus on systems by Folke et al. (2010), similarly to what was found with many of the definitions provided in Table 2.5.2. Despite this, they can also be applied to the individual. For instance, two of these examples include the Rockefeller

Foundation (2014) and Edwards (2009) that incorporate the resilience of individuals, communities and systems in their definition. Such a link is thus possible as many academics consider that individuals are actors within systems (e.g. Brown and Westaway, 2011; Simonsen et al., 2014) and components of systems (e.g. Simonsen et al., 2014; Brown and Westaway, 2011). Furthermore, many definitions of resilience include references to systems, individuals, families, groups, communities, institutions and even nations (see Table 2.5.2). Here, the interest is on the resilience of individuals, which is the focus of this research. Distinctions between general resilience and specified resilience have also been addressed by Miller and colleagues (2010) who call for a better understanding of both types of resilience. Following this, both Folke et al. (2010) and Miller et al. (2010) have raised a particular concern when the aim is to increase resilience, as in their view increasing specified resilience may have implications for general resilience, as focusing on certain types of threats threatens the general resilience to unknown or unspecified threats.

A concern raised by Leichenko (2011) resulting from the array of conceptualisations are the difficulties in finding

> 'the appropriate analytical unit for the measurement of resilience' (Leichenko, 2011: 164)

(see Section 2.3.3, for more details on resilience assessments), but despite this the concept of resilience has been increasingly gaining attention for better understand adaptation. This supports Nelson et al.'s, (2007) view that resilience includes the capacity to adapt and thus call for a resilience approach focused on enhancing the sources of resilience to assess adaptation with the ultimate goal of reducing vulnerability which is further discussed in Section 2.5.

2.3.2 Human resilience to extreme temperatures

The resilience of individuals and societies is modified by events such as extreme temperatures (IPCC, 2012). As a result the IPCC (2012) has called for improvements regarding planning and policy in order to increase resilience in the short, medium and longer terms. Opportunities to increase human resilience have been proposed and include the development and implementation of programmes aiming at reducing vulnerability (Keim, 2008). Additionally, public health approaches were identified as being the most appropriate to increase the resilience of individuals and societies (Keim, 2008).

For example, most of the emphasis on resilience to climate change and extreme temperatures in the health literature has focused on the health system (e.g. WHO, 2011) and built infrastructure (e.g. Oven et al., 2012) to deliver individual resilience. The WHO (2009) and the IPCC (2012) offer a similar argument to increase the resilience of individuals and communities aiming at reducing the impacts of climate change with a focus on service delivery by health planning (e.g. early warning systems) and health professionals. Furthermore, according to the WHO (2011)

> 'few health policies and programmes are tailored to take into consideration weather conditions and seasonal trends, current climate variability and recent climate change.' (WHO, 2011: 28).

In this sense, the focus has been on the resilience of the health-care facilities and services for the provision of care to the most vulnerable populations, such as older people aiming at reducing vulnerability and increasing resilience to extreme temperatures. Despite this, authors acknowledge that other sectors besides health can also contribute to resilience building efforts, which include for example the transport and energy sectors (Haines et al., 2010), and urban planning (Bulkeley, 2010). In addition, Marmot (2013) from a health perspective also argues for increasing individual resilience through assets in addressing the threats individuals face, including extreme temperatures.

In a study of heatwaves and climate change adaptation in the UK, Wolf and colleagues (2010) explored the role of social capital in influencing older people's adaptation as it had been argued that social networks enhanced resilience. Despite this, their findings indicate that there is a narrative of resilience among older people and their social contacts that is only changed due to negative changes in health status (e.g. illness, lack of mobility) which contrasts with the epidemiological narrative of vulnerability of older people to climate change (Wolf et al., 2010). Another study by Hansen and colleagues on perceptions of heat-related vulnerability and barriers to adaptation in Australia revealed that older people's life experiences play an important role in their resilience to heatwaves (Hansen et al., 2011). Additionally, older people's resilience was found to be an enabler for adaptation (Hansen et al., 2011). Furthermore, Lowe and colleagues (2011) in a study on adaptation advice and heatwave early warning systems call for more research on the factors that increase resilience for improvements in existing action plans.

On the other hand, regarding resilience to cold, the Department of Health in England has called for programmes and actions to increase the resilience of individuals and communities to reduce the health effects of extreme cold (DoH, 2013). Furthermore, it is acknowledged that a comprehensive approach is needed to address resilience in relation to other health issues such as inequalities and fuel poverty (DoH, 2013). Improving the resilience of most at risk and vulnerable individuals such as older people has also been advocated (DoH, 2013). In a review paper by Conlon and colleagues (2011) regarding the prevention of cold-related health effects, these authors suggest resilience building strategies at the individual, infrastructure and neighbourhood levels to improve adaptation to extreme cold based on policies and programmes aiming at increasing protection against the cold, energy efficient homes and buildings, as well as shelters, respectively.

As a result of lack of evidence on human resilience to climate change in general and extreme temperatures in particular, the IPCC argues that

> 'research is needed on the resilience of human populations to extreme events (factors which increase resilience), including responses […] heatwave risks. Inequalities – and how adaptation policies may increase or reduce social inequalities' (IPCC, 2014c: 39).

Furthermore, Curtis and Oven (2012) call for a better understanding of the social factors and processes contributing to human resilience as research has shown that reducing individual and household vulnerability (e.g. increase access to assets) may increase their resilience. In summary, the lack of evidence on the determinants of human resilience to extreme temperatures is considered a major gap in knowledge, which is addressed in this thesis by assessing both general and specified resilience to extreme heat and cold temperatures.

2.3.3 Resilience assessments

As a result of the diverse disciplinary roots of the concept of resilience many approaches have been taken to measure it (Leichenko, 2011). These have in the words of Werner (2012) allowed the concept of resilience to become

> 'overused but, ironically, somewhat underutilized.' (Werner 2012: 20).

The panarchy approach from Gunderson and Holling (2001) is possibly the most widely used for assessing resilience in ecology (Cutter et al., 2008). In the hazards literature, Cutter and colleagues have in 2008 developed the DROP (Disaster Resilience Of Place) model to assess the resilience of communities to threats. In their model, six resilience indicators are proposed comprising ecological, social, economic, institutional, infrastructure and community competence dimensions with respective candidate variables that still had to be tested, as the model had not been operationalised so far (Cutter et al., 2008). Later on, following on previous work (Cutter et al., 2008), Cutter and colleagues developed a methodology for a quantitative method to measure community resilience using a set of indicators (Cutter et al., 2010). This later work, constitutes an improvement on their earlier work and highlights the need to understand the concept of resilience for then developing an analytical approach to assess resilience. Other examples are still scarce. This supports Berkes and Ross' (2013) call for an integrated approach on community resilience through looking at the similarities between ecosystems (which deals with systems) and health literatures (which deals with the individual) as they both focus on the capacity to adapt. Opportunities for interdisciplinary research into novel theoretical and analytical approaches to resilience integrating the health, psychology and climate fields are thus considered crucial to understand what shapes human resilience (Berkes and Ross, 2013). In their model of community resilience they include a series of characteristics (e.g. social networks, knowledge, values and beliefs, people-place-relationships) leading to agency and self-organization, resilience being a function of these two (Berkes and Ross, 2013). According to Berkes and Ross (2013) the health literature brings agency to the forefront of the resilience debate which has been neglected in other sciences, such as natural sciences. Despite this, in the natural sciences, Walker and colleagues (2004) emphasize the importance of access to assets, institutions and governance within the many factors shaping resilience, which can impact on the empowerment and agency of individuals (further discussed in Section 2.5).

The health and human development literatures have a tradition in measuring resilience both at the community and individual levels through the development of quantitative measures (Brown and Westaway, 2011). As an example, in a systematic review of the literature on the use of the concept of resilience in public health, Castleden et al. (2011) found nine related key concepts: community, disaster, social-ecological, infrastructure, individual (psychological), organisational, network, urban, and system resilience. This again shows that resilience thinking is a good framework to understand the ability of systems to deal with threats and as such the concept of human resilience is to be further discussed as it allows exploring what Castleden and colleagues (2011) have called 'individual (psychological) resilience'.

In the health literature, Castleden et al. (2011) mention that there are many ways to assess resilience, but there is no agreement on which approach or indicators to use. As a result of difficulties in reaching a well-defined tool to measure resilience (i.e. due to place and context specificities), Castleden et al. (2011) call for quantitative and qualitative approaches for measuring resilience. Following these concerns, Engle and colleagues (2013) acknowledge the challenges and difficulties in achieving a set of appropriate indicators for assessing resilience, reiterating its criticality to human resilience studies worldwide. Despite a quantitative approach being considered as most desirable for policymakers, a qualitative approach on resilience is considered to be an alternative to overcome the challenges for compiling resilience indicators and can even be a more suitable way of measuring resilience through the implementation of case studies (Engle et al., 2013). An example of such an approach in the health literature is a study by Glandon and colleagues (2008) who assessed human resilience after Hurricane Katrina through the Sense of Coherence scale by gathering both quantitative and qualitative data. This is an approach to human resilience that takes a health and salutogenic outlook on the characteristics individuals possess to be able to respond to threats (Almedom, 2008).

2.3.4 Using the Sense of Coherence to operationalise human resilience

Lorenz (2013) makes direct links between the construct of resilience and health by giving special attention to salutogenesis and Antonovsky's Sense of Coherence construct, it focuses on the factors (e.g. general resistance resources, resources, assets) that make someone resilient (Wilkinson, 2005). Others have also seen the links between health and resilience, and focused on evidence that the concept of resilience is starting to be more related to human health and used in combination (Doring et al., 2013). According to Berkes et al. (2012) this is only possible if the concept of health is used in its more holistic form as both resilience and salutogenesis focus on the characteristics that allow individuals and communities to withstand threats. Almedom (2008) asserts that these changes represent a significant development that allows connections between resilience and the sense of coherence which is the central construct of salutogenesis (Wiesmann et al., 2009). Almedom and Glandon (2007) in a systematic literature review of resilience definitions and assessments in the fields of public health and psychology highlight a study by Almedom et al. (2007) that uses the 'Sense of Coherence (SOC)' scale as a quantitative measurement for individual resilience. Since this first use of the sense of coherence scale to assess resilience, Astier Almedom and her team have systematically used the SOC scale to measure individual resilience to the effects of war in Eritrea (Almedom et al., 2007) and Hurricane Katrina (Glandon et al., 2008). More recently, work by Kimhi and colleagues (2010) has also used the SOC scale to measure individual resilience after the Second Lebanon War (Kimhi et al., 2010). In addition, the use of the Sense of Coherence scale to assess human resilience is gaining more interest from researchers and is considered to be an accepted measure of individual resilience (e.g. Kimhi, 2014).

The Sense of Coherence approach to resilience is grounded in the theory of salutogenesis (Antonovsky, 1978, 1987, 1993). Antonovsky defined the SOC as:

> 'a global orientation that expresses the extent to which one has a pervasive, enduring though dynamic feeling of confidence that (1) the stimuli deriving from one's internal and external environments in the course of living are structured, predictable, and explicable; (2) the resources are available to one to meet the demands posed by these stimuli; and (3) these demands are challenges, worthy of investment and engagement.' (Antonovsky, 1978: 19).

The three components presented above are called comprehensibility, manageability and meaningfulness, respectively (Antonovsky, 1993). First, the comprehensibility component refers to the cognitive dimension defined as the skill to make sense, assess order, structure and understand the stressor. Second, the manageability component represents the instrumental or behavioural dimension and is defined as the perception of availability of assets to face the threat and the power to do so. Third, the meaningfulness component refers to the motivational dimension and expresses the degree of incentive and aspiration to deal with the stressor. Hence, the components reflect cognitions, capacities and motivations, respectively (Almedom, 2005; Lindstrom and Eriksson, 2005; Lindstrom and Eriksson, 2006; Lezwijn et al. 2011a). Within the Sense of Coherence approach individuals mobilize generalized resistance resources (GRRs) (i.e. assets) to cope with stresses and threats (Almedom, 2005), which indicates a relationship between individuals and their environment (Eriksson and Lindstrom, 2008). These assets can be psychosocial (e.g. social support, tradition, knowledge, experience), economic (e.g. money) and biological elements (Billings and Hashem, 2009). According to Antonovsky (1996) an individual with a strong SOC facing an adversity or threat will:

> ‘wish to, be motivated to, cope (meaningfulness); believe that the challenge is understood (comprehensibility); believe that resources to cope are available (manageability)’ (Antonovsky, 1996: 15).

Since Antonovsky and his research with survivors of the Holocaust (Antonovsky, 1978; Eriksson and Lindstrom, 2005; Almedom, 2005), many have implemented the Sense of Coherence scale (i.e. Orientation to Life Questionnaire). It has been used in more than 458 academic papers, in more than 33 languages and has more than 15 versions (Eriksson and Lindstrom, 2005). It has been implemented in different age samples, including older people with good reliability and validity (e.g. Forbes, 2001; Schneider et al., 2004; Borglin et al., 2006; Drageset et al., 2008; Wiesmann and Hannich, 2010; Naaldenberg et al., 2011).

The SOC is considered a universally meaningful construct that cuts across sex, social class, region and culture differences, in addition it does not relate to a particular type of coping strategy but to factors allowing specific coping with stresses (Antonovsky, 1993). As a result, an individual with a strong SOC is expected to identify a larger diversity of ‘generalized resistance resources’ (GRRs) at their disposal (Antonovsky, 1993; Eriksson and Lindstrom, 2005; Eriksson and Lindstrom, 2008) and adopts attitudes and behaviours fundamental for coping with adverse situations; thus when the need emerges the resources are triggered. Therefore, a high/strong SOC individual is found to have a positive influence on perceived health and is more often related to healthy choices (Lezwijn et al. 2011a).

However, some critics of the sense of coherence argue that it disregards the relationship between the individual and the environment they live in (e.g. society) (Lazarus and Folkman, 1984). Others like Geyer (1997) stated that rational thinking as well as emotions play a role in the way individuals deal with threats but Antonovsky’s explanations on the role of emotions are lacking, which can be seen as a weakness (Lazarus and Folkman, 1984). In addition, criticisms to the wording of questions of the SOC scale were also mentioned (Flensborg-Madsen et al., 2005). As the SOC scale has been very popular and widely used to measure the sense of coherence concept, concerns arose that Antonovsky's formulation may have been in some sense compromised by the range of translations and versions of the SOC scale (Flensborg-Madsen et al., 2005). Despite this, the sense of coherence is widely used in the health literature (e.g. Lindstrom & Eriksson, 2005; Lindstrom & Eriksson, 2006) and used to measure human resilience (Almedom et al., 2007; Glandon et al., 2008; Kimhi, 2014). According to some of the latest literature, the SOC scale continues to be a common measure of individual resilience and the empirical findings of such research continue to show benefits in its implementation, such as its validity (e.g. Kimhi, 2014).

The sense of coherence approach can help in explaining human adaptation and response to stressors for the mobilization of assets or 'generalized resistance resources' (Almedom et al., 2007). These resources are assets available to an individual or community to facilitate the process of coping effectively. The GRRs can be biological (e.g. genes, intelligence, immune system), material (e.g. money, wealth, housing) and psychological (strength, knowledge, values and beliefs, level of education, sense of control, cultural stability, ego, life experiences social networks, social support, capacities) (Antonovsky, 1993; Almedom, 2005; Eriksson and Lindstrom, 2005; Eriksson and Lindstrom, 2008; Lezwijn et al. 2011a). Almedom's (2009) work on human resilience advanced the view that

> 'individuals, families, and communities that can generate and access social capital and the material resources needed to maintain health and social stability are likely to build resilience' (Almedom, 2009: 3),

which thus relates to the concept of agency (Brown and Westaway, 2011). According to Almedom (2009), the sense of coherence is considered a general orientation that individuals, families and communities take on with respect to the internal and external environment and is hypothesized to be an important determinant of health, dealing also with issues of wellbeing. Within the salutogenic and health promotion frameworks, the concept of empowerment is considered to be one of the most important, as it deals with people's control over their lives by developing capacities and coping skills and the ability to be critical about the decisions that have to be made (Eriksson and Lindstrom, 2008).

As 'the paradigm of social resilience is a way of understanding processes of change in terms of meaning (coping capacity) and even frame them (adaptive and participative capacity)' (Lorenz, 2013: 19), similarly the sense of coherence defines perceptions of the environment based on comprehensibility, manageability and meaningfulness (Antonovsky, 1993; Eriksson and Lindstrom, 2008), thus reflecting the synergy between the individual and the environment. Furthermore, Adger and colleagues (2011)

> 'define the parameters of a resilience approach, suggesting that resilience is characterized by the ability to absorb perturbations without changing overall system function, the ability

> to adapt within the resources of the system itself, and the ability to learn, innovate, and change.' (Adger et al., 2011: 757).

This is to say that in line with resilience, the SOC reflects an individual's ability to respond to stresses (Eriksson and Lindstrom, 2005), and highlights the means by which individuals use the assets available to preserve their health (Lezwijn et al. 2011a).

In summary, the Sense of Coherence has links with assets and resilience having been used to quantitatively measure resilience (Almedom et al., 2007; Glandon et al., 2008) and accompanied with qualitative assessments. As such it has been used to better understand general and specified resilience to different threats (i.e. war, natural disasters) (e.g. Almedom et al., 2007; Glandon et al., 2008) being thought to be useful to understand general, heat- and cold-related resilience.

In this thesis, resilience is defined as the ability or capacity of individuals to respond to life events or threats through actively access, mobilise and use the available assets to positively adapt. It is a function of: 1) ability to make sense of threats; 2) the availability and access to assets; 3) the motivation to respond to threats. This definition draws upon the human health and psychology literatures on resilience presented in Tables 2.5. General resilience is defined as the resilience of individuals to all daily life circumstances and specified resilience is defined as the resilience of individuals to a particular type of threat, stress or event, which in the case of this study are extreme heat and extreme cold. This definition draws upon Folke and colleagues (2010) definition provided earlier but applied to the individual. Similarly to Berkes and Ross (2013), the approach taken here on these two types of resilience is one that considers they are related but independent, thus needing to be conceptualised and assessed separately.

In summary, a second research question emerges from the gaps identified from the literature discussed in this section: 2. How are general, extreme heat and extreme cold resilience of older people shaped?.

2.4 Adaptation

The concept of adaptation is explored here in three subsections. First, definitions and understandings of adaptation are discussed, in Section 2.4.1. Second, adaptation is reviewed in the context of extreme temperatures (Section 2.4.2). Third, adaptation assessments are explored, in Section 2.4.3.

2.4.1 Definitions and understandings of adaptation

To *adapt*, is to 'become adjusted to new conditions' (Oxford Dictionary, 2014) and adaptation is 'the action or process of adapting or being adapted' (Oxford Dictionary, 2014). There are diverse definitions of adaptation which have also been linked to other concepts already discussed above, namely vulnerability and resilience (Davoudi et al., 2012). In the context of climate change, the IPCC (2014a) defines adaptation as,

> 'the process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate harm or exploit beneficial opportunities'. (IPCC, 2014a: 1).

In addition, adaptation has been defined in many ways (Table 2.6.1), who adapts can also vary (adaptation of what) (Table 2.6.2) and adaptation can also be defined as a response to (adaptation to what) (Table 2.6.3).

Table 2.6.1 Selected definitions of 'what adaptation refers to', sources and disciplines

Definitions	Sources	Disciplines
'A process'	IPCC, 2014a; Moser and Ekstrom, 2010; Smit and Wandel, 2006; Burton, 1992	Interdisciplinary; Environmental science
'A process of deliberate change'	Nelson et al., 2007	Environmental science
'A dynamic social process'	Adger, 2003	Environmental science
'A decision-making process'	Nelson et al., 2007	Environmental science
'An adjustment'	IPCC, 2007; Janssen and Ostrom, 2006; Adger et al., 2005; Pielke, 1998; Smit et al., 1996; Watson et al., 1996; Smit, 1993; Stakhiv, 1993	Interdisciplinary; Environmental science; Sociology
'A continuous stream of activities, actions, decisions' and attitudes	Nelson et al., 2007; Adger et al., 2005	Environmental science
'Responses or actions'	Scheraga and Grambsch, 1998	Environmental science
'Actions'	Nelson et al., 2007; Smit and Wandel, 2006; Adger et al., 2005	Environmental science
'An outcome'	Smit and Wandel, 2006	Environmental science
'Changes'	Moser and Ekstrom, 2010	Sociology

Table 2.6.2 Selected definitions of 'what adapts', sources and disciplines

Definitions	Sources	Disciplines
'A system (household, community, group, sector, region, country)'	Smit and Wandel, 2006	Environmental science
'Vulnerable systems'	Scheraga and Grambsch, 1998; Watson et al., 1996	Environmental science
'Human and natural systems'	IPCC, 2014a; IPCC, 2007; Scheraga and Grambsch, 1998	Interdisciplinary; Environmental science
'Ecological, social or economic systems'	Adger et al., 2005	Environmental science
'Social–ecological systems'	Moser and Ekstrom ,2010; Janssen and Ostrom, 2006	Sociology; Environmental science
'Society'	Adger et al., 2005; Adger, 2003	Environmental science
'A behaviour or economic structure'	Smit et al., 1996	Environmental science
'An individual, group and institution'	Pielke, 1998	Sociology
'Individuals, groups and governments'	Adger et al., 2005	Environmental science
'People'	Burton, 1992	Environmental science
'Organism'	Engle, 2011	Environmental science

Table 2.6.3 Selected definitions of 'adaptation to what', sources and disciplines

Definitions	Sources	Disciplines
'Climate change'	Scheraga and Grambsch, 1998; Smit et al., 1996; Stakhiv, 1993; Burton, 1992	Environmental science
'Climate'	Pielke, 1998; Smit, 1993	Environmental science; Sociology
'Changes of climate'	Watson et al., 1996	Environmental science
'Climate variability'	Scheraga and Grambsch, 1998	Environmental science
'Observed or expected changes in climatic stimuli'	IPCC, 2007; Adger et al., 2005	Interdisciplinary; Environmental science
'Changing condition, stress, hazard, risk or opportunity'	Smit and Wandel, 2006	Environmental science
'Environmental changes and their impacts'	Janssen and Ostrom, 2006	Environmental science
'External stimuli and stress'	Nelson et al., 2007	Environmental science
'Current or future predicted change'	Nelson et al., 2007	Environmental science
'Actual and expected impacts of climate change'	Moser and Ekstrom, 2010	Sociology
'The surrounding environment'	Engle, 2011	Environmental science

Similarly to what was found regarding the resilience definitions, here the adaptation definitions (Tables 2.6.1-2.6.3) also follow a basic structure, with different levels of specificity. Additionally, recurrent elements in the definitions can also be identified with definitions presenting a common ground. Despite this, there are also differences to the definitions presented which result from research fields.

Human adaptation has been taking place ever since individuals evolved to deal with their environments (Smithers and Smit, 1997; Beall et al., 2012) by implementing adaptation strategies (Pelling, 2003); human adaptation to both extreme heat and cold temperatures are just two of such examples. Additionally, climate change is expected to increase the need for individuals to adapt (Parry et al., 2007).

In the health literature, Kjellstrom and McMichael (2013) argue that climate change adaptation is about prevention, entailing measures and actions public authorities and individuals put in place to reduce the direct and indirect effects of threats. Prevention and adaptation are thus used interchangeably and may include the use of air-conditioning, heating and insulate the house for dealing with extreme temperatures (see below in Section 2.4.2). Furthermore, Oven and colleagues (2011) assert that adaptation to climate change and health promotion have various related challenges, such as the time needed to evaluate the impacts of interventions. In this sense, according to John Last (1998: In WHO, 2003) there are a number of so called prerequisites for prevention or adaptation to happen:

> 'awareness that the problem exists; understanding of the causes; a sense that the problem matters; the capacity to intervene or influence; the political will to deal with the problem' (Last, 1998: In WHO, 2003: 18).

In the context of this thesis, adaptation is defined as action, response, strategy, or behaviour individuals implement in pre-emption or response to threats.

In some of the adaptation literatures, adaptation to climate change comprises the modifications undertaken by individuals, communities and other systems (Gallopin, 2006; Nelson et al., 2007) aiming at increasing agency and reducing vulnerability (Nelson et al., 2007). In the environmental change literature adaptive capacity has according to Brown and Westaway (2011) made links between resources or assets, structure and agency, with assets and access to assets being what determines adaptation (Grothmann and Patt, 2005). Research within climate change adaptation often takes into account an assets approach to vulnerability by focusing on the range of strategies individuals and households in the developing world adopt to respond to a threat through the use of assets (Birkmann et al., 2010).

Furthermore, Adger (2003) asserts that access to assets determines individuals' ability to adapt. In reflecting on agency itself, McLaughlin and Dietz (2008) offer the argument that individuals play a crucial role in how they deal with threats and should not be seen as passive or powerless victims of such events. Brown and Westaway (2011) captured agency as

> 'the capacity of an individual to act independently and to make one's own free choices' (Brown and Westaway, 2011: 325)

and is a function of both cognitive (i.e. experience, perception) and social spheres (i.e. society, individual, institutions). Many of these ideas have strong links with Sen's capabilities approach (Sen, 1999) and its connection with resources and assets. Additionally, the concept of assets relates to justice in adaptation to climate change. For instance, adaptation to climate change is currently posing challenges to justice in access to assets (Thomas and Twyman, 2005). Despite most of the work on equity and justice related to adaptation having been done through a development lens (e.g. Thomas and Twyman, 2005; Paavola and Adger, 2006; Adger et al., 2009b), a common ground was found, as climate change impacts most on the utmost vulnerable groups of society. Issues of equality, social justice and fairness as well as agency were found to be the biggest concerns involved in climate change adaptation (Paavola and Adger, 2006). In his book, Pelling (2010) argues that

> 'power lies at the heart of this conceptualisation of adaptation. Power asymmetries for whom, where and when the impacts of climate change are felt, and the scope for recovery' (Pelling, 2010: 5).

In response to the issues mentioned above, Benzie (2014) calls for 'social justice as a core value' for adaptation.

Successful adaptation is thus considered to be shaped by three main factors:

> 'timely recognition of the need to adapt, an incentive to adapt, and ability to adapt' (Fankhauser et al, 1999: 68-69).

The first factor is dependent on the information available but also on its reliability and level of detail; the second takes into consideration an environment that facilitates adjustments; and the last on the capacity to access and use the information to act (Fankhauser et al, 1999). The need to assess what, how and to what level human adaptation is occurring (see studies in Section 2.4.2) and how it can be enhanced in the future due to changes in extreme weather events (Deschenes, 2013) are of crucial importance.

2.4.2 Adaptation to extreme temperatures in older people

Research on extreme temperatures has been mostly limited to the impacts on human health through mortality and morbidity studies (see Section 2.2.2). Deschenes (2013) has argued that

> 'regarding the role of adaptation in mitigating the effects of extreme temperature on health, the available knowledge is limited, in part due to the few real-world data sets on adaptation behaviours' (Deschenes, 2013: 1),

resulting in an incomplete understanding of how individuals adapt and the factors influencing adaptation (Fuller and Bulkeley, 2013). Wolf and colleagues (2010) were the first to explore how older people adapt to both heatwaves and cold spells and how they feel about the challenges posed. Generally, older people regarded their adaptation strategies as common sense actions that did not involve much preparation and consisted mainly in adjusting their clothes, food and drink choices (Wolf et al., 2010). As a result there was a feeling that they just had to endure both heat and cold the best way they could with the assets they had and felt they could not do much more than what they were already doing. Other research also shows that older people do not see themselves as old or frail (Abrahamson et al., 2008; Hichings and Day, 2011; Tod et al., 2012), do not perceive themselves at risk from extreme heat (Wolf et al., 2009; Bittner et al., 2012; Loughnan et al., 2013; Nitschke et al., 2013; Hansen et al., 2014) or extreme cold (Tod et al., 2012). There are exceptions such as a study by Kosatsky et al. (2009) on heat awareness. In addition, regarding climate change, Wolf et al. (2013) add that

> 'values are crucial in shaping perception of climate change impacts and adaptation to them' (Wolf et al., 2013: 548),

where tradition, safety, freedom and harmony play major roles.

Other studies in Europe, the US and Australia have since added to this evidence on how older adults respond to extreme temperatures. The use of cooling and heating technologies, clothing adjustments and changes in daily routines are just some examples of a broader variety of adaptation strategies used (see summary in Tables 2.7 and 2.8). One study in Portugal, has found that most individuals take a shower, drink more liquids wear lighter clothes and eat lighter food during extremely high temperatures (Nogueira et al., 2005b). On the other hand, the use of air conditioning as a cooling strategy is widely cited in the U.S. and Australian literatures regarding both access and constraints (e.g. Loughnan et al., 2013; Nitschke et al., 2013), whilst in the European literature access to air conditioning was found not to be as wide among older people (e.g. Fuller and Bulkeley, 2013).

According to Hansen et al. (2011) enablers of heat adaptation strategies in old people include past adaptation strategies, measures and behaviours, social contacts and networks, whilst barriers include: problems using air conditioning; costs associated with using cooling technologies; lack of housing insulation; social isolation; low income; experience of extreme heat; clothing, not wanting to bother social contacts; culture; lack of mobility; lack of transport; poor health, and; lack of awareness and knowledge (Hansen et al., 2011). Moreover, knowledge and awareness of heat warnings was mainly obtained through TV and radio (Nogueira et al., 2005b; Kosatsky et al., 2009; Hayden et al., 2011; Bittner et al., 2012; Nitschke et al., 2013; Hansen et al., 2014) resulting in poor knowledge of health messages which in some studies did not warrant increased engagement in heat adaptation strategies (e.g. Nitschke et al., 2013). It was also found that only a small number of older people asked for help or support from their social contacts, which puts them at higher risk if they are socially isolated (Klinenberg, 2002; Hayden et al., 2011; Nitschke et al., 2013). Lack of transportation was also found to limit older people going to cooler places and increasing their risk (Hayden et al., 2011; Sampson et al., 2013). In addition to all this, older people's lower social participation in their local areas was also found to be a barrier to adaptation (Hayden et al., 2011).

Table 2.7 Extreme heat adaptation strategies or measures used by older people

Indoors	Sources
- Open windows or doors when it is cool	Sampson et al., 2013; Loughnan et al., 2013; Nitschke et al., 2013; White-Newsome et al., 2011; Wolf et al., 2009
- Close blinds, curtains and shutters	Fuller and Bulkeley, 2013; Sampson et al., 2013; Nitschke et al., 2013; Loughnan et al., 2013; Bittner et al., 2012
- Use an electric fan	Fuller and Bulkeley, 2013; Sampson et al., 2013; Loughnan et al., 2013; Bittner et al., 2012; White-Newsome et al., 2011
- Use of a self fan	Sampson et al., 2013
- Use air-conditioning	Hansen et al., 2014; Fuller and Bulkeley, 2013; Loughnan et al., 2013; Nitschke et al., 2013; White-Newsome et al., 2011; Hayden et al., 2011; Kosatsky et al., 2009
- Wear light, loose and fewer clothes	Hansen et al., 2014; Fuller and Bulkeley, 2013; Sampson et al., 2013; Nitschke et al., 2013; Bittner et al., 2012; White-Newsome et al., 2011; Wolf et al., 2010; Nogueira et al., 2005b
- Moving to a cooler room	Sampson et al., 2013; Loughnan et al., 2013; White-Newsome et al., 2011
- Leave the house	White-Newsome et al., 2011
- Change daily routines and rhythms, reduce physical activity	Hansen et al., 2014; Fuller and Bulkeley, 2013; Sampson et al., 2013; Loughnan et al., 2013; Nitschke et al., 2013; Kosatsky et al., 2009
- Change food and increase drink intake (cool)	Hansen et al., 2014; Fuller and Bulkeley, 2013; Sampson et al., 2013; Nitschke et al., 2013; Bittner et al., 2012; Hayden et al., 2011; Wolf et al., 2010; Kosatsky et al., 2009; Nogueira et al., 2005b
- Take a shower, splash water on face and arms	Sampson et al., 2013; Loughnan et al., 2013; Nitschke et al., 2013; Bittner et al., 2012; White-Newsome et al., 2011; Wolf et al., 2009; Nogueira et al., 2005b
Outdoors	
- Go to cooler places	Hansen et al., 2014; Sampson et al., 2013; Nitschke et al., 2013; Loughnan et al., 2013; Newsome et al., 2011
- Use air-conditioning in the car	Fuller and Bulkeley, 2013; Loughnan et al., 2013
- Go to a swimming pool	Sampson et al., 2013
- Wear light, loose and fewer clothes	Fuller and Bulkeley, 2013; White-Newsome et al., 2011
- Change daily routines and rhythms, reduce physical activity	Fuller and Bulkeley, 2013; Sampson et al., 2013; Bittner et al., 2012; Hayden et al., 2011
- Staying in the shade	Sampson et al., 2013; Loughnan et al., 2013; Wolf et al., 2009; Nogueira et al., 2005b
- Avoid the hottest parts of the day	Loughnan et al., 2013; Hayden et al., 2011;Wolf et al., 2009
- Reduce outdoor activities	Nitschke et al., 2013; Hayden et al., 2011; Nogueira et al., 2005b
- Wear a hat, carry an umbrella	Sampson et al., 2013

Regarding extreme cold, evidence on adaptation strategies is less abundant. Wolf et al. (2010) found that some older people in their study considered cold to be more threatening for them than heat. Another study by Fuller and Bulkeley (2013) with English expats living in Spain, also found cold – as a bigger issue than heat - 'unexpected and unwelcome' as well as 'more noticeable' (Fuller and Bulkeley, 2013: 66), mainly due to acclimatisation to heat and housing issues. A variety of factors influencing adaptation decisions and behaviours to keep warm were found by Tod and colleagues (2012) on a qualitative study and categorised as: situational or context factors (e.g. income, age, social capital, housing characteristics; health status) and attitudes, values and beliefs (e.g. thrift, pride, privacy, independence), which were found to interact with each other. As an example, Anderson et al. (2012) in a study on keeping warm with a low income found that individuals had to be frugal, cutting back on using energy to keep warm, but also reducing food, other essential and non-essential items. There is a generalized lack of studies researching cold-related adaptation behaviours in Portugal (Vasconcelos et al., 2011). However, a recent study on energy consumption and saving has highlighted a reduction in the use of electric devices (i.e. heating) due to economic costs which may be due to the economic crisis (Schmidt et al., 2014). Despite this many had even to use their savings and borrow money. In some cases, older people even revealed only heating the home when they have guests (Hitchings and Day, 2011).

Table 2.8 Extreme cold adaptation strategies or measures used by older people

Indoors	Sources
- Closing curtains during the day	Anderson et al., 2012
- Wear warmer, thicker, more layers of clothes (including outdoor clothes)	Anderson et al., 2012; Brunner et al., 2012; Day and Hitchings, 2011; Hitchings and Day, 2011; Wolf et al., 2010
- Use hot water bottles	Anderson et al., 2012; Day and Hitchings, 2011
- Use central heating or heating device	Hitchings and Day, 2011; Wright, 2004
- Heating just one room of the house	Brunner et al., 2012
- Put blankets over legs, wrapping up with quilts	Brunner et al., 2012; Anderson et al., 2012; Hitchings and Day, 2011
- Use only one room in the house	Anderson et al., 2012
- Going to bed earlier, staying in bed longer, being in bed during the day	Brunner et al., 2012; Anderson et al., 2012
- Sharing a bed	Anderson et al., 2012
- Having warm food and drinks	Anderson et al., 2012; Wolf et al., 2010
Outdoors	
- Wear a hat	Day and Hitchings, 2011

The way in which people adapt depends on many factors such as social, cultural and financial (Adger et al., 2009; Anderson et al., 2012; Brunner et al., 2012; Tod et al., 2012), perceptions of heat and cold (Wolf et al., 2010) as well as on past experiences of extreme temperatures (Fuller and Bulkeley, 2013) which may create opportunities as well as limits to adaptation. Energy-inefficient homes, types of technology, high costs (e.g. purchase and use), low income were some of the reasons mentioned as limits to keep cool or warm during extreme heat and cold temperatures, respectively (Wright, 2004; Fuller and Bulkeley, 2013;). In seeking to understand adaptation and its constraints and limits it is also needed to understand the root causes that allow or do not allow individuals to implement certain strategies and measures.

As such, understanding the causes and impacts of, for example: lack of knowledge and awareness of risks; inability to use technologies; fuel poverty (e.g. Anderson et al., 2012; Tod et al., 2012); low income (Anderson et al., 2012; Brunner et al., 2012; Hansen et al., 2014); high costs of cooling technologies (Kosatsky et al., 2009; Hayden et al., 2011; White-Newsome et al., 2011; Sampson et al., 2013; Nitschke et al., 2013); lack of neighbourhood safety in opening windows, and going to cool places such as parks (Sampson et al., 2013); will enable the search of options and opportunities to improve adaptation (IPCC, 2014d). These adaptation options or opportunities include a wide range of structural/physical (e.g. built environment, technological, services), social (e.g. education, informational, behavioural) and institutional (economic, laws and regulations, government policies and programs) option categories (IPCC, 2014d) where efforts can and should be targeted to improve older people's adaptation strategies in responding to extreme temperatures. In order to achieve this, more research is thus needed on assessing the breadth of adaptation strategies used by older people, as well as the influence of social, physical, environmental and economic factors (White-Newsome et al., 2011).

In summary, conceptualisations of adaptation and an understanding of the factors determining the implementation of adaptation strategies shape the ways in which adaptation to certain threats are explored and assessed (see below Section 2.4.3).

2.4.3 Assessment of adaptation strategies

Entangled in the definitions of adaptation is the fact that it entails several decisions on the actions to implement (Adger et al., 2005). The IPCC (2014d) asserts that adaptation assessments are deemed necessary for the identification of adaptation needs and options aimed at the reduction of the negative impacts of climate change to human health. Fussel and Klein (2006) in their work on climate change adaptation frameworks and their suitability to the human health field, grounded their adaptation assessment approach in John Last's health work (1998) which also links adaptation to assets. This included the use of the concept of prerequisites for adaptation discussed in Section 2.4.1 and developed their own prerequisites, as follows: (1) identification of the issue; (2) assessment of available options; (3) evaluation of options; (4) assessment of assets needed for implementation of options; (5) role of culture in implementation of options, and; (6) motivations for implementation of options (Fussel and Klein, 2006). Similarly, Moser and Ekstrom (2010) developed a framework for diagnosing barriers to climate change adaptation based on a rational decision making process which includes three distinct phases: (1) identify and understand the issue under analysis, (2) develop, evaluate and choose the options available, and (3) implement the options. Both Fussel and Klein (2006) and Moser and Erkstrom (2010) outlooks on adaptation as a decision making process could also be used to assess other adaptation related concepts by exploring individual needs, constraints, limits and opportunities for adaptation, as developed by the IPCCs' AR5 (2014a) and presented in Table 2.9.

Table 2.9 Definitions of adaptation-related concepts

Adaptation constraint	'Factors that make it harder to plan and implement adaptation actions or that restrict options.'
Adaptation deficit	'The gap between the current state of a system and a state that minimizes adverse impacts from existing climate conditions and variability.'
Adaptation limit - Hard adaptation limit - Soft adaptation limit	'The point at which an actor's objectives (or system needs) cannot be secured from intolerable risks through adaptive actions.' 'No adaptive actions are possible to avoid intolerable risks.' 'Options are currently not available to avoid intolerable risks through adaptive action.'
Adaptation needs	'The circumstances requiring action to ensure safety of populations and security of assets in response to climate impacts.'
Adaptation opportunity	'Factors that make it easier to plan and implement adaptation actions, that expand adaptation options, or that provide ancillary co-benefits.'
Adaptation options	'The array of strategies and measures that are available and appropriate for addressing adaptation needs. They include a wide range of actions that can be categorized as structural, institutional, or social.'

Source: IPCC (2014a: 2)

The IPCC has defined adaptation assessment as

> 'the practice of identifying options to adapt to climate change and evaluating them in terms of criteria such as availability, benefits, costs, effectiveness, efficiency, and feasibility.' (IPCC, 2014a: 2).

Such assessments have evolved greatly since the first steps in adaptation planning (Fussel, 2007b; IPCC, 2014d) but have mostly included top-down and bottom-up approaches, or even a combination of both (Dessai and Hulme, 2004; Brown et al., 2011; IPCC, 2014d). Despite this, as academics and practitioners have struggled to reach a common definition of adaptation this has resulted in difficulties of translating the concept into practice (IPCC, 2014d). Ultimately, according to Adger and colleagues (2005), adaptation assessments should take a human centred analysis and capacities to face threats, as well as take into account local climate, social, demographic, economic and political changes as they all play a role in shaping how individuals deal with threats (Pelling and Wisner, 2009). Additionally,

> ‘to date, few adaptation assessments have considered the uneven distribution of climate impacts and vulnerability across groups and individuals within society’ (Benzie, 2014: 1)

which would enable a focus on social justice within the adaptation agenda (Benzie, 2014). Furthermore, the evaluation of individual actions regarding adaptation might be hard to measure according to Adger and colleagues (2005), but it is crucial to understand the factors that shape adaptation and understand the relationship between adaptation, resilience and vulnerability, in order to be able to improve adaptation, reduce vulnerability and increase resilience to threats, such as extreme temperatures (see Section 2.5). Adger et al. (2003) also argue that climate change may enhance and strengthen inequalities by vulnerability and adaptation, and Brown (2011) goes even further to assert that adaptation may even create new inequalities to those that are already struggling under normal circumstances. Here, is thus made the link between adaptation and poverty, and adaptation implications for the vulnerable as well.

In summary, in order to address the gaps identified from the literature discussed in this section, a third research question is identified: 3. What does adaptation to extreme heat and extreme cold look like in practice?.

2.5 Understanding the interactions between human vulnerability and resilience as a guide for adaptation to extreme temperatures

In order to bring together diverse conceptualisations of vulnerability, and focus on the dynamic factors that shape and create vulnerability, this thesis focuses on bringing together the different perspectives on vulnerability mentioned above, with a special attention to: the assets literatures; vulnerability as a baseline characteristic of individuals (general vulnerability) and influenced by external events such as extreme temperatures (specified vulnerability). As such, vulnerability is conceived here as being socially constructed, rooted in the characteristics of the place and context where individuals live their lives. A working definition of vulnerability is developed which is of particular relevance for the development of concrete measures and tools to assess vulnerability

(Section 2.2.3) and to integrate other concepts such as resilience and adaptation to reduce the impacts of extreme temperatures. The climate, sociology and human health literatures are brought together for producing a definition of vulnerability. Vulnerability is thus defined in this research as the degree of susceptibility to harm determined by the availability of assets. Two types of vulnerability are explored further, general vulnerability (i.e. baseline vulnerability) and specified vulnerability (i.e. vulnerability to a specified threat, stress or event, such as extreme temperatures). General vulnerability is defined as the vulnerability of individuals to all daily life circumstances and specified vulnerability is defined as the vulnerability of individuals to a particular type of threat, stress or event, which in the case of this study entails extreme heat and extreme cold.

Vulnerability, resilience and adaptation have emerged and evolved from diverse research arenas (Nelson et al., 2007; Vogel et al., 2007; Miller et al., 2010; Turner, 2010). As a result, a growing number of studies have explored the theoretical connections between these three concepts (Berkes, 2007; Vogel et al., 2007; Nelson et al., 2007; Miller et al., 2010; Turner, 2010) but studies operationalising this relationship are still few. This section builds on existing knowledge, theories and approaches (discussed throughout this chapter) to build a novel theoretical and analytical multiconceptual approach in relation to responses to heat and cold.

The Committee on Climate Change (CCC) highlights a lack of understanding of human vulnerability from a conceptual perspective in terms of assessing all the factors mentioned above and their combined occurrence (CCC, 2014). Calls for pursuing these foci in research are varied. For instance, Wilhelmi and Hayden's work (2010) on extreme heat asserts that adaptation can reduce vulnerability and health impacts, and

> 'suggests specific heat stress adaptation and response strategies to target specific corresponding indicators of vulnerability (i.e. causes of impacts, such as lack of resources, social networks or urban land use) and their relative importance in contributing to negative health outcomes.' (Wilhelmi and Hayden, 2010: 5).

This could be explored in the context of extreme cold, for tackling inequalities (i.e. health, social and environmental) and contributing to improvements in adaptation responses (Klinenberg, 2002; O'Brien et al., 2004; Marmot, 2010). In addition, Deschenes (2013) in a literature review on temperature, human health and adaptation found that despite the wide variety of data sets and settings most studies find that temperature extremes lead to significant reductions in health, generally measured with excess mortality.

> 'Regarding the role of adaptation in mitigating the effects of extreme temperature on health, the available knowledge is limited, in part due to the few real-world data sets on adaptation behaviors.' (Deschenes, 2013: 1).

On the other hand and also applied to extreme heat, the IPCC (2004a) states that for improved human adaptation, a range of strategies and measures ought to be implemented and or improved, such as: warning systems, urban planning, built environment and transport. In addition, the IPCC (2014a) also adds that

> 'a first step towards adaptation to future climate change is reducing vulnerability and exposure to present climate variability (high confidence). Strategies include actions with co-benefits for other objectives. Available strategies and actions can increase resilience across a range of possible future climates while helping to improve human health, livelihoods, social and economic well-being, and environmental quality.' (IPCC, 2014a: 25-26).

It has been argued that public health and climate change literatures could be better integrated through interdisciplinary research to deal with the current and foreseen risks and impacts of climate change (CSDH, 2008). According to McMichael and colleagues (2006) a more holistic line of research should address the implications of climate change in regards to the determinants of health, reducing health inequalities (Marmot, 2010). Despite this, the health impacts of extreme temperatures mentioned above, are preventable, avoidable (e.g. Astrom et al., 2011) and can be mitigated through strategies aiming at vulnerability reduction, resilience increasing and adaptation improvements (Keim, 2008) but there are still numerous constraints on implementing solutions. To achieve this, Curtis and Oven argue that

> 'a more 'differentiated' perspective on the links between climate change and health is needed to capture the variable factors influencing health vulnerabilities and resilience to climate change of individuals and groups in different societies and different geographical settings' (Curtis and Oven, 2012: 660).

Here these authors also call for a better understanding of the factors shaping knowledge, perception and behaviour, in relation to vulnerability and resilience (Curtis and Oven, 2012). Oven and colleagues (2011) assert that

> 'building resilience to extreme weather now will mean individuals, communities and sectors will be better prepared to deal with climate change in the long-term.' (Oven et al., 2011: 5).

The WHO (2012) in their Health 2020 Policy Framework and Strategy give emphasis to

> 'resilience and assets that protect against harm, and on reducing or altering exclusionary processes' (i.e. vulnerability)' (WHO, 2012a: 12).

As a starting point, it is necessary to acknowledge that there is 'no one-size-fits-all approach to climate vulnerability, adaptation and resilience' (Bulkeley and Tuts, 2013: 648), but a collective agenda for vulnerability, resilience and adaptation is growing and thus, attention needs to be placed on how all three concepts are developed and operationalised in relation to each other (Bulkeley and Tuts, 2013).

Miller and colleagues (2010) offer an interesting view on the relationship between vulnerability, resilience and adaptation which is summarised in this quote:

> 'resilience and vulnerability represent two related yet different approaches to understanding the response of systems and actors to change; to shocks and surprises, as well as slow creeping changes' (Miller et al., 2010: 1).

Resilience thinking can thus provide the tools for analysing and improving adaptation (Nelson et al., 2007; Leichencko, 2011; Bulkeley and Tuts, 2013). Nelson and colleagues (2007) assert that improving adaptation may also include vulnerability reduction and increase resilience. Despite all this, Leickenko and Silva (2014) argue that not enough is known regarding how resilience is shaped and call for more research on the characteristics or factors that allow individuals to adapt, and on inequalities affecting this.

On the other hand, Brooks (2003) argues that vulnerability is influenced by adaptations that occurred in the past as well as current availability of potential options for adaptation, and relying on assets. Furthermore, Moser (2011) offers an asset-focused framework for understanding climate change (rooted in her previous work on asset vulnerability and asset adaptation) which provides

> 'the link between climate change adaptation and the erosion of assets' (Moser, 2011: 226).

As highlighted earlier, resilience is still left out when exploring empirical interactions between vulnerability, adaptation and related concepts, but despite this it represents a step forward for the conceptual linkage of related concepts such as assets, vulnerability, resilience and adaptation.

According to Miller and colleagues (2010) an individual can have high resilience and at the same time be considered vulnerable. That is why some authors argue it is crucial that translation of theory into practice and policy occurs so that research targets those individuals most impacted by threats, as in most cases they are left out (e.g. Vogel et al., 2007; Miller et al., 2010). This also calls for the use of mixed approaches in vulnerability and resilience research using both quantitative and qualitative methods, offering a holistic methodological view on both concepts (Miller et al., 2010).

This thesis adds a new dimension to the assets and vulnerability framework, a resilience dimension. The link with resilience is thus made, through an increasing interest by the health literature in the relationship between assets and resilience (Marmot, 2013) as well as connections made between resilience and the theory of salutogenesis and the 'Sense of Coherence' (Almedom et al., 2007; NHS Scotland, 2011; Marmot, 2013). Following this perspective, Canvin et al. (2009) argue that ‘salutogenesis has been implicit in the notion of ‘resilience’ (Canvin et al., 2009: 239)

and the integration of asset based approaches will make possible a greater understanding of the factors that allow individuals to thrive and implement adaptation strategies to deal with threats.

This literature review uncovered five main gaps where research is needed to reduce the impacts of extreme temperatures on human health: (1) understand the role of assets in human vulnerability, resilience and adaptation; (2) understand and operationalise human vulnerability; (3) understand and operationalise human resilience; (4) understand and address the factors influencing adaptation, and; (5) understand the relationship between vulnerability, resilience and adaptation.

In summary, assets are used in this thesis as a basis for defining the scope for assessing general and specified (i.e. extreme heat and cold) vulnerability and for opening up avenues for exploring general and specified (i.e. extreme heat and cold) resilience and adaptation to extreme temperatures.

A summary of selected definitions of the four key concepts explored in this chapter are presented in Table 2.10, aiming at providing a guide for this study in terms of the theoretical and operationalization of such concepts, as well as providing a framework for data collection and analysis. The choices made in the construction of this table took into account the interdisciplinary exploration and analysis of such concepts aiming at providing different perspectives and insights on how vulnerability, resilience and adaptation are shaped. This table, despite showcasing only two disciplinary perspectives - climate science and health - the definitions of the concepts of assets, vulnerability, resilience and adaptation in this thesis are the result of the extensive literature review explored and discussed throughout this chapter. Furthermore, at the theoretical level, this thesis’ contribution rests in advancing knowledge through a novel perspective on these concepts taking into account the broader literature it draws upon and combine (i.e. health, climate science, disaster science and sociology).

Table 2.10 Selected definitions of concepts in this thesis

Concept	Definition in the environmental science context	Definition in the health context	Definition in this thesis
Asset	'a broad array of resources that enable people and communities to exert control over their lives and to participate in their societies in meaningful and effective ways' (Ford Foundation, 2002: 4)	'any factor (or resource) which enhances the ability of individuals, groups, […] to maintain and sustain health and wellbeing and to help to reduce health inequities. These assets can operate at the level of the individual, group, community, and/or population as protective (promoting) factors to buffer against life's stresses' (Morgan and Ziglio, 2007: 18).	Human, financial, physical, place-based and social factors or characteristics directly or indirectly available to individuals in anticipating or responding to threats.
Vulnerability	'the susceptibility of a system to disturbances determined by exposure to perturbations, sensitivity to perturbations, and the capacity to adapt' (Nelson et al., 2007: 396)	'the degree to which individuals and systems are susceptible to or unable to cope with the adverse effects of climate change.' (WHO, 2003: 28)	The degree of susceptibility to harm determined by the availability of assets.
Resilience	'The ability of a system and its component parts to anticipate, absorb, accommodate, or recover from the effects of a hazardous event in a timely and efficient manner, including through ensuring the preservation, restoration, or improvement of its essential basic structures and functions.' (IPCC, 2012:563) 'resilience is a process that leads to adaptation, not an outcome, not stability.' (Norris et al., 2008)	'the process of negotiating, managing and adapting to significant sources of stress or trauma. Assets and resources within the individual, their life and environment facilitate this capacity for adaptation and 'bouncing back' in the face of adversity.' (Windle, 2011); 'describes individuals' and groups' ability to respond positively to threats, shocks, crises and other forms of adversity in ways that minimize harm to themselves and maximize benefits' (Marmot, 2013)	The ability or capacity to actively access, mobilise and use the available assets to positively adapt. Is a function of: 1) ability to make sense of threats; 2) assets availability, access and use; 3) the perception of the ability to cope and act.
Adaptation	'a stress response in light of access to resources and the abilities of people to cope' (Smit and Wandel, 2006: 284) 'the decision-making process and the set of actions undertaken to maintain the capacity to deal with current or future predicted change.' (Nelson et al., 2007: 396)	'the strategies, policies and measures undertaken now and in the future to reduce potential adverse health effects' (WHO, 2003: 17) 'the adaptation measures and actions in place in a region or community to reduce the burden of a particular health outcome' (WHO, 2003: 28)	Action, response, strategy, or behaviour individuals implement in pre-emption or response to threats.

2.5.1 Conceptual and analytical framework linking assets, vulnerability, resilience and adaptation

Having provided a review of the links between the concepts of vulnerability, resilience and adaptation, this section introduces the conceptual and analytical framework developed in this research.

The approach taken in this thesis comprises three components intrinsically connected to assets and can be summarised as follows:

- Asset vulnerability (explored in Section 2.2);
- Assets or generalized resistance resources (GRRs) and resilience (explored in Section 2.3), and;
- Asset based adaptation (explored in Section 2.4).

In seeking to bring together the distinct but related concepts of assets, vulnerability, resilience and adaptation, the figure below (Figure 2.1) is a framework representating the relationship between the concepts described in this chapter and also a reflection of the definitions of each concept used in this thesis (see Table 2.10). This theoretical model developed for the purpose of this thesis highlights the main factors or characteristics that play a role in human adaptation in general, which is specifically applied in this thesis to extreme temperatures. The individual as part of a series of networks (e.g. household, family, neighbourhood, social, religious, care, medical) is the focus. Age and genetic characteristics (e.g. sex) are considered to be fixed factors. All the other components of the surrounding layers are considered to be elements that in some instances can be changed or modified according to life circumstances (e.g. extreme temperatures):

- assets are categorised in five groups (human, financial, physical, place-based and social) (see Section 2.2.4);
- vulnerability is categorised as 'general' or 'specified' (e.g. to heat, cold, specific threats and stressors) (see Section 2.2.1);
- resilience is measured through the 'Sense of Coherence' and comprises three dimensions, namely comprehensibility, manageability and meaningfulness (see Section 2.3.4), and;
- adaptation considers the strategies, actions and behaviours individuals engage in response to threats (e.g. extreme heat and cold temperatures) (see Section 2.4).

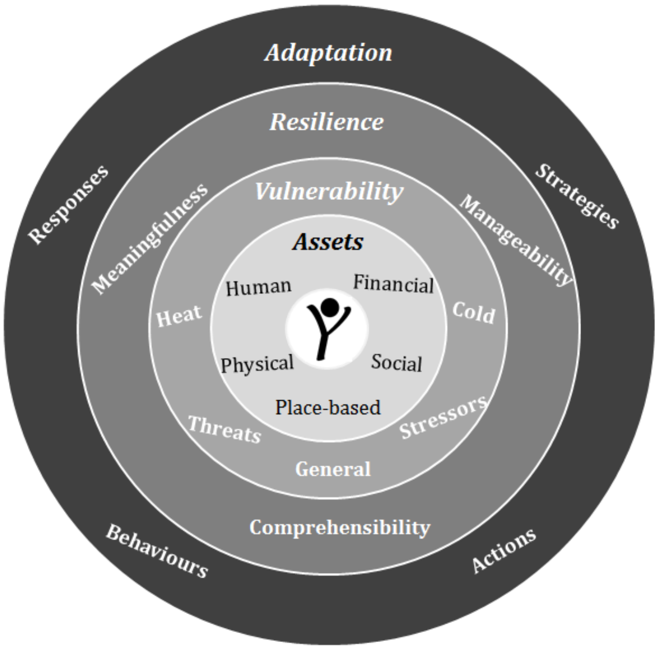


Figure 2.1 Framework for understanding the relationship between the concepts of assets, vulnerability, resilience and adaptation in this thesis.

This framework illustrates (Figure 2.1) the different layers of influence on human adaptation, by which through these the individual can develop or be assisted in developing what is needed for adaptation. Adaptation is influenced by a range of factors both within and outside the individual's control. Here is mapped the relationship between the individual and the environment where they are born, live and work. The individual is at the core, comprising different characteristics, some of these can be modifiable (i.e. level of education) but others cannot (i.e. age, genetic factors). Surrounding individuals are external factors (i.e. assets), that can be modified, that influence their vulnerability, resilience and adaptation to general or specified threats, shocks, stresses. The first layer represents assets and assets portfolio (i.e. human, financial, physical, place-based and social assets) that influence and is influenced by vulnerability and ultimately have an impact on adaptation and vice-versa. Assets operate to reduce vulnerability. The second layer represents vulnerability. Vulnerability to general daily life circumstances (i.e. general vulnerability) and vulnerability to specific threats, stressors or events, such as extreme temperatures (i.e. specified vulnerability) influences and is influenced by general and specified resilience. The next layer represents resilience, and it encompasses three dimensions. Comprehensibility (cognitive dimension), manageability (instrumental or behavioural dimension) and meaningfulness (motivational dimension) influence how resilience is shaped. Resilience, in turn, influences and is influenced by adaptation. Finally, the fourth layer represents adaptation, translated into the responses, strategies, behaviours and actions individuals implement in coping or responding to specific threats, stressors and events that affect their lives. This thesis aims to address each layer of the diagram in turn in the subsequent chapters (Chapter 4: assets and vulnerability; Chapter 5: resilience; Chapter 6: adaptation). As such, in this thesis adaptation is both a function of and determined by resilience, which in turn is linked to vulnerability and assets; whilst assets are embedded in all the other concepts. The operationalization of this model is outlined in the next chapter.

The aim was to develop an integrated approach to the different aspects of assets, vulnerability, resilience and adaptation, using a specific case study. Additionally, the framework illustrates the importance of considering individuals as embedded in cultural, social, economic and natural environments, the places where they live and work (i.e. collective and neighbourhood attributes). The framework thus, emphasizes the multi-directional interactions, at multiple levels between assets, vulnerability, resilience and adaptation.

This framework aims to help researchers, policymakers and practitioners to develop a range of questions about the role assets, vulnerability and resilience play on human adaptation, to explore their relative influence on human adaptation and the interactions between them (i.e. assets, vulnerability, resilience and adaptation). This will further help the development of programs and policies to improve access to and availability of assets, reduce vulnerability, enhance resilience and improve adaptation.

The previous sections have highlighted the key different ways in which diverse literatures have conceived the concepts of resilience, vulnerability, adaptation and assets. This section addresses how it is possible to combine these different approaches rooted in distinct scientific disciplines in order to incorporate and acknowledge the various definitions into an interdisciplinary framework conceptualizing the relationship between assets, vulnerability, resilience and adaptation. To date, much of the advance has been made in understanding each concept separately, and the attempts to integrate some of these concepts have only been done partially (i.e. vulnerability and adaptation; resilience and adaptation; vulnerability and resilience) and mainly through one disciplinary lens. For the first time, Figure 2.1 presents a full integration of the concepts in a conceptual and analytical framework. This integrated framework aims to help develop new research approaches and methodologies from which a better understanding of the concepts themselves and the synergies between them can be explored in order to reduce vulnerability, increase resilience and improve adaptation to extreme temperatures.

In order to address the knowledge gaps that emerged throughout this chapter, four research questions are developed in this thesis:

1. Do different assets affect general, extreme heat and extreme cold vulnerability of older people? If so, what are their effects and how do they occur?

2. How are general, extreme heat and extreme cold resilience of older people shaped?

3. What does adaptation to extreme heat and extreme cold look like in practice?

4. How do vulnerability and resilience interplay with adaptation to extreme temperatures and what is the nature of these relationships?

The outcome of examining the diverse literatures and addressing the knowledge gaps identified in the sections above to answer the research questions can be visualised in Figure 2.2. It represents how the attempt in this thesis to better understand the interdependencies between assets, vulnerability, resilience and adaptation is developed in the chapters that follow.

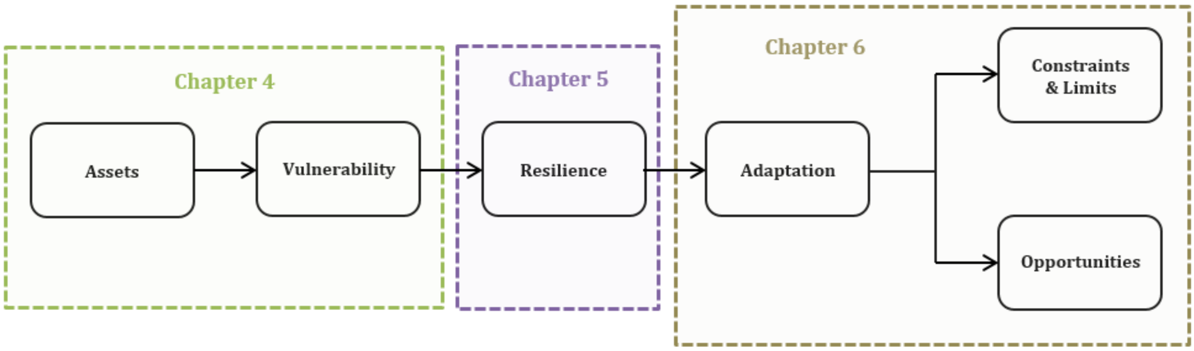


Figure 2.2 Chapter structure linking assets, vulnerability, resilience and adaptation in this thesis.

The following chapter describes the research site (country and city background), the research design and methods implemented in this research. It discusses the case study approach, the sample selection process and the different phases of the research. The use of quantitative and qualitative research methods to understand human vulnerability, resilience and adaptation is also discussed in the following chapter.

Chapter 3 - Methodology

3.1 Introduction

Building on the conceptual clarifications discussed in Chapter 2, this chapter outlines the methodological journey underpinning the gathering of empirical data for this research. It begins by presenting the rationale for the methodological and design choices made, explaining and describing the research approach (Section 3.2), design (Section 3.3) and methods (Section 3.4) used in this thesis to answer the four key research questions. It provides detail on the practical aspects of the implementation of the research, with insights on the research context and location, sample, as well as how the data collected were analysed (Section 3.5). The chapter finishes by providing a reflection on ethical considerations of research with older people and research limitations (Section 3.6).

3.2 A multimethodological research approach

The research questions in this thesis call for an integration of both natural and human sciences for a better understanding of what shapes general and specified (heat- and cold-related) vulnerability, resilience and adaptation to extreme temperatures, as such an interdisciplinary research approach is employed.

Reducing vulnerability, enhancing resilience and improving adaptation to climate change and extreme temperatures represents a real-world problem that should be addressed by problem-solving research. As this topic requires the understanding of diverse disciplines, interdisciplinarity, which involves the combination of two or more disciplines aiming at crossing boundaries between such disciplines (Barry et al., 2008; Petts et al., 2008; Lyall and Meagher, 2012) is thought to be the best approach to solve real-world problems such as the one addressed in this thesis. As the problem addressed here lies in the intersection between health sciences, environmental science and sociology, applying an interdisciplinary approach allows a creative and innovative angle to research. However, doing interdisciplinary research also presents several challenges, such as the need to preserve disciplinary integrity, interpretation of data and research funding issues which make it harder to design and implement interdisciplinary research (Petts et al., 2008). Therefore, most research is conducted within the established boundaries of a given discipline, as pure or genuinely interdisciplinary research is considered to be extremely challenging and demanding, making it uncommon (Barry et al., 2008; Petts et al., 2008).

In addition, to foster truly interdisciplinary research, interdisciplinary settings for thinking and practice where researchers discuss ideas, theories, concepts and data to a common topic ought to be encouraged (Petts et al., 2008). Interdisciplinary could be promoted as an approach that adds to existing knowledge and practice within and across disciplinary boundaries as it involves bringing together ideas from different disciplines to study a problem that needs solving and choosing the best methodology for collecting and analysing the data (Barry et al., 2008; Lyall and Meagher, 2012; Scheff, 2013).

The selection of an appropriate research approach is needed to capture the extent and complexity of such disciplinary diversity and evidence. The selection was based on the research focus and research questions, as well as the characteristics of the research sample (ethics), research timings and budget. The multimethodological approach used in this study results from a mixed-method approach where vulnerability is assessed through assets, resilience assessments are made using the sense of coherence concept and adaptation strategies identified through the behaviours older people living independently implement during extreme temperatures. In this thesis, 'older people' are those aged 65 or over and 'living independently' those living in their own homes with or without support in their daily lives. The philosophical paradigm used in this research is the pragmatic paradigm, as according to Creswell (2014) pragmatism is oriented towards understanding and solving real life problems such as the ones presented in this research, and justifies using a mixed methods approach. A mixed methods approach was thus chosen for this research as it combines features of both quantitative and qualitative approaches and involves the collection of both types of data (Bryman, 2012; Creswell, 2014). A mixed methods approach also adds focus and flexibility to the research design allowing a more comprehensive understanding (Creswell, 2007) of how vulnerability, resilience and adaptation are shaped through using more than one type of data.

The empirical phases of this research involved the collection of general quantitative data (Phase 1) followed by the collection of specified (heat- and cold-related) qualitative data (Phases 2 and 3, respectively) (see Section 3.4) with the aim of obtaining detailed information about individual participants only possible by using both types of data (quantitative or qualitative) (Creswell, 2014). A convergent parallel mixed methods design (Creswell, 2014) is used to collect parallel variables (e.g. experiences of extreme heat and cold temperatures) to explore assets, vulnerability, resilience and adaptation throughout the data collection process, allowing the separate analysis of each set of data whilst being able to bring them together for interpretation and validity. In addition, the decision to have equal sample sizes in all phases of research was taken to achieve the above and to allow a better understanding of how general and specified vulnerability, resilience and adaptation are shaped and manifested within the same individuals.

Integrating quantitative (Phase 1) and qualitative (Phase 2 and 3) data represented a challenge in this research, as they convey different means for understanding the specificities of the research topic. A strategy to bring them together has been developed to allow the qualitative data to shape the reporting of results (Ritchie and Lewis, 2003). The quantitative data will be used to support and substantiate the qualitative data and vice-versa. The qualitative results are interpreted in combination with the quantitative results to reveal the degree to which they complement each other, as the aim is to understand how older people living independently adapt to both extreme heat and cold temperatures taking into account their general and specified vulnerability and resilience. Interpretation and validation of both quantitative and qualitative data was undertaken, as well as across databases interpretation. As more than one method is used for data collection, the researcher used triangulation to review, cross check quantitative and qualitative data, as well as identify patterns and corroborate findings (Bryman, 2006).

3.3 Research design

An exploratory research design (e.g. Ruane, 2005) is used to explore the significance of general and specified (heat- and cold- related) vulnerability and resilience, and adaptation to extreme temperatures, in combination with a holistic and social ecological perspective (e.g. Stokols, 1996; Creswell, 2007) to explore the relationships between all these elements.
The sections below present a description of the case study, its location in the city of Lisbon in Portugal, sampling of Lisbon wards and older people as participants, as well as data collection procedures.

3.3.1 Case study design

In order to operationalise the conceptual framework (Section 2.5.1, Chapter 2) a case study approach combining different data collection methods is used (Hakim, 2000; Huberman and Miles, 2002; Yin, 2009; Bryman, 2012) (see Section 3.4). Case studies combine exploration and descriptive interpretations (Hakim, 2000; Flyvbjerg, 2006; Thorpe and Holt, 2008) and can focus on different social units (e.g. individuals, communities, organisations) using a variety of data collection methods allowing the use of various sources of data for triangulation (Hakim, 2000).

They are particularly useful when investigating in detail less understood, unclear, dynamic and complex events or circumstances (Yin, 2003; Flyvbjerg, 2006; Thorpe and Holt, 2008; Yin, 2009; Thomas, 2011). Case studies can be single or multiple and include both quantitative and qualitative data (Yin, 2009) allowing flexibility in the description of cases (Hakim, 2000). Using case studies also allows in-depth inquiry about the *how* and *why* looking into different perspectives allowing a three-dimensional image of an event or circumstance being even

> 'able to smell human breath and hear the sound of voices' (Thomas, 2011: 7).

All these characteristics of case studies offer an extremely rich and stimulating analysis of the data (Thomas, 2011) making it a very powerful tool (Hakim, 2000). Case study research is thus used in this research to understand what shapes general and specified (heat and cold) vulnerability, resilience and adaptation to extreme temperatures through older people's point of view, in the city of Lisbon, Portugal.

3.3.2 Case study: Portugal and the city of Lisbon

The choice of the city of Lisbon in Portugal as the location for this research was made during the PhD studentship grant application process during the year 2010 and took into account several factors, amongst them: a series of major extreme heat and cold temperatures and respective human health impacts on mortality and morbidity in recent years; the researcher's professional experience and previous research as a public health and epidemiology specialist, and an extensive literature review on the human health impacts of extreme temperatures. These are presented below in more detail.

3.3.2.1 Portugal's context

- Location, History and Politics

Portugal is a country with an area of 92.212 Km^2, located in the Iberian Peninsula in south-west Europe facing the Atlantic Ocean and is most well-known and renowned by its ascension as a world power in the 15^{th} and 16^{th} centuries with the discovery and later possessions of some regions of South America, Africa, Oceania and Asia. Portugal's empire has since disappeared. The monarchy was abolished in 1910 and between 1933 and 1974 an authoritarian regime was in power. The country became a member of the European Union in 1986 and nowadays this European nation is facing the effects of the 2007-2008 world's economic and financial crisis that led in 2011 to the intervention of the International Monetary Fund (IMF) and the European Commission (EC) with concessions of bailout loans and the implementation of austerity measures which included a combination of tax raises; cuts in public health, education and social security spending; reduction in public sector jobs; wage cuts for public sector workers; cuts in pensions; cuts in unemployment and social security benefits. The crisis has worsened inequality (OPSS, 2014) and the country is facing high rates of unemployment and emigration of young and middle age people which are contributing to rising the proportions of older people in the country (see below).

- <u>Demography</u>

Portugal's population levels were growing until 2010 and started to decrease in 2011 (OECD, 2014) resulting in a negative growth rate, and the first negative net migration growth rate in 2010 (INE, 2013; OECD, 2014). Despite this, the OECD (2014) has projected a population increase by 2020 and a subsequent decrease by 2050. As many other developed nations, Portugal's ageing population is increasing. Statistics show that between 1995 and 2012 the elderly population increased from 14.7% to 19.4% (as percentage of total population) (OECD, 2014). Portugal's ageing population is according to the Portuguese Office for National Statistics a result of both drop in fertility and increased longevity (INE, 2013). Life expectancy at birth has increased from 66.7 years in 1970s to 80.8 years in 2011, being higher for women than for men (OECD, 2014). Overall the number of older people (65 years and older) per 100 young people has almost tripled from 45.4 in 1981 to 129.4 in 2012 (Pordata, 2014).

- <u>Society and Economics</u>

Inequality in Portugal has worsened recently with an increase of population at risk of poverty from 17.9% in 2011 to 18.7% in 2012, with 14.7% for older people at risk of poverty (INE, 2014a). The Eurostat (2013) estimated that the percentage of older people at risk of poverty or social exclusion by 2011 reached 24.5% and total population risk was of 24.4%, both higher than the EU-27 mean (Eurostat, 2013), and higher than the ones presented by INE (2014a). The poverty line has now been set at 409 €/month (INE, 2014a) and severe deprivation now affects 10.9% of the population and the population at risk of poverty or social exclusion has also risen (INE, 2013; INE, 2014a). As such, Portugal's population is facing higher inequality and an at-risk of poverty rate greater than the European mean, with both young and old people most at risk (INE, 2013). Furthermore, increases in taxes and reductions in wages and pensions, combined with increases in housing, electricity, gas and water expenses are coupled with a decrease in food, housing equipment, clothes and footwear expenditures by the population (INE, 2013). Since the economic and financial crisis population unemployment rates in Portugal have almost doubled, having risen from 8.4% of total labour force in 2007 to 16.1% of total labour force in 2012 (OECD, 2014). According to the Portuguese Ministry of Finance, the total number of pensioners is 2.408.881 and around 80% of them receive a mean pension of 364 €/month (Ministerio das Financas, 2014), below the poverty line.

- Environment

Portugal is a country with mild a Mediterranean climate characterized by dry and warm summers, wet and cool winters but with significant changes in the frequency of temperature extremes resulting in severe impacts on human health (Lucio et al., 2010). Recent records indicate that both maximum and minimum temperatures have risen in Portugal more than those observed at both European and global scales: maximum temperatures have risen by 0.49°C per decade in the period between 1976 and 2006, and minimum temperatures by 0.54°C per decade in the same period (Ramos et al., 2011). Furthermore, future climate change scenarios using the HadRM3 Regional Climate Model and the B2 (A2), B2 and A2 scenarios projected changes in the frequency of both extreme heat and cold temperatures, with an increase of the former and decrease of the latter (Ramos et al., 2011). As such, Portugal is considered to be vulnerable to climate change, especially to extreme heat (Carvalho et al., 2014). Heatwaves have affected the country more frequently and with more intensity in recent years (e.g. 1981, 1991, 2003, 2006, 2009 and 2010 heatwaves) with high health impacts. Despite extreme cold having been less frequent, the 2012 cold weather contributed to high mortality rates especially among the elderly (Mazick et al., 2012).

In a study on excess winter mortality in Europe between 1988 and 1997, Portugal was the country with the highest rate of excess winter mortality (28%), followed by Spain (21%) and Ireland (21%), in comparison to the EU-14 mean of 16% (Healy, 2003). The study revealed that countries with milder climate were those with higher EWM, which the authors refer to as the 'paradox of winter mortality' (Healy, 2003). Additional findings of that study include significant relationships between excess winter mortality and macroeconomic factors, lifestyle risk factors, healthcare provision, socioeconomic factors and household thermal efficiency. Countries with milder winters such as Portugal were found to be the most affected by high winter variations in seasonal mortality and similar results were found regarding countries with poor housing – which include Portugal – that indicates low ability to protect from the cold indoors (see Table 3.1). Despite being the most affected country by excess winter mortality, there is still a lack in understanding the relationship between extreme cold and health impacts in Portugal, which also seems to be associated with a collective feeling of acceptance of such impacts; this has consequently become a neglected issue in Portuguese society (Vasconcelos et al., 2013). Furthermore, researchers in Portugal maintain that there is lack of impact assessments of both extreme heat and cold temperatures associated with a lack of mitigation as well as adaptation strategies both at the national and local levels (e.g. Lucio et al., 2010; Carvalho et al., 2014).

Table 3.1 Coefficients of seasonal variation in mortality (CSVM) and other factors.

Country	CSVM	Mean winter temperature (°C)	Cavity wall insulation (% houses)	Roof insulation (% houses)	Double glazing (% houses)	Deprivation rate (%)	Fuel poverty rate (%)
Austria	0.14	1.4	26	37	53	-	6
Belgium	0.13	3.7	42	43	62	22	10
Denmark	0.12	2.1	65	76	91	17	4
Finland	0.10	-3.5	100	100	100	-	5
France	0.13	7.0	68	71	52	28	10
Germany	0.11	1.6	24	42	88	19	5
Greece	0.18	11.6	12	16	8	58	33
Ireland	0.21	5.8	42	72	33	28	9
Italy	0.16	6.4	-	-	-	37	14
Luxemburg	0.12	1.5	-	-	-	14	5
Netherlands	0.11	4.3	47	53	78	16	6
Portugal	**0.28**	**13.5**	**6**	**6**	**3**	**56**	**50**
Spain	0.21	6.5	-			40	32
UK	0.18	5.4	25	90	61	27	9
Mean	**0.16**						

Adapted from Healy (2003). Legend: CSVM - Coefficient of Seasonal Variation in Mortality.

Portugal's reduced levels of socioeconomic progress (OPSS, 2012) and more recent austerity measures may have put individuals and households in equal or even more precarious circumstances than those found by Healy (2003). A more recent study, the EU-SILC (European Union Statistics on Income and Living Conditions, 2009), has investigated some of the issues mentioned above and confirms Portugal's low performance regarding equality, housing quality and energy affordability. In this regard, only 5% of dwellings in Portugal are equipped with heating facilities (EU-27 mean: 75%) such as central heating or similar and other fixed heating. Portugal has the lowest percentage of both dwellings comfortably warm during winter time (43% vs EU-27 mean: 84%) and dwellings comfortably cool during summer time (58% vs EU-27 mean: 76%) (EU-SILC, 2009). According to the WHO (2012b) the proportion of the population unable to keep the home warm by relative poverty level in 2009 was highest in Portugal when compared with the other EU-15 countries. When looking at household type, the percentage of households unable to keep the home warm was highest for those with one adult older than 65 years, which constituted an exception when compared to the other EU-15 countries. In 2012, 6.3% of the Portuguese population mentioned being in arrears with utility bills (EU-15 mean: 7.6%) (EU-SILC, 2014a), 27.1% lived in a dwelling with a leaking roof, damp walls, floors or foundation, or rot in window frames or floor (EU-15 mean: 11.8%) (EU-SILC, 2014b) and 27.0% of the population was unable to keep the home adequately warm (EU-15 mean: 9.5%) (EU-SILC, 2014c). Another study concludes that the capacity to keep the home cool or warm in Portugal is mainly dependent on the socioeconomic level of individuals (OPSS 2012).

Portugal imports most of the energy consumed, which reached 79% in 2011; the country's dependency on external energy was found to be higher than the European mean of 52.7% in 2010 (INE, 2013). According to Dromacque (2013) Portugal's energy prices are the 6th highest (7.71 c€ per kWh) when compared with other EU-15 countries, for example with Great Britain 13th in the ranking (5.62 c€ per kWh). In addition, countries with low income, like Portugal were found to have comparatively higher energy prices than high income countries, like Great Britain (VaasaETT, 2014). Both residential electricity and gas prices have risen in Portugal in recent years, it has the 2nd most expensive gas prices and the highest electricity prices after adjusting for purchase power when compared with the other EU-15 countries (Dromacque, 2013; VaasaETT, 2014). The combination of increased prices and lower incomes as a result of the financial and economic crisis and subsequent austerity measures are thought to have increased fuel poverty in countries such as Portugal, where households spend around 7% of their disposable income on energy (the 4th highest among the EU-15), whilst Great Britain ranks 7th with around 4.5% of households' disposable income spent on energy (VaasaETT, 2014).

- <u>Health</u>

According to the OPSS (2011) the financial, economic and social crisis in Portugal, in particular the rise of unemployment and poverty rates had a negative impact on the health of the Portuguese population. In 2011 the Portuguese Department of Health made budget cuts of 13% and increased healthcare out of pocket expenses for individuals when accessing the national health service (i.e. nonreimbursable expenses) (OPSS, 2011). Before that, citizens with chronic diseases and older people were exempt from paying GP appointments and specific medication essential to their health conditions. Currently many of these exemptions have been revoked, with impact on the access to healthcare and medication. As Portugal does not monitor the effects of the financial and economic crisis on health, as well as the impacts of budget cuts in health care provision it becomes impossible to assess the real impacts of the crisis on health (OPSS, 2012). Despite this, the media brought the issue to the public domain and raised concern about the increase of suicides, reduction in the number of GP appointments, and the increase in drug consumption since the start of the crisis (OPSS, 2012).

The impacts of the financial and economic crisis on health can depend on a number of factors such as: the baseline socio-economic; health and social protection situation; the magnitude of the crisis, and; the opportunity for and quality of responses implemented (OPSS, 2012). Despite the lack of studies in Portugal of the impacts of the crisis on mental health, studies in other countries such as

Greece, South Korea, Spain and Sweden have found such associations, including for example, increases in suicide rates and transmissible diseases such as HIV (OPSS, 2012). In the case of prolonged socio-economic crisis it is even possible to find significant changes in general mortality such as the one observed in Estonia after the collapse of the USSR, as well as increases in chronic diseases, hypertension, coronary heart disease, stroke, diabetes and infections (OPSS, 2012).

3.3.2.2 The city of Lisbon

Lisbon is Portugal's capital as well as its largest city and is located on the north bank of the Tagus River where it meets the Atlantic Ocean (38.7138° N, 9.1394° W) occupying an area of 85.0Km^2 (Pordata, 2014). The city of Lisbon is characterized by having warm temperate climate with dry and hot summers, and mild winters (Kottek et al., 2006). Since 2001, the city has seen a population reduction from 563.312 inhabitants to 530.847 inhabitants in 2012, with an increase in the older population (65 years and older) from 23.7% in 2001 to 26.9% in 2012 (Pordata, 2014) and an increase of the unemployment rate from 7.4% in 2001 to 11.8% in 2011 (Pordata, 2014).

In a study on the impacts of high temperatures on mortality in Portugal, the city of Lisbon was found to have higher associated mortality rates than the second greatest city, Oporto, and older people were the most affected group (Almeida et al., 2010) which was consistent with previous findings (e.g. Calado et al., 2004; Hajat et al., 2007; Basu, 2009). In a study on heat stress and mortality in Lisbon, Dessai (2003) assessed the potential impacts of climate change, specifically regarding heatwaves and estimated that annual heat-related deaths are expected to rise from 5.4-6 (per 100.000) in the period between 1980 to 1998, to 5.8-15.1 (per 100.000) in the 2020s and by 7.3-35.6 (per 100.000) by 2050s. Similarly, it was also found that heat-related mortality is expected to rise in Lisbon from 5.4-6 per 100.000 observed in 1980-1998, to 8.5-12.1 per 100.000 by 2020 and to 29.5 per 100.000 by 2050 (Casimiro et al., 2006). Despite human health impacts of heat having been extensively addressed in Portugal (Calado et al., 2004; Nogueira et al., 2005; Nogueira et al., 2009), there is still a pronounced gap in research and knowledge about cold-related mortality and morbidity in Portugal, as well as in the city of Lisbon (Casimiro et al., 2006; Vasconcelos et al., 2013). In addressing the human health impacts of climate change in Portugal, Casimiro and colleagues (2006) argued that their research did not include the impacts of extreme cold on health as a result of not having been investigated before due to the problems in making estimations of cold-related mortality.

In summary, the considerations above make Lisbon a suitable location for investigating factors shaping vulnerability, resilience and adaptation to both extreme heat and cold temperatures. Important and relevant are: the high health impacts observed in the city of Lisbon; the health impacts on the older population and the projected increase of an ageing population; past and climate change projections of heat-related mortality (Casimiro et al., 2006), as well as; the lack of research in Portugal regarding extreme cold. In addition, researcher's knowledge of the language, country and city specificities, as well as being able to conduct the research in such location were enabling factors for implementing this research.

3.3.3 Data collection

Within the city of Lisbon, a total of 5 wards amongst 52 wards (in 2012) were chosen as a focus for the research. The reason for deciding to work by ward emerged from the diverse characteristics (e.g. geographical, demographic, environmental) of wards within the city of Lisbon and to allow greater diversity of participants. In order to find suitable wards, researcher's knowledge of the city and its wards, as well as data from the 2011 Census were explored. Both assessments provided relevant information on the geographical, socio-economic, age diversity and contrasting inner city characteristics (e.g. existence of green spaces, health services, transport, community centres and building stock). As presented in Table 3.2, of the 5 wards chosen two were located in the central region of the city of Lisbon and presented a high percentage of older people (Wards C and D), one was located in the south region and historic centre of the city and presented a medium percentage of older people (Ward E) and two were located in the north region of the city and presented a low percentage of older people (Wards A and B) (INE, 2011). Table 3.2 also summarises the diversity of characteristics of the five wards used in this research in terms of their location in the city of Lisbon and their resident population in terms of age group (i.e. older people).

Table 3.2 Key population and location characteristics of the five wards

	Location in the city	Resident Population			
		Total	65 years and older (% of total population)	65-74 years (% of older people)	75 years and older (% of older people)
Ward A	North	11 863	14.8%	59.6%	40.4%
Ward B	North	9 935	13.7%	58.5%	41.5%
Ward C	Centre	8 869	31.5%	34.3%	65.7%
Ward D	Centre	11 727	31.3%	36.0%	64%
Ward E	South	910	23.5%	38.8%	61.2%

Source: INE, 2011. Percentage calculations specially prepared for this research.

3.3.4 Gaining access to participants

Local authorities and public or charitable institutions working with older people within the five wards were approached to gain access to prospective participants. The decision to use this method took into account the fact that approaching older people to be part of this research without the help of a gatekeeper would prove extremely problematic due to both trust and ethical issues (see Section 3.6, for an explanation of the ethical review processes undergone to approve the research). Despite this, gaining access to local authority offices and public or charitable institutions was quite challenging and time consuming. It constituted an iterative process, which included: telephone calls to find out whom the researcher could talk to about the research, its aims and objectives; sending emails with documentation about the research, and; travel to the sites for personal contact. Following a series of initial email, telephone, face-to-face contacts and meetings with gatekeepers (e.g. staff, officials), permissions were obtained for the researcher to conduct the study in five local authority offices and public or charitable institutions in the five wards. Initial authorizations were obtained in Summer 2012 for conducting general structured interviews and heat-related semi-structured interviews (see Sections 3.4.2, and 3.4.3), and additional authorizations obtained in Winter 2012/2013 to conduct the cold-related semi-structured interviews (see Section 3.4.4).

Participants in this research were selected according to the following inclusion criteria: being 65 years of age or over; living independently in their homes, and; living in one of the five wards chosen in the city of Lisbon, Portugal. The recruitment of participants encompassed a strategy to approach participants with diverse characteristics (e.g. age, sex, marital status, living arrangements, education level, financial status, health status, etc.). A mix of non-probability sampling techniques was used and is presented in Box 3.1. These were used in the preparation, development and implementation of the sampling plan.

Box 3.1. Types of sampling techniques used in the research.

- **Purposeful sampling** strategy was applied to intentionally select individuals that had specific characteristics crucial to the research. A *maximum variation* approach (selected participants with different characteristics on the criteria thought to be crucial).
- **Convenience sampling** was used to choose accessible and at hand individuals.
- **Quota sample** was selected based on age (65 years of age or older) and sex in order to produce a sample reflecting the population characteristics of the research location, in terms of the relative proportions of people in the categories chosen.
- **Snowball sampling** was initiated by making an initial contact with individuals relevant to this research topic and receiving recommendations of other local older people (only the case for 2 participants: spouse and husband of participants) to participate in the research.

(e.g. Seidman, 1998; Ruane, 2005; Creswell, 2007; Bryman, 2012; Creswell, 2014).

The researcher approached older people at the local authority offices and public or charitable institutions with the help of gatekeepers and inquired if they were willing to participate in the study during Summer 2012 and Winter 2012/2013. With those older people who expressed an interest, the researcher clarified the aims and objectives of the research, read the 'Information for Participants' sheet (Appendix 3.1) and asked if the potential participant was willing to participate. The researcher obtained contact details from participants and contacted them at a later stage to arrange an interview. When contacted, participants still had the choice to withdraw from participating in the research and this choice was also given during the interview process.

The researcher was aware of the importance of selecting participants with sufficient competence and autonomy to understand the study and their involvement in the study. The researcher was also aware of the difficulty in judging the competence of participants. Thus, the recruitment strategy used (as outlined above) was deemed likely to discourage the participation of individuals with dementia or cognitive impairment, as it was based on a free and voluntary willingness to participate (see also Section 3.6 on ethics). Usually, in the first few minutes after the initial approach, people with dementia would self-exclude themselves from participating in the study. Later, as the recruitment was made face-to-face the researcher also had the opportunity to directly screen potential participants for eligibility. The researcher assessed and evaluated participants' ability to indicate their willingness to talk about the research and to know more about what was expected from their participation in the study. The researcher also assessed their understanding of the research aims and objectives, their understanding of potential individual and collective risks and/or benefits of the research, their understanding of the option to refuse to participate and to withdraw from participating in the research, as well as their understanding of confidentiality of the data collected. Participants who did not demonstrate sufficient competence and autonomy were not selected to participate in the research and were given (face-to-face) or were read (telephone) a 'Thank you letter' (Appendix 3.2). All information for participants was first written in English and translated to Portuguese by the researcher. This information was provided to participants in Portuguese.

The sample size was decided for this research after ensuring theoretical saturation (Bryman, 2012). Following this assumption, the number of participants was achieved in accordance with logistical and conceptual aspects of the research. Although this approach does not allow a statistically representative sample size, it allowed the researcher to elicit through first person dialogue, in-depth understanding of the research topic. Also for logistical reasons (e.g. use of mixed methods, three research phases, timings and budget) a statistically representative sample was not feasible, but it was possible to mitigate these shortcomings through the implementation of a careful sampling technique (detailed in Box 3.1). Informed consent (see Appendix 3.3) was obtained for a total of 52 participants that participated in all phases of research (Phase 1 to 3), recruited from several institutions and organizations within the five Wards, as follows:

- *Ward A* - Local authority health service (nurse): 4 participants;
- *Wards A and D* - University of the 3rd Age (e.g. art classes, internet and computer classes, crafts, music): 23 participants;
- *Ward B* - Day Care Centre (lunch, afternoon snacks and activities): 13 participants;
- *Ward C* - Cultural and Activity Centre (e.g. internet and computer classes, memory games and activities for older people): 6 participants;
- *Ward E* - Lisbon Ward older people's contact list: 6 participants.

In Table 3.3 are presented some of the characteristics of participants to help clarify the composition of the sample and individual circumstances of participants. The convention used to identify participants anonymously (e.g. AM, BF) is one that reflects the order in which they were interviewed (1st letter(s) of participants' identification codes: **A**M, **B**F, **AA**F) and their sex, M for male and F for female (last letter of participants' identification codes: A**M**, B**F,** AA**F**). Research participants' mean age was 75.2 years, with a minimum age of participants being 65 years and a maximum age of 95 years, with 67% being female and 33% being male (Census data: 62% female; 38% male; INE, 2011) . Of all participants in the study, 58% lived alone (Census data: 27% lived alone; INE, 2011), 48% were widowed, 29% were married, 8% were divorced and 15% were single (Census data: 32% widowed; 52% married; 7% divorced; 9% single; INE, 2011). Appendix 3.4 outlines additional characteristics of participants.

Table 3.3 Characteristics of participants in this research

Participant	Sex	Age	Marital status	Living arrangements	Household income (€/month)	Health status	Housing tenure	Ward
AM	Male	65	Widowed	Living alone	501-800	Fair	Tenant	A
AF	Female	79	Widowed	Living alone	351-500	Poor	Social housing	A
BF	Female	80	Widowed	Living alone	< 350	Poor	Tenant	A
CF	Female	87	Widowed	Living alone	< 350	Fair	Tenant	A
DF	Female	76	Widowed	Living alone	< 350	Fair	Owner	A
EF	Female	81	Widowed	Living alone	< 350	Good	Owner	A
FF	Female	80	Single	Living alone	1501-2500	Good	Owner	A
BM	Male	75	Widowed	Living alone	1501-2500	Fair	Tenant	A
HF	Female	65	Married	Living with spouse	1501-2500	Poor	Owner	A
IF	Female	73	Widowed	Living alone	< 350	Fair	Social housing	A
MF	Female	82	Married	Living with spouse	501-800	Good	Tenant	A
NF	Female	65	Married	Living with spouse	351-500	Fair	Social housing	A
GF	Female	69	Married	Living with spouse	351-500	Fair	Tenant	B
CM	Male	68	Married	Living with spouse	351-500	Poor	Social housing	B
JF	Female	83	Widowed	Living alone	351-500	Poor	Tenant	B
KF	Female	65	Widowed	Living alone	< 350	Poor	Owner	B
LF	Female	71	Married	Living with spouse	801-1500	Fair	Owner	B
DM	Male	83	Single	Living alone	351-500	Fair	Tenant	B
PF	Female	76	Widowed	Living with family members	801-1500	Poor	Tenant	B
QF	Female	74	Widowed	Living alone	801-1500	Fair	Tenant	B
RF	Female	79	Widowed	Living with family members	351-500	Poor	Tenant	B
SF	Female	75	Widowed	Living alone	351-500	Fair	Tenant	B
EM	Male	78	Single	Living alone	801-1500	Good	Tenant	C
FM	Male	95	Widowed	Living alone	801-1500	Good	Owner	C
GM	Male	69	Divorced	Living alone	1501-2500	Good	Tenant	C
HM	Male	87	Widowed	Living alone	351-500	Very good	Owner	C
IM	Male	76	Married	Living with spouse	1501-2500	Fair	Owner	C

Table 3.3 cont. Characteristics of participants in this research

Participant	Sex	Age	Marital status	Living arrangements	Household income (€/month)	Health status	Housing tenure	Ward
OF	Female	72	Married	Living with spouse	1501-2500	Good	Owner	C
TF	Female	70	Married	Living with spouse	801-1500	Fair	Owner	D
UF	Female	70	Married	Living with spouse	501 - 800	Good	Rented	D
VF	Female	76	Widowed	Living with family members	351-500	Poor	Owner	D
JM	Male	80	Married	Living with spouse	801-1500	Fair	Owner	D
XF	Female	80	Widowed	Living with family members	351-500	Fair	Owner	D
KM	Male	65	Married	Living with spouse	801-1500	Good	Owner	D
ZF	Female	79	Widowed	Living with family members	501-800	Excellent	Rented	D
AAF	Female	75	Divorced	Living alone	801-1500	Fair	Rented	D
LM	Male	65	Married	Living with spouse	> 2500	Good	Owner	D
BBF	Female	74	Widowed	Living alone	801-1500	Good	Owner	D
CCF	Female	78	Divorced	Living alone	801-1500	Excellent	Rented	D
MM	Male	85	Widowed	Living alone	1501-2500	Very good	Rented	D
DDF	Female	65	Married	Living with spouse	> 2500	Good	Owner	D
NM	Male	69	Widowed	Living alone	801-1500	Fair	Rented	D
EEF	Female	72	Widowed	Living alone	351-500	Fair	Owner	E
FFF	Female	84	Divorced	Living alone	< 350	Fair	Rented	E
GGF	Female	84	Widowed	Living alone	351-500	Fair	Rented	E
OM	Male	65	Single	Living alone	351-500	Good	Rented	E
HHF	Female	76	Single	Living alone	< 350	Fair	Rented	E
IIF	Female	87	Single	Living with family members	501-800	Good	Rented	E
JJF	Female	77	Widowed	Living alone	501-800	Fair	Owner	E
PM	Male	65	Single	Other non-relatives	351-500	Good	Rented	E
KKF	Female	71	Married	Living with spouse	801-1500	Poor	Rented	E
QM	Male	65	Single	Living alone	< 350	Fair	Rented	E

3.3.5 Timing of research activities

In exploring vulnerability, resilience and adaptation to both extreme heat and cold temperatures the decision to implement an inter-seasonal approach for data collection was the one that allowed interviewing participants during the time of the year were it is more likely for them to experience extreme heat and cold temperatures and relate their actions, strategies, behaviours, options and associated limits to those periods. Data was collected during 2012 summer months (June, July and August) regarding Phases 1 and 2 (general and heat-related, respectively) and during 2012/2013 winter months (December, January and February) regarding Phase 3 (cold-related), as outdoor and indoor temperatures are higher and lower, respectively, than in other seasons. After being part of Phases 1 and 2 of the research, participants were also invited to take part in Phase 3 of data collection. Figure 3.1 shows an overview of the research approach, design and methods.

In summary, primary data and case study of actual experiences of extreme heat and cold temperatures allowed the recall of individual responses, actions, strategies and behaviours (adaptation). Additional assessments of general and specified vulnerability and resilience allowed a better understanding of the factors and drivers that generated different opportunities and limits to adaptation at the individual level through a multimethodological research approach.

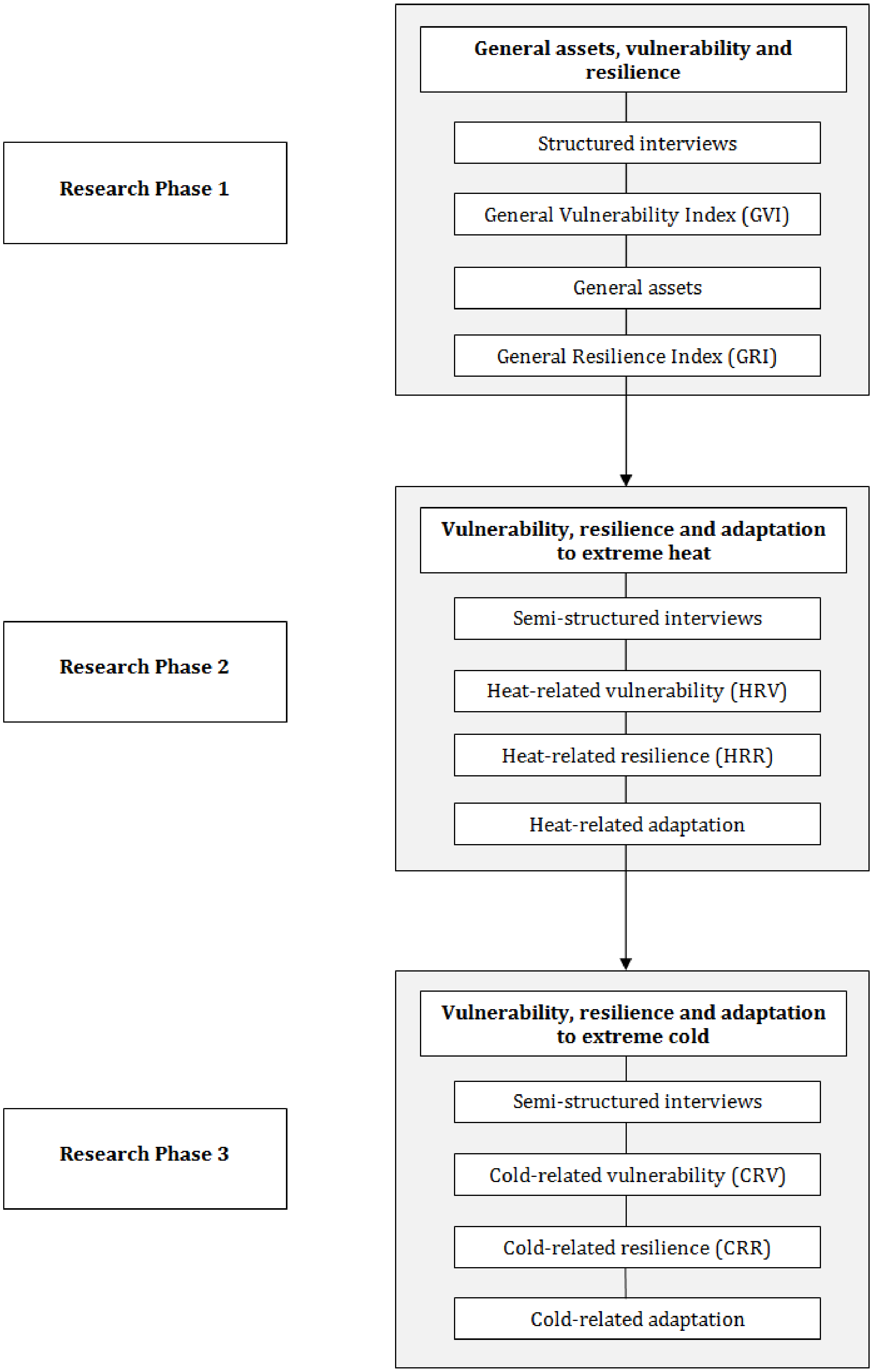


Figure 3.1 Overview of the research approach, design and methods

3.4 Research methods for data collection

Structured interviews were used to quantitatively identify participants' general assets, vulnerability and resilience and determine the most important features associated with these (Phase 1). Afterwards, semi-structured interviews were used to explore participants' specified assets, vulnerability, resilience and adaptation to extreme heat (Phase 2) and extreme cold (Phase 3). This qualitative method was developed and implemented with the aim of gaining an understanding of older people's views and identify how vulnerability, resilience and adaptation are shaped so that priority may be taken in addressing such features in order to reduce vulnerability, increase resilience and improve adaptation to extreme temperatures through health promoting programmes, strategies and initiatives in public health and social care. Integrating quantitative and qualitative methods to the research design (mixed methods) added depth to the findings and the processes involved as well as providing a more comprehensive insight than individual approaches would allow.

Interview protocols used in all research phases were developed and informed by an extended review of the relevant literature. Main topics were covered and specific questions were established, with special attention being taken to account for the phrasing of questions and their sequential order. This approach to the interview protocol was advanced so that the researcher had a guide to follow but that also allowed the participant to comment and interact as he/she wishes but maintaining a coherent flow during the interview. The interview protocols also included reminders of potential additional and follow-up questions, prompts and probes. Interviews were developed to allow further comments and discussions from the participants as they were not only asked to answer questions on the topic of research but also share their views and opinions along the data collection process.

Interview protocols were first written in English and then translated to Portuguese. Prior to the interview, participants were informed about the aims of the research and informed consent was obtained. Face-to-face interviews were scheduled for a time most convenient for the participant via telephone or face-to-face. Interviews were arranged to take place in a familiar location to participants, in a private and neutral environment in the Lisbon ward where they were recruited from. An office or meeting room was provided in all wards for the researcher to conduct interviews with participants which enabled the protection of participants' privacy and confidentiality. The interview settings were comfortable, quiet and allowed the privacy needed for conducting the interviews (King and Horrocks, 2010). At the time of the interview the researcher further read the 'Consent Form' and inquired if the potential participant understood what was being asked of him/her, agreed to participate and could sign the consent form. All interviews were conducted by the researcher, administered and read out-loud in Portuguese. If and when participants look tired a break would be offered, and if needed an option to continue the interview another day was also given. All interviews were digitally recorded with participants' consent as the recording of interviews allowed better focus on participants' responses and the introduction of prompts and asking for additional information when necessary. As the language used during the interviews was Portuguese, the recordings were transcribed in Portuguese and essential quotes translated to English by the researcher.

Interviews combined the gathering of information on quantitative measurements and assessments, and also qualitative information. Quantitative data collection (Phase 1) included socio-demographic characteristics, human assets, financial assets, physical assets, place-based assets and social assets to assess general vulnerability, and the Sense of Coherence scale (SOC-13) to assess general resilience. Qualitative data collection (Phases 2 and 3) comprised participants' experiences, beliefs and opinions, and included questions about attitudes, awareness, perceptions, behaviours and knowledge of both extreme heat and cold temperatures, characteristics of specified assets in order to assess specified vulnerability, resilience and adaptation (heat- and cold-related).

After each interview, the researcher reflected on the overall interview. This reflection allowed the improvement of interviewing skills and to think about ways of improving participants' interaction, how they answered the questions and their willingness to explore the interview topics.

3.4.1 Pilot study

An interview pilot was essential for refining the data collection procedures and improving the research design. In addition to evaluating the research protocol and questions, the goal was also to assess participants' willingness to participate and their overall contentment to answer all interview questions. Careful planning and piloting of the interview protocol was given to achieve a guide that was both focused and allowed the elaboration of new ideas with the aim of representing an informal and relaxed conversation about older people's views, experiences and behaviours related to the topic of the research, and the pilot study was the opportunity to do so.

Pilot study data collection took place over a period of a week during the month of March 2012 and followed a cold spell affecting Europe, Portugal and the city of Lisbon in February 2012. It comprised interviews with 6 older people living independently on general assets, vulnerability and resilience (structured-interviews from Phase 1) and extreme cold (semi-structured interviews from Phase 3). The selection of the pilot cases took into account the sampling techniques considered above (see Box 3.1) and criteria such as convenience, access and proximity (Yin, 2009). These participants were asked to complete the interviews and also to evaluate their experience after the interviews. A technique introduced by Patton in 2002 called 'think aloud' also allowed to capture participants' comments and questions about the data collection procedures (Ruane, 2005). All interviews were audio-recorded and the data generated analysed. The analysis of both researcher's and participants' experiences during the pilot study allowed the establishment and confirmation that both structured and semi-structured interviews were the best way of gaining access to information on general and specified (heat- and cold-related) assets, vulnerability, resilience as well as adaptation to extreme temperatures.

The pilot study pointed to some areas in which question wording and content of the final protocol could be improved, as some participants found it difficult to understand what was being asked in some of the questions. As a result, some questions were re-structured to allow participants to share their thoughts and opinions in a more conversational way and prompt for more insights from participants and allowing participants to elaborate on their ideas. The interview protocols were therefore revised taking into account the issues raised by participants and several logistical and practical improvements were made as follows:

a) <u>Structured interviews (Phase 1)</u>

- Make cards with answer options to show to participants, as it was difficult for them to understand the Likert-scales answer category options;

b) <u>Semi-structured interviews (Phase 2 and 3)</u>

- Improve the wording of some questions to allow greater understanding of what is being asked;
- Add more qualitative questions to explore ideas and allow more comments from participants;
- Re-write some questions in order for them to be more specific, as some were considered to be too general;
- Include more prompts to allow more explorations of participants' ideas and thoughts;
- Rethink the order of questions for greater logical flow.

Overall, the piloting of the interview protocols allowed increased flexibility during and after the interview protocol implementation. It was also conducive for the researcher to improve her interviewing skills and technique by making the interviews less formal, to become more relaxed and confident as interviews were progressing and, as a relationship with the participants was being developed allowing more flexibility and interaction with participants. Furthermore, it allowed the researcher the opportunity to test and prepare for the actual data collection phases, aiding at becoming more familiar with the sequence and wording of questions. At the end of the interviews participants were very interested in discussing the topics and ideas introduced with the questions and participants were given the opportunity to explore their own views in their own way, commenting on the topics of the interview and research overall. This was found to be crucial as the objective was to interview all participants twice (inter-seasonal approach): the first time to implement Phases 1 and 2 and the second time to conduct Phase 3 of the research.

3.4.2 Phase 1: General structured interviews

The quantitative structured interviews protocol was refined as a result of the implementation of the pilot study, above. Appendix 3.5 presents Phase 1 protocol in English and Portuguese. Phase 1 structured interviews were designed to explore the general assets portfolio, general vulnerability and general resilience of participants. The questions were asked in the order presented in the interview protocol, so that general socio-demographic and health related questions are addressed first, followed by more personal questions on social contacts and finance/income. The broad topics in the structured interviews protocol included:

- Socio-demographic information (sex, age, marital status, living arrangements, level of education, occupation);
- Health, quality of life and Sense of Coherence;
- Social capital, social support and social participation;
- Housing and appliances information;
- Neighbourhood, city and country information;
- Finance/Income.

The aim of Phase 1 was to provide a better understanding of the role of assets in shaping general vulnerability and general resilience, and to investigate whole sample and individual general vulnerability and general resilience. In addition, Phase 1 also allowed the development of vulnerability and resilience indices, as well as insights on the relationship between vulnerability and resilience at the sample and individual levels (see Section 3.5.1). Fifty two interviews were conducted during summer 2012 between June and August (all participants in Table 3.3). With participants' permission, the researcher digitally recorded the interviews and participants' responses to the structured interviews (Phase 1) in addition to being audiotaped were also recorded (handwriting) using individual participants' interview sheets. Immediately after the implementation of Phase 1 structured interviews, Phase 2 semi-structured interviews were conducted for both the researcher's and participants' convenience, thus taking place in the same day.

3.4.3 Phase 2: Heat-related semi-structured interviews

Informed by the pilot study, the Phase 2 qualitative interview protocol was developed by converting the cold-related questions piloted into heat-related questions (Appendix 3.5). This was possible through the collection of parallel variables (Creswell, 2014) to explore assets, vulnerability, resilience and adaptation. In order to gain more detailed and better understanding on vulnerability, resilience and adaptation to extreme heat, semi-structured interviews were conducted. Fifty two interviews with the same participants from Phase 1 were conducted during summer 2012 between June and August (all participants in Table 3.3). Heat-related semi-structured interviews were employed to capture older people's asset portfolio, vulnerability, resilience and adaptation to extreme heat, allowing participants to freely express their opinions, experiences as well as behaviours. Furthermore, the approach taken here allowed participants to freely respond to the questions with their own interpretation, doubts and comments allowing participants to express their views in a conversational style that aimed at making participants feel that expressing their opinions is crucial and there are no right or wrong answers. The broad topics explored in the qualitative interviews included:

- Experiences, everyday behaviours and responses to heat;
- Barriers to adaptation to heat;
- Perceptions of vulnerability to heat;
- Knowledge of affected groups;
- Perceptions of heat-related risks;
- Daily disruptions during heat;
- Perceptions of warming weather;
- Extreme heat information;
- Social contacts and health during extreme heat;
- Residential characteristics during extreme heat;
- Knowledge of the Heatwave Plan.

Interviews were conducted (audio-recorded) and transcribed in Portuguese by the researcher. At the end of the interviews participants were asked if they were willing to participate at a later stage in Phase 3 of the research (cold-related semi-structured interviews). Transcriptions were made into Microsoft Word 2010 documents that were further used to allow the researcher to familiarise herself with the data and for data analysis (see Section 3.5). Both Phase 1 and Phase 2 interviews combined ranged from 22 minutes to 1 hour and 47 minutes, with a mean of 55 minutes, and a total of 48 hours of interviews. The mean age of participants in these two research phases was 75.1 years, a minimum age of 65 years and a maximum age 95 years.

3.4.4 Phase 3: Cold-related semi-structured interviews

Research Phase 3 consisted of qualitative semi-structured interviews aimed at exploring participants' vulnerability, resilience and adaptation to extreme cold (Appendix 3.6). Both extreme heat and cold temperatures interviews contained parallel variables (Creswell, 2014) as the same questions were asked, the only difference being the extreme heat or cold focus. Informed by the pilot study, improvements to the interview protocol were also implemented and interviews were conducted during winter 2012-2013 between December and February (year 2013). Cold-related interviews followed the same procedures as presented in Section 3.4.3, and the broad topics explored included:

- Experiences, everyday behaviours and responses to cold;
- Barriers to adaptation to cold;
- Perceptions of vulnerability to cold;
- Knowledge of affected groups;
- Perceptions of cold-related risks;
- Daily disruptions during extreme cold;
- Perceptions of cooling weather;
- Extreme cold information;
- Social contacts and health during extreme cold;
- Residential characteristics during extreme cold;
- Knowledge of the Cold Weather Plan.

From the initial fifty two participants that took part in Phases 1 and 2 only six participants withdrew from this phase of the research (4 females and 2 males) (Table 3.3). The extreme cold sample is thus of 46 participants. Of these 6 participants, 3 were not willing to participate (CF, EM and HM), 1 was not home during the telephone contacts (NF), 1 was ill with pneumonia (DF), and 1 was not able to travel to the ward office were interviews were taking place due to a diabetes crisis and other health problems (VF). Participation rate in this phase of the research was of 88.5% and interviews ranged from 17 minutes to 2 hours, with a mean duration of 37 minutes and a total of 29 hours of interviews. The mean age of participants in this research phase was 74.8 years, a minimum age of 65 years and a maximum age 95 years.

In summary, so far this Chapter has argued that a mixed methods research approach through the implementation of both quantitative (structured interviews) and qualitative methods (semi-structured interviews) is the best choice to better understand what shapes vulnerability, resilience and adaptation to both extreme heat and cold temperatures, building on a conceptual and analytical framework linking assets, vulnerability, resilience and adaptation (see Chapter 2, Section 2.5.1). The research employed interview protocols to collect older people characteristics, assets availability, vulnerability and resilience as well as individual responses and actions implemented to deal with extreme temperatures. A total of 52 structured interviews (Phase 1), 52 heat-related semi-structured interviews (Phase 2) and 46 cold-related semi-structured interviews with older people aged 65 or older in the City of Lisbon, Portugal were analysed. Figure 3.2 presents a summary overview of the research including the quantitative and qualitative data analysis integration process.

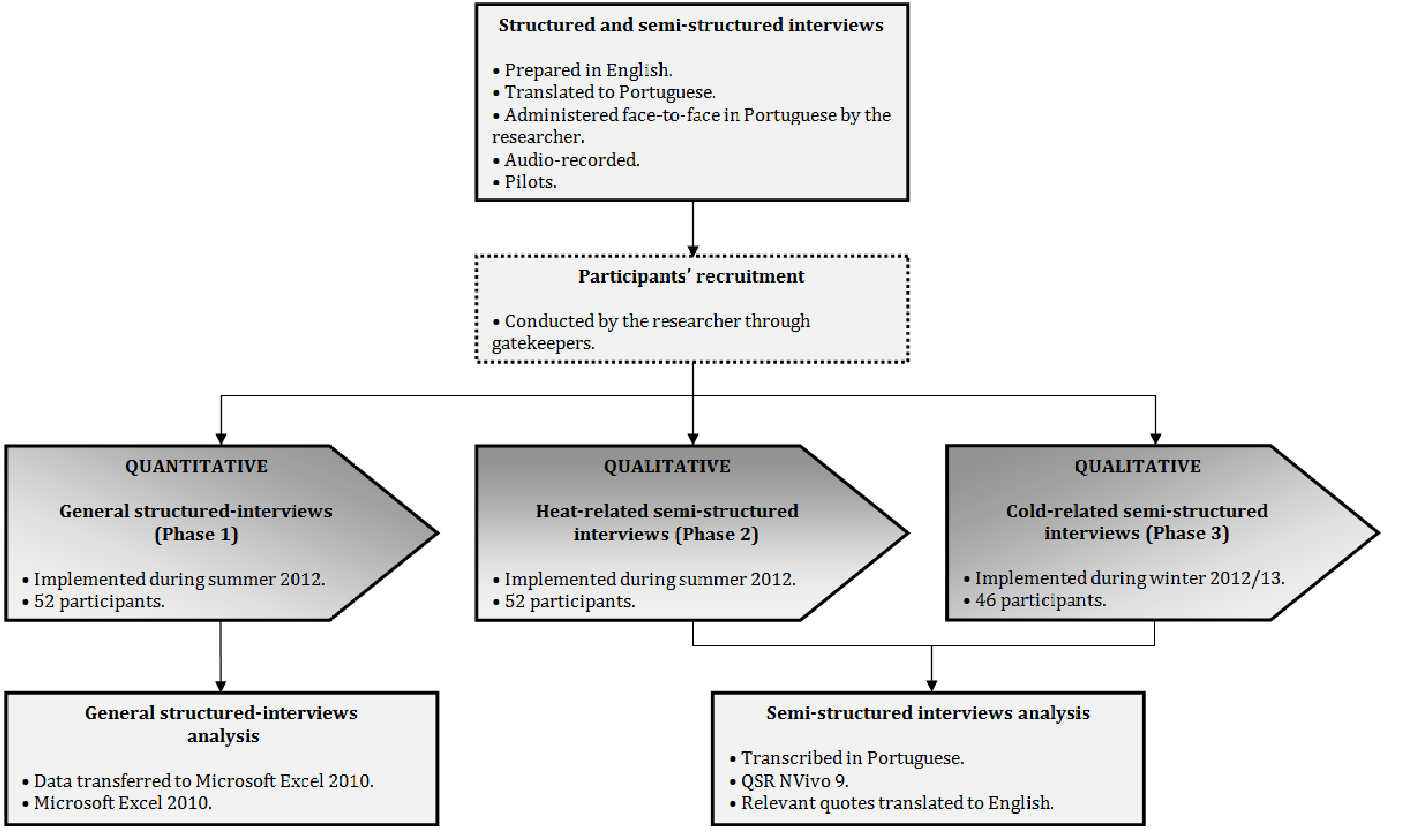


Figure 3.2 Summary overview of research

3.5 Analytical approach: Considerations for data management and analysis

Each interview (Phases 1, 2 and 3) was audiotaped and recorded (handwriting) using individual participants' interview sheets. The structured interviews data collected by the researcher (Phase 1) were transferred to a bespoke data entry tool and an analysis tool developed by the researcher for the purpose of this research in Microsoft Excel 2010. The data entry tool is comprised of: an 'overview' sheet; a 'structured interview' sheet and; a 'frequencies' sheet. The 'overview' sheet provides an overview of all interview questions, of information on the type of question (e.g. closed or open-ended), of the possible answers and the codes for each answer. The 'structured interview' sheet is where each participant's data is introduced in a specific row within the sheet. The 'frequencies' sheet contains pre-entered formulas that automatically provide descriptive frequencies of all data entered. Semi-structured interview transcripts (Phases 2 and 3) of audio records were performed by the researcher into Microsoft Word documents and transferred later into NVivo 9 qualitative coding software (QSR International).

Individual participants and not only whole sample analysis of both general (quantitative), heat- and cold-related (qualitative) data are used throughout the empirical chapters, as it enriches the analysis of the results and allows a better understanding of the factors shaping vulnerability, resilience and adaptation. When analysing the sample results it is difficult to grasp the whole spectrum of relationships between certain factors, and how they interact. Sample level data analysis is limited and only allows a certain degree of understanding but cannot produce concluding outcomes. As such, using individual participants' data provides a more insightful tool on the characteristics of older people and addresses the specificities of the population and setting under study in order to provide tailored results and recommendations.

The analytical approach chosen allowed the researcher to better familiarize herself with both the quantitative and qualitative data. A convergent parallel mixed methods design (Creswell, 2014) is used, consisting in the analysis of each set of data separately and only afterwards bringing them together to compare all sets of results (Phases 1, 2 and 3). Sections below present additional analytical procedures conducing to data analysis of empirical data in Chapters 4, 5, 6 and 7.

3.5.1 Quantitative

Data analysis of the structured interviews (Phase 1) was undertaken in two stages. During the first stage of analysis, descriptive results were compiled for all the variables included in the protocol. The second stage comprised the development of two indices, the General Vulnerability Index (GVI) and the General Resilience Index (GRI). The decision to organize the structured interview protocol in order to be able to calculate these indices arose from the review of the literature regarding the need to assess both general vulnerability and general resilience (see Chapter 2, Sections 2.2.3 and 2.3.3) in order to understand the role of assets in shaping general vulnerability and the role of the different aspects of resilience in shaping general resilience. The relevance of assessing both general vulnerability and resilience in this study through these indices further allows the use of an analogous strategy to qualitatively evaluate both heat- and cold-related vulnerability and resilience through parallel variables. Detailed information on indicators collected, approaches used for calculating the indices and analytical methods used are presented below. The quantitative data analysis includes the sample characteristics using descriptive statistics and organized into the framework for the constructs of assets, general vulnerability and general resilience. Descriptive statistics (frequency counts, means, ranges, and standard deviations) are used to examine the sample characteristics and distribution of scores, and to check for data input errors. Reliability of the Sense of Coherence scale used as a measure for general resilience in this study was also assessed.

The analytical approaches and indices derived from the data collected are:

- Composite Index Approach – the purpose is the calculation of the General Vulnerability Index (GVI) and build on previous work on composite indices (e.g. Sullivan, 2002; UNDP, 2007; Hahn et al., 2009);
- Sense of Coherence Approach – the Orientation to Life Questionnaire (SOC-13 scale) is used to access resilience and ultimately for calculating the General Resilience Index (GRI). The development of the GRI through the SOC-13 scale values constitutes a novel contribution of this research and builds on Antonovsky (1987) work and on composite indices approaches (e.g. Cutter et al., 2008).

The development of the General Vulnerability Index (GVI) and the General Resilience Index (GRI) draws upon the Sustainable Livelihoods Approach (SLA) and the Salutogenic Approach (Sense of Coherence - SOC), respectively. Building on the analytical approach by Hahn et al. (2009), a new and improved theoretical approach was developed to integrate the SLA and SOC in order to construct the GVI and the GRI. The approach implemented here builds on work developed by Sullivan et al. (2002) and Hanh et al. (2009) and differs from earlier research that was reliant on secondary data and climate models (Hahn et al., 2009; Preston et al., 2011). The approach here implemented uses individual primary data collected during Phase 1 of data collection from structured interviews with independent living older people in Lisbon, Portugal. The data collected in the structured-interviews and used for the construction of the indices are presented in Table 3.4 and included information on assets (i.e. human, financial, physical, place-based and social), vulnerability through the use of assets and resilience through the use of the Sense of Coherence approach.

Table 3.4 Types of information and main indicators collected in the structured interviews used for the development of the indices.

Types of information	Main indicators
Human assets	- Living arrangements - Level of education - Occupation - Health status
Financial assets	- Financial situation - Income - Sources of income - Financial difficulties
Physical assets	- Housing type - Floor number - Existence of lift - Age of building - Housing tenure - Satisfaction with house - Living conditions - Equipment's / goods
Place-based assets	- Access to facilities - Quality of public services - Access to green spaces - Heatwave Plan and Cold Weather Plan
Social assets	- Social contacts - Social support - Emotional support - Financial support - Social participation - Social activities
General Vulnerability Index (GVI)	Composite Index Approach : - Human assets - Financial assets - Physical assets - Place-based assets - Social assets
General Resilience Index (GRI)	Sense of Coherence Approach: - Meaningfulness - Comprehensibility - Manageability

3.5.1.1 The General Vulnerability Index: composite index approach

The GVI composite index developed here builds on other composite indices (e.g. Sullivan et al., 2002; Hahn et al., 2009) and uses primary data collected at the individual level. The literature indicates that using primary data for the development of these types of indices is not common as most studies rely on available data and are subject to issues of missing data and errors of using different time and space scales (e.g. Hahn et al., 2009) (see Chapter 2, Section 2.2.3). Additionally, community and household level data is usually used (Hahn, 2009; Antwi-Agyei et al., 2013; Shah et al., 2013) and there are no examples to date in the published literature of the use of individual level primary data, like the approach implemented in this research, which makes this study novel. Firstly, this enabled the researcher to tailor the data collection protocols according to the characteristics of the context where older people live in the city of Lisbon (e.g. social, historical, political, etc.). Secondly, it allowed the researcher to undertake different approaches in analysing the data in order to develop the index presented. By bringing together the different variables into indicators and sub-indicators to compose the index, the approach taken in this study allows the findings to reflect individual participants' and overall sample characteristics. As a result, the indicators and sub-indicators used herein were developed for the purposes of this research and included in the structured interview protocol implemented in Phase 1 of research. The calculation of the GVI took into consideration the theoretical framework developed in Chapter 2 which incorporates assets within the sustainable livelihoods approach (Chambers and Conway, 1992) and the salutogenic approach (Antonovsky, 1987). The decision to use both a development and health approach to assets for assessing vulnerability is based on the evidence that they complement each other and add rich insights to the approach developed in this study for the development of both whole sample and individual participants' indices.

The GVI developed specifically for this research is composed of fifty eight sub-indicators aggregated in five indicators. These indicators were selected based on the literature review on the theoretical role each of the indicators has in shaping vulnerability (see Chapter 2, Section 2.2.3). The five major indicators comprise: human assets, financial assets, physical assets, place-based assets and social assets. In Appendix 3.7 can be seen a summary of each major and sub-indicators, how they are quantified and the question used in the structured-interviews to obtain the indicator data. Following the selection of indicators, a balanced weighted approach was implemented determining that each of the sub-indicators contributes equally to the overall vulnerability (Sullivan, 2002; Vincent, 2004; UNDP, 2007; Vincent, 2007), despite each indicator being composed by a different number of sub-indicators. The decision of applying a balanced weight approach is based on the aim to simplify the development of the GVI that can be used by different end-users in different settings. This decision does not exclude the possibility of applying different or more suitable weightings for each of the different sub-indicators and can be revised to meet other or future requirements.

A sensitivity analysis was undertaken to test the robustness of the GVI values. It consisted of repeating the primary analysis of the quantitative data, substituting the values used in the balanced weighted approach with other values to determine if the analysis was robust or sensitive to these changes. Sensitivity analysis was thus used to determine whether these had been determined by the use of a balanced approach which involved comparing the ranges and standard deviations calculated using an unbalanced approach. The sensitivity analysis tested both overall sample and individual participants' GVI values using a strategy of doubling the weighting of each type of asset at a time. The sensitivity analysis showed that overall the results are not affected by the changes done, revealing high levels of certainty, which also shows robustness. Despite this, the results show for which participants the test is more sensitive (higher standard deviation); these seven participants (AM, GF, DM, HM, OM, PM and QM) are mostly males, live alone and have no children (6 participants), are single (5 participants) and aged 65 years (4 participants). All seven participants had high vulnerability in at least one type of assets and two had high vulnerability in all types of assets.

A number of steps were undertaken for calculating the GVI in this research for the whole sample and for individual participants. The approach taken in this thesis differs from previous approaches (i.e. Vincent, 2004; UNDP, 2007; Hahn et al., 2009) that used a regional, area or location focus instead of an individual or sample focus as is taken here. As a result, modified formulae are presented below to account for such differences:

1) In order to assess their comparability, all indicators were standardized using the UNDP (2007) procedure (Eq. 1) which also guarantees that all indicators are normalised to relative positions between 0 and 1 (Vincent, 2004; Hahn et al., 2009). By using this procedure of standardisation all indicators are in a range between 0 the lowest value, and 1 the highest value, where the highest value corresponds to the highest vulnerability.

$$index_{s_i} = \frac{s_i - s_{min}}{s_{max} - s_{min}} \qquad \text{(Eq. 1)}$$

In this equation, s_i represents the original sub-indicator value and s_{min} and s_{max} represent the minimum and maximum possible value for the sub-indicator, respectively.

2) After the standardisation of each sub-indicator the mean of the standardised value of each indicator is calculated using Eq. 2 (Hahn et al., 2009), obtaining a final value for each indicator (i.e. assets).

$$M_i = \frac{\sum_{i=1}^{n} index_{s_i i}}{n} \qquad \text{(Eq. 2)}$$

In the equation, M_i represents one of the five indicators [Human Assets (HA), Financial Assets (FA), Physical Assets (PA), Place-based Assets (PBA), or Social Assets (SA)], $index_{s_i i}$ represents the sub-indicators, indexed by i, that are part of each indicator, and n is the number of number of sub-indicators for each indicator.

3) Following the calculation of the mean standardised values of each of the five indicators, their balanced/equally weighted means were merged using Eq. 3 (also expressed as Eq. 4) (Hahn et al., 2009) to create the GVI score. The weighting of each indicator depend on the number of sub-indicators that are part of each indicator, allowing all indicators contribute in an equal way to the overall vulnerability (Sullivan et al., 2002).

$$GVI_i = \frac{\sum_{i=1}^{5} w_{M_i} M_i}{\sum_{i=1}^{5} w_{M_i}} \qquad \text{(Eq. 3)}$$

also expressed as

$$GVI_i = \frac{w_{HA}HA_i + w_{FA}FA_i + w_{PA}PA_i + w_{PBA}PBA + w_{SA}SA_i}{w_{HA} + w_{FA} + w_{PA} + w_{PBA} + w_{SA}} \qquad \text{(Eq. 4)}$$

In equations 3 and 4, GVI_i represents the General Vulnerability Index value, resulting from the weighted mean of the five indicators. The w_{M_i}, represents the weights of each indicator and is derived from the number of sub-indicators that are part of each indicator. The inclusion of the w_{M_i} ensures that all sub-indicators have an equal contribution to the overall GVI. In this research the GVI varies between 0 (low vulnerability) and 1 (high vulnerability) with a 0.500 cut-off point.

The contribution of each of the five types of assets (e.g. human, financial) to the GVI was also calculated by dividing the GVI indicators index for each type of assets by the sum of all GVI indicators index values.

What this approach does not allow is a comparison of results between studies and interpretation of results has to be carefully done (Hahn et al., 2009). Other limitations that should be taken into account are those related to the general use of indicators and indices. Using quantitative data and transforming it into indices is considered to constitute a very simplistic approach to understand reality; as noted by Vincent (2007) the theoretical and conceptual choices made in the collection of the data and in developing the indices incorporate an expected bias to the indices. Using maximum and minimum values to standardize indicators constitutes another limitation as it will not allow comparisons with other studies unless they use exactly the same number and type of variables or indicators in their indices. The weighting system chosen for calculating the indices can be either a limitation or a benefit. It can be a limitation in the sense that in a balanced/equally weighting all sub-indicators had the same weight and in reality they may influence vulnerability in different levels. Furthermore, it can be seen as a benefit as it can be bespoke according to the approach implemented. Weightings can be generated through elicitations from experts, researchers, policymakers and, or by communities and individuals, depending on the objectives set (Sullivan, 2002; Vincent, 2004; UNDP, 2007; Vincent, 2007). In addition, using means to calculate the values of indicators is also a limitation as it does not allow the integration of variance to the sample. Despite this, the development of such indices contributes to a better understanding of what shapes individual and whole sample general vulnerability and general resilience.

3.5.1.2 The General Resilience Index: Sense of Coherence approach

In this approach the Sense of Coherence concept and the Sense of Coherence scale (SOC-13) are used to assess both whole sample and individual participants' general resilience through the collection of primary data. The Sense of Coherence scale has been previously used to assess resilience in war settings in Eritrea (Almedom et al., 2007) and Lebanon (Kimhi, 2014) as well as in the post-Katrina hurricane in the U.S. (Glandon et al., 2008) (more details in Chapter 2, Section 2.3.4), but it is the first time it is used for the development of a General Resilience Index (GRI). The SOC scale employed in this research is composed of 13 items and has a seven-point Likert scale answer option (Appendix 3.8). This scale allows the assessment of resilience as well as its three dimensions (comprehensibility, manageability and meaningfulness). The comprehensibility dimension is composed by 5 items, the manageability dimension is composed by 4 items and the meaningfulness dimension is composed by 4 items, with an overall 13 items, thus called SOC-13 (Antonovsky, 1987).

The salutogenic approach introduced by Antonovsky (1987) was used to assess general resilience among the study sample (a total of 52 older people living independently in the city of Lisbon, Portugal). The total general resilience sum scores and general resilience dimensions scores (comprehensibility, manageability and meaningfulness) are calculated and used for subsequent analysis and development of the general resilience index (GRI), using a similar method to the one used to calculate the general vulnerability index (GVI), and adapted from Hahn et al. (2009). Theoretical validity of calculating the GRI in the way the GVI has been calculated is justified in this research to allow coherence in the quantitative data analysis through two different theoretical concepts (i.e. vulnerability and resilience). In doing so, transforming the SOC scores into a General Resilience Index is novel and has not yet been attempted elsewhere.

The values of the GRI indicators (comprehensibility, manageability and meaningfulness) and the GRI value are derived from Eq. 1 (as used for calculating the GVI, above)

$$index_{s_i} = \frac{s_i - s_{min}}{s_{max} - s_{min}} \qquad \text{(Eq. 1)}$$

In this equation, s_i represents the original indicator value (sum of all scores within the specific indicator), and s_{min} and s_{max} represent the minimum and maximum possible value for the indicator, respectively.

The contribution of each of the three dimensions of resilience (e.g. comprehensibility) to GRI is calculated by dividing the GRI indicators index for each dimension by the sum of all GRI indicators index values.

Upon the calculation of both GVI and GRI at the sample and individual levels, matrices were developed to represent the distribution of participants as having 'high' or 'low' vulnerability and resilience. Matrices of the GVI, its five asset components and GRI were developed (see Chapters 4, 5 and 7). The GRI is presented in the matrix and its dimensions (comprehensibility, manageability and meaningfulness) were not represented as the aim is to understand the relationship between resilience and vulnerability and its components (assets). The decision to represent the findings in the form of matrices resulted from the aim of presenting and summarizing the findings in a more visual and objective way.

Quantitative data analysis techniques for testing associations, such as multiple components analysis (MCA) were not used in this thesis to graphically display the relationships between vulnerability and resilience, as both quantitative (GVI and GRI) and qualitative (HRV and HRR; CRV and CRR) data are used. In addition, the author also wanted the graphic representation between all sets of data (i.e. quantitative and qualitative data) to be graphically comparable. As a result, quantitative data analysis techniques such as MCA could only be used for general vulnerability and general resilience data (quantitative data) but not for extreme heat and extreme cold vulnerability and resilience (qualitative data). MCA was not used as Figures 7.3 and 7.4 rely on qualitative data. As such, Figures 7.2 were performed 'manually' to provide comparable outputs (see also Section 3.5.2).

In summary, using the type of indices developed herein helps identifying the levels of general vulnerability and general resilience as well as help characterise the levels of different indicators (human assets, financial, physical, place-based and social assets) contributing to vulnerability and resilience.

3.5.2 Qualitative

A hermeneutical phenomenology approach is used for interpreting the qualitative data obtained from the heat- and cold-related semi-structured interviews (Phases 2 and 3) (Creswell, 2007).

Firstly, to start familiarising herself with the data the researcher transcribed all interviews obtained from Phases 2 and 3 (heat- and cold-related interviews) and read all transcripts several times performing a preliminary analysis of the transcripts. An outline of preliminary content and themes was developed after thorough reading and re-reading all 52 individual heat-related and all 46 individual cold-related interview transcripts in an iterative process.

Secondly, all textual data were grouped, coded and analysed at both the individual and whole sample levels in NVivo 9 qualitative data analysis software. Initial themes and codes arose from interview transcripts and as transcript analyses developed additional codes were included until the achievement of final codes. Initial themes were refined and changed throughout this iterative data analysis process until final themes were obtained. This was possible by coding and categorising all data using a systematic approach which enabled data interpretation and the identification of themes and sub-themes. Overall data and individual transcripts were analysed taking into account the research and sub-research questions looking for content and patterns on the concepts under analysis (vulnerability, resilience and adaptation) on both heat- and cold-related interviews.

Thirdly, the qualitative data analysis of individual participants' transcripts allowed the researcher to assess lived experiences, understanding the meaning of experiences and to explore the significance of different assets in shaping individual vulnerability, resilience and adaptation to both extreme heat and cold temperatures, which was further used to develop profiles of participants (see Section 3.5.3). The qualitative data analysis process has been developed as follows (Box 3.2).

Box 3.2. Qualitative data analysis process

1 - Develop individual participants' text interview records (transcripts).

2 - Taking into account preliminary themes developed from the interview protocol question and based on the research questions, read and re-read the transcripts thoroughly.

3 - Note key themes from transcripts.

4 - Development of initial themes that include emergent themes, sub-themes and categories.

5 - Link emergent themes, sub-themes and categories to the theoretical concepts of assets, vulnerability, resilience and adaptation.

6 - Review and improve the initial themes to achieve a final themes list.

7 - Code or recode all transcripts according to the final themes.

8 - Create a matrix for each participant interview transcript entailing extreme heat and cold vulnerability, resilience and adaptation content and themes.

9 - Examine the matrix for interpreting individual participants' data and to look for similarities and differences between participants.

10 - Develop profiles of participants (see Section 3.5.3).

11 - Investigate and integrate the qualitative interpretations with the quantitative results.

3.5.2.1 Heat- and cold-related vulnerability

Qualitative semi-structured interview data from Phases 2 and 3 were coded and indexed through thematic analysis (King and Horrocks, 2010) where major themes arose from the analysis highlighting both sample and individual participants' asset portfolio and vulnerability to extreme heat and cold temperatures. The researcher looked for a balance between within-case and cross-case patterns for developing the themes taking into account both similarities and differences within and between cases (participants) (King and Horrocks, 2010). This balance was used so that themes that were not frequently mentioned did not have the same status as themes very frequently mentioned. This was done to show the more generally expressed themes, but not as much used. In order to be able to understand the different levels of vulnerability within the sample the researcher developed a high and low classification of participants by organizing different themes according to the five types of assets that shape vulnerability (human, financial, physical, place-based and social assets) also used to develop the GVI. Specific questions in the semi-structured interviews protocol were examined individually for each participant, and an iterative and systematic coding process was used to highlight the major vulnerability characteristics of individual participants. Heat- and cold-related vulnerability were assessed taking into consideration individual assets portfolio. High asset-based vulnerability was thus defined as follows:

- High human assets vulnerability, when participants revealed having health problems during very hot/cold weather and/or physical health limitations during very hot/cold weather;
- High financial assets vulnerability, when participants faced difficulties paying energy bills for cooling/heating and/or did not want to spend energy/money to keep cool/warm;
- High physical assets vulnerability, when participants had problems with temperature in the home and/or inability to keep the home cool/warm and/or not able to keep themselves cool/warm in the home during very hot weather and/or no use of cooling/heating devices;
- High place-based assets vulnerability, when participants did not have/or went to green spaces and/or facilities close by to keep cool/warm and were not aware of the Heatwave/Cold Weather Plan and/or had no interest on it, and;
- High social assets vulnerability, when participants revealed having low social contacts and/or not receiving or providing information or advice on what to do and/or low social activities during very hot/cold weather.

Overall heat- and cold-related vulnerability were assessed through the following procedure: participants with at least three 'high' assets vulnerability are considered to have high heat-/cold-related vulnerability; on the other hand, participants with two or less 'high' assets vulnerability are considered to have low heat-/cold-related vulnerability. This information was compiled for all participants in a table and presented in the form of a matrix, representing in two different quadrants all participants either revealing high (top quadrant) or low (bottom quadrant) vulnerability. In these matrices, the order of participants' codes (i.e. AM, BF) within each quadrant does not reflect different levels of vulnerability within each quadrant and the two different types of grey are used for distinction between quadrants (darker grey represents high vulnerability and lighter grey represents low vulnerability) (see Chapter 4).

3.5.2.2 Heat- and cold-related resilience

As above, qualitative semi-structured interviews data are used to assess individual participants' levels of resilience to extreme temperatures. In doing so, the researcher took into account the characteristics of all three dimensions of resilience (comprehensibility, manageability and meaningfulness) in each participants' transcripts and, through an iterative and systematic coding process, was able to define each of the resilience dimensions as 'high' when:

- High comprehensibility, when participants saw heat/cold as a nonstressor as they had previously dealt with extreme heat/cold temperatures and had experience dealing with them, thus not posing a problem to them.

- High manageability is characterised by participants perceiving that they had assets available to them either at their direct or indirect control needed to deal with the threat/stress heat/cold poses to them but did not feel victims to such extreme temperatures.
- High meaningfulness, when participants feel confident that one was able to deal with the heat/cold and feeling motivated to deal with it as it is seen as an important area of their lives (see Chapter 5).

Overall heat- and cold-related resilience were assessed through the following procedure: participants 'high' in at least two resilience dimensions are considered as having high heat-/cold-related resilience and participants 'high' in one or none resilience dimensions were considered to have low heat-/cold-related resilience. This information was compiled for all participants and presented in the form of a matrix, representing in two different quadrants all participants either revealing high (top quadrant) or low (bottom quadrant) overall resilience. In these matrices, the order of participants' codes (i.e. AM, BF) within each quadrant does not reflect different levels of resilience within each quadrant and the two different types of grey are used for distinction between quadrants (darker grey represents high vulnerability and lighter grey represents low vulnerability) (see Chapter 5).

These 'high' or 'low' codings are then related to the three dimensions of resilience: comprehensibility, manageability and meaningfulness. The three resilience dimensions (comprehensibility, manageability and meaningfulness) are coded as 'high' (H) or 'low' (L), indicating the pressure of resilience to move up (👆), to be stable (☺ or ☹) or to move down (👇). An example of a resilience type is HLH which represents being high on comprehensibility, low on manageability and high on meaningfulness (see Appendix 3.9).

3.5.3 Developing profiles of participants

Profiles of individual participants were developed to present as well as integrate both quantitative and qualitative interview data (see Chapters 4, 5, 6 and 7). All profiles are developed using participants' interview data, by reading each transcript and selecting the most characteristic parts (Seidman, 1998) and to bring to life participants' individual characteristics, as each participant represents a unique pool of vulnerability, resilience and adaptation characteristics that can be underrepresented when looking at overall sample data. A review of individual participants' transcripts (Phases 1, 2 and 3) was undertaken to develop individual participants' profiles that can be found in Chapters 4, 5, 6 and 7. These profiles correspond to individual participants in this research and portray their 'real' characteristics as obtained from their transcripts.

3.6 Ethical considerations

Involving and researching older people poses several ethical challenges. To ensure that these issues were fully understood and taken into account, ethical approval was required and obtained from the University of East Anglia, Faculty of Medicine and Health Sciences Research Ethics Committee (Reference 2011/2012 – 30) (Appendix 3.10) and from Universidade de Lisboa, Instituto de Ciências Sociais Ethical Committee (Appendix 3.11).

In the next sections, detailed information is given on the procedures implemented before, during and after data collection procedures.

3.6.1 Prior to data collection

Since the first steps in developing this study the researcher had clear in her mind that the focus in researching independent living older adults would be one that would build on consulting and involving them in the research and founded in principles of inclusion, equal treatment, respect and empowerment of those involved. Furthermore, issues of illness, frailty and dementia were carefully taken into account in order to preserve older people's health and wellbeing. The researcher also took into account the potential psychological or emotional effects that participating in the research could have in developing painful thoughts or memories and create distress during and after the three phases of research. A telephone number of the researcher was provided in the 'Information for Participants' sheet for participants to contact in case of needing any support. The researcher also sought feedback from participants after each phase of the research to which participants said the process was not perceived to have distressed or harmed them, and the telephone number for support was not used by any participant in the research.

All prospective participants in the research were approached and invited by the researcher to participate in the study. Due to likelihood of difficulty in understanding terms such as assets, vulnerability, resilience and adaptation, as well as extreme (heat and cold) temperatures, the research title on the 'Information for Participants' and 'Consent Form' is "Understanding the factors influencing older adults' views and behaviours during very hot and very cold weather". The 'Information for Participants' was the preferred choice in providing participants with information outlining the research overall. It was developed instead of a 'Letter to Participants' as first contact with participants was made in person by the reseacher and it would duplicate the information provided by the 'Information for Participants'. Care was also taken in providing older adults with documentation with appropriate font sizes and vocabulary to ensure total inclusion of participants. 'Information for Participants' contains information on:

- The research title;
- The nature and purpose of the research, its methods and data collection procedures;
- The importance of participation in the research;
- The voluntary nature of participating in the research;
- The right to withdraw from participating in the research at any point;
- Expected outcomes and deliverables of the research;
- Anticipated ethical issues arising from the participation in the research;
- The assurance of confidentiality and anonymity of the participants, and data storage issues;
- The name of the researcher, institutions and contacts.

The researcher also followed guidelines to secure voluntary written informed consent. Informed consent was obtained from all participants in this research. As the research includes an inter-seasonal approach consent was obtained two times, one to participate in Phases 1 and 2 (summer 2012), and another to participate in Phase 3 (winter 2012/2013). As mentioned before, some participants were not able to read but gave their consent after listening to what the document contained and by writing either their name (i.e. first name or first and last names) or by writing the first letter of their first name, which all did without constraints.

The 'Consent form' (Appendix 3.3) contains information on:

- The research title;
- The nature and purpose of the 'Information for Participants';
- The voluntary nature of participating in the research;
- The right to withdraw from participating in the research at any point;
- The recording of the interview;
- The assurance of confidentiality and anonymity of the participants, and data storage issues;
- The assurance of anonymity of the participants in publications and presentations arising from the research;
- The agreement in taking part in the research (Seidman, 1998).

Some participants in this research were not able to read either the 'Information to Participants' or 'Consent Form' due to illiteracy. In such cases, as the researcher read these documents to all participants out loud and made sure that participants understood what was being asked to them, being unable to read was thought to have no impact on older people willingness to take part in the research.

3.6.2 Data collection procedures

Participants' safety and well-being were also taken into consideration when conducting the interview. A break and the option to continue the interview later were options given to participants in case of tiredness or other commitments.

Researcher's physical safety and welfare were taken into account when scheduling the data collection procedures. A safety protocol was put in place that included among other:

- Carrying a mobile telephone;
- Informing a colleague, friend or family member about the time and place of the data collection procedures;
- Be aware of safety issues that can arise during the data collection process;
- Letting the contact person know when the data collection is over.

3.6.3 Data analysis and data protection procedures

Transcription of interviews was carried-out by the researcher in order to ensure confidentiality and anonymity and also to develop familiarity with the data.

All information regarding this research, including participants' details and information will be known only to the researcher. This information was treated with the utmost respect and discretion, is confidential and is stored securely. Confidentiality and anonymity were assured prior, during and after the data collection process, data analysis and publication of results.

Identifying details and information were removed in order to protect each participant from being identified as so. The researcher implemented a process of coding participants (e.g. AM) and securing names of participants in a separate and secure file to which only the researcher can access (e.g. filing cabinet with lock and password protected computer) enabling confidentiality of information.

Any presentations, reports or publications resulting from this research will not disclose participants' identity. In the case that an official organization asks to review any data collected in this study, a copy of the information will be provided but all participants' names and other identifying personal details (e.g. telephone number) will be deleted before the release of any information.

Chapter 4 - Assets and human vulnerability

4.1 Introduction

The background of this research and its methodology have been discussed in Chapters 2 and 3, respectively. This chapter is one of four empirical chapters to answer the four research questions. The current chapter focuses on general and specified (heat- and cold-) vulnerability, Chapter 5 focus on general and specified (heat- and cold-) resilience, Chapter 6 on adaptation to extreme heat and cold temperatures, and Chapter 7 explores the interactions between vulnerability, resilience and adaptation.

The goal of this chapter is to explore the characteristics of older people and their surrounding environments that influence their vulnerability. Thus, it investigates overall sample and individual participants' vulnerability drawing upon structured (quantitative) and semi-structured (qualitative) interviews with persons aged 65 years or over in Lisbon, Portugal during three research phases (developed in Chapter 3). This chapter builds on the integrated framework discussed in Chapter 2 and answers the first research question and sub-research questions:

- Research Question 1:

'Do *different assets affect general, extreme heat and extreme cold vulnerability of older people? If so, what are their effects and how do they occur? '*

And sub-research questions:

1a) How and why do levels of vulnerability differ between older people?
1b) How is vulnerability to the health impacts of expressed?
1c) What types of assets available to older people? How diverse are the assets?
1d) Why and how do assets contribute to and shape vulnerability?

This chapter starts by assessing general vulnerability (Section 4.2) detailing the context and diversity of assets shaping general vulnerability (Section 4.3). It explores the perceptions of factors contributing to vulnerability (Section 4.4), followed by the mapping of individual participants' vulnerability and the development and presentation of two participants' profiles

(Section 4.5). Profiles are developed from research participants own transcripts regarding their vulnerability characteristics.

4.2 Characteristics, determinants and distribution of general vulnerability

As discussed in Chapter 2, the sustainable livelihoods framework and the five capital assets (Chambers and Conway, 1992; Scoones, 1998) have been recognized as a valuable framework to understand the availability of assets both in developing and developed countries. By exploring the relevance of these assets for vulnerability, structured interview (quantitative) data were used to develop a composite vulnerability index, below.

4.2.1 General Vulnerability Index: a composite index approach

The use of vulnerability indices allows the estimation of vulnerability at different scales, including specific groups in society, as well as individuals (Smit and Wandel, 2006). The quantitative data obtained from the structured interview was used for a better understanding of the characteristics of the overall sample and individual participants, and to develop the General Vulnerability Index (GVI) using a composite approach. Regarding overall vulnerability, Appendix 4.1 presents a full list of the GVI results for the fifty eight sub-indicators and five indicators. A three step example for calculating the GVI, as explained in Chapter 3, Section 3.5.1.1 is also available. The GVI, for this research sample has a value of 0.413 and values range from 0 (least vulnerable) to 1 (most vulnerable). The obtained value expresses a moderate general vulnerability of the study sample. Table 4.1 shows the indicators index values for each component of the general vulneravility index (human, financial, physical, place-based and social assets), the number of sub-indicators in each indicator, the value of each indicator value and the composite index value (see Appendix 4.1 for calculations).

Table 4.1 Summary of calculations of the General Vulnerability Index (GVI) indicators (human, financial, physical, place-based and social assets), GVI and its values

	Number of sub-indicators	Indicators index value	GVI value
Human assets	6	0.407	0.413
Financial assets	6	0.449	
Physical assets	13	0.448	
Place-based assets	14	0.358	
Social assets	19	0.421	

As Table 4.1 shows, the research sample presented greatest vulnerability on financial assets (FA = 0.449), followed by physical assets (PA = 0.448), social assets (SA = 0.421), human assets (HA = 0.407) and place-based assets (PBA=0.358). The results of the indicators values are presented in Figure 4.1 as a radar chart.

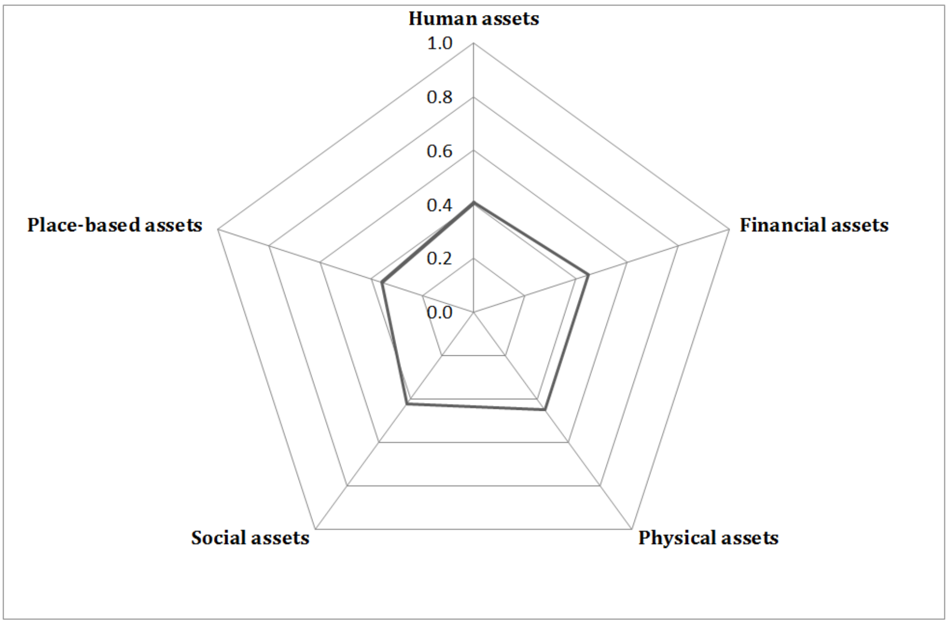


Figure 4.1 General Vulnerability Index (GVI) radar chart for the overall sample (52 participants)

Legend: Values range from 0 (least vulnerable) to 1 (most vulnerable).

The assets contributing to general vulnerability are shown in Figure 4.2. The greatest contributors are the lack of financial assets (21.5%) and the lack of physical assets (21.5%), followed by the lack of social assets (20.2%), human assets (19.5%) and place-based assets (17.2%).

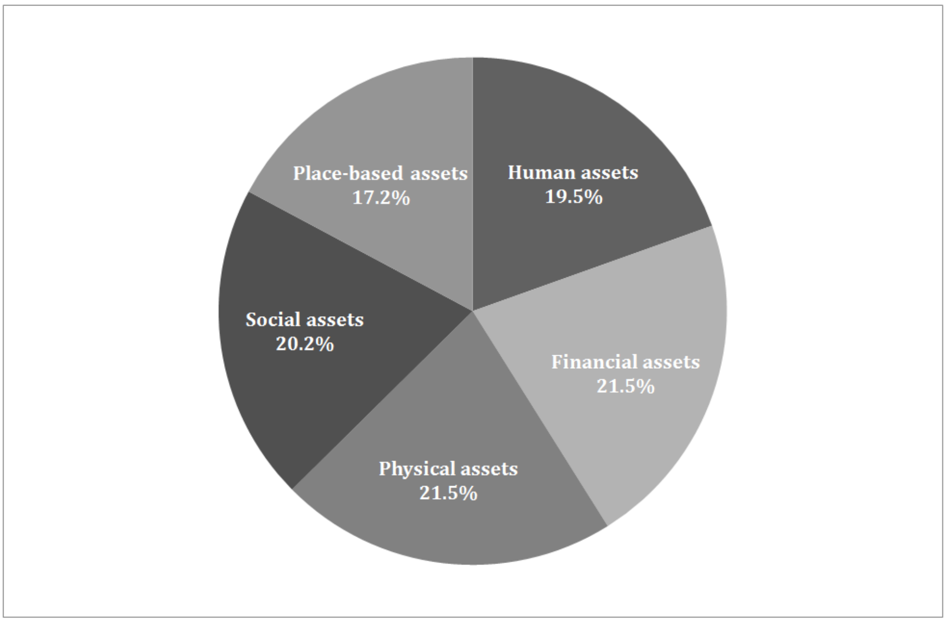


Figure 4.2 Assets' contribution to overall GVI for the overall sample (52 participants)

However, focusing only on the quantitative interview data on general vulnerability does not allow an understanding of vulnerability to specified threats, stresses or shocks such as extreme heat and cold temperatures. Only by undertaking qualitative interviews on such specific topics it is possible to gain insight into specified vulnerability to heat and cold.

4.3 Context and diversity of assets

Following on the review of the literature discussed in Chapter 2, vulnerability is seen as a composite or umbrella concept, made of several elements and constituents (i.e. assets) (Rayner and Malone, 1998). As a result, individuals can be more vulnerable or less vulnerable generally in their daily lives (e.g. general vulnerability) or to specific threats, stresses, shocks or events (e.g. heat- and cold-related vulnerability) due to social, cultural and environmental changes. Furthermore, assets (e.g. Bebbington, 1999; DFID, 1999; Moser and Dany, 2008) developed in the first instance in the sustainability arena, have proved to be a useful tool in helping to understand what makes someone more or less vulnerable to general or specified threats, stresses, shocks or events.

This section details the context and diversity of assets shaping general, heat- and cold-related vulnerability based on quantitative and qualitative methods. The quantitative structured interviews reveal the general vulnerability of the sample and individual participants taking into account different sources of vulnerability rooted in the internal and external environments. The qualitative semi-structured interviews on the other hand, provide a deeper understanding of the drivers of vulnerability to extreme heat and cold temperatures, revealing several emergent themes coded under the five main types of assets arising from the Sustainable Livelihoods Framework (human, financial, physical, place-based and social assets). Both quantitative (structured interviews) and qualitative data (heat- and cold-related semi-structured interviews) on assets and vulnerability are discussed below.

4.3.1 Human assets

This first type of assets relates to the notion that vulnerability is influenced by a number of characteristics such as living arrangements, level of education, occupation, and health status. In exploring human assets in relation to vulnerability, the quantitative data (Phase 1) indicates that participants were moderately vulnerable in general (0.407 according to the human assets vulnerability sub-index calculated - on a scale ranging from 0, least vulnerable to 1, most vulnerable). Major contributing factors to vulnerability explored through a human assets perspective included a high percentage of participants (71.1%) in the lower supervisory and technical occupations, semi-routine and routine occupations (as defined by National Statistics Socio-economic Classification) or participants that never worked, and a high percentage of participants that lived alone (57.7%). Other contributing factors included being hampered in daily activities (48.1%), current health worse than a year ago (30.8%), poor self-rated health (19.2%), as well as having no formal education (17.3%). Appendix 4.1 presents the sub-indicators included in the human assets vulnerability index and corresponding values.

The qualitative interviews provided deeper understanding of the effects and influence of human assets. The heat- and cold- related interviews revealed four themes coded as 'independence and control', 'return to the nest', 'illiteracy and health illiteracy', 'chronic illness not frailty'. '

The first theme – *independence and control* – was associated with participants' living arrangements. It reflects some participants' pride in being independent and wishing to keep their independence despite their age and health status. Much of the comments focused on the idea that through independent living older people could do whatever they wanted in terms of keeping cool or warm during extreme heat and cold temperatures, respectively. This was more prominent for those living alone whereas some of the married participants sometimes felt they had to compromise on being cool or warm due to their spouse's preferences. In regards to both heat and cold risks, participants mentioned the fear of frailty, of losing their physical and mental abilities (especially the capacity to walk). The fear of falls in the home and outdoors, and becoming incapacitated as a result was only mentioned in relation to extreme cold.

The second theme – *return to the nest* – was linked to the topic of living arrangements and to changing relationships within the household as some of participants' children had returned to participants' homes due to unemployment or divorce. These were great worries for those facing this situation and for many it was taking over their lives with consequences for their mental health, as well as undermining both their economic (see Section 4.3.2 on financial assets) and motivational abilities (related to resilience which will be discussed in Chapter 5) to keep cool or warm.

The third theme – *illiteracy and health illiteracy* – was directly related to the level of education of participants. This was mentioned by many as a reason either personally or generally for not knowing what to do when it is very hot or very cold, although some participants relied on information and knowledge from their previous occupations (e.g. nurse, healthcare assistant). Participants mentioned concerns about the reach and effectiveness of health education campaigns not only regarding older people but the general population who may not be interested or not listening/paying attention to health messages because they do not understand the risks and impacts of extreme temperatures. Taking advantage of opportunities to learn more about these issues through specialist initiatives (e.g. their GP, personnel from the ward they lived in) were welcomed by participants if they could deliver personalised advice according to individual needs. Activities for older people at the ward level were also thought to provide valuable skills on how to keep cool and warm (see Section 4.3.5 on social assets).

The fourth theme – *chronic illness not frailty* – was linked with health status, as chronic illnesses were for many participants a reason for not feeling able or motivated (see Chapter 5) to act upon the challenges extreme heat and cold posed in their lives. Despite this, some participants revealed they should be more careful with their health when it is very hot and very cold but were not, as they assumed that what they felt was 'normal' for their age and health condition and did not relate it to the impacts of extreme temperatures. The majority of participants stated that their physical health limited what they could do during very hot and very cold weather; in other words their ill-health made them more aware of appropriate behaviours, but in some cases this was not linked to undertaking such behaviours. For some, the seriousness of their chronic illnesses prevented them from even thinking about the health risks of heat or cold and taking action, as other areas of their lives were perceived as more important or needing more attention. In addition, some participants mentioned that older people should be advised on how to better protect themselves from the impacts of heat and cold, depending on their health status. Despite this, participants did not feel frail or vulnerable, they valued their independence and valued self-care and endurance.

In summary, these additional qualitative dimensions of heat- and cold-related semi-structured interviews support the moderate human assets general vulnerability emerging from the quantitative (structured) interviews and revealed additional deeper vulnerabilities related to the need for independence and control, changing relationships in the household, illiteracy issues and health issues that were not apparent from the structured interviews. These pose further challenges to being able to keep cool or warm (adaptation, discussed in Chapter 6). Thus, extreme heat and cold temperatures increased human assets vulnerability by adding more pressure on the existent human assets general vulnerability. This reveals the need to address and invest in these critical dimensions of human assets and their importance in reducing older people's vulnerability to heat and cold by increasing health literacy, as well as knowledge and awareness of health impacts of extreme temperatures and enabling older people to use human assets to take action (see Chapter 8).

4.3.2 Financial assets

The second type of assets is linked to several aspects of financial status and difficulties, such as income and sources of income (e.g. pensions, savings), difficulties in paying for housing, food, healthcare or medication expenses. The quantitative data (Phase 1) showed that having a pension as only source of income is the major contributing factor (94.2%) to financial assets vulnerability. Other contributing factors included a high percentage of participants with a monthly income equal or less than €500 (46.1%) and a high percentage of those facing financial difficulties (42.4%). Participants were also financially vulnerable due to difficulties paying for health care or medication (30.8%), housing expenses (e.g. rent or mortgage and utility bills such as electricity, water and gas) (28.8%) and food (26.9%). These sub-indicators contributed to making participants vulnerable at 0.449 (vulnerability ranging from 0 to 1) in terms of financial assets (see Appendix 4.1). The quantitative interviews also revealed that many participants facing difficulties in paying housing expenses stated this happened often and mostly due to their low pension and unexpected health conditions. Difficulties in paying for food were also prevalent, the main reasons being low pensions and many competing expenses. One participant mentioned having to sell a gold necklace to buy food (XF) and many others revealed cutting on food to be able to afford medication and energy bills. Strategies used were reducing intake of meat, fish, vegetables and fruit, and even cutting down on the number of meals they had every day. At least two participants mentioned they had lost much weight the year before Phase 1 interviews (AM, IIF). Other participants stated that the food they got at the community centre they attended for lunch and afternoon tea was sufficient for their daily food intake as they were old and did not need much to eat (e.g. DM, IF). Despite this, not many participants received help from local food banks.

In addition, many participants mentioned having difficulties in paying for healthcare or medication, the major reason mentioned was having a low pension. Going to their GP was also something that many participants did less and less often. The main justification was that due to austerity measures many were no longer entitled to exemption from paying medical appointments (so they had to pay 'out-of-pocket expenses'). As a result they would only go to the doctor when they needed prescriptions but did not go when they had a sudden health problem.

The qualitative interviews (Phases 2 and 3) provided deeper understanding of the outcomes arising from these levels of financial assets and revealed a range of emergent themes. The heat- and cold-related interviews revealed three themes coded as 'managing competing expenses and still struggling', 'savings should be savings' and 'thrifty and proud'.

The first theme – *managing competing expenses and still struggling* – linked to statements of financial difficulties in particular due to low pensions. The implementation of State austerity measures were mentioned as a further burden due to additional cuts in pensions. The circumstances mentioned above affected how participants balanced the income available and their expenses (e.g. housing, food, medication and healthcare), their priorities, and how these ultimately impacted on their daily lives during both extreme heat and cold temperatures. Increasing electricity, gas and water costs were considered a threat to most participants in both extreme heat and cold temperatures. Due to these constraints some participants saw themselves having to choose between keeping cool/warm at home through using a fan/heating device for example or buy essentials such as food or medication. This theme revealed to be important in both heat and cold interviews – although more prominent in cold interviews. This was due to spending more money in energy bills to be able to keep warm at home by using electrical devices in winter, than to be able to keep cool in summer. As such, participants refrained from using energy both to keep cool or warm. Participants' income and perceived financial situation shaped the way they prioritized, were motivated (detailed in Chapter 5) and engaged in cooling or warming behaviours during extreme heat and cold temperatures, respectively (detailed in Chapter 6).

The second theme – *savings should be savings* – denotes that savings should not be used to pay for current expenses. Participants felt very reluctant in using savings to afford being able to stay cool or warm during extreme heat and cold temperatures. Conversely, they used savings to pay for unexpected housing and health expenses. Fitting air conditioning (physical asset) was for some participants something that could be done if they used their savings. Despite this, in both heat and cold interviews due to the uncertainty of their future and their health status, participants were not willing to use their savings for that purpose, preferring to keep hold of them in order to afford going to a good care home, if and when necessary.

The third theme – *thrifty and proud* – was related to participants' comments revealing they had always been careful in budgeting and only buying basic and essential products. Most participants mentioned being influenced by their life experiences of economic difficulties. They had always been frugal, used to hard living conditions their entire lives and thrift was thus a very important theme. They revealed a need to be in control of their money, by checking prices, balancing expenses and making choices of what to buy and when, with consequences for their health and well-being. Overall, participants were reluctant to increase their spending on electricity (by using cooling or heating devices) as it would affect their tight budgets. During the cold-related interviews some participants revealed that they would only heat one room in the house to save money, but the majority did not even do that. Participants also found difficult to refurbish their home with double-glazed windows or roof insulation as they either did not own the house or did not have the money available to do so. These statements were also associated with participants being extremely proud and independent and not willing to ask for help either to their close family, public institutions or organizations (social assets, see Section 4.3.5) both during heat and cold qualitative interviews. They saw this as a sign of failure and did whatever they could to avoid asking for help. This was particularly relevant when one of the main reasons for not asking for help to either close family or public institutions was that it would mean that people they know would become aware of their difficulties and they did not want that to happen.

In summary, these additional qualitative dimensions of heat- and cold-related interviews support the moderate financial assets vulnerability found in the structured interviews and revealed supplementary vulnerabilities related to current pressures of austerity measures in reducing pensions and older people' pride in not asking for help, struggling alone to afford essential housing expenses, and only then considering food and medication with direct impacts on their mental and physical health. Keeping cool and warm was thus not a priority for most participants, as they did not have enough money or wish to spend it on this. Thus, extreme heat and cold temperatures increased financial assets vulnerability by posing more pressure on the existent financial assets general vulnerability. Furthermore, extreme cold did prove to constitute a bigger threat to participants than extreme heat, as they found easier not to increase their energy bills during extreme heat than during extreme cold. This highlights the need to improve the financial capacity of older people for affordable housing and housing expenses, affordable health care and medication, as well as food to enable improvements in their mental and physical health. Addressing issues such as electricity, gas and water prices or subsidies are critical in this endeavour to reduce older people' vulnerability to extreme heat and cold temperatures (see Chapter 8).

4.3.3 Physical assets

The third type of assets is related to housing, housing quality, tenure and ownership of equipment and goods (e.g. landline phone, mobile phone, TV, radio, computer, car). In addressing physical assets, the quantitative (structured) interviews showed high percentages of participants living in buildings without lift (82.7%), living in apartment buildings (76.9%) and in old houses (50 years old or more) (69.3%), which were the greatest contributors to general physical assets vulnerability. Other factors, such as not owning a car (69.2%) or computer (65.4%) were also high contributors. Regarding housing tenure the majority of participants lived in rented homes or social housing (61.5%) and more than half of all participants (59.6%) were not happy with their living conditions. All these and other physical assets sub-indicators (see Appendix 4.1) made participants moderately vulnerable (0.448) on physical assets.

In order to provide deeper understanding of the issues behind general physical assets vulnerability, the qualitative interviews revealed a range of emergent themes coded in two categories as 'lack of insulation' and 'lacking cooling and heating devices'.

The first theme – *lack of insulation* – related to participants' comments on the inability to keep their homes cool or warm during extreme heat and cold temperatures, respectively. Many participants perceived the temperature in their home during the summer and winter seasons as a problem and many were not able to keep their home and keep themselves cool or warm in their home due to lack of insulation (e.g. single glazed windows, lack of wall and/or roof insulation). In both heat and cold, lack of insulation was a barrier to using cooling and heating devices as it was thought to be a waste as the home would not keep the coolness or warmth, respectively. For example, living either in the top or ground floor were cited as reasons for having more difficulties in keeping cool and warm due to lack of roof of insulation and being more exposed to the heat and cold, as well as fear of opening windows during hot weather, respectively. Heat-related interviews also revealed that most participants' houses were very exposed to the sun and were therefore hotter. Participants renting or owning lacked the ability to improve their living conditions by refurbishing the house they lived in due to income constraints, low confidence and control. Despite this, most participants were aware of the importance of housing conditions (e.g. window, wall and roof insulation) to be able to better keep cool and warm, in summer and winter, respectively.

The second theme – *lacking cooling and heating devices* – linked to the finding that most participants did not own an electric fan, air conditioning or heating devices. No participant mentioned having central heating installed in their homes and only five participants revealed having air conditioning - of these two were couples (the only two couples in the whole sample).

Some participants would like to have such devices, but did not because they considered it to be very expensive to buy and/or use (financial asset), or because the house lacked insulation and would not be able to be kept cool or warm (see section above). During the qualitative interviews some participants mentioned receiving fans and heating devices as gifts. There were exceptions to this: a limited number of participants used cooling and heating devices and were aware of their benefits for their health (human asset) and were willing to make an effort to be able to afford using them (financial asset).

In summary, these additional qualitative dimensions support the moderate physical assets vulnerability found in the structured interviews and uncover deeper drivers of physical vulnerability to extreme heat and cold temperatures. Thus, extreme heat and cold temperatures increase physical assets vulnerability by posing additional pressure on the existent physical assets general vulnerability. These were mainly related to the lack of housing insulation and the lack of cooling and heating devices, that ultimately are rooted in the lack of investment on home insulation from landlords as the majority of participants lived in rented homes and on financial assets vulnerability to afford buying and using cooling and heating devices. Intervening in both issues would reduce physical assets vulnerability in the older people' population (see Chapter 8).

4.3.4 Place-based assets

The fourth type of assets are connected to participants' location, such as proximity to amenities such as food store, post office, bank, cinema, public transport, public and private spaces and facilities, quality of environments and amenities (e.g. neighbourhood, health services, public transport, state pensions quality), as well as knowledge of the Heatwave Plan and Cold Weather Plan.

In addressing place-based assets, the quantitative (structured) interviews revealed that the lack of access to amenities such as cinema, theatre or cultural centre (60.8%) and post office (50.0%), and the lack of access to public facilities close to participants' house (42.3%) were some of the contributing factors to place-based assets vulnerability. In terms of the quality of public amenities, the biggest contributors were the low quality of state pension system (64.7%), followed by public transport (35.3%), health services (26.9%) and care services for the elderly (26.4%). The majority of participants did not go to public facilities to engage in physical activity (71.2%) or to private and public spaces (50.0%), contributing to an overall place-based assets vulnerability of 0.358 (see Appendix 4.1).

The importance of place-based assets identified in the quantitative interviews were also revealed in the qualitative heat- and cold-related interviews data and coded into four themes of 'indoor versus outdoor spaces', 'work the land', 'ward level activities' and 'Heatwave/Cold Weather Plan, what Plan?'.

The first theme – *indoor versus outdoor spaces* – was related to the use of spaces by participants during extreme heat and cold temperatures and related to issues of availability and quality. Regarding heat-related interviews, difficulty of access to local infrastructure and amenities, such as mobility problems, distance from their home, lack of public transport and not having anyone to go with (associated with social capital, Section 4.3.5) were some of the reasons mentioned. Regarding other infrastructures, only two participants mentioned going to shopping centres and supermarkets to avoid the heat at home or outside (GM, LM). Other public places such as the Revenue and Customs offices and Social Welfare offices were also mentioned as cool places where participants like to stay but that were not available to everyone, only those needing to solve related matters (e.g. CM). Another strategy some participants used to protect themselves from the heat was going to a coffee shop with air conditioning (e.g. KM). Staying in their own gardens, sitting in benches, going to parks and gardens nearby their homes were the most cited. Other participants found it hard to find shade and mentioned the lack of trees and safe places in the areas they lived (participants in Wards A, B and E). In one of the wards participants mentioned they would like to have a safe park nearby in order to be able to go there and to protect themselves from the heat, as the one that existed was closed for refurbishments and before there was a risk of mugging and drugs (Ward A).

The second theme – *work the land* – was connected to participants' youth as most were not born in the city of Lisbon, but in small villages in the countryside and used to work in agriculture when they were young. Several participants revealed they still went to the countryside and worked their land (e.g. TF, BM). Access to land on the limits of the urbanized area and within the city limits in the form of allotments (EF) or in the countryside were ways some participants found to keep occupied, fit (human assets), reduce food costs and improve their ability to afford other essentials and goods (financial assets). Working the land during very hot and very cold days was mentioned by these participants, which despite being aware of the risks and impacts were putting their health at risk by doing so, as they say the work has to be done even if it is very hot or very cold.

The third theme – *ward level activities* – linked with availability of alternatives to staying home such as going to the countryside or to the beach, were particularly cited by participants. Some Lisbon wards provided the opportunity for older residents to go to the beach or countryside in June or September as part of the local authority or institutions activities (Wards A and E). Many participants engaged and identified this as their only opportunity to get out of their home and travel. Others that did not have this opportunity raised difficulties about being able to go on their own, such as the distance to the beach/countryside, the need to use public transport, mobility and financial issues. Going to the beach was a very important and overarching theme in the heat-related interviews. Ward authorities also provided other activities where participants could learn crafts, a musical instrument, although these were only provided during school term-time, not during the hottest months of the year or during parts of the winter months (December, January), when it is either to hot or too cold, respectively.

The fourth theme – *Heatwave/Cold Weather Plan, what Plan?* – was associated with the awareness and knowledge of the Heatwave and Cold Weather Plans in Portugal and particularly in Lisbon. The vast majority of participants had never heard about either the Heatwave or the Cold Weather Plans but were interested in knowing more about them when mentioned during the interviews. Although mortality and morbidity related to extreme heat and extreme cold was acknowledged by some, most participants mentioned these events were not a threat in Lisbon, or even Portugal, but only abroad. Despite not knowing about the preparedness plans, many participants watched the weather forecast and media warnings. For the minority of those aware of the Heatwave and Cold Weather Plans references to prevention and protection against the heat and cold were mentioned. A common belief and misconception across participants was that health authorities warned about the risks of sun exposure as being more harmful to health than extreme heat. Some participants also acknowledged that many people die during heatwaves and cold spells and that many of these die alone in their homes (social asset). Most participants had heard about extreme heat and extreme cold, and related risks and impacts, mainly through the news on TV and on the radio and were aware of 'a structure' that coordinates information and action when these events happen. Past experiences were considered by many as sufficient to successfully respond to very hot and very cold weather but others welcomed more information. During the cold-related interviews, many participants revealed having taken the flu vaccine for the first time, as during that winter (2012/2013) it was the first year that the Portuguese NHS made the vaccine available for free to individuals aged 65 years and older.

Participants revealed strategies and interventions for reducing their place-based vulnerability. For example, some participants mentioned that an intervention aimed at reducing the impacts of heat and cold would be for Ward level authorities to contact vulnerable people via telephone and through their GP. Despite this, some revealed that the government had no interest in doing anything about it, and felt helpless as many old and poor people did not have the assets needed to protect themselves from both heat and cold (see Chapter 8).

In summary, these additional qualitative dimensions of heat- and cold-related interviews support the moderate place-based assets vulnerability found in the quantitative interviews and uncover the drivers of place-based vulnerability to extreme heat and cold temperatures. Thus, extreme heat and extreme cold increased place-based assets vulnerability by extending the pressure on the existent place-based general vulnerability. These were mainly related to the fact that not many participants made use of assets such as green spaces, the countryside, the beach, land, food production and were not aware of the Heatwave and Cold Weather Plans. Ward activities were thought to be crucial both as a source of skills and information about adaptation to heat and cold (discussed in Chapter 6), but access to public cool and warm places was not widely acknowledged and barriers were found to exist in their use. Overall, knowledge about the Heatwave Plan and Cold Weather Plan, its aims and objectives was minimal, but more information on strategies to keep cool and keep warm, respectively, was widely welcomed.

4.3.5 Social assets

The fifth type of assets is centered on aspects of social capital, social support and social participation. The quantitative (structured) interviews revealed that social assets vulnerability was greatly influenced by the high percentage of participants that took part in voluntary and charitable activities less often than once a week (92.3%), the percentage that had direct contact (face to face) with their extended family once or twice a month or less (88.5%) and the percentage that cared for and educated children less often than once a week (82.7%). Other contributing factors included spending little time taking part in voluntary work or political activities (78.8%), spending little time in contact with family members (60.0%) and finding it difficult or very difficult to borrow money in the case of serious financial difficulties (60.0%). Similarly, having indirect contact (e.g. telephone) once or twice a month or less with friends and neighbours (54.9%) and with their extended family (48.1%) also made participants vulnerable in terms of social assets. Furthermore participants spent little time in other types of social contact besides family (44.2%), and little time in their hobbies and interests (32.7%). These were the greatest contributors to social assets vulnerability (0.421). Other contributors can be found in Appendix 4.1.

From the qualitative interviews three themes arose regarding specificities of social assets. These were coded as ‘I'm connected… to my family’, ‘I feel supported and I never ask for help’ and ‘I socialise but not as much as I should’.

The first theme – *I'm connected… to my family* – was related to bonding, bridging and linking social capital. Most connections participants had were with their children and elderly neighbours to which they were close (bonding social capital). Checking on and being checked by them during extreme heat and extreme cold was a common strategy implemented by participants. Besides family and neighbours, old acquaintances in their area were people they talked to (bridging social capital) and shared advice on how to deal with very hot and cold weather. Despite this, many participants mentioned not having friends or close neighbours either because they had already passed away, or due to lack of trust. Some participants also revealed having connections with the social care staff and officials from their Lisbon ward (linking social capital) where some participated in social activities for older people but whom they did not ask for help during heat and cold. One of these wards (Ward E) had compiled a list with names, ages, marital status, telephone number (landline and mobile) and address of all the older adults (65 and older) living in their area, which they used to regularly contact older adults to check how they were doing and if they needed any help or support given to them.

The second theme – *I feel supported but I never ask for help* – was associated with participants' comments on instrumental, emotional and informational social support, especially social support from family and neighbours. They provided instrumental, emotional and informational support to older adults. Family was thought to be the most trustworthy source. Instrumental support was mostly provided by participants' family. However, most participants (as mentioned earlier) despite having financial difficulties and being unable to keep cool/warm in their homes during very hot/cold weather found it hard or impossible to ask for help to either their family or public authorities as they did not want others to know. Most of the help they received was in the form of gifts (e.g. fan, heating device). Regular face-to-face contact and phone contact with children, family members, friends and neighbours was a source of emotional support used to keep in touch with others and to check on their health and well-being, giving and receiving information and advice on how to keep cool/warm during extreme heat/cold. Despite this, many participants would not accept advice from neighbours, acquaintances or friends as it was perceived that they knew less about extreme heat and cold. Older adults were relatively keen to receive information and advice, but keener on intergenerational transmission of information and advice to their grandchildren and children, and to older adults that they considered more vulnerable than them. Emotional support was also mostly provided by participants' family. Notwithstanding, being able to count on their neighbours when in need was a resource for those participants lacking family support. Regarding informational support, many participants stated receiving information, or advice on what to do during very hot/cold weather they did not ask for. Sources of information mentioned included: TV and radio (news and weather forecast), followed by health professionals and social contacts. Most participants trusted their children and their GP to give them advice, as well as other health professionals such as nurses and pharmacists. Despite this and due to financial constraints some participants chose to go to pharmacies for health advice rather than seeing their GPs (not free to older people anymore due to State austerity measures). Some participants did not trust TV and radio as sources of information, as they only gave general advice and they would like personalized advice. In the qualitative interviews, participants revealed high levels of self-reliance, lack of trust in others and in society in general, including governmental authorities, but high levels of faith and trust in God. The word 'God' was extensively used during the interviews and with many diverse meanings. Participants talked about God ruling and commanding the weather and their lives, providing for them, giving them health, wealth, strength and helping endure everything (linked with resilience, see Chapter 5), and they thank God for all this. In their views, only God can help them during very hot and cold weather, as such they pray to God and ask for His help as some are alone and have no one else to turn to. Participants also mentioned that God is giving signs (e.g. disasters, flooding, heatwaves) to humanity on wrong doings that are happening, as God gives everything good and bad. Despite this, many mentioned 'God forbid things to get worse' regarding very hot and cold temperatures. A discussion on fatalism and lack of sense of agency is presented in Chapter 5.

The third theme - *I socialise but not as much as I should* – was linked with participants' engagement in social activities. Participants that engaged in social activities did it mainly through the ward they lived in, their parish, day centres for the elderly and community centres. These free activities ranged from citizenship classes, arts and crafts classes, computing and internet classes, choir, dance and memory training. Being part of such activities was for most a way of getting out of the house, being occupied, meeting new people, making new friends and learning new things. Notwithstanding, these activities were only held during school term time, ending during the hotter months of the year (from June to September) and many participants felt that this should change as during July and August when it is hotter older adults still need to be occupied and tended to stay home where it was hot, whilst the places where activities were held had air conditioning. During parts of the colder months of the year, such as Christmas and Easter holidays, these activities were also unavailable and according to many participants such activity places provided a cool/warm environment and a place for people to meet, talk and socialise. The qualitative interviews also revealed that most participants stayed more at home during extreme heat and cold temperatures, which increased their levels of isolation and also their levels of risk as their homes were hotter/colder during these periods, respectively.

In summary, these additional qualitative dimensions of heat- and cold-related support the moderate social assets vulnerability found in the quantitative interviews and uncover the roots of social vulnerability to extreme heat and cold temperatures. Thus, extreme heat and extreme cold increased social assets vulnerability by generally enhancing the existent social assets general vulnerability, but some exceptions were found regarding participants who took part of activities at their ward. In addition, heat did pose a greater threat of social isolation as older people took refuge from the heat at home - but despite being cold participants still went out. More isolated participants lacked sources of information or help, felt helpless when thinking about adapting to extreme temperatures and less able to deal with the heat and cold. Socially connected participants felt more confident in receiving and giving information to others, as well as in finding ways to keep cool and warm. Face to face information provided by someone participants trusted, like their GP, were the preferred way of receiving bespoke and individual information and advice. Such considerations revealed a gap in the way health and social authorities currently convey information on heat and cold preparedness (through mass media), whilst older adults prefer individualised advice. Social activities and contacts such as the ones provided by some Lisbon wards were also enablers of social capital and strategies to keep cool and warm, as they provided the means for older people to meet and be with others, fight social isolation, and at the same time provided warm and cool places with heating and cooling devices that otherwise would not be available to them. These and other considerations arising from the findings presented and discussed here so far, should be considered in taking into account feasibility and viability of options to enhance assets during heat and cold through measures within Heatwave and Cold Weather Plans, which are further discussed in Chapter 8.

The overall themes emerging from the heat and cold data are summarised and presented in Table 4.2 according to the different types of assets (i.e. human, financial, physical, place-based and social). Most of the themes shaping vulnerability are related to assets but life experience and faith in God were also found to shape participants' vulnerability to both extreme heat and cold. To give a sense of diversity of the main themes shaping vulnerability in this sample, as presented in Table 4.2, the most frequently mentioned assets and themes included: financial assets (income constraints, costs of energy) and physical assets (lack of insulation; lack of cooling and heating devices); and the least mentioned assets and themes included: social assets (self-reliance, social isolation, lack of trust in others); human assets (illiteracy, awareness of risks to health), and; place-based assets (lack of safety and cleanliness, used to keep cool and warm).

Table 4.2 Main themes shaping vulnerability arising from the interview data on extreme temperatures

Heat and Cold-related Vulnerability Themes	Examples
Human assets	
- Health status	Awareness of individual health impacts. Misconceptions of higher impact of sun exposure than heat exposure.
- Level of education and occupation	Importance of literacy, education and understanding of risks.
- Skills and skills training	Opportunities to learn.
- Living arrangements	Changing relationships in the household.
Financial assets	
- Pensions	Income constraints. Financial difficulties. Cost of energy consumption. Struggling to make ends meet, especially being able to afford heating and cooling costs.
- Savings	Access in case of sudden health problems, not to improve insulation, for example.
Physical assets	
- Housing	Understanding of links to health. Reduced housing stock quality. Reliance on landlords' refurbishments. Lack of insulation.
- Household goods	Reliance on TV and radio for preparedness and warnings.
- Cooling and heating devices	Not widespread.
Place-based assets	
- Green spaces, countryside and land	Alternative strategy to keep cool. Reduced cleanliness and safety. Alternative source of food.
- Ward activities	Opportunity to socialise, keep active and learn. Travel opportunity (e.g. beach, countryside). Alternative strategies to keep cool and warm.
- Local infrastructure and access to amenities	Alternative strategies to keep cool and warm.
- Heatwave and Cold Weather Plan	Knowledge and information not widespread.
Social assets	
- Bonding, bridging and linking capital	Reliance on ability to take care of oneself. Reliance mostly on family and neighbours. Social isolation.
- Instrumental, emotional and informational social support	Reliance mostly on family and neighbours. Importance of receiving and giving advice, from and to trusted people. Mistrust of information sources.
- Social activities and participation	Reliance on Ward activities provision. Need for whole year activities.
Other	Importance of life experience. Faith in God.

In summary, there are many commonalities but also some differences between heat- and cold-related vulnerability rooted in the characteristics of participants and their surrounding environments, their general vulnerability and lastly to the characteristics of extreme temperatures themselves. The levels of heat- and cold-related vulnerability are thus dependent on the general asset context and diversity and how heat and cold support or oppose, enhance or reduce the stock of assets available to participants. Overall, both extreme heat and extreme cold enhanced general vulnerability and posed challenges to all types of assets without exception.

4.3.6 The dynamics of juggling the assets portfolio

Having presented the context and diversity of assets, it is important to also consider the dynamics of juggling the assets portfolio of the participants in the study, exploring participants' access to and availability of assets, how the process of assets replacement, exchange or substitution takes place, and what are the linkages between and within assets.

Participants' life circumstances have seen significant changes along the years not just because of intrinsic factors such as their age, general health and well-being but also because of external factors such as economic and social changes. During the qualitative interviews, many participants revealed different types of constraints that impacted on the accessibility to and availability of different types of assets. In order to overcome these difficulties participants engaged in activities of assets replacement, exchange or substitution, as assets can interrelate, strengthen or be replaced by other assets (e.g. Antonovsky, 1987; Moser and Dany, 2008).

In the qualitative interviews a deeper understanding of the dynamics of juggling the assets portfolio were revealed. Examples included the sale of a car and jewellery (physical assets) in exchange for money (financial assets) that enabled participants to buy food and medication beneficial to their health (human assets). Renting rooms in their homes was another example of substitution of physical assets for financial assets to better cope with financial difficulties. Those with a private garden or access to an allotment (place-based assets) were able to produce vegetables and herbs, as well as poultry for self-sufficiency, contributing to their health (human assets) and enabling them to sell some of these products (financial assets). Deeper understanding of the use of specific heat- and cold-related assets was also revealed by qualitative interviews. Examples included the substitution of income (financial assets) to improve home insulation, to buy cooling or heating devices and to pay energy bills to maintain thermal comfort. Substitution/replacement of assets despite being mentioned by some was not very frequently mentioned by the majority of participants, most of them preferring to be thrifty and savvy. Participants that engaged in substitution/replacement of assets managed to reduce their vulnerability in the short-term (e.g. sell jewellery for money) but also in the long-term (e.g. rent a room for money).

In summary, the lack of a certain type of asset may undermine access to a different type of asset or even to different types of the same asset. In some cases being able to replace, exchange or substitute one type of asset for another type can reduce vulnerability. Having a deeper understanding about the linkages between and within assets is extremely valuable for the development and implementation of mechanisms to tackle specific aspects of accessibility and availability of assets (discussed further in Chapter 8).

This whole section has examined the context and diversity of each of the five types of assets under study (human, financial, physical, place-based and social) through the analysis of structured and semi-structured interview data. Following this characterisation, the next section aims at understanding the significance of the each of these types of assets on overall sample and individual participants' general, heat- and cold-related vulnerability.

4.4 Perceptions of factors contributing to vulnerability to extreme heat and cold temperatures

Taking into account the asset context and diversity and the aspects of vulnerability presented in the sections above, the following sections explore older people's perceptions of factors contributing to vulnerability that the qualitative interviews on heat and cold uncovered.

4.4.1 Contextualising experiences

Vivid and accurate recollections of extreme heat, particularly in the recent past or associated with noteworthy experiences were evident from the interviews. A great number of participants mentioned the week and weeks before the qualitative heat interviews (Summer 2012) as being remarkably hot. The month of June 2012, to which participants referred to was uncommonly hot with mean daily maximum temperature of 26.68°C, above what is expected for that time of year (1.9°C higher when compared with the mean (24.78°C) for the period 1971-2000). The maximum temperature registered in Lisbon during that month was of 36.8°C (IM, 2012a). Some participants associated very hot temperatures with noteworthy experiences in their lives, such as health impacts (e.g. heatstroke, pacemaker insertion) and loved ones (e.g. ill next of kin), death of chickens and rabbits. In addition, some participants stated that every year is very hot and that the last few years have also been very hot. Overall, and despite in some cases not remembering specific dates or years, all participants mentioned recent experiences of extreme heat:

> 'Today is hot, but not like yesterday: yesterday was horrible. This week has been very hot. Yesterday was very hot […] Saturday was very hot as well' (CF[87])
>
> 'Last week was very hot.' (MF[82])
>
> 'I think that this month has been very hot, really very hot.' (VF[76])
>
> 'Maybe in 2003, I remember there was a heatwave. My husband was very ill at the time.' (BBF[74])

Regarding extreme cold, a lower recollection of past events was found when compared with extreme heat, as participants mentioned finding it easier to recall very hot weather than very cold weather. Similarly to what was found for extreme heat, most participants mentioned the weeks before the winter interviews (Winter 2012/2013) as being very cold. Many participants also remembered Winter 2011/2012 specifically the month of February 2012 as being particularly cold in Lisbon with impacts on mortality. During this month (February 2012), the mean value of minimum air temperature was much lower than the normal value (years 1971-2000) and in the city of Lisbon the mean minimum temperature was of 6.62°C, much lower than the mean for 1971-2000 of 9.19°C (IM, 2012b). Other participants associated extreme cold to snowfall in Lisbon around 7 to 8 years before the interview. The majority of participants stated that every winter is cold and that every winter there are some very cold days. Despite this, overall participants did not find Lisbon to be a very cold city.

> 'Last year there were some very cold days [winter 2011/2012]. And this year the cold is still yet to come [winter 2012/2013]. But last year, oh there were some really cold days.' (AF[79])
>
> 'I don't remember. Very hot weather I remember very well but very cold .... ah in Lisbon it even snowed, do you remember? I don't know how many years ago, it was in January it were 3-4 degrees. I was having lunch and I started to see the snowflakes, but don't know what year. It was prior to 2007, maybe 7-8 years ago, I'm not sure.' (BBF[74])
>
> 'Last week it was very cold, but I don't remember well. For how cold it was in the past, when I was younger in my home village … we would all be always 'frozen'.' (EEF[72])

4.4.2 Perceptions of warming and cooling weather

The main emergent theme was - *It's changing ... There have been many changes*. During the qualitative interviews many participants revealed perceiving the weather was getting hotter year on year and talked about changes in 'normal' weather during summer, such as sudden variations in temperature, peaks in temperature and high prevailing temperature. The weather was believed to have become more uncertain and hotter. Hotter periods were occurring more frequently and intensely than ever before and not only during summer. Extremes in temperatures, global warming, melting icecaps, melting glaciers, as well as deaths due to heat were some of the consequences mentioned. Although participants talked about heat locally and abroad, the occurrence of heat impacts for the environment and for human health were thought to be taking place in distant places (e.g. in the Poles, in Africa or in Russia) but not in Portugal or Lisbon.

Furthermore, many participants did not perceive that it is getting hotter year on year as they considered that it was hotter in the past when they were younger and this was the reason for not perceiving warming weather.

> 'I think it is getting warmer and colder, and the temperature variation in a 24 hours period is much greater.' (MM[85])
>
> 'Yes, I do; but I also see on TV certain types of things I have never seen: glaciers falling, melting into the sea and the sea rising. The sea rises because it has more water, because of the 'rocks'. I call them 'rocks' but they're not, and the water has to go somewhere [...]. Because of pollution, cars and all that; there are too many cars and makes warming and glaciers melt. That's why!' (UF[70])
>
> 'I think it's the opposite (laugh), I think it's the opposite. I think it's less hot that it was in the past. It's very irregular. In the past the seasons were well marked and now they are not. Now it's like the four seasons in one day. It's very irregular. Sometimes there is a really hot and suffocating day but then it changes again, the mornings are cold and the evenings are also cold and midday is very hot.' (CCF[78])

On the other hand, perceptions of cooling weather were fewer, with less participants mentioning the weather was getting colder year on year. For these participants this was due to being able to tolerate better the cold in the past - when they were younger - and feeling colder now. But for the majority of participants, it was colder in the past (when they were younger), as in the past they had worse living and working conditions and had memories of snow and ice in their home villages before moving to Lisbon. Better clothing and better living conditions were mentioned as being the reasons for presently not perceiving that the weather was getting colder.

> 'I think it is getting warmer; it is warmer than usual, than when I was younger. It was always very cold and now it's warmer I think.' (TF[70])
>
> 'I think that there was always cold. I think that now people complain more, everything confuses them. We used to always be cold, to see ice, snow, rain. There was always this and we in the countryside would be very, very cold and it would be very uncomfortable, we didn't have anything, and I think that people had to conform to what they had.' (EF[81])

4.4.3 Perceptions of health impacts

The vast majority of participants identified both heat- and cold-related health impacts. Qualitative heat-related interviews showed that participants focused mainly on generally not feeling well, skin problems due to sun exposure (i.e. skin cancer, skin damage), respiratory problems, exacerbation of allergies, increased sweat, dehydration, discomfort, distress, heat exhaustion and heat stroke, respiratory infections, illness, and death.

> 'I think we don't feel well when it's very hot. The body starts to feel unwell, more tired and unwilling to do everyday activities. The body is less active, weaker and we feel like resting and lying down.' (XF[80])

> 'I think it can, there are many people that are careless and stay in the heat at the beach and develop skin diseases and so on... The heat can affect the skin but also affect breathing as well.' (BF[80])

> 'Yes, very very hot weather can even kill, if someone does not protect from the heat and cool down, if they don't wear light clothing, if they don't drink many liquids that are not alcoholic drinks.' (SF[75])

On the other hand, in the cold-related interviews participants acknowledged specific health conditions such as the development of colds, flu, pneumonia, bronchopneumonia, bronchitis and related respiratory problems, illness and death.

> 'If people don't protect from the cold they can get pneumonia, or flu, if they're not protected. And flu in old age is a very severe health problem.' (FM[95])

> 'Yes, bronchopneumonia, isn't it? It worries me, because my mother died due to a bronchopneumonia.' (HF[65])

> 'It affects health. There are many people that go to the hospital because of it. Ill, develop fever, lung problems … and have to go to the hospital.' (IF[73])

4.4.4 Perceptions of everyday life disruptions

Most participants did not identify any everyday life disruptions resulting from experiencing either extreme heat or extreme cold. Being retired, not having many things to do and having no obligations were some of the reasons mentioned. Despite both heat and cold most participants protected themselves as they could and did the things they had to do independently of how hot and cold it was, as things needed to be done.

> 'No, because now I don't do many things at home, my daughter does the cleaning, I don't do anything, my daughter does everything.' (JF[83])

> 'No, I endure and resist, do chores slowly. If it's very hot, I sit down and have a break. But I can't be seated for long I have to always be doing something, I am always moving. I do the chores' (IIF[87])

> 'I do everything the same. For now I don't change anything, for now…' (AM[65])

Others perceived themselves as being more affected (when very hot and very cold weather stopped them from doing the things they usually did in their everyday lives) and changed their daily routines. Doing housekeeping was an activity that had opposite responses from participants: generally to be avoided when it was very hot but which they welcomed when it was very cold. Waking up earlier than usual and going out early in the morning were common strategies used to avoid the heat. Most participants do not change their daily routines when it is very cold, one of the exceptions being when it is raining, due to the fear of slipping and falling.

> 'Yes, if it's very hot for example if I am cooking I have to open the windows so I can breathe because I feel unwell. Sometimes I stop cooking and say that I'm not going to cook because it's too hot and I can't stand the heat. The stove is terrible and I cook a lot, for me and for others (laughs).' (UF[70])

> 'Yes, now it's worse maybe because of my illness (diabetes) [...] when it's very hot I have to go to the market very early in the morning and have to take the bus home because I get too tired and is very hot.' (VF[76])

> 'Oh yes, if it's very cold, very very cold I stay home… I avoid, avoid if it's very cold. I stay more at home, I don't like it but I do it.' (AAF[75])

4.4.5 Perceptions of own vulnerability

During the qualitative heat-related interviews only a minority of participants perceived themselves as vulnerable to either hot or cold weather mainly due to their health status (e.g. heart disease, asthma, diabetes, cancer, heart conditions, and allergies), to physiological impacts of heat or cold and individual characteristics (e.g. housing). Other reasons mentioned for feeling vulnerable were being older and currently feeling colder in winter and being more difficult to bear the cold and keep warm.

> 'Yes, due to my cardiovascular problems, but I also had a surgery to remove a prostate cancer that was in regression, but is coming back again. I have diabetes for a long time, I have many problems ... diabetes and many other things that are not worth mentioning now.' (CM[68])

> 'I think I am more affected because currently, since I have the pacemaker I believe I am more affected, I deal worse with very hot weather than with very cold weather. Now I tolerate less very hot weather [...] feel tired and don't want to do anything.' (MM[85])

On the other hand, the majority of participants did not feel vulnerable to either heat or cold as they mentioned they were used to those temperatures, endured the conditions, felt that when they were younger it was hotter and colder, and perceived that other individuals were more affected than them. Not being afraid of the heat or cold, being able to keep cool and warm during extreme heat and cold, and perceiving that there are other individuals in worse conditions than they are, were reasons for not feeling vulnerable.

> 'No, I think not. I hear other people complaining more about the heat than myself. If it is hot everyone feels hot, as I do. They say that people with heart conditions suffer more with very hot weather, in fact in my case I feel very hot but don't feel more afflicted than other people.' (AF[79])

> 'No, it's the same. I am affected same as others. (EEF[72])

4.4.6 Perceptions of universal vulnerability

The interviews also demonstrated that despite not perceiving themselves as vulnerable (i.e. assessment of their own vulnerability) the vast majority of participants were well aware of universal vulnerability (i.e. they perceive their age group and other groups as vulnerable) to both heat- and cold-related risks and impacts, and talked about particular groups of people who may be more affected by very hot and cold weather. These included: frail and ill individuals; disabled individuals; individuals with health problems (cardiovascular and respiratory); elderly people (over 60 years old, or older than them); children and babies; overweight and obese adults and children; individuals that work outdoors (i.e. in agriculture); individuals living in hotter climates (i.e. Brazil, Africa), individuals that live in old and/or hot and cold houses; poor or unemployed people (unable to buy or pay for using cooling and/or heating devices; unable to buy medication); and the homeless. The qualitative cold-related interviews also revealed that participants acknowledged poor nutrition as a factor contributing to vulnerability in cold weather (which was not mentioned during the heat-related interviews). Despite perceiving older people as vulnerable to heat, generally participants did not identify themselves as old or as vulnerable, as seen in Section 4.4.5.

> 'Yes, people that sweat a lot you can see that they are more affected. Poor people, that don't have resources to do other things that they could do to help them.' (IIF[87])

> 'Oh yes, very old people, with many diseases, with breathing problems and heart conditions they would of course feel unwell. As well as children and babies, I think they are more affected and defenceless.' (BBF[74])

> 'Well, children for example and older people, older than me or even the same age as me... because different people tolerate the heat differently. I think it is biological, some people tolerate it better than others.' (PM[65])

A reduced number of participants could not identify any heat- or cold-related vulnerable groups. Some justified this by mentioning they did not know about other people's problems and were only concerned about themselves.

In summary**,** the perceptions of factors contributing to both heat- and cold-related vulnerability discussed above seem to be rooted in both the asset portfolio and participants' values regarding heat and cold (e.g. independence, control, experience), and ultimately impact on older people' motivation, willingness and perceived capacity to engage in both heat and cold adaptation behaviours (i.e. resilience, to be discussed in Chapter 5) and to actually engage in responding to both threats (i.e. adaptation, to be discussed in Chapter 6).

4.5 Individual participants' vulnerability

The findings presented above, resulted from overall sample analysis of structured interview data (quantitative) and the coding and categorisation of interview data (qualitative). Here, a further investigation of individual participants' vulnerability was undertaken to bring to life participants' individual vulnerability characteristics, as each participant represents a unique pool of vulnerability characteristics that can be underrepresented when looking at overall sample data. This was possible through the analysis of individual quantitative and qualitative data**.**

4.5.1 Individual participants' general vulnerability

In addressing the quantitative structured interview data, the same methodology used for calculating the overall sample general vulnerability (GVI) (Section 4.2.1), is used here for calculating individual participants' general vulnerability. Drawing upon individual responses to the structured interviews, participants' general vulnerability and five types of general assets indicators were developed. Findings showed that the majority of participants fall into the high vulnerability group (values equal or higher than 0.500, cut-off point) regarding financial assets (59.6% of participants), followed by human assets (53.8% of participants) and social assets (53.8% of participants). Some participants also revealed high place-based assets vulnerability (32.7% of participants), followed by high physical assets vulnerability (17.3% of participants). In addressing general vulnerability, the structured interviews data revealed that the majority of participants (59.6%) displayed low levels of general vulnerability (values lower than 0.500, cut-off point). Appendix 4.2 presents the coding for the five types of general assets and general vulnerability (GVI) for individual participants, respectively. A representation of individual general vulnerability in a defined space and time is presented below in Figures 4.3. and 4.4.

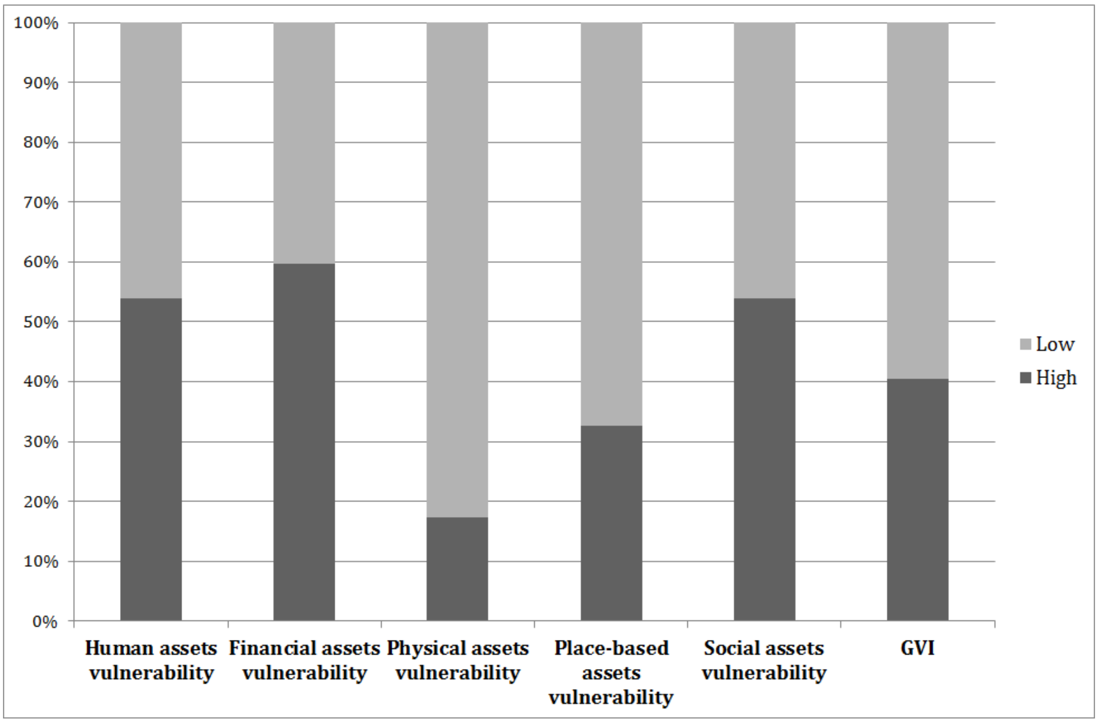


Figure 4.3 Distribution of participants according to high and low **general assets and general vulnerability** (GVI)

Legend: Y axis represents the percentage of participants exhibiting high and low general assets and vulnerability.

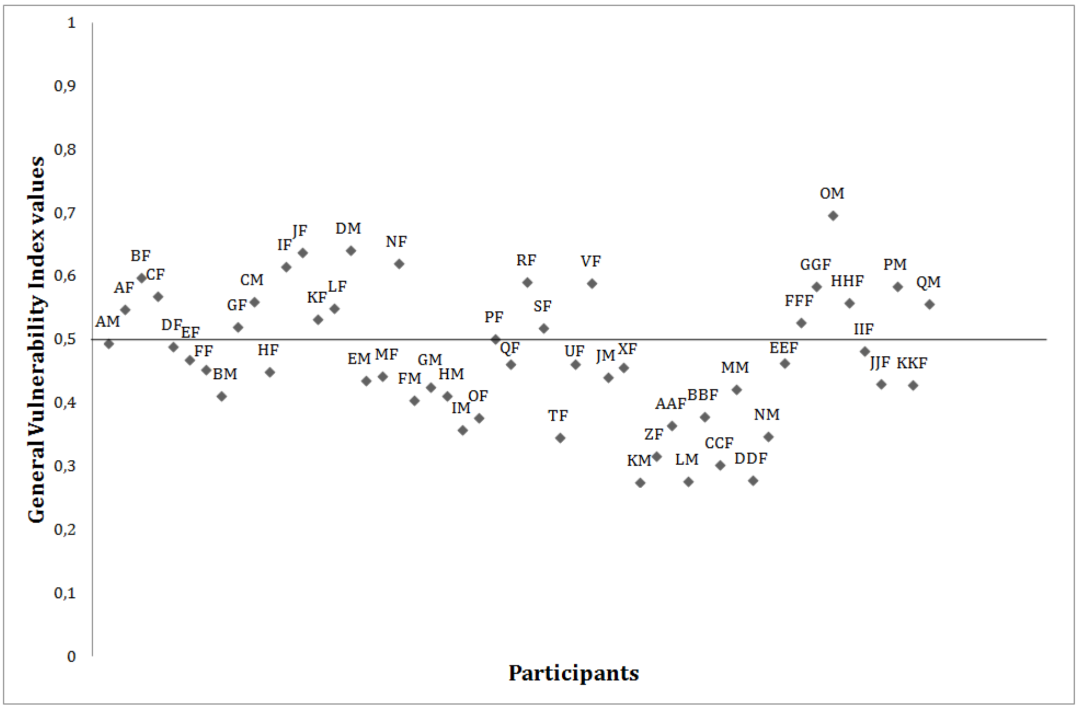


Figure 4.4 Mapping of participants' **general vulnerability values** (GVI) (quantitative data) (i.e. corresponds to the right hand column in Figure 4.3)

Legend: Y axis represents GVI value. Vulnerability ranges from 0 (least vulnerable) to 1 (most vulnerable). The horizontal line represents the 0.500 index cut-off.

4.5.2 Individual participants' heat-related vulnerability

Each participant's qualitative heat-related interview data was analysed and the types of assets vulnerability and heat-related vulnerability were coded as 'high' or 'low' according to the relative availability of heat-related human, financial, physical, place-based and social assets. This constitutes an iterative and systematic examination and interpretation of individual participants' qualitative interview data involving organisation and highlighting of characteristics of each type of heat-related assets and heat-related vulnerability (HRV). The reason for undertaking this task is answer Research Question 1 and exploring the differences and commonalities between individual participants' general vulnerability assessed through quantitative data (discussed in Section 4.5.1) and specified vulnerability, both heat-related (discussed here) and cold-related (discussed below in Section 4.5.3). In order to reduce subjectivity a framework was devised to enable a systematic coding process.

For the purpose of this research, high heat-related assets vulnerability was characterised in Section 3.5.2.1

This mapping of individuals based on the qualitative interviews required a thorough analysis of transcripts, related themes and sub-themes making sure these accurately reflected individual participants' vulnerability. It was a continuous process where all relevant characteristics and factors were taken into account for each participant to compile an overall characterisation for each one. Subjectivity, complexity and transparency concerns constituted limitations in mapping participants' heat-related vulnerability. As such, the order of participant codes within each quadrant does not reflect different levels of vulnerability.

Appendix 4.3 presents the coding for the five types of heat-related assets and heat-related vulnerability (HRV) for individual participants, respectively. The majority of participants revealed high physical assets vulnerability to heat (84.6% of participants), followed by high human assets vulnerability to heat (75.0% of participants), high financial assets vulnerability to heat (67.3% of participants), high place-based assets vulnerability to heat (65.4% of participants), and social assets vulnerability to heat (53.8% of participants). Overall, the vast majority of participants demonstrated a high vulnerability to heat (75.0% of participants). These findings illustrate the range in which participants' vulnerability to heat is rooted. A representation of individual vulnerability to heat in a defined space and time is presented below in Figures 4.5. and 4.6.

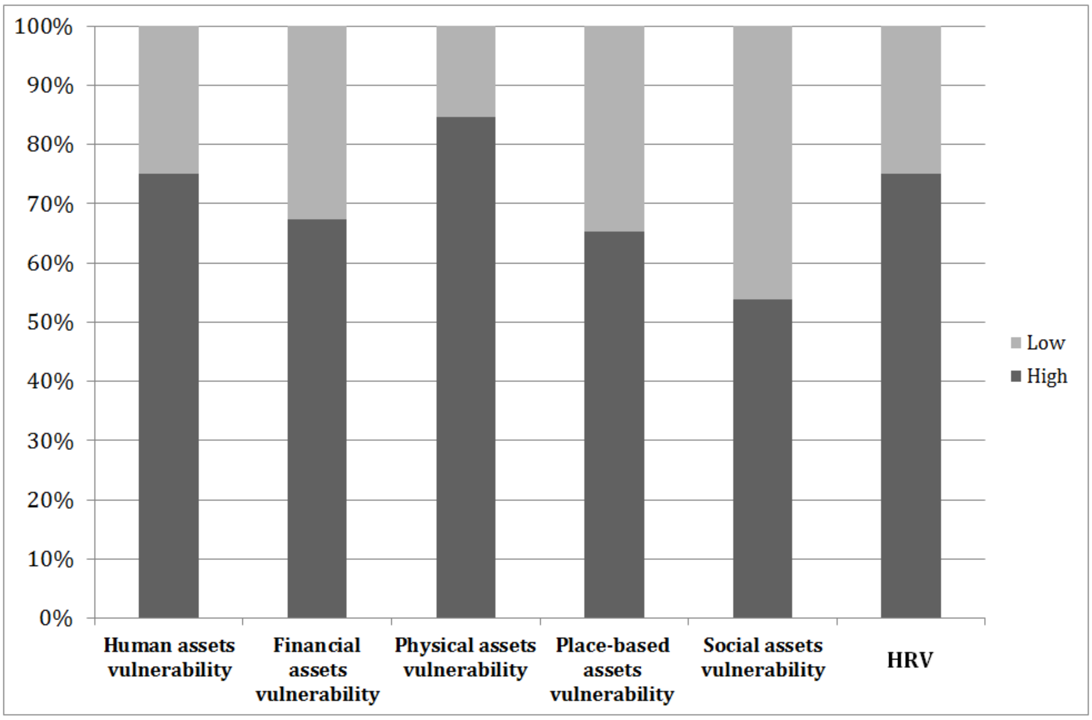


Figure 4.5 Distribution of participants according to high and low asset-based and **heat-related vulnerability** (HRV)

Legend: Y axis represents the percentage of participants exhibiting high and low heat-related asset-based and vulnerability.

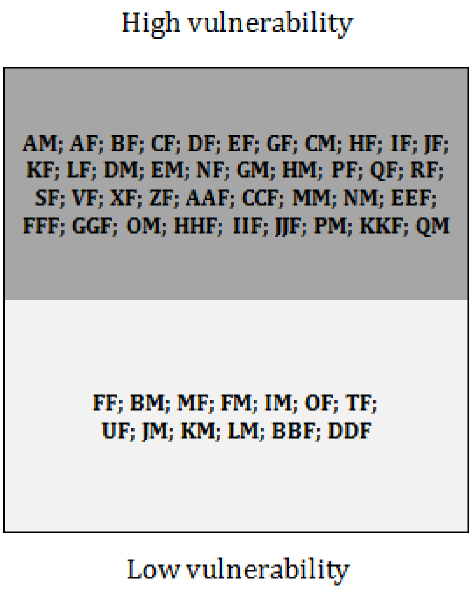


Figure 4.6 Mapping participants' heat-related vulnerability (HRV) (qualitative data) (i.e. corresponds to the right hand column in Figure 4.5)

Legend: Order of participant codes within each quadrant does not reflect different levels of vulnerability. The horizontal line dividing the two halves represents the cut-off point.

4.5.3 Individual participants' cold-related vulnerability

This was assessed for each individual following the same procedure as in the section above (Section 4.5.2, see Section 3.5.2.2 for characterization of cold-related vulnerability) but regarding extreme cold. Appendix 4.4 presents the coding developed for the five types of assets regarding cold-related vulnerability (CRV). In the case of cold, the vast majority of participants showed very high levels of human assets vulnerability (82.6% of participants) and place-based assets vulnerability (82.6% of participants), followed by physical assets vulnerability (71.7% of participants), financial assets vulnerability (69.6% of participants) and social assets vulnerability (56.5% of participants). Overall the majority of participants revealed high cold-related vulnerability (73.9% of participants). A representation of individual cold-related vulnerability in a defined space and time is presented below in Figures 4.7. and 4.8.

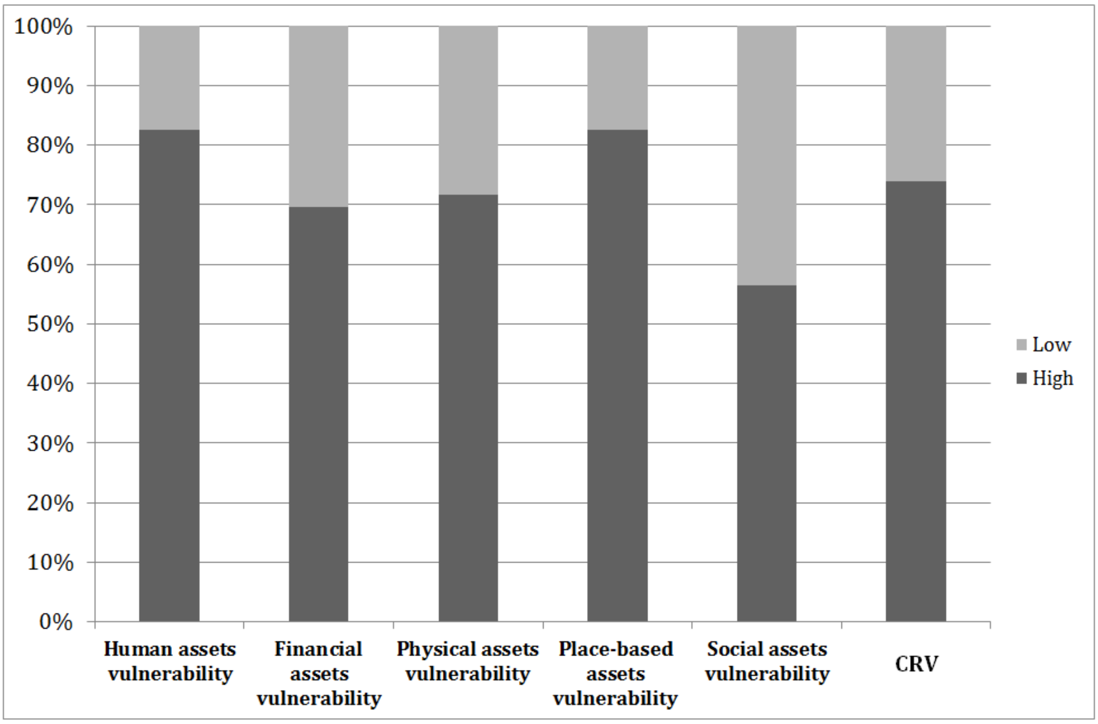


Figure 4.7 Distribution of participants according to high and low asset-based and **cold-related vulnerability** (CRV)

Legend: Y axis represents the percentage of participants exhibiting high and low cold-related asset-based and vulnerability.

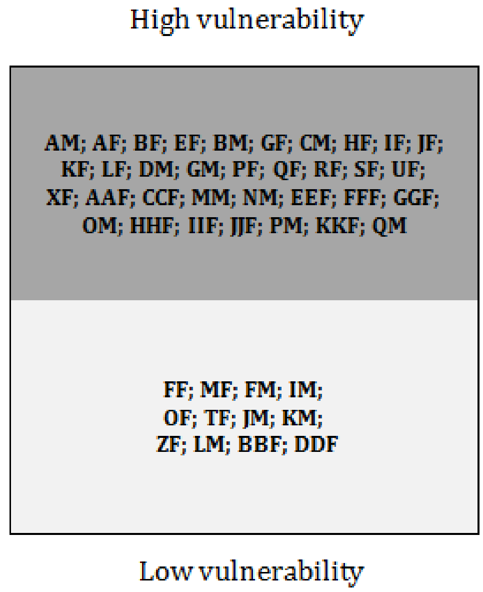


Figure 4.8 Mapping participants' **cold-related vulnerability** (CRV) (qualitative data) (i.e. corresponds to the right hand column in Figure 4.7)

Legend: Order of participant codes within each quadrant does not reflect different levels of vulnerability. The horizontal line dividing the two halves represents the cut-off point.

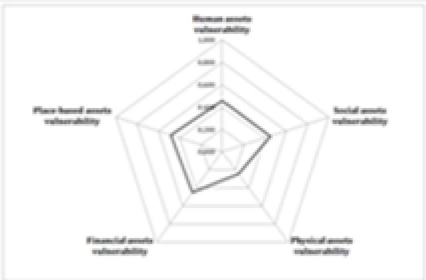
This section has explored general and specified (i.e. heat- and cold-related) individual participants' vulnerability. In doing so, it has outlined that there are differences between the distribution of the different types of assets vulnerability between general, heat and cold, and slight differences between heat- and cold-related vulnerability among participants. This type of investigation is relevant to understand the root causes of specified vulnerability in order to tackle the sources of vulnerability, as well as to plan and implement strategies to reduce vulnerability through different types of assets.

In summary**,** following the findings on vulnerability from Research Phases 1 and 2, high heat-related vulnerability is more frequent (75.0% of participants) than high general vulnerability (59.6% of participants). On the other hand, looking at Research Phase 1 and 3 high cold–related vulnerability is more frequent (i.e. affects 73.9% of participants) than high general vulnerability (i.e. affects 59.6% of participants). In addressing both heat and cold qualitative interviews, heat-related vulnerability is slightly more frequent than cold-related vulnerability.

4.5.4 Vulnerability profiles

In this section, the aim is to bring to life participants' individual vulnerability characteristics according to the framework developed in Section 4.5.2, as each participant represents a unique profile of vulnerability that can be underrepresented when looking at overall sample data. Individual profiles were developed from participant's interview transcripts and are presented below (Figures 4.9 and 4.10) illustrating each participant asset context and diversity as well as their real individual general, heat- and cold-related vulnerability. Two of the most diverse participants in respect to general, heat- and cold-related vulnerability (participants BM and ZF) are presented below.

Low general vulnerability, Low heat-related vulnerability & High cold-related vulnerability participant – BM



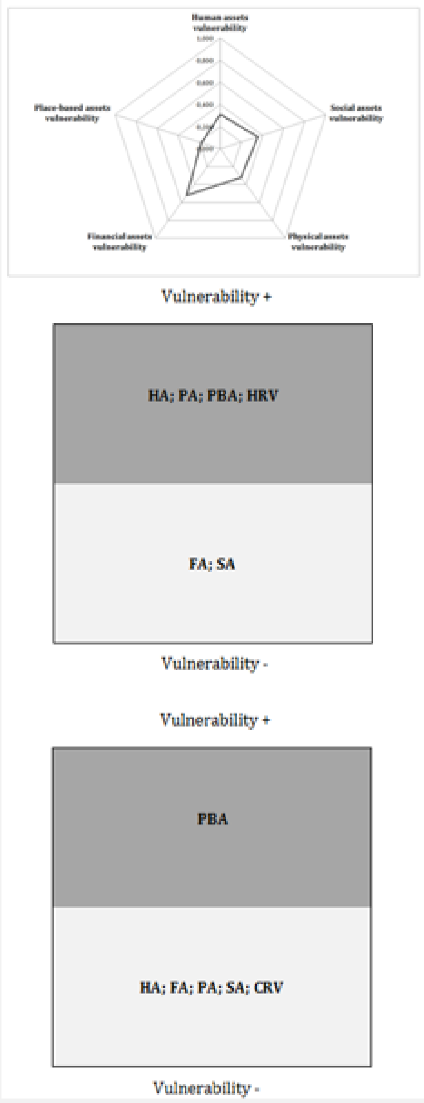
BM is 75 years old, is widowed and lives on his own. He has children, a daughter that lives close by and a son that lives in Luxemburg. He was a policeman and rates his health as fair and the same as a year ago. His monthly income is high (£1200-2100/month) and he lives in a rented old (around 85 years old) terraced house. He owns a computer and a car. BM lives in an area with close-by facilities (e.g. supermarket, bank and public transport) but without a post office or cinema/theatre/cultural centre. At least once a week BM attends social activities at his Lisbon district before they close for Summer holidays.

BM does not feel he is more affected by heat and his health is not affected during hot weather. He does not have difficulties paying for energy bills but he does not own a fan or air conditioning. BM is aware of the Heatwave Plan and has contact with people every day or almost every day during very hot weather.

BMs physical health does not limit what he can do during very cold weather but he has blood circulation problems. He has heating devices but his home is cold, although he does not have difficulties in paying heating expenses. He is not able to keep his home warm as it lack insulation and would be very expensive warm it. He uses a hot water bottle to keep his feet warm instead of using the heating devices. When his children visit him they complain about how cold it is in his home. BM is aware of the Cold Weather Plan and would like to know more about it.

General Vulnerability: 0.412*; Human assets vulnerability: 0.454; Financial assets vulnerability: 0.450; Physical assets vulnerability: 0.242; Place-based assets vulnerability: 0.482; Social assets vulnerability: 0.450;* ***Heat-related vulnerability: low****; Human assets vulnerability: low; Financial assets vulnerability: high; Physical assets vulnerability: high; Place-based assets vulnerability: low; Social assets vulnerability: low.* ***Cold-related vulnerability: high****; Human assets vulnerability: high; Financial assets vulnerability: high; Physical assets vulnerability: high; Place-based assets vulnerability: low; Social assets vulnerability: high.*

Figure 4.9 Participant BM vulnerability profile



Low general vulnerability, High heat-related vulnerability & Low cold-related vulnerability participant – ZF

ZF is 79 years old, is widowed and two of her grandchildren live with her as they are working and doing an undergraduate degree at university in Lisbon. She worked as a seamstress and she rates her health as excellent and much better than a year ago. She lives with around £550/month pension and despite having many expenses never had difficulties paying for housing expenses. ZF lives on the 1st floor of an old building (60 years old) without lift. The area she lives in has all the facilities needed and she is socially active attending several social activities at her church and at her Lisbon District.

ZF feels she is more affected by very hot weather and her health in hot weather limits her activities. ZF children pay her energy bills, as their children live in the house and use many electric appliances (e.g. computer, fan). She does not perceive the temperature in her home as a problem but her grandchildren use fans very often to keep cool in the house. ZF is not aware of the Heatwave Plan. She has contact with other people every day or almost every day and attends activities at her church and at her Lisbon district before they close for Summer holidays.

ZF does not feel she is more affected by very cold weather and her physical does not limit what she can do. She never had difficulties paying heating expenses, as her children pay it for her. She does not perceive the temperature in her home as a problem, as is able to keep warm at home and keep her home warm. ZF's grandchildren are always cold indoors and have heating devices in their rooms that warm the whole house, despite her not liking heating devices. She is not aware of the Cold Weather Plan and would not like to know what it is. She has contact with other people every day or almost every day during very cold weather.

General Vulnerability: 0.317; *Human assets vulnerability: 0.310; Financial assets vulnerability: 0.517; Physical assets vulnerability: 0.319; Place-based assets vulnerability: 0.179; Social assets vulnerability: 0.357;* ***Heat-related vulnerability: high****; Human assets vulnerability: high; Financial assets vulnerability: low; Physical assets vulnerability: high; Place-based assets vulnerability: high; Social assets vulnerability: low.* ***Cold-related vulnerability: low****; Human assets vulnerability: low; Financial assets vulnerability: low; Physical assets vulnerability: low; Place-based assets vulnerability: high; Social assets vulnerability: low.*

Figure 4.10 Participant ZF vulnerability profile

Participants' profiles as the ones presented above reflect the type and depth of individual participants' data (i.e. quantitative and qualitative) that allowed both individual participants' and sample level data analysis and interpretation.

4.6 Conclusions

This research explores vulnerability as a composite or umbrella concept made of several elements or constituents (i.e. assets) (Rayner and Malone, 1998). As a result, individuals can be more vulnerable or less vulnerable generally in their daily lives (e.g. general vulnerability) or to specific threats, stresses, shocks or events (e.g. heat- and cold-related vulnerability) due to social, cultural and environmental changes. Taking this approach, the chapter has showed that there were many manifestations of general, heat- and cold-related vulnerability, mainly exacerbated by a lack of perception of extreme heat and extreme cold as events and as threats or posing risk to participants' own health. The role of assets as building blocks in shaping vulnerability was explored in this chapter. Aspects of daily living such as low incomes and lack of savings (financial assets), lack of insulation and lack of cooling and heating devices (physical assets) as well as few opportunities to take advantage of place-based assets (e.g. go to the beach or countryside; go to cool or warm places) were all limited by financial assets. Health problems, lack of literacy and health literacy (human assets), and mainly relying on close family members when available due to lack of other social ties (social assets) were other relevant types of assets that increased vulnerability to both heat and cold. Due to the existing levels of general vulnerability found in the structured interviews, the outcomes of the interviews also revealed that the asset portfolio available to participants was threatened by the challenges and burdens of extreme temperatures. Vulnerability to heat and cold were thus increased due to inability to assemble and accumulate the needed assets to face such events.

Besides presenting the findings of the quantitative structured interviews on general vulnerability and qualitative interviews data on heat- and cold-related vulnerability, this chapter has compared and contrasted overall sample outcomes as well as recognised participants' individuality on vulnerability. Being part of a certain collective group (older people) is undoubtedly not a defining factor of vulnerability, according to the findings of this chapter on individual participants. The findings have shown a range of asset-based vulnerability influencing general, vulnerability to heat and cold, and ultimately on the expressions of such vulnerability. Extreme temperatures were found to increase participants' general vulnerability as they limited and increased pressure in assets diversity and availability.

The structured interviews were used as a diagnostic tool of general vulnerability but did not capture the pressures extreme temperatures pose to the general assets portfolio which were revealed by the qualitative interviews that also allowed capturing the expressions of vulnerability rooted in values (O'Brien and Wolf, 2010; Wolf et al., 2013) such as independence and experience for better understand how these shape resilience and adaptation to extreme temperatures, discussed in Chapters 5 and 6. The qualitative interviews were used as exploratory tools to capture deeper understanding of the burden that extreme temperatures posed to an already weakened general vulnerability of the sample of older adults in this research (Section 4.2.1).

Presenting overall sample results followed by individual participants' profiles aligning quantitative and qualitative data is novel and is a contribution to knowledge in the sense that individual distinctiveness is lost when only taking into account overall data. The reason for making the distinction between overall and individual findings was based on the recognition that overall data are not able to demonstrate the diversity of vulnerability within the sample. It is considered that this approach enriches the analysis of the results and allows a better understanding of the role of assets in shaping vulnerability. When analysing the sample results it was difficult to grasp the whole spectrum of relationships between and within assets and how they interact to shape individual vulnerability. The approach provides a more insightful tool on the assets available to older people and addresses the specificities of the population and setting under study in order to provide tailored results and recommendations for vulnerability reduction. This approach also helps to make the case for the development and implementation of individualised and bespoked vulnerability reduction strategies due to the diversity and distinctiveness of participants' vulnerability profiles found in this research sample. The approach put forward here contradicts a famous quote *'one size fits all'* (by Frank Zappa) and here is advocated that 'one size does not fit all', thus the need for health and social advances on individualised and bespoke vulnerability reduction strategies.

The findings revealed in this chapter initiated the debate on the assets that shape vulnerability and the values that influence the expressions of vulnerability, and ultimately what makes someone vulnerable to extreme temperatures and how this relates to general vulnerability. As Smit and Pilifosova (2001), this research sees vulnerability as a determinant of adaptation, thus having an understanding of how and why vulnerability occurs will help devote action towards the characteristics that influence adaptation (see Chapter 6). Similarly, resilience is also seen as a determinant of adaptation, and is the core subject of Chapter 5. Following the vulnerability, resilience and adaptation chapters an integrated/combined analysis (Chapter 7) is presented. Concluding remarks of the links between vulnerability and resilience and the implications of both to adaptation and relevant policy and practice interventions will be considered in Chapter 8.

Chapter 5 - Understanding human resilience and its dimensions

5.1 Introduction

The previous chapter detailed the assets shaping general, heat- and cold-related vulnerability and the nature of their relationships in a sample of independent living older people in Lisbon. The current chapter proceeds to explore general, heat- and cold-related resilience aiming to answer,

- Research Question 2:

'How are general, heat- and cold-related resilience of older people shaped?

And sub-research questions:

2a) To what extent do cognitive, instrumental or behavioural and motivational dimensions of resilience contribute to the resilience of older people?
2b) Do levels of resilience differ between older people, and if so who is resilient, and why?

This chapter investigates overall sample and individual participants' general, heat- and cold-related resilience, drawing upon the responses to general structured interviews (Phase 1), heat- and cold-related semi-structured interviews (Phases 2 and 3). It starts by assessing resilience (Section 5.2) and exploring the dimensions of general, heat- and cold-related resilience (Section 5.3) in the whole sample. The next section then focuses on the examination of individual participants' resilience and the development of individual resilience profiles of participants (Section 5.4) as an illustration of individual participants' resilience characteristics. Enablers, barriers and limits to resilience are also presented (Section 5.5).

5.2 Assessing resilience

For the purpose of this research, general resilience represents the capacity or ability of individuals to manage life as a whole. Whereas resilience to extreme heat and cold is about the ability to make sense and manage the threat extreme temperatures pose, assess their assets portfolio and be motivated (see Chapter 2, Section 2.3) in order to be able to respond to these threats.

5.2.1 General resilience

The Sense of Coherence short scale (SOC-13) was used to quantitatively assess the general resilience of the study's sample as part of the Phase 1 quantitative (structured) interviews. It has been widely used by many academics in the field of health and health promotion and applied to the assessment of resilience of individuals and families (see Chapter 2, Section 2.3.4).

Cronbach's alpha, a coefficient of internal consistency, was calculated for the study's whole sample to estimate the reliability of the scale; its value (0.741). Participants' general resilience (SOC) scores ranged from 38 to 82 (13 being the lowest possible score and 91 being the highest possible score, with the mean of the scale being 52), with a score of 63.43 ± 9.82 (mean ± SD). This result indicates that most participants had high general resilience Comprehensibility sub-scale scores ranged from 15 to 32, with a score of 23.06 ± 4.21 (mean ± SD). Manageability sub-scale scores ranged from 9 to 26, with a score of 18.63 ± 40.5 (mean ± SD). Meaningfulness sub-scale scores ranged from 9 to 28, with a score of 21.75 ± 4.07 (mean ± SD) (Figure 5.1). These results show that overall participants in this study revealed higher ability to make sense of their lives (CO) and motivation to respond to life threats (ME) and lower availability and access to assets (MA).

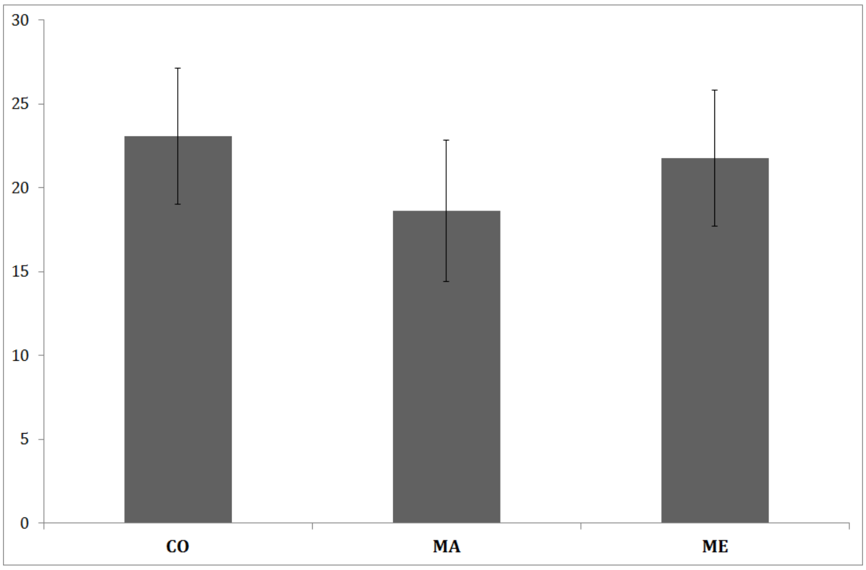


Figure 5.1 Comparison of general resilience (SOC) score with the three sub-scales (comprehensibility, manageability and meaningfulness).

Legend: CO – comprehensibility; MA – manageability; ME – meaningfulness.

The mean level of SOC was slightly higher in male participants, in the oldest age group (85+) and lower for single and widowed participants (see Figure 5.2). In addition, SOC scores were slightly lower for those living alone as well as for one participant living with other non-relatives. More literate participants and those with higher income and better financial situation had higher sense of coherence. These findings suggest that resilience is shaped by participants' asset portfolio and thus vulnerability, such as certain human assets (e.g. living arrangements; level of education) and financial assets (e.g. income).

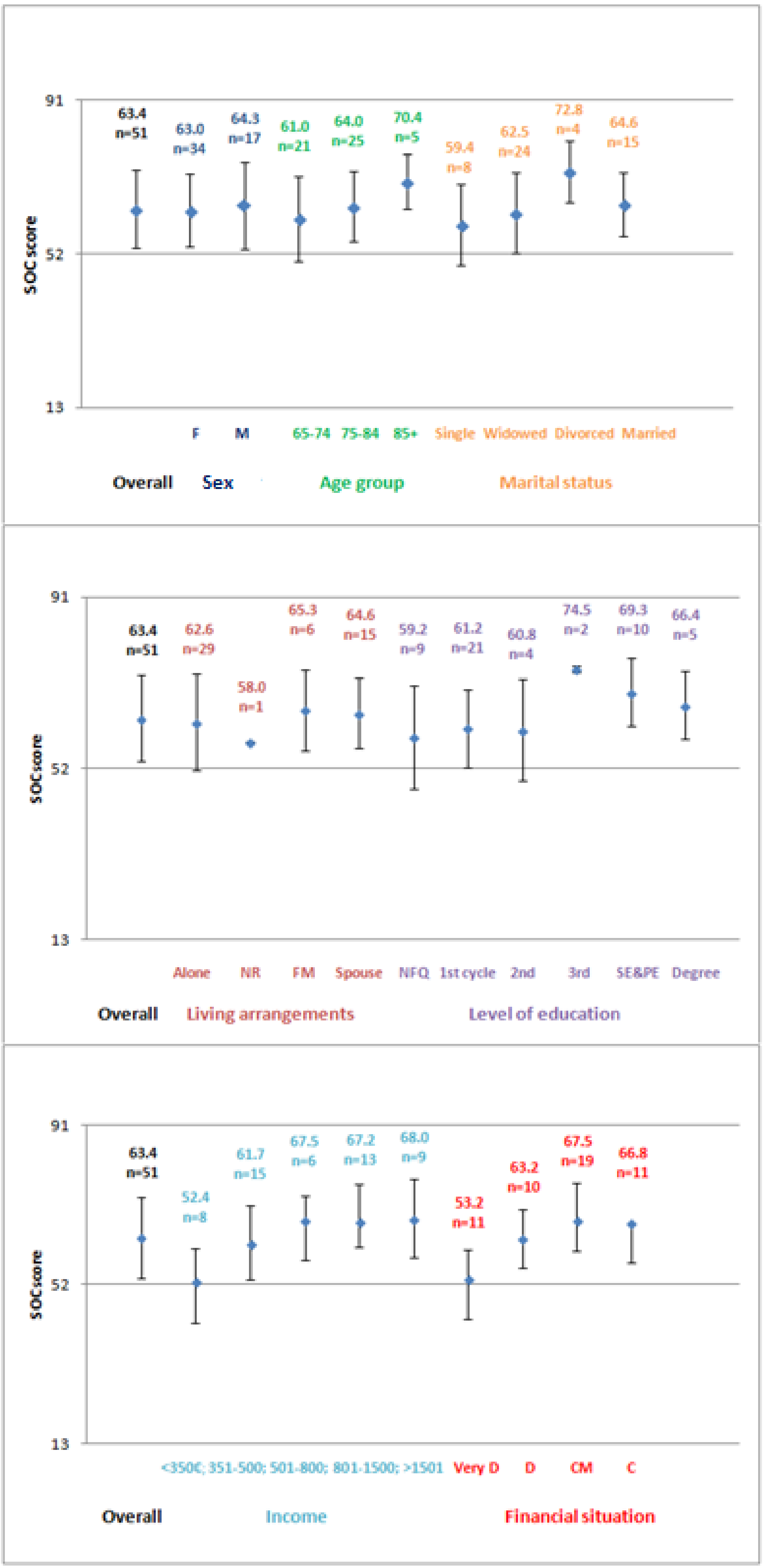


Figure 5.2 General resilience (SOC) scores by variables: sex, age group, marital status, living arrangements, level of education, income and financial situation.

Legend: F-female; M-male. NR-other non-relatives; FM-family members; NFQ-no formal qualifications; SE&PE-secondary education and professional education. Very D-things are very difficult; D-we have difficulties making ends meet; CM-we have to be careful, but we manage; C-comfortable.

The development of a General Resilience Index (GRI) was found to be useful as a means to compare general vulnerability (GVI) with general resilience (GRI). The method used for calculating the GRI incorporating the Sense of Coherence scale was based on the same method used for calculating the GVI discussed in Chapter 4, and adapted from work by Hanh and colleagues (2009). Furthermore, it is the first time that such approach is developed to measure resilience using the SOC scale, which represents a novelty of this research. Theoretical validity of calculating the GRI in the way the GVI has been calculated is justified in this research to allow coherence in the quantitative data analysis through two different theoretical concepts (i.e. vulnerability and resilience) enabling the comparison of the two sets of data. In doing so, transforming the SOC scores into a GRI is novel and has not yet been attempted elsewhere. The GRI ranges from 0 (less resilient) to 1 (more resilient) and the value of the index for the study's sample was 0.647 (Table 5.1) which indicates that the overall sample had high general resilience (values equal or higher than 0.500, cut-off point). Indicators values for the comprehensibility, manageability and meaningfulness sub-scales also revealed high resilience amongst the sample (0.740, 0.602 and 0.647, respectively) (Table 5.1)

Table 5.1 Summary of calculations of the General Resilience index (GRI) indicators (comprehensibility, manageability and meaningfulness), GRI and its values

	Mean value	Maximum value	Minimum value	Index value
Comprehensibility	23.06	35.00	5.00	0.602
Manageability	18.63	28.00	4.00	0.610
Meaningfulness	21.75	28.00	4.00	0.740
General Resilience Index (GRI)	63.43	91.00	13.00	0.647

The research sample showed greatest resilience on meaningfulness (0.740), followed by manageability (0.610) and comprehensibility (0.602). The results of the indicators values are presented in Figure 5.3 as a radar chart portraying the indices values presented above.

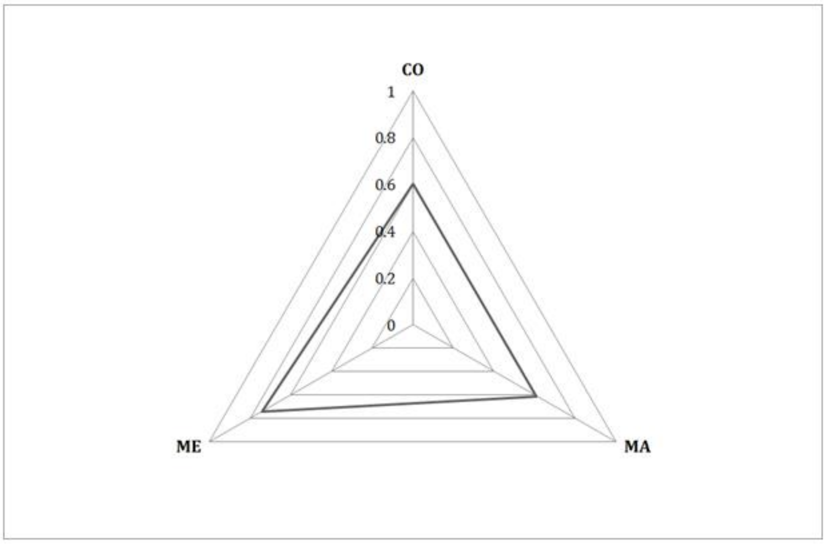


Figure 5.3 General Resilience Index (GRI) radar chart for the overall sample.
Legend: CO – comprehensibility; MA – manageability; ME – meaningfulness.

The resilience dimensions contributing to general resilience are shown in Figure 5.4. The greatest contributor is meaningfulness (38%), followed by comprehensibility (31%) and manageability (31%).

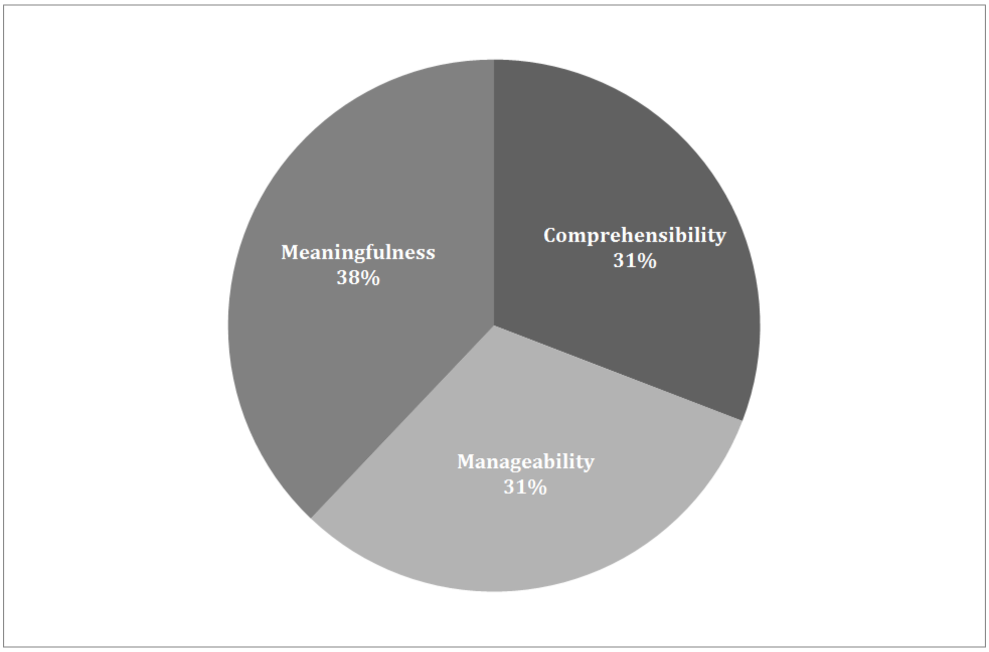


Figure 5.4 Resilience dimensions contribution to overall GRI for the overall sample.

5.2.2 Heat- and cold-related resilience

The heat and cold qualitative interviews aimed at assessing the three dimensions of resilience (comprehensibility, manageability and meaningfulness) for both heat and cold temperatures, as such the questions developed for these two different phases of research (Phase 2 and Phase 3, respectively) were comparable and can be found in Appendices 3.5 and 3.6, respectively. The overall resilience themes in each of the three resilience dimensions (i.e. comprehensibility, manageability and meaningfulness) arising from the heat- and cold-related qualitative interviews are presented in Table 5.2 which represents a summary of the interviews data collected with 52 participants during the heat-related interviews and 46 of those participants during the cold-related interviews. The resilience themes were organised around the three dimensions of resilience and reflect older people's resilience characteristics in terms of cognitive (comprehensibility), instrumental/behavioural (manageability) and motivational (meaningfulness) features when dealing with extreme heat and extreme cold. Many of the themes related to resilience were similar to both extreme heat and cold. Despite this, some differences were found that relate to the levels of predictability which were lower for cold than heat (comprehensibility), availability of assets was found to be higher for heat than cold (manageability) and availability of strategies to deal with cold lower than heat (meaningfulness).

Table 5.2 Themes related to resilience arising from the heat and cold qualitative interview data according to the three resilience dimensions

Comprehensibility	Manageability	Meaningfulness
Extreme heat		
• Predictability of heat: - Every year there are very hot days; - Every summer there are very hot months. • Recent personal experiences and memories of heat. • Awareness of the effects of heat health risks and impacts. • Perceived ability to deal with the heat. • Perceived ability to acclimatise. • Perceived ability to respond, to adapt.	• Moderate availability of assets. • Assets mostly under one's direct control. • Preferable direct control over assets. • Heat threatens certain types of assets, particularly human (poorer health status), physical (hot homes) and financial (use cooling devices). • Barriers: - Low income; - High electricity costs; - Lack of insulation / hot house; - Fans and AC are bad for health.	• Heat as an important and significant feature of everyday life which requires investment. • Need to actively engage in heat-adaptive behaviours. • Other pressures of life requiring investment limit engagement with heat prevention measures (e.g. financial difficulties, bereavement, depression, isolation). • Availability of strategies to deal with heat now and hypothetically in the future; • Perceptions of adaptability. • Perceptions of ability to act.
Extreme cold		
• Lower predictability of cold: - Every year there are some cold days. • Personal experiences and memories of cold in the past but not recently. • Lack of awareness of the effects of cold on health. • Perceived ability to deal with the cold because it is not usual and is not thought as being a threat.	• Unavailability of assets. • Assets mostly under one's direct control. • Preferable direct control over assets. • Improvement of individuals' assets portfolio needed. • Cold threatens certain types of assets, particularly, physical (cold homes) and financial (use heating devices). • Barriers: - Low income; - Lack of insulation / cold house; - Only able to heat one room.	• Cold as an important and significant feature of everyday life; difficult to enact responses (including investments) to deal with it. • Other pressing facets of life requiring investment limit engagement in cold prevention measures (e.g. financial difficulties, bereavement, depression, isolation) and undermine resilience. • Lack of availability of strategies to deal with the cold now and in the future.

5.3 Dimensions of resilience

This section integrates and discusses the quantitative and qualitative findings on the three dimensions of resilience (comprehensibility, manageability and meaningfulness) presented earlier.

5.3.1 Comprehensibility

The structured-interviews results revealed that within the five items comprising comprehensibility the sample had a high level of belief that the problems and challenges in their lives are structured, ordered, explicable and understood (indicator value: 0.602; ranging from 0 least comprehensible to 1 most comprehensible). Within the sample, the majority of participants felt that when something happened they generally saw things in the right proportion (62.7% of participants) and were surprised by the behaviour of people whom they knew well (51.0% of participants). The items mentioned less frequently by study participants were: having feelings inside they would rather not feel (25.5% of participants), feeling that they are in an unfamiliar situation not knowing what to do (15.7% of participants) and having very mixed-up feelings and ideas (5.9% of participants). Participants maintained that problems they may face in the future are predictable, almost as if they are already expecting to face them and as such they are ordered and explicable (e.g. illness, death of a loved one, own death). The structured interviews only permitted exploring a general view on life but the qualitative interviews provided a deeper understanding of the effects that extreme heat and cold can pose to older people and impacts on resilience.

The qualitative heat- and cold-related interviews revealed two main emergent themes that were coded as 'predictability' and 'misfortune'.

The first theme – *predictability* – was associated with participants' high comprehensibility of both stressors (heat and cold). The qualitative interviews revealed that overall participants' comprehensibility reflected a structured, expectable and explainable understanding of the occurrence of extreme heat- and cold in their lives. For most, heat and cold were a seasonal occurrence they had experienced and foresee to experience in the future. When integrating both heat and cold qualitative data, heat was considered the 'norm' during summer months, as every year there were very hot days, whilst cold was also expected during some of the winter months but was considered to be less frequent and as such had less prominence and was considered less important. The main issues discussed by participants took into account feelings of tolerance and acceptance towards heat and cold, the need to face, endure and accept that during parts of the year it is either very hot or very cold. High comprehensibility participants found extreme temperatures predictable, expected events and not a surprise to them. They were able to make sense of the stress they posed in their lives as they had experienced them many times before, especially in relation to heat (but not as much regarding cold). These participants had confidence and were more positive in their perception of the ability to meet the challenges heat and cold posed to them, by realising the need for heat and cold adaptation responses (to be discussed in Chapter 6). Some participants even mentioned a threshold beyond which it became difficult for them to manage heat and cold which would make them assess the assets available to them (manageability) and be motivated to engage in adaptation behaviours (meaningfulness). This threshold meant that beyond certain circumstances (i.e. temperature, thermal comfort) participants acknowledged the need to engage with additional actions to keep cool and warm.

> 'Well, I guess that at this time, there's the idea that people deal better and somewhat more easily with very hot weather.' (GM[69])
>
> 'I deal with it okay, as normal. If it's very cold I protect myself better, if it's not as cold I protect less.' (EEF[72])

The second theme – *misfortune* – was linked with participants who manifested low heat- and cold-related comprehensibility. Such participants saw heat and cold as uncertain, inexplicable, uncontrollable and 'chaotic' events that disorganised their lives, adding high levels of stress and limiting daily activities, making them hopeless and helpless. Some participants almost could not accept having to deal with such levels of stress. This resulted in participants' inability to make sense of the challenges heat and cold posed to them and therefore an inability to deal with them. These participants found that they just could not do anything about heat or cold, felt anxious, confused and would give up. They also felt frustrated as they did not deal well with heat or cold. Heat and cold were also seen as unfortunate events; these participants did not understand why they were affected, and felt like victims due to the difficulty in finding solutions to deal with the challenges heat and cold posed.

> 'I feel I deal very badly. When it's not very hot it's already bad, but when it is, I don't know … it is a nightmare, I can't stand any clothes, I don't eat, well I don't know …' (KM[65])
>
> 'I deal very badly, I feel ill [with very cold weather]. It limits our activity, it limits everything' (CM[68])

In summary, the supplementary qualitative dimensions revealed by interviews correspond with the findings from the quantitative structured interviews and provide further insights on how seeing life as comprehensible overall (i.e. general comprehensibility) is not a predictor for heat and cold comprehensibility. Participants with low comprehensibility felt victimised and puzzled by the challenges brought by heat and cold and were prone to give up attempts to deal with them, which conveys concerns about participants adoption of adaptation strategies and measures (see Chapter 6). In addition, as extreme heat had been experienced by participants more frequently - and therefore participants had more experience in dealing with it - it was easier for them to make sense of the threat heat posed to them and understand what was needed to deal with the heat- (higher comprehensibility) than to make sense of the threat cold posed to them and understand what was needed to deal with the cold.

5.3.2 Manageability

The structured interviews revealed that the sample had a high level of perception that assets are available to them to face the problems and challenges in their lives (indicator value: 0.610; ranging from 0 least manageable to 1 most manageable). Within the sample, only a minority of participants indicated they had been disappointed by people whom they counted on most (37.3% of participants), felt that they were treated unfairly (19.6% of participants), felt like losers in certain situations (15.7% of participants) and felt that they were not sure they can keep under control (13.7% of participants).

The qualitative interviews on heat and cold revealed two main emergent themes coded as ‘managing’ and ‘vulnerabilities and struggling’.

The first theme – *managing* – was mentioned by participants with high manageability of heat and cold. Participants’ manageability of both heat and cold revealed a great diversity in the extent to which they perceived having assets available to deal with these events. Participants that perceived having assets available to them either under their own direct control or indirect control (through people they trusted such as a spouse, family, friends and neighbours) mentioned ways of accessing assets when deemed necessary. Participants who were confident about their available assets maintained they were sufficient in their everyday life when dealing with heat and cold. For these participants the most frequently mentioned assets during the heat-related interviews included: physical assets (e.g. using fans or air conditioning, having a shower) and; place-based assets (e.g. being able to go to cooler places). On the other hand, possession of certain physical assets (such as heating devices and adequate clothing) were the most mentioned during the cold-related interviews. Participants who perceived having a greater quantity and variety of assets did not feel victims of the threats or challenges these events posed to them as they could easily access the assets needed to deal with these events. Nor did they feel these events affected them more than others as they felt able to deal with them.

References to God, God's will and faith in God (i.e. that all will be as it has to be) were prominent in the interviews. These references had both positive and negative effects in the way participants conveyed how they managed heat and cold. Positive effects were reflected through thanking God for the assets they had (e.g. human assets: being alive, having health; physical assets: having a home and clothes) and actively seeking ways to improve the assets they already had. Negative effects translated into asking God's help to deal with heat and cold and thinking that God will provide for them what they need without actively seeking other ways of accessing the assets they need. There were also references to future uncertainties, especially not knowing if they will have the same assets (e.g. income reductions due to austerity measures). Overall, having human assets, such as mental and physical abilities, were widely mentioned by participants in both heat- and cold-related interviews as being crucial for accessing and being able to use other types of assets when needed in order to respond to the threats heat and cold posed.

> 'Yes, I have [assets], but even if I didn't I would make sure I would get them.' (FF[80])
>
> 'Yes, yes I have. That I have. In the future, I can't predict the future [laughs] Maybe some innovations may come up...' (IM[76])

The second theme – *vulnerabilities and struggling* – was linked to the low manageability of some sample participants who were negative about the availability of assets, especially about not having assets or not enough assets under their direct and indirect control to effectively respond to heat and cold. These participants felt that they could only count on themselves and on no-one else (e.g. family, neighbours, authorities). Limitations and insufficiencies were found on all types of assets: financial assets (low income available and savings), physical assets (lack of housing insulation), social assets (not having family around or available, not having friends or neighbours they could count on), place-based assets (not having help from local authorities) and human assets (being old and having low health status). In some ways, these participants felt like victims of both heat and cold, more affected by them and felt less able to deal and respond to them due to lack of assets. Possible responses to cold and lack of assets needed for responding to cold posed much more constraints to participants as the use of energy was found to be essential to keep the house warm and to keep themselves warm at home. The high costs of electricity and gas, and the lack of home insulation, were examples some participants used to highlight how access to more assets (financial, place-based and social) is necessary to enable them to better deal with the cold. Cold posed more stress on participants' assets portfolio than heat (which also did, but to a lesser degree, partly because participants had more experience in dealing with it and perceived less need of assets). Aspects of assets availability also had impacts on the motivation to act (meaningfulness), which is discussed below.

> 'I don't know, we make savings for that right? [to have assets available to meet demands posed by heat] We spend the least we can to have better comfort. I don't say I have… but we try. […] In the future I don't know, only God knows. The way things are now, we don't know our future. The way it is now it is only going to get worse. In everything, they are taking our pensions, subsidies, health cover, you see? Us paying for everything? And cutting on pensions, can you see?' (KKF[71])

> 'I have to have [enough assets], if I don't have I won't be able to live, as such I have to accept very hot and very cold weather because I can't change it. There is always the financial issue that affects all of us … Obviously I am not a specialist that can do things, like install air conditioning in my house […] we can't do everything we want as we don't have assets for that. We improve things slightly, but beyond that we're not able to do anything else.' (MM[85])

5.3.3 Meaningfulness

The structured interviews revealed that within the four items comprising meaningfulness the sample had very high levels of investment, engagement and commitment to deal with the problems and challenges they face in their lives (indicator value: 0.740; ranging from 0 least meaningful to 1 most meaningful). Within the sample, most participants felt that doing the things they do every day is a source of pleasure and satisfaction (78.4% of participants), that their life has had clear goals and purpose (70.6% of participants). Only some felt that they do not really care about what goes on around them (21.6% of participants) and that there is little meaning in the things they do in their daily life (11.8% of participants). The participants had high levels of motivation to emotionally address the problems and stressors in their lives. To understand if dealing with heat and cold are some of the areas in which participants invest in dealing with, the qualitative interviews findings are presented below.

The qualitative heat- and cold-related interviews revealed two main emergent themes coded as 'drive and investment' and 'helplessness, hopelessness and avoidance of threat'.

The first theme – *drive and investment* – emerged from the interviews with participants that scored high on meaningfulness. These participants were motivated and interested in adapting to both heat and cold as they already had the experience of doing so (they were aware of the demands and challenges that heat and cold posed to them and had already engaged or invested in responding to them in the past). These participants were motivated to change their routines and rhythms as well as engaging and investing in adaptive strategies and measures; they felt that they were capable of positive adaptation. These participants were thus positive about their ability to adapt to these specified stressors by dealing in the best way possible to the challenges heat and cold pose in their lives.

> 'I deal well with everything, even if it's very cold, or less cold. I'm that kind of person. We deal with everything as it happens. […] We have to deal and find solutions. We have to be that way; we have to face the weather as it is; it has to be like this.' (ZF[79])

> 'It's me that has to see and look how to deal with it (hot weather) […] I like organising my life and when it's very hot I never go out [laughs]. We cannot dictate the weather, we have to manage the best way we can I think.' (FFF[84])

The second theme – *helplessness, hopelessness and avoidance of threat* – was linked to participants' low meaningfulness. These participants were not motivated or interested in dealing with heat or cold and felt helpless and hopelessness when they occurred. These participants were also particularly negative in facing the reality of such events; they avoided the challenges of heat and cold by not thinking about them at all, felt unable to do anything about them and did nothing about them. This was particularly, prominent in the cold-related interviews.

> 'No, no. There is nothing I can do. […] If I ruled the world I would make summer as it should be for people. Summer for people to feel good not very cold or very hot. A summer in which to feel well. […] If I could I would make everything good, nothing would be bad. […] I have clothes and shoes to wear when it's hot.' (JF[83])

> 'Oh, and what am I supposed to do?!? If it's very cold I wrap myself in clothes and drink hot things to feel a bit better… I can't go out, because it's very cold… So, what can I do more? […] In the future?!? […] I don't know…' RF[79]

In summary, the qualitative dimensions provided by the heat- and cold-related interviews support the findings from the quantitative interviews. The interviews revealed how some of the sample participants had little motivation to invest in responding to cold, and to a lesser extent, to heat. Participants with low meaningfulness felt that they were not able to mobilise the assets needed to deal with heat and cold, but especially cold, and felt a lack of sense of engagement and willingness to deal with the demands these events posed to them. Overall, mental and physical abilities, confidence about the capacity to do something about both heat and cold were essential for motivating individuals to deal with these events.

The contrasting themes found for high and low comprehensibility, manageability and meaningfulness reflect how the different resilience dimensions are expressed and impact on how older people view their ability to act when faced with extreme temperatures. Extreme cold proved to constitute a bigger stressor to participants' asset portfolio than extreme heat, as the options available to deal with it were mostly based on energy consumption and home insulation (which was lacking in most homes, both rented and owned). Information and support, as well as equity and social justice were mentioned by participants during the interviews as ways of increasing the assets portfolio and ultimately, manageability and adaptation (see Chapter 6) when dealing with both heat and cold.

5.4 Individual participants' resilience

This section presents an analysis of individual participants' resilience based on each individual's structured and semi-structured interview data (in contrast, the previous sections in this chapter have presented analyses referring to the whole or subsections of the entire sample).

5.4.1 Individual participants' general resilience

The same methodology used in Section 5.2.1 for calculating the overall sample resilience (GRI), is used here to calculate individual participants' general resilience and respective dimensions. The analysis of 51 individual structured interviews (one participant is not included as general resilience was not assessed) revealed that the majority of participants were high on the three dimensions of general resilience (comprehensibility, manageability and meaningfulness) and general resilience (high CO: 70.6% of participants; high MA: 70.6% of participants; high ME: 94.1% of participants; and high GRI: 84.3% of participants). Appendix 5.1 presents individual participants' GRI, and Figures 5.5 and 5.6 represent the resilience of individual participants according to its sub-dimensions and the distribution of individuals' general resilience scores.

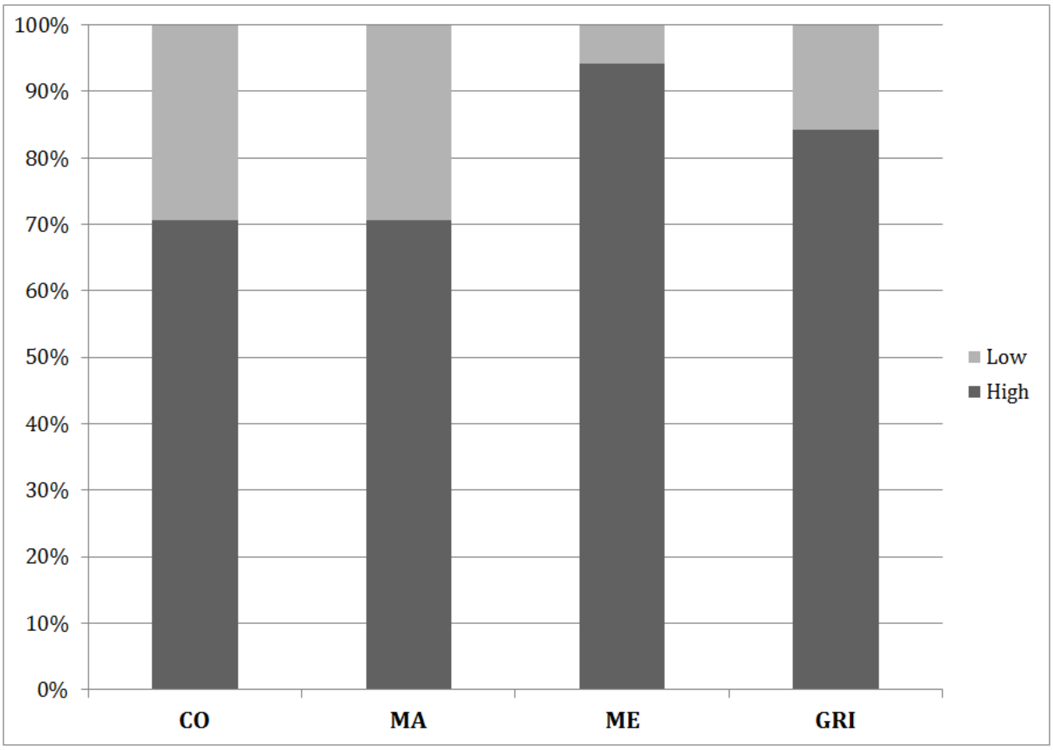


Figure 5.5 Distribution of participants according to high and low **general resilience dimensions and general resilience** (GRI).

Legend: Y axis represents the percentage of participants exhibiting high and low general resilience.CO: comprehensibility; MA: manageability; ME: meaningfulness; GRI: general resilience index.

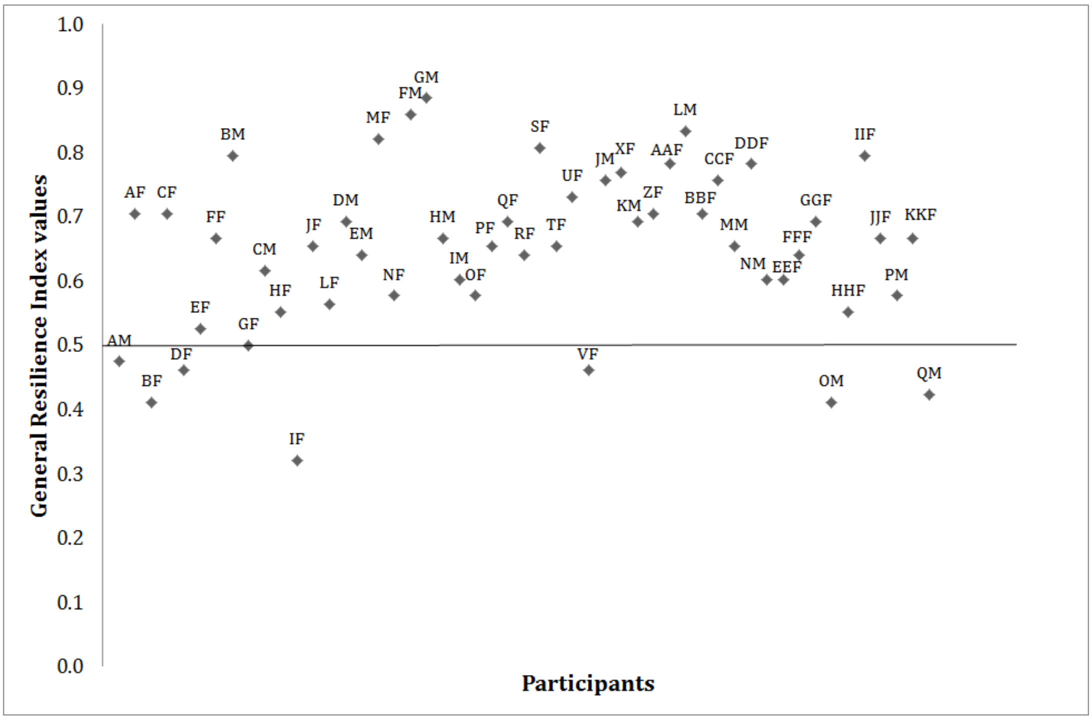


Figure 5.6 Mapping of participants' **general resilience values** (quantitative data) (i.e. corresponds to the right hand column in Figure 5.5).
Legend: Y axis represents GRI value. Resilience ranges from 0 (least resilient) to 1 (most resilient). The horizontal line represents the 0.500 index cut-off.

Participants with high general resilience had hope, greater lucidity and were more likely to see challenges in their lives as positive changes with which they could deal with (e.g. AF; CF; EF; FF; BM; CM; HF), whilst participants with low general resilience felt hopeless, anxious and confused, and were more prone to see challenges as stressors which were very difficult to deal with (AM; BF; DF; IF; VF; OM; QM).

Antonovsky's seminal work (1987) also enabled the elicitation of different predictions of resilience (see Chapter 3, Section 3.5.2.2): the three resilience dimensions (comprehensibility, manageability and meaningfulness) are coded as 'high' (H) or 'low' (L), indicating the pressure of resilience to move up (☝), to be stable (☺ or ☹) or to move down (☟). These high or low codings are then related to the three dimensions of resilience: comprehensibility, manageability and meaningfulness. An example of a resilience type is HLH which represents being high on comprehensibility, low on manageability and high on meaningfulness. The majority of participants revealed a high stable resilience prediction (68.6% of participants) characterised by high levels of all three dimensions of resilience (type HHH). Nine participants manifested a resilience prediction to move up (types LLH and HLH) as their levels of meaningfulness were high which indicates their motivation to deal with problems or stressors; high comprehensibility enables individuals to view these challenges as structured and explicable. According to Antonovsky, type LLH (11.8% of participants) 'is perhaps the most interesting case of all' (Antonovsky, 1987; 21) as these participants revealed high motivation to deal with problems and stressors in their lives (meaningfulness) despite seeing them as unpredictable and unstructured (comprehensibility), and perceiving they did not have the assets available to deal with them (manageability). Motivation was thus important but is not a guarantee for success in dealing with problems (BF; DF; GF; HF; VF; OM).

On the other hand, five participants (9.8%) revealed a rare resilience prediction combination, characterised by low comprehensibility, high manageability and high meaningfulness (EM, PF; MM; HHF; JJF) defined as type LHH. This is thought to be unusual as high manageability is very dependent on high comprehensibility; hence feeling that one has the assets needed to deal with a problem or stressor is dependent on being able to make sense of that problem or stressor. In addition, one participant (QM) was coded as having a prediction to move down (type HLL) as his motivation and perceived availability of assets to deal with problems and stressors was low; this in the long term could lead to seeing them as inexplicable and unpredictable (low levels of comprehensibility). One participant (IF) was also found to have a stable low resilience prediction as she scored low in all three dimensions of resilience (type LLL), meaning that the problems faced are thought to be inconsistent and inexplicable, the assets are not available and she has no motivation to invest in dealing with them.

5.4.2 Heat-related resilience of older people

Each of the 52 individual participants' heat- related interview data were analysed and the three dimensions of resilience were coded as 'high' or 'low'. The process of examining and interpreting participants' interviews constituted an iterative and systematic process through the organisation and coding of data for each dimension of resilience. This is not with a degree of subjectivity which was reduced by the use of a structured coding process. This included the development of what is meant by high heat-related comprehensibility, high heat-related manageability and high heat-related meaningfulness, as well as high heat-related resilience:

- Participants with high comprehensibility saw heat as a nonstressor as they had previously dealt with heat and had experience dealing with it, thus not posing a problem to them;
- High manageability is characterised by participants perceiving that they had assets available to them either at their direct or indirect control needed to deal with the threat/stress heat poses to them but did not feel victims to such events;
- Feeling confident that one was able to deal with the heat and feeling motivated to deal with it as it is seen as an important area of their lives were the characteristics of high heat-related meaningfulness.

The outcome of these features is high heat-related resilience, defined by combining at least two high resilience dimensions.

On the other hand, low heat-related dimensions are characterised by the opposite or contrasting of high heat-related dimensions, and low heat-related resilience is defined by combining at least two low resilience dimensions.

Attaining such a categorisation based in the qualitative interviews with the arranging and allocation of individual participants' positions required a thorough analysis of transcripts, related themes and sub-themes making sure that participants' position accurately reflected participants' resilience stances. It represents a continuing process where all relevant characteristics and factors were taken into account for each participant. Subjectivity, complexity and transparency concerns constituted limitations in categorising participants' heat-related resilience. As such, the order of participant codes within each quadrant does not reflect different levels of vulnerability.

The majority of participants revealed high heat-related comprehensibility (88.5% of participants), followed by high meaningfulness (67.3% of participants) and high manageability (57.7% of participants). Overall, the majority of participants revealed high heat-related resilience (61.5% of participants). These findings suggest that most participants viewed heat as being predictable and explicable (comprehensibility), to which they had assets available to deal with (manageability) and in which they invested their efforts in order to be able to respond to it (meaningfulness). Individual heat-related resilience distribution is presented in Figures 5.7 and 5.8. Appendix 5.2 presents the coding for the three dimensions of resilience and overall heat-related resilience for individual participants.

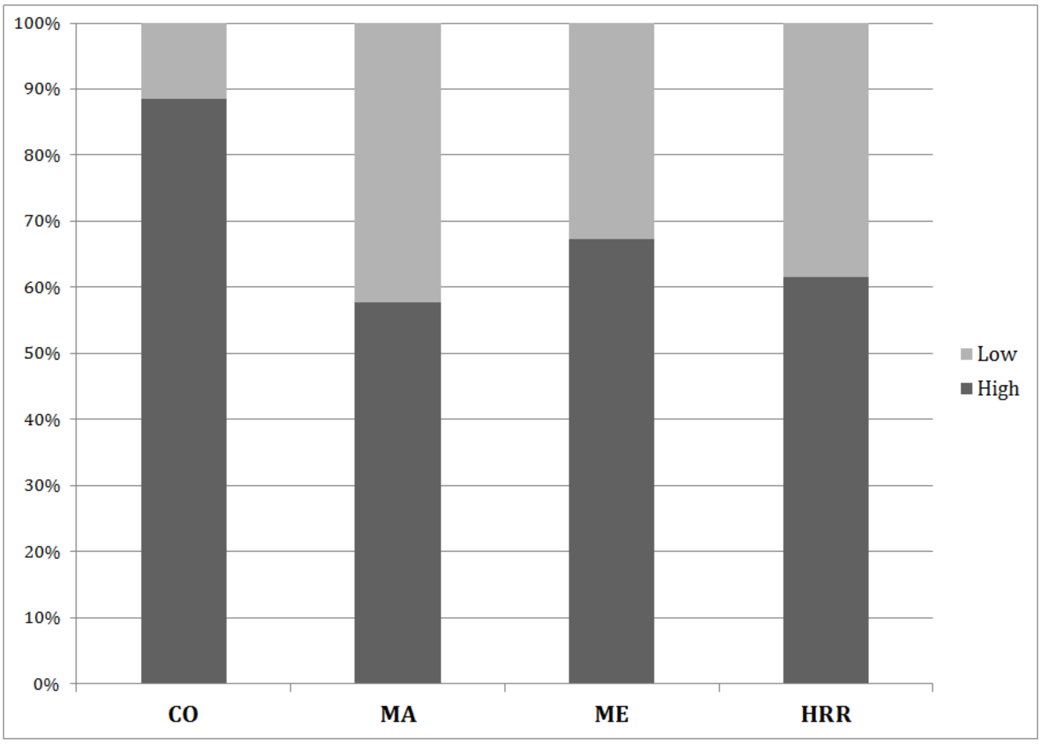


Figure 5.7 Distribution of participants according to high and low **heat-related resilience dimensions and heat-related resilience** (HRR).

Legend: Y axis represents the percentage of participants exhibiting high and low heat-related resilience. CO: comprehensibility; MA: manageability; ME: meaningfulness; GRI: general resilience index.

High resilience

AM; DF; EF; FF; BM; HF; MF; FM; GM; IM; OF; PF; QF; SF; TF; UF; JM; XF; ZF; AAF; LM; BBF; CCF; MM; DDF; NM; EEF; FFF; GGF; HHF; IIF; JJF
AF; BF; CF; GF; CM; IF; JF; KF; LF; DM; EM; NF; HM; RF; VF; KM; OM; PM; KKF; QM

Low resilience

Figure 5.8 Mapping participants' heat-related resilience (HRR) (qualitative data). (i.e. corresponds to the right hand column in Figure 5.7)

Legend: Order of participant codes within each quadrant does not reflect different levels of resilience. The horizontal line dividing the two halves represents the cut-off point.

Only one participant (DM) demonstrated a rare resilience prediction (LHL) as he scored low in comprehensibility and meaningfulness but scored high on manageability. It is defined as a rare prediction, following Antonovsky (1987), as this participant perceives heat as not making sense in his life and was not motivated to deal with it, but felt that he had the assets deemed necessary to deal with the heat. In this sense, it is considered to be rare as to be able to have a sense of the assets available to deal with the heat, one should see it as making sense in one's own life in order to be able to understand the demands it poses. Four participants (AF; NF; RF; QM) revealed having a stable low heat-related resilience (LLL), and twenty-seven (27) participants had a stable high heat-related resilience (HHH) characterised by scoring high in all three resilience dimensions. Eight participants revealed pressure to move up (HLH; LLH) as they were motivated to deal with the heat and they saw it as a challenge worth investing in (high meaningfulness), but lacked the assets and in some cases saw heat as not making sense in their lives (low comprehensibility) (e.g. participants AM; EF; GF; KM). Prediction LLH is thought to be 'the most interesting case of all' (Antonovsky, 1987: 21) as these participants revealed a high motivation to dealing with the stress heat poses to them, but lacked understanding of the threat and assets available, but their motivation could drive them to achieve higher levels of understanding and obtaining additional assets. On the other hand, thirteen participants revealed pressure to move down (HLL; HHL) (see Appendix 3.9). As they lacked motivation to invest and to commit in dealing with the heat this can lead to changes in comprehensibility and necessity or availability of assets (e.g. participants EM; HM; OM; KKF) that can result in lower levels of both comprehensibility and manageability dimnesions of resilience, and as such lower levels of heat-related resilience. Appendix 5.2 presents the coding for the three dimensions of resilience and overall heat related-resilience, as well as resilience types and predictions for each participant in this research.

5.4.3 Cold-related resilience of older people

The procedure used in the section above (Section 5.4.2) was also used for cold-related resilience. Appendix 5.3 presents the coding for the three dimensions of resilience and overall cold-related resilience for individual participants. Figure 5.9 shows that the majority of participants revealed high cold-related comprehensibility (87.0% of participants) and that half of participants revealed high meaningfulness (23/50.0% of participants). Fewer participants revealed high manageability (32.6% of participants) and the majority revealed low cold-related resilience (52.2% of participants).

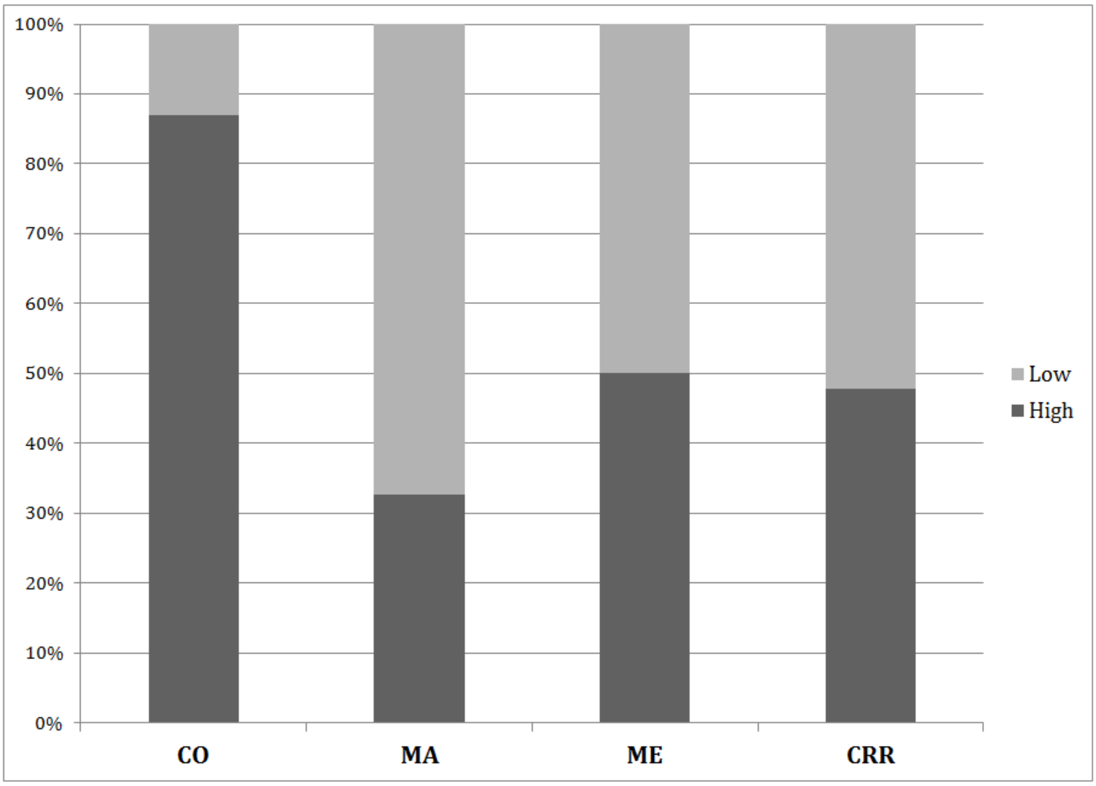


Figure 5.9 Distribution of participants according to high and low **cold-related resilience dimensions and cold-related resilience** (CRR).

Legend: Y axis represents the percentage of participants exhibiting high and low cold-related resilience. CO: comprehensibility; MA: manageability; ME: meaningfulness; GRI: general resilience index.

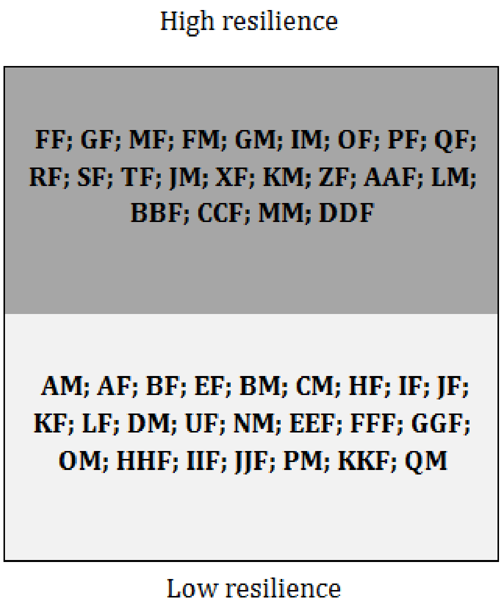


Figure 5.10 Mapping participants' cold-related resilience (CRR) (qualitative data) (i.e. corresponds to the right hand column in Figure 5.9).

Legend: Order of participant codes within each quadrant does not reflect different levels of resilience. The horizontal line dividing the two halves represents the cut-off point.

Appendix 5.3 presents individual participants' cold resilience, comprehensibility, manageability and meaningfulness, as well as resilience types and predictions. No participant revealed any rare cold-related resilience prediction (LHH, LHL) but three participants (BF; CM; MM), revealed a stable low cold-related resilience (LLL) and nine participants presented pressure to move up resilience predictions (LLH, HLH). These nine participants (e.g. NM, AAF, XF, UF) mentioned cold as an important area in their lives which they were motivated to deal with (meaningfulness), but did not have the assets available (comprehensibility) or lacked making sense of the threat it posed (comprehensibility). Stable high cold-resilience was found in fourteen participants (e.g. DDF; CCF; JM; TF) who scored high in all three resilience components (HHH) and twenty (20) participants revealed cold-related resilience pressure to move down (HLL, HHL) as, despite being able to understand and make sense of the threat that cold poses to their lives (comprehensibility), they lacked the motivation to deal with it (meaningfulness) and in some cases also lacked assets (manageability).

In summary, following the findings on resilience of Research Phases 1 and 2, high general resilience is more frequent (84.3% of participants) than heat-related resilience (61.5% of participants). On the other hand, looking at Research Phases 1 and 3, high cold-related resilience was much less frequent (52.2% of participants) than high general resilience (84.3% of participants). In addressing both heat and cold interviews, heat-related resilience is more frequent than cold-related resilience.

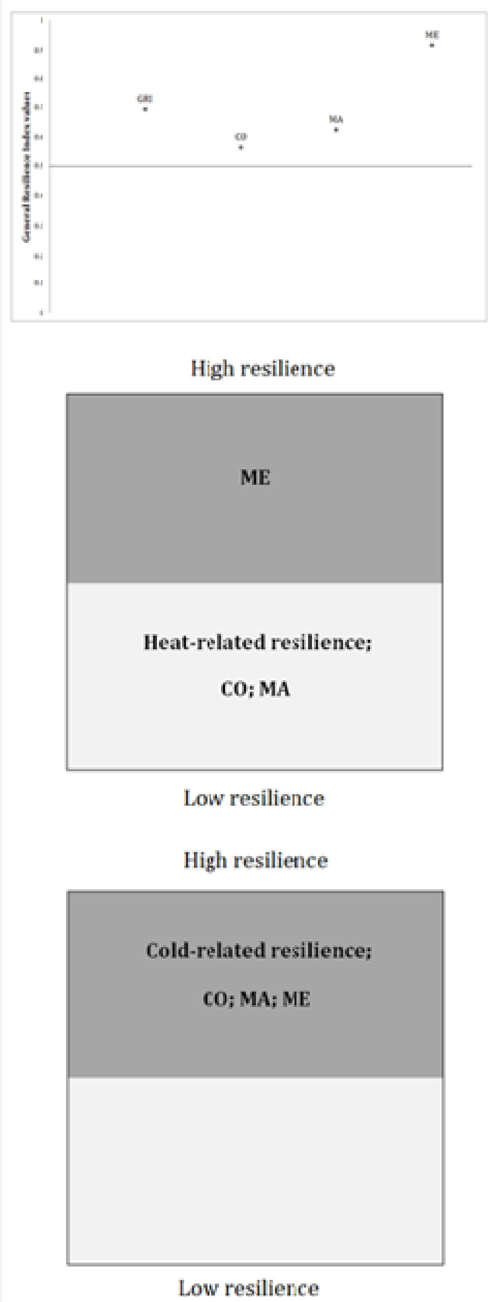
The most interesting outcome therefore is that having high general resilience was not a predictor for high heat- and cold-related resilience. Many participants saw their lives as being coherent. But when looking in more detail at two specified types of events (heat and cold), the areas of their lives related to them where not seen as coherent in many cases, because they could not make sense of the event (extreme temperatures), and/or they perceived not having the available assets to deal with it, and/or because they were not motivated to invest in that area of their lives (responding to heat and/or cold). Individual resilience profiles of two participants (KM, GGF) are developed from their interview transcripts and presented bellow as an illustration of the diversity of their general, heat- and cold-related resilience.

5.4.4 Resilience profiles

The sections above have examined overall sample and individual participants' data. The goal of this section is to explicitly illustrate individuals' resilience characteristics to exemplify how different participants' lives reveal specific general, heat- and cold-related resilience profiles. The three dimensions of resilience (CO, MA and ME) are also represented in the profiles, enabling a better understanding of what each of these represent in terms of actual participants' characteristics. Participants' profiles presented here are an illustration of their real individual general, heat- and cold-related resilience. Two profiles are presented below in Figures 5.11. and 5.12 (participants KM and GGF).

High general resilience, Low heat-related resilience & High cold-related resilience participant – KM

KM is 65 years old, is married and lives with his wife and daughter at their owned bungalow.



KM very seldom or never feels that he is in an unfamiliar situation and does not know what to do, nor has mixed-up feeling and ideas, but when something happens he has generally found that he overestimates or underestimates its importance (CO). He very seldom or never feels that he is being treated unfairly (MA). KM very seldom or never feels that he does not care about what goes on around him and until now his life has had very clear goals and purpose, plus doing the things he does every day is a source of deep pleasure and satisfaction (ME).

KM deals very badly with very hot weather and for him it is a very stressful time, which he feels disrupts his life and is very bad to his health. He feels very anxious and confused during very hot weather and sees it as a very complex problem (CO). It is very difficult for him to respond to heat. He does not feel that he has enough assets to be able to efficiently engage in heat prevention measures and behaviours. He would like to have air conditioning fitted in his home, as well as double glazing windows and a new roof as his home lacks insulation. He is very concerned with the related costs despite finding that these changes would improve his and his family living conditions and ability to keep cool indoors, as some of his neighbours have done it and feel they can now keep their home cool and feel cool at home (MA). He has thought about going ahead with improving insulation in his home but has not decided to do it yet, but thinks he will do it soon as he feels that heat-related hazards are becoming more frequent and intense which makes it harder for him to deal with it if his house is not properly insulated (ME).

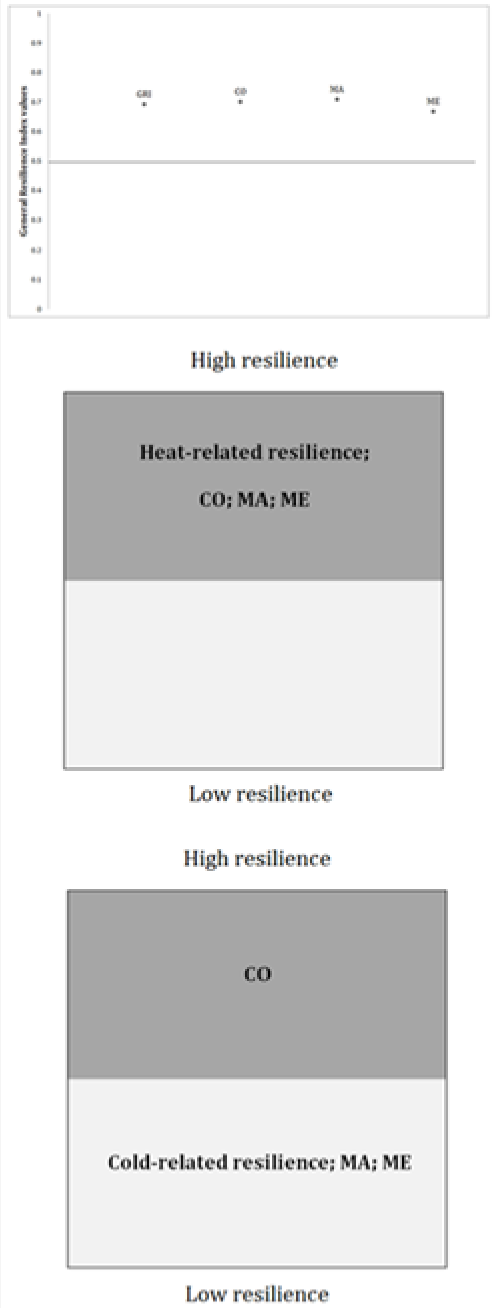
KM feels that cold is predictable, that the challenges it poses are clear and structured, and he deals well with it (CO). He feels he has all the assets needed at his disposal to deal well with the cold, as he has a fireplace in his home that keeps it very warm (MA). He is motivated to dealing with the cold and would like to have more information on how to better protect his health from the impacts of cold (ME).

General Resilience: 0.692; *CO: 0.567; MA: 0.625; ME: 0.917;* ***Heat-related resilience: Low****; CO: Low; MA: Low: ME: High; Type: LLH; Prediction: pressure to move up;* ***Cold-related resilience: High****; CO: High; MA: High; ME: High; Type: HHH; Prediction: stable.*

Figure 5.11 Participant KM resilience profile

High general resilience, High heat-related resilience & Low cold-related resilience participant – GGF

GGF is 84 years old, is widowed and has no children. She lives alone in a rented studio apartment in a building owned and run by a charity.



GGF is a very positive person and used humour several times when talking about her life events and circumstances. Very seldom or never she has the feeling that she is in an unfamiliar situation and does not know what to do, plus when something happened she saw things in the right proportion and very seldom or never she has feelings inside her she would rather not feel (CO). GGF very seldom or never feels she is being treated unfairly (MA) and she very seldom or never has the feeling that she does not really care about what goes on around her. Until now, her life has had no clear goals or purpose at all but doing the things she does every day is a source of pleasure and satisfaction. She very seldom or never has the feeling that there is little meaning in the things she does in her daily life (ME).

GGF feels she deals with the heat the best she can as it has a will of his own. To her heat is predictable and an ordered event in her life (CO). She feels she has all the assets needed to respond well (MA). She thinks she is capable to deal well with very hot weather and searches for ways to improve the way she deals with it (ME).

GGF feels she has to conform, endure the cold but she feels hope and sees it as a challenge in her life (CO). She feels she has some assets to deal with the cold as where she lives there are heating devices in a common room but no one stays there the hole day to keep warm. Thus, as her home is very cold and damp she would like to have more assets such as be able to use heating devices in her own home and afford paying electricity bills in order to respond better to the cold (MA). She feels demotivated during very cold weather as she does not see where she could improve the way she responds to cold (ME).

General Resilience: 0.692; *CO: 0.700; MA: 0.708; ME: 0.667;* ***Heat-related resilience: High;*** *CO: High; MA: High: ME: High; Type: HHH; Prediction: stable;* ***Cold-related resilience: Low;*** *CO: High; MA: Low; ME: Low; Type: HLL; Prediction: pressure to move down.*

Figure 5.12 Participant GGF resilience profile

5.5 Enablers, barriers and limits to resilience

Sources of resilience were investigated through individual structured and semi-structured interviews, and were found to be varied and diverse. Individual resilience lies primarily in the factors that shape comprehensibility, manageability and meaningfulness dimensions of resilience. Multiple sources of resilience are therefore dependent on cognitive, behavioural or instrumental and motivational factors in older people' internal and external environments. The findings reported in this chapter reveal how believing that the threats and challenges are structured and ordered (comprehensibility), perceiving that assets are available for one to face the threats and challenges (manageability), and feeling it is worth investing in dealing with these threats and challenges (meaningfulness) are sources of general, heat- and cold-related resilience. Older people with higher levels of these characteristics were found to have high resilience, in their life in general, and when facing heat and cold. Changes in each of the dimensions of resilience allow adjustments that ultimately can lead to increases or reductions in the levels of resilience. As an example, improvements in physical assets such as provision of air conditioning, heating devices or insulation can therefore increase the perceptions of assets available to deal with heat and cold and as such the levels of manageability can increase the levels of resilience in dealing with such events.

It was found that the variation in the levels of individual resilience was due to differences in feelings of control, perceptions of assets availability and motivation for investing in dealing with general life issues, heat and cold. The combination of these features is what shapes resilience. The way in which the three dimensions of resilience are combined in this study are present in Antonovsky's work (1987) but have not been used widely elsewhere. The use of these predictions to understand how resilience is shaped constitutes a novel approach as it uses Antonovsky's 'predictions to understand the different dimensions of resilience and the role they may play in efforts for building the resilience of individuals, reducing vulnerability, as well and improving adaptation to extreme temperatures (further discussed in Chapter 8). Individuals with high resilience are those that see life events as experiences that can be dealt with; on the other hand, individuals with low resilience are those that see that everything that happens in their lives are unfortunate events to which they have no say and no ability to respond to. The motivational source of resilience (meaningfulness) is according to Antonovsky (1987) thought to be most important as being motivated to deal with the threats one faces is the first step and also the most consistent to better understand the threat one is facing and evaluating the assets available. Having motivation to act guarantees either a stable or rare high resilience, or pressure to move up (types HHH, LHH, and HLH, LLH, respectively). Without motivation to act, high levels of resilience (types HHL) are pressured to move down; and is consistent with low resilience levels (types LHL and

LLL; prediction rare and stable, respectively). The cognitive source of resilience (comprehensibility) is seen to be the second in importance as only after understanding the threats/challenges one is able to assess the availability of assets. Understanding the threats one faces combined with motivation to act guarantees high levels of resilience, either stable or pressure to move up (types HHH and HLH, respectively). Having an understanding of the threats without motivation to act is only enough to achieve transitory levels of resilience: high (type HHL; pressure to move down) and low (type HLL; pressure to move down). According to Antonovsky (1987), despite being considered the less crucial dimension of resilience the behavioural or instrumental source of resilience (manageability) is also considered to be important but is in most cases only assessed once one feels motivated to act upon a threat or/and as a result of understanding what is needed to deal with it. However there are exceptions to this such as a rare type of low resilience (LHL). Low levels of perception of asset availability (manageability) can be present in both high and low levels of resilience, when combined with high levels of motivation (meaningfulness) result in pressure to move up (types HLH and LLH), as being motivated to act will make one access the assets available. If one perceives one has low levels of assets needed to act (manageability), this can lead to reduced levels of both understanding (comprehensibility) and motivation to deal with (meaningfulness) the threat.

5.6 Conclusions

This chapter has investigated the extent to which general, heat- and cold-related resilience is shaped by certain characteristics and assets. It did so through the development of a general resilience index (GRI) building on primary data collected through individual quantitative interviews, and through qualitative heat- and cold-related interviews with older people in Lisbon. The approach taken in this chapter was to present general, heat- and cold-related resilience overall sample results followed by individual participants' resilience characteristics.

Different facets of participants' lives shaped their heat- and cold-related resilience that included: perceptions of their own vulnerability to the adverse effects of heat and cold; perceptions of the risks posed by extreme temperatures; cognitive dimensions of exposure to risk; perceived ability to deal with the threat; agency in actively dealing with the threat. They were all related to the three dimensions of resilience and constitute opportunities to: increase resilience; understand barriers that need to be controlled and/or eliminated for increasing resilience in dealing with such events.

Evidence was found that participants generally possessed high levels of general resilience. Despite this, resilience to both heat and cold was found to be lower than general resilience. Resilience to heat was related to the predictability of heat, perception of available assets ready to be used and the wish to keep cool by investing in available actions. Resilience to cold was found to be associated with both apathy and anxiety towards cold as participants either did not see cold as a threat, or saw it as a burden, respectively. Participants found it hard to be motivated to deal with the cold mainly due to lack of assets available, in particular, financial (lack of affordable heating), physical (lack of thermal insulation) and social assets (lack of social connections and ties).

Both extreme heat and cold posed challenges to resilience. Resilience to heat and cold had links with general resilience but its relationship was not straightforward. Some participants with a high general resilience did not think that experiencing and living through extreme heat and/or cold was comprehensible, manageable and/or meaningful, resulting in low heat-related resilience and/or cold-related resilience, respectively. Participants in this research set boundaries on what matters or not in their lives, and what lies outside these boundaries, even if comprehensible, manageable and meaningful, is not thought as important and does not materialise into something worth investing in. Having high general resilience may or may not mean having a high resilience to heat and/or cold.

Believing that the events could be ordered and understood was related with high levels of comprehensibility, and perceiving one had the assets at his/her own disposal or under the control of trusted others (family, friends, and neighbours) to keep cool or warm were the major determinants of manageability, whilst meaningfulness was ultimately dependent on feeling able to deal with the event and having the willingness to invest and mobilise the assets available. Heat and cold created stress in participants' lives and put to the test their cognitive (comprehensibility), instrumental/behavioural (manageability) and motivational (meaningfulness) components of resilience which revealed to generally have weak predictions 'structures' and as such more prone to feel the impacts and consequences of both heat and cold. All three dimensions of resilience were considered essential but had different levels of importance/significance. The different dimensions of resilience can be considered separately, but their unique combinations are what express resilience. Seen as pieces of a jigsaw that are distinctive when on their own, the dimensions of resilience when brought together all combinations are possible (eight predictions) to achieve a high or low level of resilience. The next Chapter will explore participants' heat and cold adaptation strategies.

Chapter 6 –Adapting to extreme heat and extreme cold

6.1 Introduction

The two previous empirical chapters have presented the results of general, heat- and cold-related vulnerability (Chapter 4) and resilience (Chapter 5) of independent living older people (aged 65 years and over) in Lisbon. This chapter presents the results of adaptation strategies implemented by participants in responding to heat and cold and explores their views on opportunities to improve their adaptation.

The goal of this chapter is to go beyond the identification of adaptations to heat and cold (Sections 6.2 and 6.3), and exploring the similarities and differences between them discussing constrains and limits to adaptation (Section 6.4), to also explore the determinants of adaptation (Section 6.5). A focus is also given to the opportunities for enhancing older people' adaptation responses (Section 6.6), according to participants' opinions and suggestions. This chapter also investigates overall sample and individual participants' adaptation to heat and cold, drawing upon the responses to qualitative interviews. Whole sample adaptation findings are presented throughout the chapter, which closes with the profiles of two participants to illustrate their adaptation strategies (Section 6.7).

This chapter aims to answer the third research question and is structured around its sub-research questions:

- Research Question 3:

'What does adaptation to extreme heat and cold temperatures look like in practice?'

And sub-research questions:

3a) What strategies do older people use to respond to extreme temperatures, and what can be done to help older people respond better to them?

3b) How do older people use assets for adaptation to extreme temperatures? What types of assets are important?

3c) What is the role of vulnerability and resilience in responding to extreme temperatures?

3d) How do adaptations differ between older people?

6.2 Exploring what adaptation to extreme heat looks like in practice

In this section, heat-related adaptations are explored by considering the range of responses, strategies and behaviours used by study participants to stay cool.

6.2.1 Changes in behaviours during extreme heat

Participants were asked if there was anything they started doing to protect themselves from very hot weather. They generally failed to recognise specific adaptations to heat as direct consequences of heat. Only two participants (AF and IM) stated buying a fan as a strategy to keep cool after experiencing extreme heat (i.e. very hot weather).

> 'I bought a fan (laughs), bought a fan with two blades. There was nothing else… (laughs).' (IM[76])

Most participants engaged in adaptive behaviours but did not see it as something they started doing in response to heat but as 'common sense' and 'normal' behaviours to deal with the heat that they had often adopted in the past.

> 'No, I just changed to cooler clothes, it's what we do, isn't it?' (FF[80])
>
> 'No, it's only to stay home and that's it. I don't do anything else besides drinking liquids.' (TF[70])
>
> 'Nothing, I stay in the shade. I don't go to the beach… If I have to go outside I go, if not I stay home.' (HHF[76])

Most participants mentioned they did not start doing anything as a direct strategy to deal with heat and in order to keep cool. Participants responded to heat, but did not recognise their actions as being a direct response to heat. Rather their actions are 'common sense' and 'normal' and part of their daily routines not requiring rationalisation and are automatic. Responding to heat was thus embedded in participants' ways of life, which can be interpreted in two ways: as a pro-active adaptive behaviour (participants already respond to heat and do not consider their behaviours as exceptional, rather they are seen as 'normal'), but it can also be an expression of constraints or limits to adaptation to heat hiding underlying vulnerabilities and low levels of resilience (see Section 6.4.1).

6.2.2 Adaptations to stay cool during extreme heat

Individual cooling strategies adopted by participants were analysed to understand how they adapted to heat in their daily lives. The following strategies were defined by combining major codes and themes emerging from the Phase 2 interviews (heat-related). The interviews show that participants undertake an array of behaviours and responses to deal with heat in indoor environments (at home) and outdoor environments (outside the home) during different parts of the day, presented in Table 6.1. Every participant in this research was familiar with and had experienced extreme heat (Chapter 4, Section 4.4.1). As all participants lived independently in their homes they had control, some more than others, over the possible heat adaptation actions available to them. During the interviews participants mentioned engaging in more than one adaptation strategy (Table 6.1) and most participants combined several of these strategies to keep cool. The table shows clear differences between the strategies to stay cool during extreme heat in indoor and outdoor environments both during the day and evening/night. These strategies were more diverse among participants during the day and in indoor environments.

Table 6.1 Strategies to stay cool during extreme heat.

	Indoor environments	Outdoor environments
During the day	Open windows early in the morning. Close windows, curtains, blinds and shutters. Close blinds or shutters, and open windows. Stay at the window to get some air. Use the balcony or go to the house garden. Keep lights off. Use of hand fan. Use of fan. Use of air conditioning. Go to a cooler room. Have a cold shower. Splash cold water on face and body. Use a wet or damp cloth. Wear cooler, light clothing (e.g. cotton, linen, light colours). Wear less clothing. Drink more water. Eat more salads, light meals and fruit. Avoid hot and warm meals. Do household tasks early in the morning (e.g. 6am) or wait for a cooler day to do them. Have an afternoon 'siesta' and take extra rest. Reduce physical activity; engage less with housework (e.g. cooking, ironing, hoover, cleaning). Go outside to a garden or park.	Go out early morning. Go out late in the afternoon. Avoid the hottest hours of the day (11.30am-5pm). Only go outside when urgent or strictly necessary (e.g. medical appointment). Wear a hat. Wear cooler and light clothing (e.g. cotton, linen, light colours). Drink more water. Walk through the shade of trees or buildings to avoid direct sunlight. Go to a cooler location (e.g. parks, gardens beach, countryside) Use sun protection (e.g. sun cream). Wear sunglasses. Go to the swimming pool (e.g. aqua fit). Use of hand fan. Avoid going to the beach in the hottest hours of the day (11.30am-5pm). Go to community and activities centres nearby. Use of air conditioning in the car.
During the evening/ night	Open windows. Keep lights off. Wear less clothing. Stay at the window to get some air. Use of hand fan. Use of fan. Use of air conditioning.	Go to a coffee shop outdoors. Use the balcony or house garden. Wear cooler and light clothing (e.g. cotton, linen).

Some participants mentioned regularly watching (TV) or listening (radio) to the weather forecast (e.g. GGF, MF) as a way of deciding which behaviours or responses to implement, such as choosing adequate clothing, choosing what time of the day to go outdoors, choose not to go outside and other health promoting and protecting behaviours (e.g. carry a water bottle).

Despite engaging in a variety of responses, some of these responses were found to be harmful behaviours and others were found to be protective behaviours. One example of a harmful behaviour used as a strategy to keep cool by participants was the use of fans. This was found to be harmful as participants used fans and kept windows closed which increased air movement but also increased the temperature indoors (e.g. AF, FF, HF; MF, GF). Protective behaviours were found to be more common both indoors and outdoors. Opening windows early in the morning when it was still cool or late in the evening if it was not hot (e.g. AF, LF, HM, TF) were widely used protective behaviours. Other protective behaviours included: getting up early in the morning to do housekeeping, go food shopping or go to the doctor (e.g. UF, LF, SF, JM), avoid going outdoors during the hottest hours of the day (11.30am-5pm), going outdoors late in the afternoon/evening were also mentioned by participants (e.g. MF, MM). In outdoor environments, walking in the shade (e.g. DF, BM, OM, IF, MF) was a widely mentioned protective behaviour. Resting and avoiding strenuous activities when it was very hot were also common protective behaviours mentioned by participants during the interviews (e.g. RF, UF, FFF, GGF, IIF, PM). Drinking water (e.g. CM, KF, LF, PF, SF, EM), having a shower and splashing water on the face and arms (e.g. AM, SF, LM, BBF, GGF) when feeling hot were also found protective. However, wearing a hat (AM, FM), sun glasses (JM) and sunscreen (AM) were less often mentioned as protective behaviours.

In summary, most of the adaptations implemented by participants during extreme heat were non-technological adaptations that did not involve the use of electrical devices to keep cool such as fans and air conditioning. The use of technological adaptations was not widespread both due to unavailability of such devices and also due to the costs associated to their use (see Section 6.4.1 for more details on adaptation constraints and limits).

6.3 Exploring what adaptation to extreme cold looks like in practice

When asked about how they had prepared for winter, the majority of participants in this research (58.7% of participants) took the flu vaccine the winter the interviews took place (2012/2013) (e.g. AAF, AM, BM, GGF, KM, OM). This high rate can be due to the fact that for the first time the flu vaccine was available for free to older people (aged 65 and more) in Portugal. For some participants this was the first time they took the flu vaccine (e.g. SF). Despite this, many participants did not take the flu vaccine due experiencing allergic reactions to the vaccine in previous years (e.g. EEF, FF, IIF, PF) or because someone they knew had had a reaction to it (e.g. LF). Other reasons mentioned for not taking the flu vaccine included: not believing in its benefits; their children were healthcare professionals and did not advise them to take it (CCF, GF); or their GP advised them not to take it (UF).

6.3.1 Changes in behaviours during extreme cold

A range of changes in behaviours for individual protection from extreme cold were mentioned by some older people (33% of participants). These ranged from buying and wearing warm clothes and shoes (e.g. EF, BM, AM), using a hot water bottle (MM), using a blanket over their legs (DDF), heating the house with electrical devices (FF, KF), using an electric blanket in bed (JM), using a dehumidifier (PF), staying more at home (RF) and implementing 'normal' strategies to keep warm as it was too expensive to use heating devices (GGF).

The majority of participants did not feel they were doing anything special despite implementing several strategies to keep warm (67% of participants). These included: using heating devices (AF, BF, IM), wearing more layers of clothes and a warm pyjama (e.g. BBF, KM, OF), staying more at home (QF), and eating oranges, drinking orange juice and taking vitamin C to protect themselves from colds (XF, OF).

> 'No, I don't do anything special. If it's cold I turn on the heater, it it's not I don't. I go to bed early, I wear more layers of clothes. That's all I do, I don't do anything special.' (AF[79])
>
> 'No. If I am cold I put on one extra jumper or coat, nothing special' (BBF[74])

Despite mentioning a range of changes in behaviours participants failed to acknowledge that they were actually undertaking these as a direct response to cold.

6.3.2 Adaptations to stay warm during extreme cold

As described by participants, a range of individual adaptation responses were implemented for staying warm during extreme cold. The interviews revealed the strategies participants used to keep warm in their homes and outdoors (see Table 6.2) which have been influenced by their experiences of cold (Chapter 4, Section 4.4.1). Evidence shows that each participant used at least one of the strategies presented in Table 6.2, and was able to choose and decide which one to implement and when, according to the availability, control and perceived positive effects in keeping warm. The table shows clear differences between the strategies to stay warm during extreme cold in indoor and outdoor environments both during the day and evening/night. These strategies were more diverse among participants during the day and in indoor environments.

Table 6.2 Strategies to stay warm during extreme cold.

	Indoor environments	Outdoor environments
During the day	Wear several layers of clothes (3-5). Wear warm socks and shoes. Wear warm slippers. Wear a bedroom gown. Wear a shawl. Drink warm drinks (e.g. tea) and eat warm food. Put a blanket over ones' legs in the living room whilst watching TV. Go to bed earlier if the house it too cold. Stay in bed longer in the morning if the house it too cold. Going or staying in bed during the day if it is too cold in the house. Use a hot water bottle. Pets help to keep warm (e.g. cat, dog) by sitting on their legs. Keep active doing housekeeping and chores. Using the hob or oven to cook and its heat. Stay in a warmer room with direct sunlight or glazed balcony. Use heating devices, heat sources or fireplaces (gas, electrical, wood) in one room of the home. Use of air conditioning in one room of the home.	Wear several layers of clothes (3-5). Wear warm socks and shoes. Wear warm coats and jackets. Wear a scarf. Wear gloves. Wear a hat. Choose heated environments (e.g. shops, shopping centres, coffee shops). Use heating or air conditioning in the car. Avoid going outdoors.
During the evening/ night	Use warm bed linen, duvet, blankets and wear a warm pyjama in bed. Going to bed early if it is too cold in the house. Use a hot water bottle. Use heating devices, heat sources or fireplaces. Using the hob or oven to cook and its heat.	-

Most participants in this research felt they did nothing 'special' or 'extraordinary' in dealing with cold (e.g. EF, GM, BM, AM) and this included participants that used technological adaptations such as heating devices (e.g. FF, KF) and those who did not (e.g. GGF, CM, AM). 'Normal' adaptations were also mentioned by participants and included only the use of non-technological strategies to keep warm, such as wearing more layers of clothes, use a blanket over the legs when sitting down. Some of the reasons for not using technological strategies to keep warm at home included misconceptions about the detrimental effects for health of using heating devices (e.g. AM, BM), fears regarding safety in using electrical and gas heating devices (e.g. IIF) and being too expensive to pay for electricity and gas costs (e.g. GGF) (see Section 6.4.1). Staying home during extreme cold was a widespread strategy, despite many participants mentioning having temperature problems in their homes, due to cold and damp homes (e.g. PF).

In summary, the most common adaptation strategies mentioned by participants included non-technological responses. No participant had central heating installed in his/her home and most participants avoided the use of any type of heating device (i.e. electrical or gas) by increasing the number of layers they wear, using blankets or wearing shawls to keep themselves warm. Heating the home or even just one of the rooms in the home was not a priority to most participants.

6.4 Similarities and differences between adaptation responses to extreme heat and cold

Among the range of responses presented in Sections 6.2 and 6.3 above, it is interesting to note that participants undertook several adaptations in order to respond to heat and cold. Participants acknowledged that they were the ones responsible for taking action to protect themselves from these types of events. During the interviews it became apparent that participants relied mostly on themselves and their close family, as they felt public authorities could not or were not willing to take action to protect individuals, especially older people.

6.4.1 Adaptation constraints and limits

Despite acknowledging the existence of potential adaptation strategies available to respond to these events many participants felt constrained and limited to implement and use those strategies due to lack of assets. Several factors that impede adaptation behaviours, actions or responses were mentioned by participants as being directly related with asset availability.

Health-related beliefs and misunderstandings were also among the most common constraints and limits to adaptation. Many participants revealed not using cooling and heating devices because they thought they would be harmful for their health. Reasons mentioned included: the air movement these devices produce (e.g. fan, air conditioning); the excess of cold air (e.g. air conditioning), and; only being able to heat one room in the home. Fears of gas and electrical problems arising from the use of heating and cooling devices, such as leaks and fires related to the quality and safety of devices as well as the age of the electrical installation in the house, were also found to constrain and limit the ability to keep cool and warm. Air quality issues regarding the use of air conditioning and gas heaters were mentioned by some participants as reasons for personally not owning or using such devices (e.g. IM[76]). Several participants indicated that information on the best adaptation strategies for health should be available to everyone, especially those with specific health conditions.

The price of electricity was one of the most frequently mentioned factors that impeded adaptations to both keeping cool and warm. Cooling and heating costs and high energy bills related to low pensions were reasons participants mentioned for avoiding and restraining from using electrical devices. Financial constraints and not being able to afford cooling and heating posed major limits for adaptation. During the interviews participants revealed having other more pressing priorities besides cooling and heating, such as paying for compulsory housing expenses (e.g. rent, water, gas, and electricity), medication and food. Only after these had been secured, they would consider deploying cooling and heating, but even then many participants were reluctant and thrifty preferring to save for other pressing needs. This was supported by the widespread absence of electrical fans, air conditioning and heating devices. However, other factors might be associated with this finding, such as older people not perceiving themselves vulnerable to the impacts of both heat and cold. Housing characteristics, particularly insulation problems, were found to deter the use of electricity to keep cool or warm as participants considered this a 'waste' of money as all the coolness or warmth would rapidly escape from poorly-insulated homes.

Several constraints and limits to actions mentioned by participants related to specific housing conditions. Living in a very hot house or very cold and damp house, during heat and cold respectively, were pointed as reasons for being unable to keep cool or warm. Many participants referred to issues regarding building materials, building design and layout, ventilation and insulation as being the drivers of temperature problems inside their homes. Bad quality of housing stock that needed improvements they could not afford, as well as being unable to move house were issues mentioned by some participants. Most participants lived in rented accommodation in old buildings that had not had any refurbishment. These participants felt that landlords were not held accountable, as it is their responsibility to ensure housing quality (despite the low rents charged). However, recent changes in renting laws in Portugal have made it possible for landlords to increase rents without increasing housing quality standards, making many older people unable to pay their rent. Living on the top floor was mentioned by some participants as a reason for temperature problems and difficulties in keeping themselves and the home cool and warm. Lack of roof insulation, high sun exposure during hot weather and high exposure to rain and wind were among the most common aspects mentioned by participants facing these problems. On the other hand, participants living on the ground floor felt that they faced constraints in opening windows to ventilate their house due to safety reasons, noise, insects and bugs.

The lack of shade and trees, as well as the problem of safety in public parks and gardens were mentioned by a number of participants. Going and being outside to keep cool during hot periods would only be possible if safer and better quality green spaces were available close to their home. For example, some participants in Ward A mentioned that a park close to their homes had been closed for several years for maintenance works but were concerned that safety issues and problems of illicit use of drugs would return after it reopens. However, several participants also pointed out that lack of social contacts was seen as a constraint to take advantage of such places. Several participants mentioned going to a park or garden as a way to keep cool but did not actually engage in such action. Fear of falls was mentioned by several participants as a constraint to going outside during extreme cold both because the cold restricts their movements and makes it more difficult to walk but also because of water in traditional Portuguese pavements made of cobblestone which makes them very slippery. Among participants awareness of the both the Heatwave Plan and Cold Weather Plan was low, especially regarding the Cold Weather Plan. For those aware of these early warning systems, the lack of general awareness among the population was attributed to an individual lack of interest in being informed and lack of awareness of the health risks of both heat and cold.

Because of their perceptions and responses to both extreme heat and cold, participants in this research appeared to spend more time at home, which increases social isolation, contributes to lower levels of social activities and social support during periods of heat and cold. In addition, in most Lisbon wards social activities for older people are restricted to school term-time, meaning that they cease during the hotter summer months (July to September) and during some of the colder period for around three weeks around Christmas and New Year (December). Social activities, contacts and relationships are thus reduced but could constitute crucial safety nets for older people in the city of Lisbon. Combined, these factors increase isolation and risk of health impacts due to heat and cold. In Table 6.3 is presented a summary of constraints and limits to adaptation discussed here, taking into account the different types of assets (i.e. human, financial, physical, place-based and social). It shows clear similarities between the constraints and limits participants face in adapting to heat and cold with respect to assets (i.e. human, financial, physical, place-based and social).

Table 6.3 Constraints and limits to adaptation drawing on assets

Category	Heat	Cold
Human		
Health beliefs or misconceptions	Cooling is bad for health; Fan and air conditioning is bad for health.	Heating is bad for health; Heating only one room of the house is worse than no heating; Fear of flu vaccine
Lack of information, knowledge and education:	on the best adaptation options to implement.	on the best adaptation options to implement.
Financial		
Expenses	High electricity prices	High electricity and gas prices
Pensions	Low income; Austerity measures; Cuts in pensions; Cooling not a priority.	Low income; Austerity measures; Cuts in pensions; Heating not a priority.
Physical		
Technological	Not owning cooling devices	Not owning heating devices
Technological beliefs	Not liking cooling devices; Fear of poor air quality and disease by using air conditioning (e.g. changing filters)	Not liking heating devices; Fear of gas or electrical due to old house and old electrical installations
Built environment	Hot house; Home lacks insulation; Building codes; Low quality housing stock; Lack of building insulation; Single-glazed windows; Living on the top or ground floors; Lack of safety	Cold and damp house; Home lacks insulation; Low quality housing stock; Lack of building insulation; Single-glazed windows; Living on the top or ground floors; Lack of safety; Fear of falls
Housing tenure	Renting; No refurbishments; Inability to move house (both tenants and owners)	Renting; No refurbishments; Inability to move house (both tenants and owners)
Place-based		
Early Warning Systems	Lack of awareness and knowledge	Lack of awareness and knowledge
Urban planning and Green spaces	Lack of trees and shade	Fear of falls
Social		
Social contacts	Lack of company to go to places; Isolation; Reluctant to ask for help	Isolation; Reluctant to ask for help
Social activities and participation	Isolation; Lack of sense of community	Isolation; Lack of sense of community

In summary, the factors related to older people's access to assets (human, financial, physical, place-based and social) act as constraints and limits to adaptation; they are related to vulnerability to extreme temperatures and expressed as strategies that are not available or that are not possible for older people to engage with or implement. These can interact to impede adaptation, although they could represent a diverse array of opportunities to improve older people's adaptation to heat and cold (see Section 6.6).

6.5 Adaptation and its determinants

This section explores the determinants of adaptation that influence how heat and cold impact on older people's health. These may arise from diverse sources, rooted in assets, vulnerability and resilience discussed in previous empirical chapters (Chapters 4 and 5). Here, particular attention is given to the characteristics of older people that influence adaptation to heat and cold, either by enhancing or decreasing the capacity or ability to act and respond.

A range of adaptations were identified as responses to extreme temperatures and the analysis revealed broad determinants regarding the factors affecting the nature or outcome of the responses used (determinants of adaptation). These determinants comprise (1) vulnerability, and; (2) resilience. Due to extensive and complex array of topics identified, partition into these two determinants of adaptation allowed the opportunity to explore how adaptation is affected by both vulnerability and resilience separately, and to explore the interlinks and overlaps that may exist. Conversely, a summary of adaptation responses to extreme temperatures are presented in Table 6.4, taking into account the role of vulnerability and resilience. This table summarises the results and shows how adaptation were classified with respect to its determinants. The relationship between vulnerability and adaptation, as well as resilience and adaptation are presented. Adaptations implemented by participants are affected by many different facets of vulnerability (i.e. assets, experiences, perceptions) and resilience (i.e. understanding the threats, perception of assets availability, motivations to act and respond). It can be seen that adaptations are mainly based on assets and perceptions of vulnerability as well as being able to make sense of the threat heat and cold pose and feel motivated to act.

Table 6.4 Summary of determinants of adaptation (i.e. vulnerability and resilience) and implications for the implementation of adaptation strategies

Vulnerability	**Adaptation**
• *Context and diversity of assets*	- Adaptations based on assets were predominant. - Adaptations based on *human assets* were mainly influenced by level of education and health status. - Adaptations based on *financial assets* were determined by available income and costs of using cooling and heating devices. Past and current financial situation influenced current adaptation behaviours. - Adaptations based on *physical assets* translated into improvements in housing quality and insulation, but tenure influenced both the capacity and ability to do so. - Adaptations based on *place-based assets* were greatly influenced by the availability and willingness to participate in Ward activities. Distance to and cost of transport and other public infrastructures (i.e. swimming pool) were also crucial. - Adaptations based on *social assets* were surprisingly low mainly due to lack of friends and close neighbours, as well as a lack of a community sense.
• *Contextualising experiences*	- Past extreme heat and cold experiences were found to determine future adaptation interest and enhanced adaptation efforts for some participants.
• *Perceptions of warming and cooling weather*	- Adaptation responses were found to be determined by actual experiences of heat and cold, and not in perceptions of warming and cooling temperatures.
• *Perceptions of own vulnerability*	- The implementation of adaptation responses revealed to be rooted not in the perception of own vulnerability but in participants' physical and mental abilities and capacities. Feeling physically and mentally fit were the biggest determinants for feeling able to respond to both heat and cold.
• *Perceptions of universal vulnerability*	- Adaptation responses were found to be a result of perception of universal vulnerability but not own vulnerability.
• *Perceptions of health impacts*	- Adaptation responses were found to be associated with both knowledge of health impacts and own health status.
• *Perceptions of everyday life disruptions*	- The degree to which participants felt more affected by heat and cold influenced changes they made in their daily lives and how they adapted.
Resilience	**Adaptation**
• *Comprehensibility*	- Feeling one understands and is able to deal with the challenges extreme temperatures pose to one's life was found to be a determinant for feeling the need to engage in adaptation responses and feeling able to do so.
• *Manageability*	- Feeling one has the assets needed to respond to extreme temperatures was found to be a determinant of how older people' actually respond to these events.
• *Meaningfulness*	- Feeling motivated to respond to extreme temperatures was found to be a crucial determinant in the ability to act and adapt, thus determining when and how to engage in adaptation behaviours.

The analysis of this research findings revealed that adaptation responses are influenced by the levels of resilience and resilience dimensions. Discussed here are the resilience characteristics and factors that shape adaptations to heat and cold.

6.6 Opportunities for enhancing older people's adaptation to extreme temperatures

Previous sections have presented the adaptation responses actually implemented by participants during extreme heat and cold, the constraints and limits for action and the determinants of adaptation. In addition, during qualitative interviews participants were asked if there was anything that could improve the means they have to be able to respond to both heat and cold presently and in the future. The aim of the question was to allow participants to personally express what they felt that they would like to do or that could be done for them to support and enhance their adaptation strategies. It revealed to be a great occasion for them to discuss individual, group, community issues but also wider local and national societal concerns related to opportunities for adaptation to extreme temperatures. Despite this, many older adults found it hard and decline from both realistically and hypothetically reflect on what could be improved in their lives to allow better adaptation to heat and cold. A good example is the case of participants systematically stating that 'for me everything is always fine' (e.g. AF), uncovering a sort of unspoken silence of unattended, neglected and even ignored needs that older people seem to perpetuate through their late years. In this case, unspoken opportunities are in itself constraints and limits for action for enhancing adaptation.

6.6.1 Opportunities building on assets

Asset-based opportunities to improve adaptation are presented in this section for heat and cold respectively, referring to the five types of assets used in this research (human assets, financial assets, physical assets, place-based assets and social assets).

- <u>Extreme heat</u>

Many older people (39%) revealed capability and competence to envision possible ways in which their current asset-based adaptations could be improved. As such, they identified several actions that could improve the way they respond to very hot weather, which included: moving to a better home, winning the lottery or EuroMillions; reduction of electricity and water prices; having air conditioning at home; improvements in public infrastructures and places where people (not only older people) can get together; building and home refurbishments. On the other hand, most participants (50%) felt powerless and helpless, as well as unable to move beyond their current adaptation responses and portray what assets would improve the way they respond to heat. These participants felt there is nothing that could improve the assets they have and use to respond to heat in the present time, justifying it by saying: they do not need anything; they are not demanding people; what they have is enough; they can only do things as usual; they are not able to do more than what they already do, and; have no one or nowhere to go to get help. These participants rely mainly on themselves, on their mental and physical abilities (human assets) to adapt and are constrained by housing (physical asset) and income (financial asset). It was possible to enquiry participants to unravel the deeper roots of such powerlessness and helplessness which turned to be revealing of the passiveness imbedded in older people's ways of life. Feelings that no one does anything for them or gives anything to them, that they can only rely on themselves, that it is a 'save yourself if you can' world, revealed lack of social capital with a great reliance on individual and household actions and reduced or none collective action and state or private actor action. Furthermore, deep down these participants are acting almost as if there is no solution for improving adaptation just because they feel that there is no reason in pointing that out because they know they cannot do anything about it and that no one will do anything about it. By keeping their views to themselves it is like the 'wound heals on its own', fades away and does not exist anymore. In addition, some participants (21%) were not able to tell if there was anything that could improve their assets for adaptation to extreme heat.

When asked about if something could improve the assets they use to respond to heat in the future, most participants (50%) did not know how that could happen. Participants identified the country's bankruptcy, the austerity measures implemented and the societal and economic crisis as greater sources of uncertainty and unpredictability of what the future may hold to them. Many were those that referred to 'only God knows…', as a way of saying that it is not in their hands to be able to improve how they adapt. Other sources of uncertainty included: not being able to predict the future and know if they will keep their mental and physical abilities in order to think and act as they should (e.g. dementia); being complicated to think about what the future might bring; and even not knowing if they will get there (to the future) due to their old age. Other participants either answered positively (28%) or negatively (22%) to the question. Those feeling there is something that could improve the assets they use to adapt to heat in the future said that having a higher pension would allow them to pay for their electricity bills and use fans and air conditioning more often, another option would be to reduce the price of electricity. Improving healthcare, providing free healthcare to the older people, lower the prices of essential goods such as food and medication, and improve housing (double glazing, roof insulation, wall insulation) and living conditions were also mentioned as measures that would make it easier to prioritize and focus on adapting to heat. Technological innovation and better technology, healthier, safer, easier to use and more cost-effective (low cost and low usage associated costs – energy related), as well as increased sources of social capital (having someone to help them around the home, someone to talk to and go to places). Another group of participants (22%) felt there is nothing that could improve their asset portfolio for responses to very hot weather in the future as: they do not see how and what can be done; what they have is enough; they cannot do anything else; they lack social capital (social assets), and; their age limits what they will be able to do in the future (human assets). In addition, financial assets were also identified as reasons as they will also limit responses and older adults felt the future may only bring more difficulties due to cuts in pensions and healthcare provision arising from austerity measures. Participants also felt powerless and helpless regarding their homes as they have problems with temperature.

- Extreme cold

Participants were asked the same questions regarding extreme cold which revealed a higher percentage of participants (57%) that felt something can be done to improve the assets used in their adaptation. Examples of measures acknowledged by participants involved: improving housing conditions and insulation (windows, wall, roof and floor); being able to use more heating devices if energy was cheaper (electricity and gas); cheaper clothes to keep warm; getting help from public and local authorities to find strategies to get the 'best out of your money' such as help on how to lower housing expenses (gas, electricity and food), and; have someone to help around the house, cook meals, do laundry. These participants felt it is in the hands of politicians to create better living conditions to older people, as such the Government should provide access to free healthcare and transport, as well as better and dignified pensions and housing, as a way to improve health, reduce the levels of difficulties older people face in responding to cold and reduce social isolation and depression rates. Participants also felt they lack information and knowledge on what to do and where to go to get help, thus needing more personalized and specialised advice to find better solutions to respond to cold. Despite this, 41% of participants felt that there was nothing that could improve how they responded to cold, as no one helps anyone, not even public, local or health authorities.

When asked if there was something that could improve the assets they have to respond to cold in the future, 37% of participants identified a number of opportunities, such as: scientific innovation; home care; befriending services for those living alone; subsidies to install heating; more support from family, friends and neighbours. But 35% of participants felt there was nothing that could improve the assets they have to respond to cold in the future as: they already have what is needed; they do not have illusions about things getting better, only worse (e.g. less income, more austerity), and; only rich people can have good homes with double glazing, central heating and not wear many layers of clothes.

6.6.2 Opportunities building on constraints and limits

In general, older people reported low levels of actions, responses or behaviours they wanted to implement but were unable to, to adapt to heat and cold. Linked with the goal of implementing adaptation responses and being unable to do it are the root causes of such inability that have been defined as constraints and limits.

- <u>Extreme heat</u>

When responding to extreme heat some participants wanted but felt unable to implement some adaptation strategies (15%). One participant wanted to read information about what to do during extreme heat but was unable to do it because of illiteracy (AM) and another wanted to be able to have a shower on her own but was unable to do it because her bathroom was not adapted to her mobility problems and as such she needed help from her daughter to do so (IF). Three participants noted they wanted to install air conditioning in their homes but were unable to do it either because of building codes (HF), because the home lacked insulation (KKF), or because the participant did not want to spend his savings to do so (MM). This last participant (MM) also wanted to go on holidays abroad to a cooler place but felt unable to do so for the same reason (not wanting to spend his savings). Other three participants wanted to go to cooler places, one participant wanted to go to the countryside but was unable to do it due to financial constraints (UF), another wanted to move to his home village but was unable because his wife needs frequent medical treatments (KM), or go to the beach but being far way, having to take several public transports and not having anyone to go with did not make it possible (BBF).

Clearly, the vast majority of participants (85%) believed that there is nothing they would like to do to respond to heat that they were unable to do. These participants expressed that they already did what they wanted to do, because they could not think of anything else to do besides what they already did (e.g. FF), for example because they already had fans they could use (e.g. BF).

- <u>Extreme cold</u>

On the other hand, regarding extreme cold several participants (24%) mentioned a range of actions they would like to undertake but were unable to implement. Some would like to have central heating and solar panels but was not financially possible to them (JM, MM), others would like to improve the insulation in their homes (BM, KKF), especially roof insulation (BF), others would like to be able to use heating devices but could not afford as it was too expensive (CM, HF, KKF) or use them more often (OM). One participant wished she was able to clean her house as it is damp and mould is growing in the walls and ceilings (IF). Another participant would like to live in a better insulated house but was not able to afford it (OM), another wanted to be able to reach blankets in her wardrobe but was unable due to physical health limitations after a fall (RF) and one other would like to have help with food shopping and help with housekeeping. A participant noted she wanted to do something to better respond to cold but mentioned she could not do anything else besides what she already did and could not ask for anything to anyone (PF).

Despite the majority of participants stating there was nothing they wanted to do to better deal with the cold (76%) they shared some of the reasons why they did not want to do anything else besides what they already do. Reasons mentioned ranged from wearing enough clothes already (e.g. DM, QF) and included having heating devices if they want to use (e.g. BBF), the perception that Lisbon's weather is not that cold and extreme cold does not occur frequently (e.g. GM) and a general perception that what they already do was enough to deal with the cold.

In summary, opportunities for heat- and cold-related adaptation, according to older people's views are deeply rooted in assets availability as well as motivation to act, which links closely with vulnerability and resilience, respectively. Heat- and cold-related adaptation opportunities can be focused on human assets (i.e. lifelong education; health care provision in rural areas), financial assets (i.e. reduction of energy and insulation costs; cooling and heating installation grants; help with cleaning and housekeeping costs), physical assets (i.e. accessible baths, improve insulation; revise building codes to allow air conditioning installation), place-based assets (i.e. access to affordable public transport) and social assets (i.e. help with cleaning, housekeeping and food shopping; improve social contacts and trust). The high proportion of participants feeling there is nothing they wanted to do to protect themselves from extreme temperatures suggests high levels of hopelessness regarding adaptation needs felt by older adults. This is an important finding as it links with vulnerability and access as well as use of assets. Clearly there are needs that must be accounted for as many participants showed high vulnerability levels (see Chapter 4) but it seems that most participants lack the agency to speak out their adaptation needs.

6.6.3 Opportunities building on aspirations under older people's own control

One issue explored by the interviews were adaptation opportunities rooted on the possibility, desire or wish to improve the way participants respond to heat and cold.

- <u>Extreme heat</u>

Several participants (33%) answered positively to the possibility of enhancing their adaptation to heat (things they could do) through going to cooler places such as the countryside (e.g. UF, KM) and the beach (e.g. BBF), and installing air conditioning (e.g. KKF, HF). However, the majority of participants (67%) felt there was nothing they could do to improve their responses to heat motivated by disliking the use of fans or air conditioning, by already avoiding the heat by staying home or searching for shade outdoors, having a cool shower, or opening windows. Other reasons included the need to save on electricity and reducing the use of fans and air conditioning, not having the means to go to cooler places, but also because they already did the things that they felt helped them keep cool and which in their perspective was perceived to be enough.

When asked if there was anything that they would like to do to improve their responses to heat a similar proportion of participants felt there were ways that could improve their responses (48%) through installing air conditioning, go to cooler places (i.e. beach, countryside, cooler country), insulate the home and increase the use of fan and air conditioning to keep themselves and their homes cooler; to those that felt there was nothing they would like to do (41%) as they did not know what else to do besides what they already did, they already used fans and air conditioning, and what they did was enough in their view.

- <u>Extreme cold</u>

Most participants (70%) felt there was nothing they could do to improve the way they deal with extreme cold, as they already did what they could, the best way they could, or because they could not afford to improve home insulation (e.g. JM, IM) and also because they do not own the home they live in and cannot undertake the changes they wanted, such as installing a fireplace (e.g. BM) or improve insulation (e.g. HHF). For those that felt there was something they could do to improve adaptations (28%), responses included moving to a warmer location (e.g. AAF), use heating devices more often (e.g. HF), as well as increasing physical activity (e.g. FM).

Improving home insulation through double glazing windows (e.g. RF), floor insulation (e.g. JM) and roof insulation (e.g. MM), moving to a warmer location (e.g. AAF), installing a fireplace (e.g. BM) or central heating (e.g. HF, FFF), as well as having and using heating devices more often to keep warm at home (e.g. GGF, JJF) were mentioned by many participants (67%) as responses they would like to implement to improve adaptations to cold. Other participants (30%) felt that there was nothing they would like to do, mainly because of the difficulty of envisaging new strategies or opportunities that would enable them to better with deal and respond to cold.

In summary, opportunities building on aspirations under older people's control are critically embedded in both assets availability and vulnerability but also engrained on difficulties to expressing needs, as there are clearly needs to be met linked to the vulnerability levels of many participants.

6.6.4 Opportunities building on aspirations dependent on trusted others

Here, older people's adaptation wishes and desires are explored through how others could help them to achieve their adaptation goals, nonetheless participants found it hard to realise that someone else beside them could actually help them improving adaptation to extreme temperatures.

- <u>Extreme heat</u>

According to the vast majority of participants, there is nothing that could be or that they would like to be done for them to improve the way they adapt to heat, as they found it difficult to grasp that someone could actually help them to better adapt to the heat and often replied asking who, who would help them, giving examples such as an institution, someone. These participants are not used to anyone doing anything for them and are not waiting for others to do things for them, not until the time of the interview. But the future brings many uncertainties over the ability to continue physically and mentally independent and still be in control of their decisions and actions. Older people in this research also felt they do not need anything else to be done for them or do not know anything else that could be done for them, were already doing what they wish to do to keep cool, they protect themselves according to their possibilities and have to protect themselves, search for ways to deal with the heat, but only they can do that, no one else. At this stage of their lives they are used to what they have always done to respond to heat and feel that no one else, no institutions or the State do anything about it. Not liking to ask for help to others was also a main reason for feeling that nothing could be done for them. Some of these participants also showed helplessness regarding their stage in life associated with their age and that there is no need to improve their life as they might not have much time left to live, revealing a very negative approach about the future.

Having the opportunity to move to a cooler location, being offered air conditioning or fans, being offered lower electricity tariffs, moving to a better home were some of the adaptation strategies mentioned by a minority of older people that could be done for them or that they would like to be done for them that would improve the way they adapt to very hot weather. Other strategies mentioned included: improving housing conditions and insulation through a fund or grant, and;

pay less taxes. In addition, some of these participants despite welcoming others to help them were not able to reveal what they would like to be done for them. Being better treated by other people was also mentioned during the interviews, revealing that participants feel discriminated by their age. Older people in this research also felt that citizens in general should do more for the ones in need.

- Extreme cold

The results of the cold-related interviews also revealed participants inability to express what could be or what they would like to be done for them to improve the way they adapt. Despite this, a range of opinions emerged from the interviews on how the state, social and health institutions, energy companies and social workers could engage in activities aiming at improving the way older people adapt to cold. As such, examples included: reduction of energy costs; increasing social and physical activity for improving mental and physical capacities; more information on the best and cost-effective ways of keeping warm at home. Participants that rented their homes also mentioned they would like their landlords to improve home insulation. In addition, issues of social justice regarding responding to cold were also mentioned as being the role of the state to ensure older people live fulfilling lives.

According to participants, responsibility for improving the way individuals respond to heat and cold falls mainly on individuals themselves. Individual action was found to be the engine for adaptation to extreme temperatures. Despite this, some participants mentioned the national government and noted the role of social institutions. The State, energy companies, public institutions and social carers, were those thought to be able to help and those called to do so. Despite this, participants also mentioned that these institutions promise to do things but they do not see any actions from them. There is a feeling of disappointment and abandonment in participants' comments about what could be done and is not, that extends to all levels of society from the State, to institutions and other citizens. The concept and notion of community or local community was never mentioned by participants and this reveals one of the more complex issues that may be crucial to improve in order to enhance Portuguese older people's adaptation to extreme temperatures in particular, but to increase social capital in the Portuguese society in general.

A detailed list of adaptation opportunities mentioned by participants and presented throughout this section can be found in Table 6.5, bellow. Here are summarised the adaptation opportunities identified by participants according to the different type of assets (human, financial, physical, place-based and social) that would improve their responses to extreme heat and cold. Opportunities to improve adaptation ranged across all types of assets, and included improving education and individualized advice, incentives and income, insulted and more energy-efficient homes, access to heating and cooling technologies, social and health services, policies and safety nets, as well as social activities for older people. These were considered by participants to be opportunities that if implemented would enhance older adults responses to both extreme heat and cold.

Table 6.5 Adaptation opportunities suggested by participants to improve their responses to heat and cold

Category	Heat: examples	Cold: examples
Human		
- Educational	Life-long education; Knowledge sharing and learning; Communication through media.	Life-long education.
- Informational	Individualized advice by health professionals.	Individualized advice by health professionals.
Financial		
- Incentives and subsidies (e.g. fund, grant)	Financial incentives to improve home insulation, install air conditioning. Electricity subsidies to reduce costs.	Financial incentives to improve home insulation, install heating devices. Gas and electricity subsidies to reduce costs.
- Income	Increased pensions. Reduce austerity measures. Seasonal migration.	Increased pensions. Reduce austerity measures.
Physical		
- Housing	Better housing. Well insulated home. Adapted homes. Enforce responsibilities and liabilities of landlords to refurbish/repair old homes.	Better housing. Well insulated home. Enforce responsibilities and liabilities of landlords to refurbish/repair old homes.
- Urban planning laws and regulations	Enforce building standards. Alter building codes to allow installation of air conditioning.	Enforce building standards.
- Engineered and built environment	Enforce building codes; Improve building insulation.	Enforce building codes; Improve building insulation.
- Technological	Air conditioning.	Central heating.
Place-based		
- Green infrastructure / Aforestation	Create shade; Improve quality and safety of gardens and parks.	-
- Services	Social safety nets; Social protection; Food banks and distribution of food surplus; Free healthcare and transports.	Free healthcare and transports.
- Policies and Programs	Health Early Warning Systems; City-level plans; Local action to support older people.	Local action to support older people. Help in managing personal budget; Home care; Befriending programs.
Social		
- Activities	Local activities for older people, even during summer months.	Local activities for older people.
- Participation	Develop old people and intergenerational participation in society.	Develop old people and intergenerational participation in society.

In summary, opportunities for enhancing older people's adaptation to extreme temperatures mostly rely on assets (i.e. human, financial, physical, place-based and social). Participants in this research build mainly on assets under their own control as they cherish their independence, rely more on themselves and struggle to ask or receive help from others (e.g. family members, health or social services). Participants access to and availability of assets showed that they engaged in using assets already available to them aiming at ptotecting the assets they already have and trying the they can to maintain those same assets as they are scarce. Some participants also found that that transforming one type of asset into another type of asset was a strategy they could use in the short term to be able to adapt to extreme temperatures. Despite this, opportunities building on constraints and limits, as well as aspirations under older people's control also play an important role in understanding what can be done to improve adaptation to extreme temperatures. Participants showed low levels of agency and fatalist features. These are some of the reasons considered to influence older people's reliance on autonomous adaptation rather than planned adaptation.

6.7 Individual profiles

The sections above have looked at overall sample and individual participants' adaptation related findings revealing how participants in this research respond to both heat and cold. In this section, the goal is to explicitly present participants' individual adaptation characteristics and outlooks to exemplify how different participants' lives unravel specific heat- and cold-related adaptation profiles. This was possible through the analysis of both heat and cold related individual qualitative interviews. Individual participants' adaptation profiles were thus developed and two are presented below in Figures 6.1 and 6.2 (participants BBF, OM).

BBF (74)

BBF starts to have problems with the heat when temperatures are higher than 25°C as she has heart problems. She mentioned one time when she was younger when she was closer to the beach and felt ill due to the heat. She feels that at that time she was not as careful with her health as she is now, and that now she drinks more water to keep hydrated, as she feels very hot, almost does not sweat and feels the heat is kept trapped in her body. BBF is more concerned with her health now than she was in the past as she feels that 'at her age' anything small may become something very dangerous. Air conditioning was installed in the living room of her apartment during the 2003 heatwave due to her husband's illness to better deal with the heat as it is a top floor apartment that gets very hot in summer and very cold in winter. Despite this, now she only uses the air conditioning in very hot days, when temperatures reach 30°C or more. The air conditioning is only used as a 'last resort', she said as it consumes a lot of electricity. During the day BBF closes all windows, curtains and shutters, drinks more water, eats fruit and salads. She also avoids doing housework or any other tasks. BBF has cool showers, wets her arms and hands to feel cooler. In the evening if is cooler she opens the windows to let some fresh and cool air in, but if that is not the case she turns on the air conditioning before going to sleep. She feels privileged for having air conditioning, as many other people do not have it. She also feels that having a fan is not the same thing as having air conditioning. Having air conditioning in all rooms would be ideal but she feels that maybe it would be too much to ask for, and having it in one room is enough. Avoiding going outside when it's very hot is one of the strategies used to protect herself from the heat, others include wearing light clothes, cotton mostly, not synthetic fibers as she feels they are warmer, and walking in the shade. She realizes she stays home more when it's very hot, but goes out early in the morning to have her daily expresso (coffee). This is because it is very hot outside but also because the activities she attends at her local district do not run during summer, but she would like these activities to run all year round. BBF would like to be able to go to the beach as she feels its cooler there, but mentioned she was unable to go due to transport links and not having anyone to go with. Because of this, she goes to the beach less and less often.

BBF did not prepare for very cold weather as she did not take the flu vaccine due to a previous allergic reaction. When it's very cold during the day she wears more layers of clothes, 'nothing special' she says. She usually sits down to read or watch TV and does nothing else, as she feels that walking makes her feel colder and she avoids it. A gas heating devices is also used to heat the living room as it is quicker and less expensive than the electric heating as electricity is very expensive. She does not heat other rooms and sometimes not even the room she is in, as her home is too big. Despite also having air conditioning she does not use it or uses it rarely. During the evening she wears suitable clothes to go to bed and the gas heating, in addition to a hot water bottle to heat her feet in bed. The gas heater is only used when it's very cold, not all the time. During winter she goes to bed earlier as for her being in bed is where she is warmer. All windows in her apartment are single-glazed but her bedroom has double windows to increase insulation. When she goes outside she likes wearing a scarf to protect hear neck and throat, as well as gloves as her hands are usually cold. She does not like to wear hats, because as she mentions 'you wear it and then you take it off and your hair is all messy', so she doesn't wear it in Lisbon, only when she goes to the north of Portugal (where it's colder).

BBF is aware of the information and advice given on TV as she tries to follow them is she can. She mentioned that when there is a flu outbreak information and advice is given on TV on how to protect oneself. Despite this, she feels that when it's very hot there is more advice than when it's colder. She feels that information about very cold weather is thus fewer and there should be more advice, as it would be better for everyone if there was. The media (TV, radio) focus more on heat and on cold. She lacks awareness of both Heatwave and Cold Weather Plans but would like to know more about them. She deals better with cold weather as wears several layers of clothes, uses the gas heating and feels there are more options to deal with the cold than there are to deal with the heat. She is concerned with financial constraints regarding electricity bills, as well as cuts and austerity measures that have affected pensions.

Figure 6.1 Participant BBF adaptation profile

OM (65)

OM feels he is responding worse to very hot weather as he is sweating more. He mentioned this may be related to his housing conditions as the apartment he rents lacks insulation and glazing in windows, or to his health and 'other' problems. OM has put a legal action against his landlord as he hasn't done any refurbishments to improve living conditions. He stated he doesn't do anything to protect himself from the heat, that he could use the fan, but hasn't and is aware it might be detrimental to his health. Despite this, he wears less clothes and less bed linen. He questioned 'What can I do there?' [in his apartment]. He mentioned he does not want to be in air conditioning environments and close to fans as it can lead to pneumonia. He mentioned that if he was younger he would use the fan but said he is not that young anymore (65 years old)... There was nothing he wanted to do and couldn't do to keep cool, he said. He keeps himself cool at home shirtless and sometimes only with pants, and doesn't do anything else besides that. In the evenings is the same. When he is outside he usually drinks a cool beer which he feels helps him to be cooler and stays in the shade. He only wears a shirt when going outside and feels he doesn't know why but in the past the heat was more bearable than it is currently. Going to the beach is something he would like to do and he used to go with his Lisbon ward, but uncertainties regarding budget and will to carry on this activity are according to him making it harder for it to be available to older persons. He feels he knows how to protect himself from the heat and does not need information. He protects himself from the heat by staying in the shade, and drinking water, cool water.

OM's housing problems are aggravated by his financial constraints. Generally, he feels powerless, helpless and unable to act in the face of such problems. This was the first year he took the flu vaccine as he had a cold during the autumn and was advised to take it, and as it was free he did. Despite this, news about the possibility that flu vaccines might be harmful to people made him suspicious and reluctant in taking it again. He keeps warm by wearing several layers of clothes. He feels his health is being affected by being cold at home and also by the damp, being his bones the most affected. During the evening before he goes to sleep, he uses a heating device, not as much to keep him warm but because of his pets [a cat and a dog]. He mentioned they struggle with the cold and the heating helps them to keep warm. Then he switches it off and the pets sleep on top of his bed covers. Despite knowing that the recommended temperature indoors is around 18°C, he is not able to say how cold his home is. Heating is only used for a short period of time as electricity costs are very high, as such he has to wear more layers, jumpers and even coats when he is at home. At home sometimes he drinks a glass of wine which in his views helps to keep him warm, but he also stated he doesn't drink a lot. Sometimes he feels that his home is colder than outside. When he is outside does not wear gloves or hat very often.

OM would like his home to be refurbished, or somewhere else in the countryside with more trees and shade. If he could, he would move to a better home, better insulated, one which would allow him to have a better quality of life. In addition, he mentioned he has been used to the heat and cold all his life. OM would also like to have a better financial situation to be able to improve his quality of life. He also mentioned he would like changes in the way the country is being governed; he would like to see people to live better lives, to escape poverty. He feels governments are to blame for the situation the country and people are in and called for justice and social justice to overcome this. He doesn't want these changes just for his sake but also for the sake of others worse off, and feels the government, public authorities and wealthy people could help and contribute to reduce injustice and improve equity but they don't. OM has even thought of leaving the country to look for a better live. Despite this, he feels no one can do anything to improve how he deals with heat- and cold, only he can. Most information on protection during extreme heat and cold reaches him through the media, especially TV and newspapers. OM feels he has the information he needs to looks after himself and his pets the best way he can. He feels that dealing with the heat is less challenging than dealing with the cold as it is easier to take showers and search for shades than it is to heat the home. He has heard about the Heatwave Plan but doesn't know what it is, and has no idea what the Cold Weather Plan stands for but would be interested to know.

Figure 6.2 Participant OM adaptation profile

6.8 Conclusions

This chapter has presented and discussed the adaptation strategies participants implement to respond to heat and cold, and has also addressed adaptation constraints and limits, as well as opportunities mentioned by participants that if implemented would improve the way older adults adapt to heat and cold. Adapting to both heat and cold was found to be challenging by participants in this research. In addition, some participants saw adapting to one type of extreme temperatures more challenging than adapting to the other. This was primarily due to their health status (e.g. chronic disease), or to their perception of inability to effectively adapt through the options available to them. These participants felt they could not do more than what they were already doing – although it was not enough to keep them cool or warm - as they found there were limits to what they could do during heat and cold. For those considering heat more challenging, they found there were limits, e.g. a point where it was not possible to 'take any more clothes off'; using fans only helps to keep cool to a certain degree, beyond which only air conditioning would enable them to keep even cooler. On the other hand, finding cold more challenging was related with finding it hard to keep warm by only wearing several layers of clothes without using heating devices. Here the challenges posed were again similar to the ones found for heat, and derived from the level of ability to keep warm and keep cool, respectively. Most adaptations implemented by participants were found to be non-technological and did not involve the use of electrical devices. Use of technological adaptations was not widespread both due to unavailability of such devices and also due to the costs associated to their use.

Constraints and limits of adaptation were found to be related to health beliefs and misunderstandings, gas and electric devices and installations safety, price of electricity and gas, as well as lack of housing insulation. Determinants of adaptation (i.e. vulnerability and resilience) were found to determine when and how older adults engage in heat and cold adaptation behaviours in preparation and during extreme temperatures.

Despite this, opportunities for improving older people's adaptation exist and were also explored through older people's perspective, unravelling areas of future investment as they constitute viable options to be considered by national and local authorities, as well as social and health institutions that have older people agreement. Supporting older people's adaptation to heat and cold are possible and they have shown how it can be possible. Adaptation efforts based on older people's accounts may be sustained and reinforced in order to support adaptation to extreme temperature, and combined with efforts to reduce vulnerability and enhance resilience, which will be further discussed in Chapter 8. The next chapter, brings together and integrates the vulnerability, resilience and adaptation findings to understand the links between these three concepts in the context of extreme temperatures.

Chapter 7 – Exploring the interactions between vulnerability, resilience and adaptation

7.1 Introduction

This chapter aims at bringing together the findings on vulnerability, resilience and adaptation (from Chapters 4, 5 and 6, respectively) through a combined outlook which includes the interactions and links between the three concepts to answer:

- Research Question 4:

'How do vulnerability and resilience interplay with adaptation to extreme temperatures and what is the nature of these relationships?'

And sub-research questions:

4a) How and why do levels of combined vulnerability and resilience differ between older people?
4b) To what extent do lower vulnerability and higher resilience contribute to increasing adaptation?

This chapter investigates data for the overall sample as well as individual participants' general, heat- and cold-related vulnerability and resilience, and adaptation to heat and cold. Structured and semi-structured interview data are used as the bases for the combined findings (Section 7.2), followed by individual participants' data presented in the form of vulnerability and resilience matrices (Section 7.3). This chapter also brings together six individual participants' profiles which have already been presented in previous chapters (4 to 6) as an illustration of their combined general, heat- and cold-related vulnerability, resilience and adaptation to extreme temperatures (Section 7.4).

7.2 Integrating vulnerability, resilience and adaptation findings

Findings presented throughout the three previous empirical chapters resulted from the implementation of a mixed method research design on three research phases, comprising general quantitative structured interviews (Phase 1), heat-related qualitative semi-structured interviews (Phase 2) and cold-related qualitative semi-structured interviews (Phase 3). Firstly, the quantitative structured interviews explored participants' asset portfolio spanning human, financial, physical, place-based and social assets in relation to general vulnerability, as well as participants' general resilience. Secondly, the qualitative semi-structured interviews conveyed a more detailed understanding of participants' vulnerability, resilience and adaptation to both heat and cold. Finally, the combination of the three sets of findings was designed to investigate the links between vulnerability, resilience and adaptation. Below, in Table 7.1 is presented a summary of the research questions and key findings of each research phase as well as outlining the combined main findings of this research presented throughout Chapters 4 to 7. In addition it also presents a summary of the findings for combined vulnerability, resilience and adaptation. Participants in this research showed a variety of levels of both vulnerability and resilience as well as adaptation. Such findings allowed exploring the constraints and barriers of adaptation associated with such diversity for understanding the roots and design solutions for reducing vulnerability, enhancing resilience and improving adaptation.

Table 7.1 Summary of research questions, methods, research findings and combined main findings

	Vulnerability	Resilience	Adaptation
Research questions	Do different assets affect general, heat- and cold-related vulnerability of older people? If so, what is their effect and how does it occur?	How are general, heat- and cold related resilience of older people shaped?	What does adaptation to extreme heat and cold temperatures look like in practice?
Methods	Quantitative and qualitative interviews	Quantitative and qualitative interviews	Qualitative interviews
Research findings	Overall greater vulnerability deriving from lack of financial assets, followed by physical assets, social assets, human assets and place-based assets. Vulnerability associated with heat and cold were primarily rooted in the characteristics of participants and their surrounding environments. Specified vulnerability was found to be much higher than general vulnerability. Heat-related vulnerability was slightly higher than cold-related vulnerability, and both were much higher than general vulnerability.	Overall high general resilience, greater resilience regarding meaningfulness, followed by manageability and comprehensibility dimensions. Overall high heat-related resilience, with higher comprehensibility followed by meaningfulness and manageability. Overall low resilience to cold with high comprehensibility followed by lower meaningfulness and manageability. High comprehensibility of life events and both heat and cold allowed participants to make sense of these threats and stressors, but this contrasts with lower levels of both meaningfulness and manageability of extreme temperatures, especially cold.	Participants engaged in a variety of adaptation strategies and responses. Adaptation is determined by vulnerability and resilience. Engaging in adaptation strategies and behaviours requires adequate information on health risks and impacts of extreme temperatures, in order to identify asset needs and availability for assessing appropriate adaptation options to reduce risks and impacts. Adaptation constraints and limits associated with high levels of vulnerability and reduced resilience. Opportunities for enhancing adaptation responses exist and both relate to reducing vulnerability and building resilience to heat and cold.
Combined main findings	- Participants revealed diverse combinations of vulnerability-resilience and adaptation actions. Numerous barriers to resilience and adaptation were found to be related to participants and place characteristics (i.e. asset-based vulnerability). - The levels of vulnerability and resilience convey important bases for: targeting at-risk older people (high vulnerability & low resilience); developing vulnerability reduction actions (high vulnerability & high resilience); resilience building actions (low vulnerability & low resilience), and; understanding 'success cases' (low vulnerability & high resilience) and learn from them for developing appropriate policy measures. Generally, planned adaptation options were implemented by low vulnerability & high resilience participants, whilst autonomous adaptation options were more common within other participants. - Participants commented on the links between vulnerability, resilience and adaptation with social justice, equity and austerity, especially to whether participants or trusted ones have the scope to reduce their vulnerability (assets portfolio) and enhance resilience for adaptation.		

7.3 Developing general, heat- and cold-related vulnerability and resilience matrices

Both quantitative and qualitative vulnerability and resilience findings presented in Chapters 4 and 5, respectively, showed a great diversity and differences of vulnerability and resilience amongst participants in this research. The following analysis is intended to understand how vulnerability and resilience interact with each other at the individual level by developing a 2x2 matrix. Participants are positioned in each matrix taking into account their levels of combined vulnerability and resilience, using both quantitative and qualitative data (see Chapters 4 and 5). The development of the matrices started by defining the variables axis (y axis corresponds to vulnerability and x axis corresponds to resilience) and characterizing the four quadrants: 1) low vulnerability & low resilience (bottom-left quadrant) representing participants with access to assets but with low ability to act; 2) high vulnerability & low resilience (top-left quadrant) representing the most threatened participants, with lack of assets and low ability to act; 3) high vulnerability & high resilience (top-right quadrant), representing those with lack of assets but with high ability to act, and; 4) low vulnerability & high resilience (bottom-right quadrant), with access to assets and high ability to act, representing the strongest participants and the 'success cases' from which to learn for developing appropriate policy measures. Additionally, a colour scheme spanning from light to dark grey was added to each quadrant indicating the combined vulnerability-resilience (Figure 7.1).

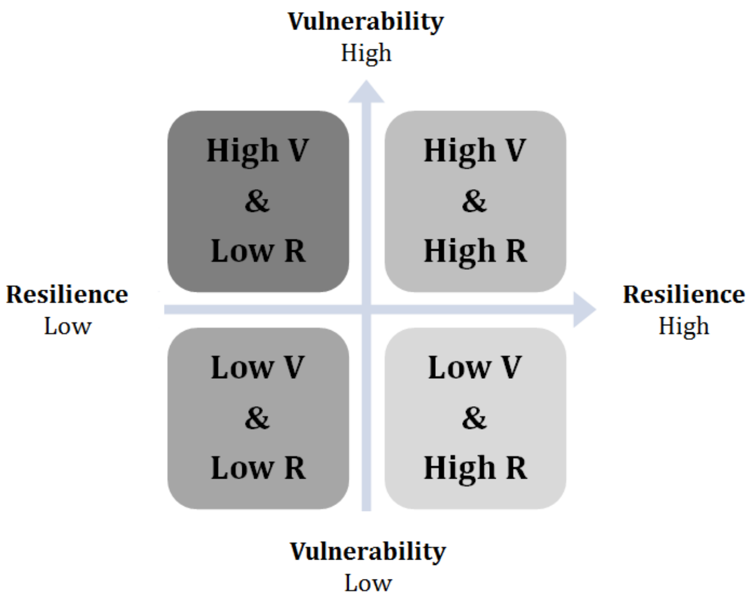


Figure 7.1 Representation of the vulnerability-resilience matrix.

Legend: V – vulnerability; R – resilience.

7.3.1 General vulnerability and general resilience matrices

Each of the participants were positioned in the vulnerability-resilience matrices according to their individual overall indices values (GVI-general vulnerability index and GRI-general resilience index, see Chapter 4 Section 4.5.1 and Chapter 5 Section 5.4.1), as well as each corresponding vulnerability indicators (human, financial, physical, place-based and social assets).

The combined GVI and GRI matrices are presented in Figures 7.2 a) to f). General resilience values are constant and characteristic to each participant throughout, but vulnerability values change according to the general vulnerability and each asset-related vulnerability values. The great majority of participants fall into the two high resilience quadrants (top- and bottom-right quadrants) revealing that most participants despite their levels of vulnerability both low or high showed high levels of resilience. These participants revealed an overall orientation expressing feelings of confidence in their lives. Analysis of the relative position participants take in the overall GVI and GRI matrix (Figure 7.2 a) shows that the majority of participants are in the 'low vulnerability & high resilience' group (54.9%) and 13.7% fall into the 'high vulnerability & low resilience' group. The assets-related vulnerability-resilience matrices also show that around 12% to 14% of all participants are part of the 'high vulnerability & low resilience' group for indicators such as, human assets (13.7%), financial assets (13.7%), social assets (11.8%), (Figure 7.2 b), c) and g), respectively). The percentage of participants falling into the high physical and high place-based assets vulnerability & low resilience is smaller (5.9%; 5.9%, respectively) (Figure 7.2 d) and e), respectively). These findings suggest that the 'high vulnerability & low resilience' group of participants are characterised to a larger extent in terms of human assets vulnerability, followed by financial assets vulnerability and social assets vulnerability in their lives in addition to low resilience. Furthermore, in addition to the lack of assets these participants with low resilience struggle to make sense of their lives, and/or perceive they do not have the assets needed and/or lack the motivation to act using the scarce assets available. High resilience participants (bottom- and top-right quadrants), independently of their vulnerability are confident they can confront any threat or stressor and/or perceive they have assets available and/or are motivated to act as best as they can.

Appendix 7.1 presents a summary of participants' general vulnerability and general resilience from which the matrices were developed (see Chapters 4 and 5).

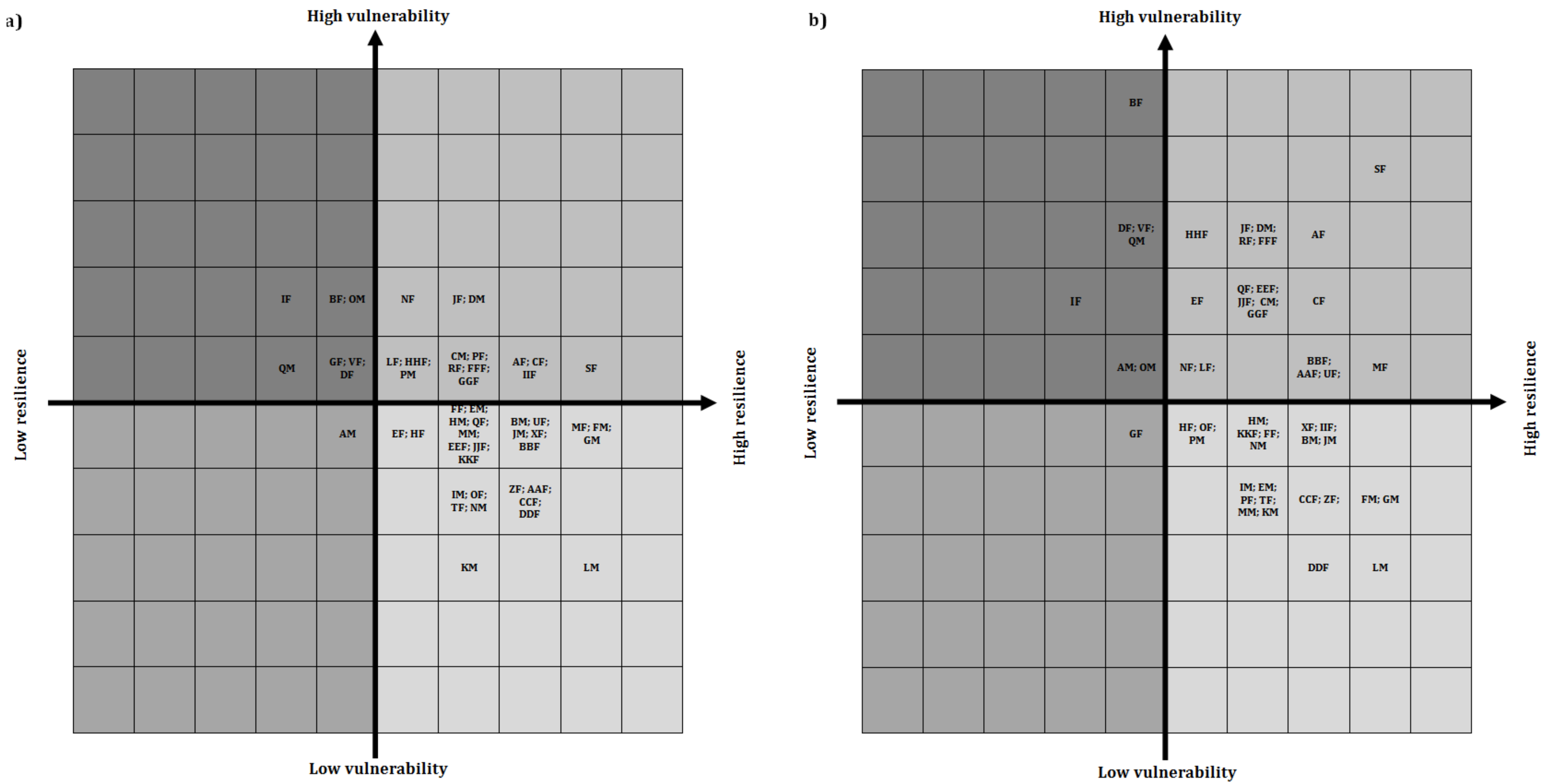


Figure 7.2 Participants position on general vulnerability and general resilience (GRI) matrices

Legend: a) GVI & GRI; b) human capital vulnerability & GRI.

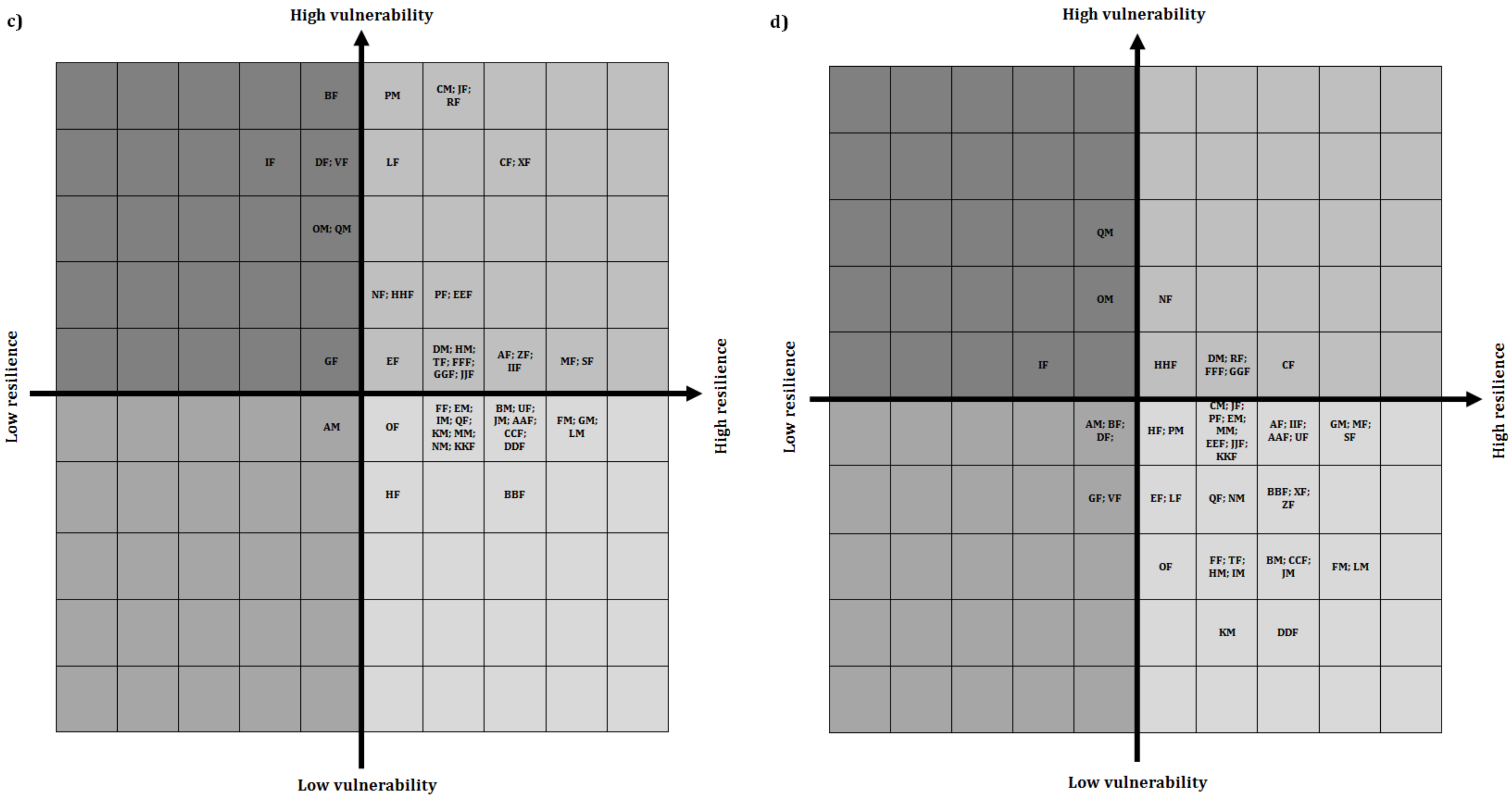


Figure 7.2 (cont.) Participants position on general vulnerability and general resilience (GRI) matrices

Legend: c) financial assets vulnerability & GRI; d) physical assets vulnerability & GRI.

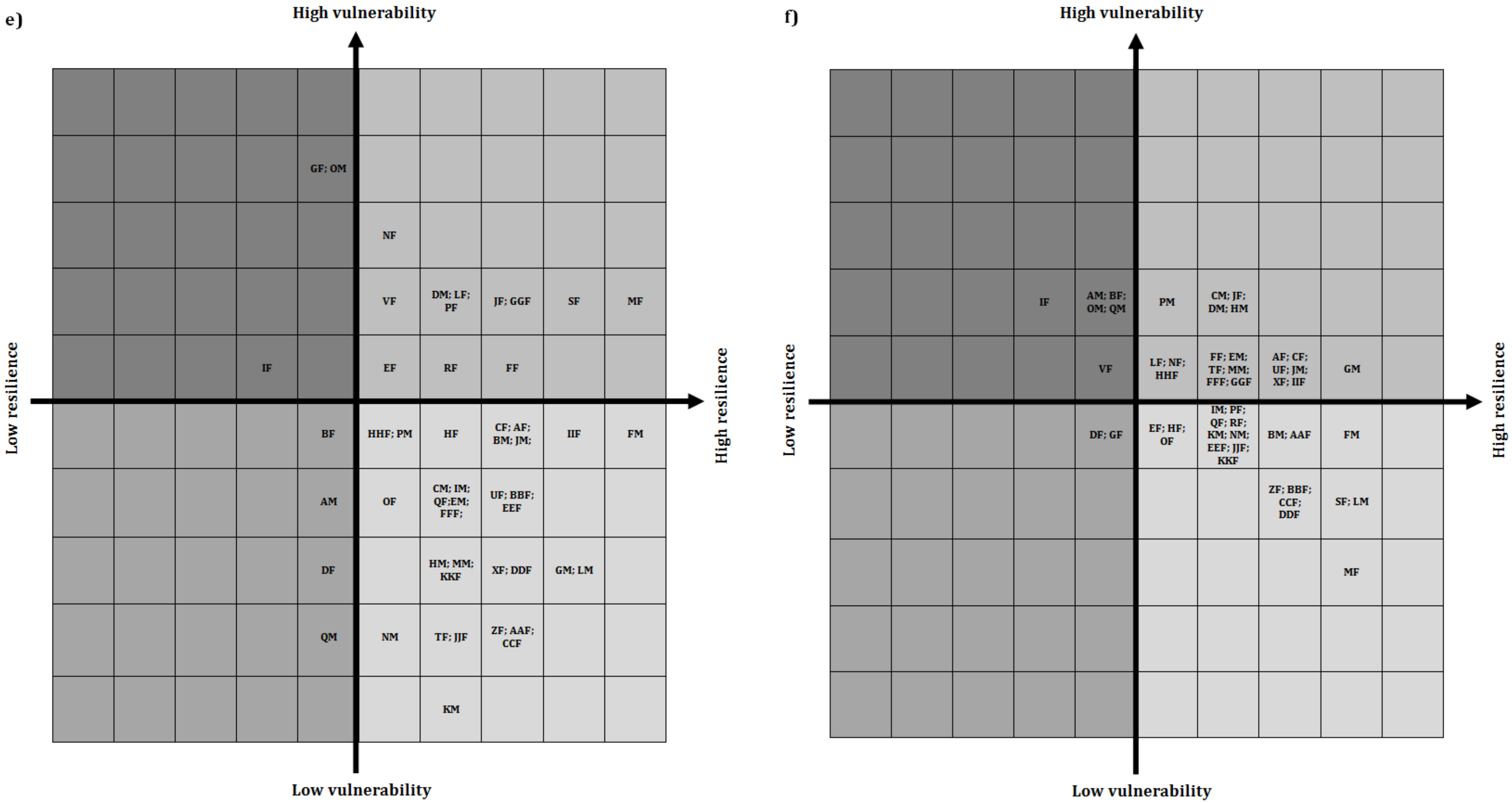


Figure 7.2 (cont.) Participants position on general vulnerability and general resilience (GRI) matrices

Legend: e) place-based assets vulnerability & GRI; f) social assets vulnerability & GRI.

7.3.2 Heat-related vulnerability and resilience matrices

The findings presented here result from the coding and categorisation of heat-related qualitative interviews data presented in Sections 4.5.2 and 5.4.2. Here, the aim is to bring to life individual participants' characteristics and the factors shaping their vulnerability and resilience to heat, and ultimately, adaptation to heat. Each participant represents a unique combination of vulnerability and resilience that are not fully evident when looking at the whole sample dataset. Appendix 7.2 presents a summary of participants' heat-related vulnerability and heat-related resilience (see Chapter 4 and 5).

A review of all 52 heat-related individual participants' transcripts was undertaken to characterize their vulnerability and resilience characteristics and map participants on a vulnerability-resilience matrix. Figure 7.3 was developed according to individual heat-related vulnerability and resilience characteristics and provides a qualitative snapshot of individuals' vulnerability and resilience at a defined point in time (that of the interview and the periods the interviewees referred to). It represents a continuing process where all relevant characteristics and factors were taken into account for each participant until reaching a final matrix for all participants (Figure 7.3). As these characteristics and factors arise from qualitative data, subjectivity, complexity and transparency concerns constituted limitations in mapping participants' relative position to each other. As such, the order of participants within each quadrant of the matrix (high & low) does not reflect different levels of vulnerability or resilience.

Figure 7.3 presents the combined vulnerability and resilience findings where resilience features (high or low) of each participant are constant throughout and vulnerability features change according to overall heat-vulnerability and asset-related vulnerability. Participants' distribution within the heat-related vulnerability-resilience matrix is not uniform and the biggest proportion fall into three of the four quadrants of the matrix. In Figure 7.3a) of all participants the worse-off (36.5%) fall into the 'high vulnerability & low resilience' quadrant (top-left) and are the most threatened from suffering the impacts of heat as they lack assets, have lower understanding and/or awareness of what causes the impacts, and/or lack the knowledge of which assets are available and how to use them, and/or lack the motivation to act in order to deal with the threat heat poses to health. 'High vulnerability & high resilience' participants (38.5%) (top-right quadrant) lack assets but manage to make sense of the problem and/or use the assets available to them and/or are motivated to act upon. Better-off participants (23.1%) are situated in the 'low vulnerability & high resilience' quadrant (bottom-right) and overall have the assets and/or the understanding and/or motivation to act in order to reduce the health impacts of heat. Only one participant (1.9%) is located in the 'low vulnerability & low resilience' quadrant (bottom-left) which means that despite having assets needed to respond to heat, this participant lacks the understanding, and/or uses of the assets available to him ineffectively and/or lacks motivation to act (participant KM). Regarding the asset-related vulnerability-resilience matrices (Figures 7.3b) to f)) participants' positions change to a certain extent. A higher number of participants show high physical assets vulnerability and low resilience (38.5%), and a lower number is included in the high place-based assets and low resilience group (23.1%). Thus, a higher number of participants are most threatened by the combination of having problems with temperature in the home during very hot weather and/or inability to keep the home cool and/or not being able to keep themselves cool in the home during very hot weather and/or not using of cooling devices (high physical assets vulnerability) and low resilience; and a lower number of participants reveal being most threatened by the combination of not being aware of the Heatwave Plan and/or had no interest on it (high place-based vulnerability) and low resilience regarding heat. The development of bespoke strategies and interventions focusing on each group of participants positioned in each quadrant of the vulnerability-resilience matrix are explored and discussed in Chapter 8 with the aim of reducing vulnerability and increasing resilience of older people to heat.

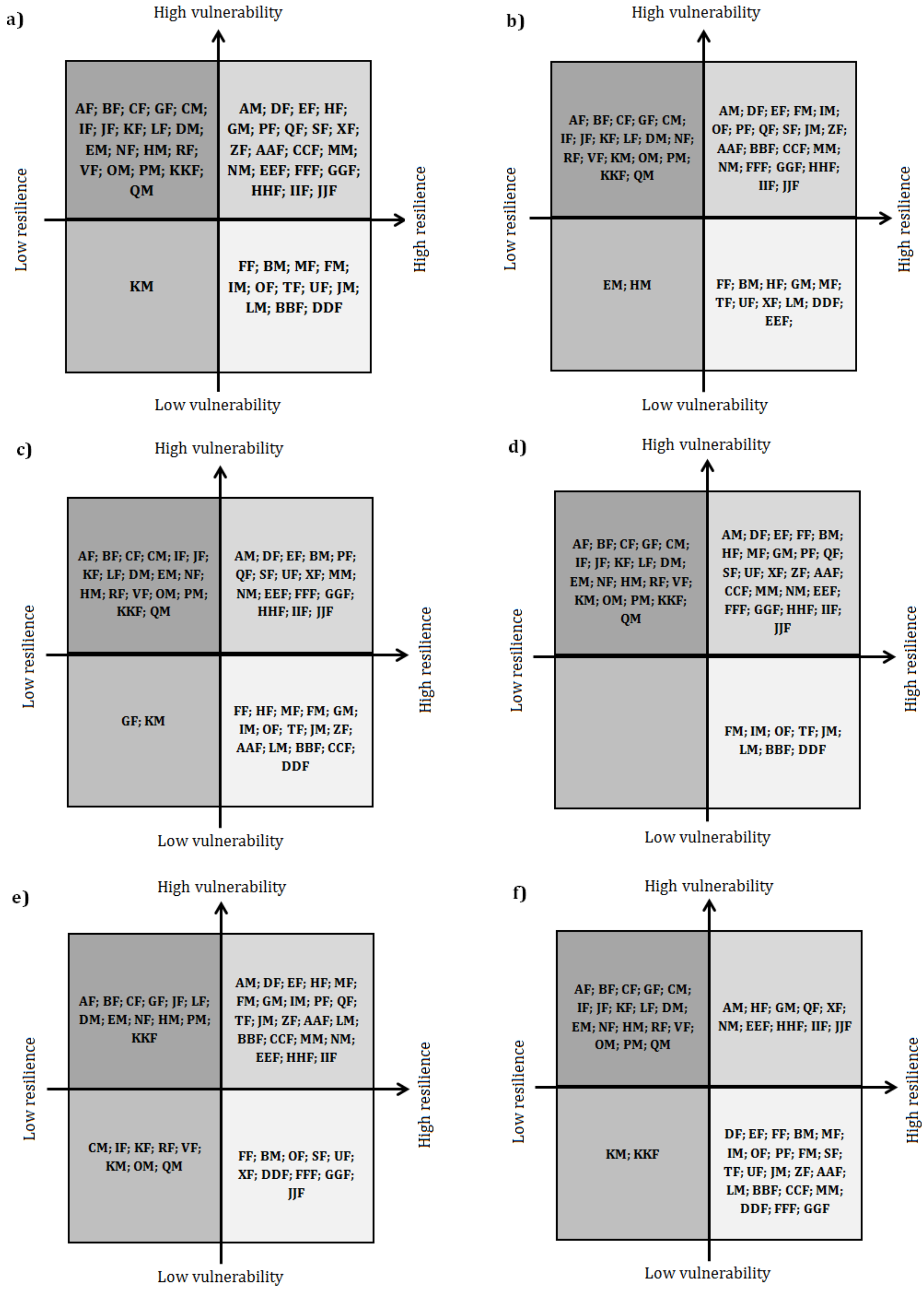


Figure 7.3 Mapping participants on a heat-related vulnerability- resilience matrix

Legend: a) Overall vulnerability & overall resilience; b) human capital vulnerability & overall resilience; c) financial assets vulnerability & overall resilience; d) physical assets vulnerability & overall resilience; e) place-based assets vulnerability & overall resilience; f) social assets vulnerability & overall resilience.

Note: Participants' position inside each vulnerability-resilience quadrant of the matrix does not reflect different levels of combined vulnerability and resilience.

7.3.3 Cold-related vulnerability and resilience matrices

As mentioned in the section above (Section 7.3.2) the findings presented here result from the analysis of 46 individual participants qualitative cold-related vulnerability and resilience interviews discussed in Chapter 4, Section 4.5.3 and Chapter 5, Section 5.4.3. Appendix 7.3 presents a summary of participants' cold-related vulnerability and cold-related resilience (see Chapter 4 and 5).

The mapping of participants on a vulnerability-resilience matrix was developed following a review of the 46 individual participants' qualitative interviews and is a qualitative illustration accounting unique individual features in a defined space and time (see Figure 7.4).

Participants' distribution within the cold-related vulnerability-resilience matrix is not identical and the biggest proportion falls into three of the four quadrants of the matrix. In Figure 7.4a) the majority of participants (52.2%) fall into the 'high vulnerability & low resilience' quadrant (top-left) and are the most threatened from suffering the health impacts of cold as they lack the assets, have lower understanding and/or awareness of what causes the impacts, and/or lack the knowledge of which assets and how to use the assets available, and/or lack the motivation to act in order to deal with the threat cold poses to health. 'High vulnerability & high resilience' participants (21.7%) (top-right quadrant) lack assets but manage to make sense of the problem and/or use the assets available to them and/or are motivated to act upon. Better-off participants (26.1%) are situated in the 'low vulnerability & high resilience' quadrant (bottom-right) and overall have the assets and/or the understanding and/or motivation to act in order to reduce the health impacts of cold. No participant is located in the 'low vulnerability & low resilience' quadrant (bottom-left). Regarding the asset-related vulnerability-resilience matrices (Figures 7.4b) to f)) participants' positions change to a certain degree. A higher number of participants show high human assets vulnerability and low resilience (46.2%), and a lower number is included in the high place-based assets and low resilience group (34.6%). Thus, a higher number of research participants reveal being most threatened by the combination of having health problems during very cold weather and/or physical health limitations during very cold weather (high human assets vulnerability) and low resilience, and a lower number of participants reveal being most threatened by the combination of not being aware of the Cold Weather Plan and/or had no interest on it (high place-based vulnerability) and low resilience regarding cold. The development of bespoke strategies and interventions focusing on each group of participants positioned in each quadrant of the vulnerability-resilience matrix are explored and discussed in Chapter 8 with the aim of reducing vulnerability and increasing resilience of older people to cold.

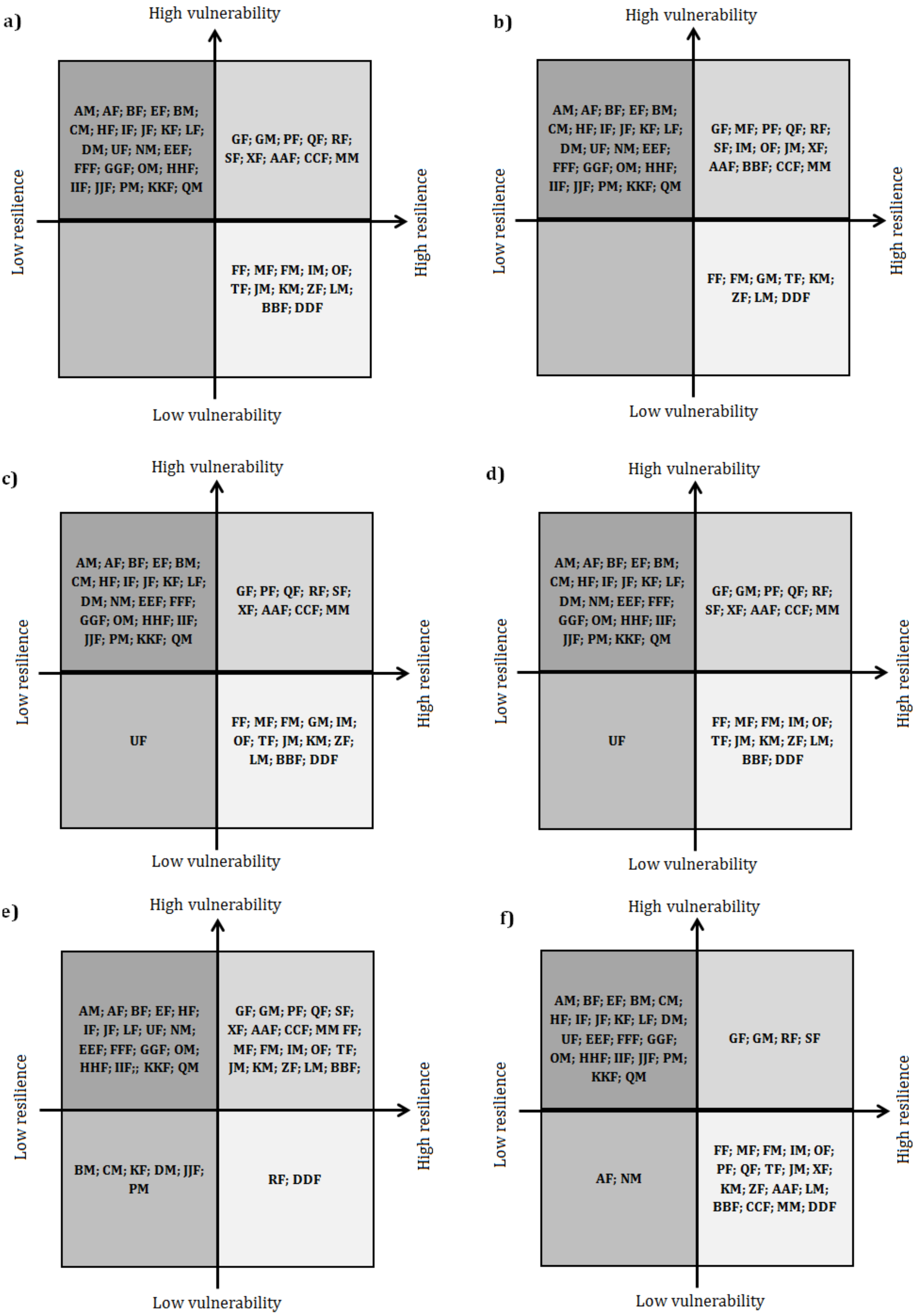


Figure 7.4 Mapping participants on a cold-related vulnerability- resilience matrix

Legend: a) Overall vulnerability & overall resilience; b) human capital vulnerability & overall resilience; c) financial assets vulnerability & overall resilience; d) physical assets vulnerability & overall resilience; e) place-based assets vulnerability & overall resilience; f) social assets vulnerability & overall resilience. Note: Participants position inside each vulnerability-resilience quadrant of the matrix does not reflect different levels of combined vulnerability and resilience.

In summary, participants' combined vulnerability and resilience to heat and cold reveals that more participants are included in the overall 'high vulnerability & low resilience' quadrant in extreme cold (46.2%) than in extreme heat (36.5%) (Figures 7.3a and 7.4a). These findings unravel higher concerns regarding the ability of these participants to respond to extreme cold. An equal number of participants reveal overall 'low vulnerability & high resilience' (23.1%) to both heat and cold, where all participants kept their position in the matrices, except one participant (BM). This participant saw his vulnerability increase (BM) and his position was occupied by another participant (ZF) who saw her vulnerability decrease (ZF). Most participants kept their positions in the matrices (e.g. BBF, OM) but some saw their vulnerability increase (e.g. BM) and their resilience decrease (e.g. GGF, BM) regarding cold. Despite this, a small number of participants saw their vulnerability decrease (e.g. ZF) and their resilience increase (e.g. KM). Profiles of these six participants can be found in Section 7.4. Comparatively, regarding the asset-related matrices for both heat and cold (Figures 7.3 and 7.4 b) to f)), there is a consistent higher proportion of participants falling into the 'high vulnerability & low resilience' quadrant regarding cold in all types of assets.

7.3.4 Integrating adaptation to extreme heat and cold

Having developed the vulnerability and resilience matrices presented above, this section integrates these findings with adaptation to heat and cold. Participants' adaptation to extreme temperatures is varied and intricate with many diverse features, however, recognisable differences in participants' adaptation can be drawn from participants' location within the vulnerability-resilience matrices.

Participants who revealed comparatively lower levels of vulnerability and higher levels of resilience to extreme temperatures compared to others demonstrated to be able to better respond to heat and cold. Reasons for this comprise having more diverse and greater assets portfolio readily available to use, and being more likely to define extreme temperatures as non-stressors, non-problematic and believing one can adapt to the demands they pose. Based on the overall sample findings, planned adaptations seem to be a feature more frequently observed in participants with lower vulnerability and greater resilience. Their strategies and responses are based on previous experiences, present impact and envisioning future extreme temperatures stresses and impacts to their health. Their adaptations to both heat and cold were extensive and diverse as they were seen as threats and dependent on their health status.

Participants demonstrating relatively higher levels of vulnerability and lower levels of resilience to extreme temperatures compared to others were more likely to reveal narrow and limited strategies and responses. Extreme temperatures were more likely to be seen as universal but not individual threats to health. These participants either did not see themselves needing to engage in planned adaptations as in their view what they already did was deemed enough, or felt they were not able or did not know what and how to engage in additional strategies or responses to be able to deal with the threats these events posed, both now and in the future.

Those participants who revealed somewhat greater vulnerability and resilience to extreme temperatures compared to others, felt hope that their responses enabled them to actively deal with the threats these events pose to them. They were not able to engage in planned adaptations due to limits to their asset portfolio but if in provision of enough and the right amount of assets would be likely to initiate planned adaptations as they understood the threat and were motivated to act, and this would be the case for both heat and cold.

Demonstrating relatively lower vulnerability and resilience to extreme temperatures was uncommon in the research sample. These participants were more likely to be anxious and at the same time show apathy towards acting in the face of the threats of extreme temperatures, they felt confused and lacking the ability to act. Adapting to heat and cold was found to be focused on emotional features of not being able to manage the anxiety, feeling hopeless, almost as paralysed and overwhelmed to deal with the stress arising from these events. Such participants despite having the assets available to deal with these events see them as stressors, as burdens and assume that they cannot adapt to the demands they pose.

It was found that not only vulnerability influences and impacts on the possibility, willingness and motivation to act (resilience), but that it plays a crucial role in determining how older people make sense of the threat posed by extreme temperatures, how they perceive the assets available to them to deal with the threat and the motivation to act, and ultimately, adapt. These findings are present in participants' interviews and based on that both vulnerability and resilience are determinants of adaptation. Those participants that revealed greater and extended strategies and responses relatively to others were those with lower vulnerability and higher resilience to extreme temperatures. Justifications for this include having more assets available to use, perceiving the threat in an ordered way, feeling that the assets available are adequate and having the motivation to act (bottom-right quadrants). Despite this, other participants with higher vulnerability and higher resilience showed that not having as many assets available did not constrain their orientation to endure; they felt confident that they were able to act and engaged in responses to extreme temperatures with the assets available to them (top-right quadrants). Participants with high vulnerability and low resilience were somewhat most at risk from the impacts of extreme temperatures, as the assets available to them are limited and their confidence and motivation is low making it extremely difficult to them to understand the threat and internally find it worth of investment which in practice meant that their behavioural responses to heat were also restricted (top-left quadrants). Based on the vulnerability-resilience matrices, there were also participants with low vulnerability and low resilience. Their assets availability was high but their orientation and confidence to deal with the threat extreme temperatures posed to them, the perception of assets available to them and their motivation to act was very low which seemed to compromise their responses, meaning that not much strategies and measures were put in action to deal with the health impacts of heat (bottom-left quadrants).

In summary, both vulnerability and resilience to extreme temperatures are determinants of adaptation. The integration of adaptation in the vulnerability-resilience matrix demonstrated that the most threatened group of participants are the ones that have high vulnerability and low resilience (top-left quadrant) and should be those to which heatwave and cold weather planning should primarily target to limit the health impacts they might be subject to. The strongest group of participants who demonstrated the most suitable responses for their circumstances were those with low vulnerability and high resilience (bottom-right quadrant) and should be the basis of health and social policy measures to emulate. The remaining two groups should also be targeted to both reduce their vulnerability (top-right quadrant) and build their resilience (bottom-left quadrant). A further discussion of these issues will be presented in Chapter 8.

7.4 Individual profiles

So far this chapter has presented individual participants' analysis and positioning in relation to general, heat- and cold-related vulnerability and resilience, as well as providing an approach to integrating adaptation to heat and cold. In this section, more details on the individual characteristics of participants are brought to light by presenting profiles of particular participants as an illustration of their vulnerability and resilience characteristics and adaptation responses in the face of heat and cold. The profiles developed aim to provide the reader with a more detailed account of participants' characteristics, into a narrative representation of each participant, attempting to bring participants' vulnerabilities, resilience and adaptation to life. The profiles of six participants have been presented in previous chapters (4, 5 and 6), showcasing stability and diversity in individual specificities regarding the combination of vulnerability, resilience and adaptation to extreme heat and extreme cold (Figures 7.5 to 7.10).

The different profiles were developed to illustrate and 'bring to life' certain features of the participants, with the goal of showcasing rich and interesting sketches of how vulnerability, resilience and adaptation to heat and cold materialize revealing different spheres of participants' lives. The six individual outlooks presented were chosen from all participants taking into account their relative positions in both heat- and cold-related vulnerability-resilience matrices but do not represent fixed typologies of characteristics of participants in the same position of the matrices, thus they are not intended to represent the vulnerability-resilience quadrant they are part of.

Participants' levels of vulnerability and resilience are intrinsically linked to the ways in which they adapt. Less vulnerable participants are in a better position to have high resilience and better adapt to heat. Despite this, some exceptions were found in this research, where low vulnerability does not predict high resilience (KM) revealing that not all older people with the necessary assets have the willingness and motivation to act/adapt, and due to this face important barriers and limits to adaptation. Similarly, having high vulnerability did not define levels of resilience in this research. A high number of participants were defined as having high vulnerability but with distinguished levels of resilience. Again, not having the necessary assets to deal with heat was not a predictor of the willingness and motivation to act/adapt. A range of diverse factors besides assets are influencing participants' resilience and adaptation behaviours, as discussed above, and can be better understood by looking at six profiles of participants.

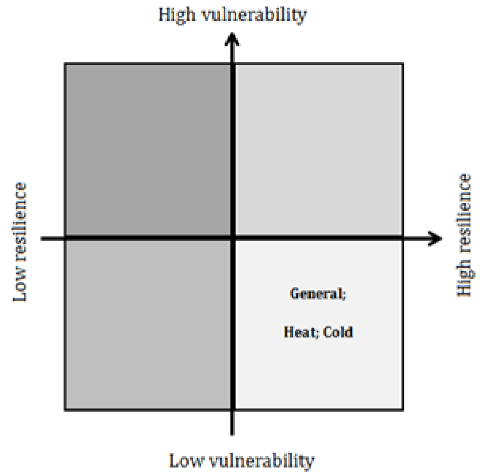
Findings	Vulnerability	Resilience	Adaptation
 ***General Vulnerability: 0.379****; Human assets: 0.581; Financial assets: 0.400; Physical assets: 0.373; Place-based assets: 0.321; Social assets: 0.356;* ***General Resilience: 0.705****; CO: 0.800; MA: 0.708; ME: 0.873; Type: HHH; Prediction: stable.* ***Heat-related vulnerability: Low****; Human assets: High; Financial assets: Low; Physical assets: Low; Place-based assets: High; Social assets: Low.* ***Heat-related resilience: High****; CO: High: MA: High: ME: High; Type: HHH; Prediction: stable;* ***Cold-related vulnerability: Low****; Human assets: High; Financial assets: Low; Physical assets: Low; Place-based assets: High; Social assets: Low.* ***Cold-related resilience: High****; CO: High; MA: High; ME: High; Type: HHH; Prediction: stable.*	BBF is 74 years old, is widowed and lives alone in a house she owns. She worked as a secretary in the public sector and has to be careful, but manages with a pension of about £1300/month. She rates her health as good but somewhat worse than a year ago. She lives on the 3rd floor of a 40 years old building without a lift. BBF is satisfied with her house but would move as the building does not have a lift. There are parks and gardens near her house but does not go there because she does not like those places. She has people available that can help her when she needs and people that care for her. She has a son and a granddaughter, and has direct contact with her close family at least once a week. She sees her neighbours and friends every day or almost every day, and participates in voluntary and charitable activities at least once a week and participates in social activities every day in her city ward. BBF's health is affected by very hot and very cold weather and her physical health limited what she can do. She installed an air conditioning unit in her home after the 2003 Heatwave due to her husbands' illness. BBF was not aware of both the Heatwave Plan and Cold Weather Plan. She is very active and participates in many social activities in her local ward all year round. She has made many friends she keeps in touch with even when activities are not running during some of the summer months.	BBF feels that her life is structured and consistent. Although her husband died several years ago, she managed to make sense of his sudden death. Having a good social network from the activities she is now involved made coping a bit easier. The biggest motivation in her life is her granddaughter and her friends in the activities she takes part of at her city ward. BBF found heat and cold predictable and found the challenges they pose structured and able to make sense of the threat. She felt confident she can deal with them and perceived having the assets needed to do so. She also revealed being motivated to engage in adaptive behaviours and responses, changing her routines and felt motivated and able to overcome the challenge heat and cold pose.	During the day when it is very hot BBF closes all shutters and blinds to keep the home cool and she also has cold showers keep her cool. BBF drinks more water and eats more fresh fruit and salads. BBF changes and reduces her daily activities as she knows it is bad for her health. In the evening she opens the windows if is cool outside, if not she turns on the air conditioning before going to bed. BBF avoids being outside when it's very hot, but when going out she wears light clothes and walks in the shade. As she has a heart problem and is aware of the impacts of heat to health she uses the air conditioning. During very cold weather BBF stays in bed longer in the morning but during hot weather she wakes up earlier than usual to start the day earlier. She as a gas heating device she uses more often as the electrical one does not heat as much and uses a lot of electricity. The gas heating is only used in one room when is very cold and only during specific amounts of time; and she only uses the air conditioning during very hot weather. Goes out every day wears more layers, scarf and gloves, but does not like wearing hats.
Combined conclusions	BBF deals better with the cold than with the heat, if it is not too extreme. It is easier for her to wear more layers of clothes, keep warm and use the gas heating device. But if it's too hot, she less opportunities to keep cool either at home or outside. For her, during cold weather clothes keep people warm and so do heating devices; but during hot weather are thought to be more complicated to keep cool especially outside.		

Figure 7.5 Participant BBF combined portrait and profile

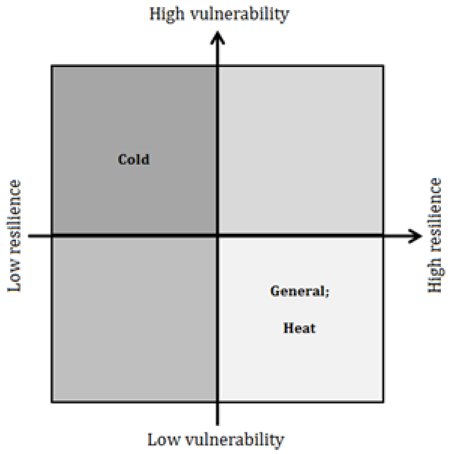
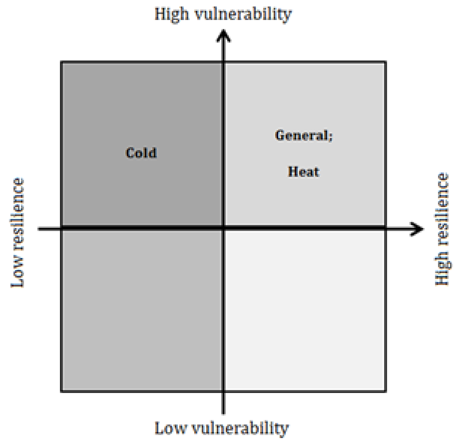
Findings	Vulnerability	Resilience	Adaptation
 ***General Vulnerability: 0.412****; Human assets: 0.454; Financial assets: 0.450; Physical assets: 0.242; Place-based assets: 0.482; Social assets: 0.450;* ***General Resilience: 0.795****; CO: 0.800; MA: 0.708; ME: 0.875; Type: HHH; Prediction: stable;* ***Heat-related vulnerability: Low****; Human assets: Low; Financial assets: High; Physical assets: High; Place-based assets: Low; Social assets: Low.* ***Heat-related resilience: High****; CO: High; MA: High; ME: High; Type: HHH; Prediction: stable;* ***Cold-related vulnerability: High****; Human assets: High; Financial assets: High; Physical assets: High; Place-based assets: Low; Social assets: High.* ***Cold-related resilience: Low****; CO: High; MA: Low; ME: Low; Type: HLL; Prediction: pressure to move down.*	BM is 75 years old, is widowed and lives on his own. He has children, a daughter that lives close by and a son that lives in Luxemburg. He was a policeman and rates his health as fair and the same as a year ago. His monthly income is high (£1200-2100/month) and he lives in a rented old (around 85 years old) terraced house with a garden and fruit trees. He owns a computer and a car. At least once a week BM attends social activities at his local ward. BM did not feel he was more affected by heat and his health was not affected during hot weather. He had problems with temperature in his home during hot weather but did not want to spend money/electricity to keep cool. As such, he did not own a fan or air conditioning. BM was aware of the Heatwave Plan and had contact with people every day or almost every day during very hot weather. BMs' physical health does not limit what he can do during very cold weather but he has blood circulation problems that get worse during cold weather. His home is cold and he has heating devices but he doesn't use them. He is thrifty and does not want to spend money in electricity to keep warm. He also mentioned he was not able to keep his home warm as it lacked insulation and would be very expensive to warm it. BM was aware of the Cold Weather Plan and would like to know more about it. He stays home more during very cold weather and does not have many social contacts.	BM found that he sees things in the right proportion and that he knows what to do when faced with an unfamiliar situation. He is aware of the issues and challenges in his life and around him and felt his live has had and has meaning and goals in his daily life. BM dealt well very hot weather and was confident he takes needed precautions to meet the challenges it posed. He felt he had the assets needed to deal with very hot weather and felt confident about the availability to additional assets if needed be, under his control. He was used to experiencing hot weather and felt motivated and interested in responding to it. He stated changing his daily routines and rhythms and only gardening in the coolest hours of the day. BM understood the challenges cold poses in his life and was confident about being able to meet those challenges. Despite this, he was negative about having the assets needed as it was expensive to warm the home and if he owned the house he would install a fireplace to burn wood. Due to this, his motivation to act was reduced.	When it's very hot BM closes all shutters and blinds during the day, he drinks more water and has a shower every day. He does not like air conditioning and that is one of the reasons why he never installed it, another reason is that he does not own the house he lives in. When he is outdoors he walks in the shade, a bit quicker than usual to avoid the sun and heat and he only works in his garden when it is cool. During the evening he opens all windows. He has several thermometers at home and during summer the temperature at home usually reaches 18°C in the morning and 24-25°C in the afternoon. Life experience has taught him how to protect himself from the heat. BM stays home more during very cold weather and watches the weather forecast every day. The house is not well insulated and the heat escapes, is a waste of money in electricity. He uses a hot water bottle to keep his feet warm instead of using heating devices. Has a thermometer that usually reaches 12-14°C when it's cold, but if he's is cooking the temperature rises. He endures the cold by wearing more layers, warm sleepers and a hot water bottle. He has a heating device but does not use it to save on electricity. He only uses heating devices when has people around as he wants the home to be warmer for his visits. Even then when his children visit him they complain about how cold it is in his home.
Combined conclusions	BM is used to the cold and has experienced very cold weather when he visits his son in Luxembourg. There they have central heating and the homes are too warm. His son bought him a heating device because it was too cold for his liking when he visited BM. He thinks that Portugal is not that cold reason why the house doesn't have central heating and each country does what is best to protect its citizens from the heat or cold. His house is old and lack insulation and if someone heats the home they spend too much money.		

Figure 7.6 Participant BM combined portrait and profile

<table>
<tr><th>Findings</th><th>Vulnerability</th><th>Resilience</th><th>Adaptation</th></tr>
<tr>
<td>

General Vulnerability: 0.584; Human assets: 0.657; Financial assets: 0.550; Physical assets: 0.508; Place-based assets: 0.661;Social assets: 0.568; General Resilience: 0.692; CO: 0.700; MA: 0.708; ME: 0.667; Type: HHH; Prediction: stable; Heat-related vulnerability: High; Human assets: High; Financial assets: High; Physical assets: High; Place-based assets: Low; Social assets: Low; Heat-related resilience: High; CO: High; MA: High: ME: High; Type: HHH; Prediction: stable; Cold-related vulnerability: High; Human assets: High; Financial assets ; High; Physical assets: High; Place-based assets: High; Social assets: High; Cold-related resilience: Low; CO: High; MA: Low; ME: Low; Type: HLL; Prediction: pressure to move down.</td>
<td>GGF is 84 years old, is widowed and has no children. She has asthma, high blood pressure and stomach problems. She lives alone in a rented studio apartment in an old building (100 or more years) owned and run by a charity as she lives with a low pension (£290-415/month). She goes out every day and has contact with the other ladies living in the same building as her. She visits her sister and brother in law every weekend.

GGF asthma gets worse both with hot and cold weather. Her health conditions limit what she can do during very hot during hot and very cold weather. Due to her low pension she saves on electricity, gas and water so she can pay all bills. She has problems with temperature as her apartment is both hot and cold/damp and she is not able to keep it cool/warm or keep herself cool/warm inside during hot and cold weather, respectively. She has heard about the Heatwave Plan and Cold Weather Plan and has low social contacts and very low social activities during very hot weather. Despite this, she has increased social contacts during cold weather as she goes out more.</td>
<td>GGF is a very positive person and used humour several times when talking about her life events and circumstances. She feels she usually knows what to do in an unfamiliar situation and does not have mixed-feelings or ideas.

GGF feels she deals with the heat the best she can as it has a will of his own. To her heat is predictable and an ordered event in her life. She feels she has all the assets needed to respond well. She thinks she is capable of dealing well with very hot weather and is motivated to search for ways to improve the way she deals with it.

GGF feels she has to conform, endure the cold but she feels hope and sees it as a challenge in her life although it is sometimes a burden. She feels that personally she does not have many assets to deal with the cold. Despite this, where she lives there is a common room with heating devices but no one stays there the whole day to keep warm. Thus, as her home is very cold and damp she would like to have more assets such as being able to use heating devices in her own home and afford paying electricity bills in order to respond better to the cold. She sometimes feels demotivated as she does not see where she could improve the way she responds to cold.</td>
<td>GGF watches the weather forecast every day. Due to her asthma and circulation problems she has taken more care about her health during very hot weather. She drinks more water, uses a hand fan, closes all shutters and blinds and has showers to keep cool. She wears less and cooler clothes as well. She does everything she can to protect herself, is very self-reliant as she does not have anyone around to take care of her. When it's very hot her home becomes hot and the whole building is hot. She visits her sister in a care home twice a week and they have air conditioning there and which she says is very good, but getting home is harder as some public transports have air conditioning and others don't. Due to her asthma sometimes she feels ill and has to use the inhalers outside in hot weather. She feels she has to go out and see people every day as she can't bear staying at home all day,

GGFs niece gave her a heating device but she only used it once as it is very expensive to use. She endures and wears more layers and a blanket and in the evening wears a warm pyjama and has a warm duvet. She drinks warm drinks, tea mostly to keep warm at home. Outside she wears gloves and scarf. She only has a warm shower once a week because of gas bills being very high. The building where she lives has a communal room with heating; she spends some time there as it is warmer and it helps saving on electricity.</td>
</tr>
<tr>
<td>Combined conclusions</td>
<td colspan="3">GGF finds it hard to both keep her home cool and warm in summer and winter, respectively, as it is very expensive to achieve that taking into account she has a low pension and electricity prices are rising. The saves what she can in electricity but it is still expensive. She has to endure with what she has and what she can afford, but feels it is worse to deal with the cold as her home is very cold and damp making it difficult to keep warm.</td>
</tr>
</table>

Figure 7.7 Participant GGF combined portrait and profile

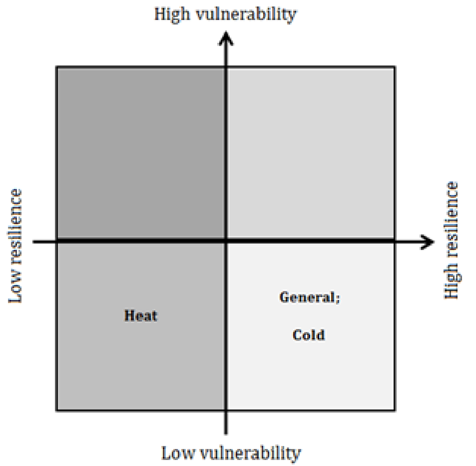
Findings	Vulnerability	Resilience	Adaptation
 ***General Vulnerability: 0.276;*** *Human assets: 0.373; Financial assets: 0.442; Physical assets: 0.106; Place-based assets: 0.089; Social assets: 0.446;* ***General Resilience: 0.692;*** *CO: 0.567; MA: 0.625; ME: 0.917; Type: HHH; Prediction: stable;* ***Heat-related vulnerability: Low;*** *Human assets: High; Financial assets: Low; Physical assets: High; Place-based assets: Low; Social assets: Low;* ***Heat-related resilience: Low****; CO: Low; MA: Low: ME: High; Type: LLH; Prediction: pressure to move up;* ***Cold-related vulnerability: Low;*** *Human assets: Low; Financial assets: Low; Physical assets: Low; Place-based assets: High; Social assets: Low;* ***Cold-related resilience: High****; CO: High; MA: High; ME: High; Type: HHH; Prediction: stable*	KM is 65 years old, is married and lives with his wife and daughter at their owned bungalow. He has hay fever and other allergies. He used to work as a bus driver, has low education level and a pension of £660-1240/month. He lives in a terraced house, in a neighbourhood where he has many friends and helps in his local ward where he engages in many activities. The worse time of year to his health is spring and summer, when it's too hot as his hay fever and allergies are at its highest. As such, very hot weather limits his physical health and his blood pressure is low, he feels ill and tired. The temperature at home during very hot weather is a problem, as the house is very hot because it lacks insulation. It was built without planning permission and at the time it was built was considered 'illegal'. He is not able to neither keep the house cool nor stay cool at home. Being hot does not have impacts in his life but has impacts in his health. During very cold weather he house is not cold and he is able to keep warm. He never heard about the Heatwave Plan and Cold Weather Plan and has many social contacts.	KM when in an unfamiliar situation usually knows what to do but has generally found that he overestimates or underestimates the importance of problems He cares about what goes on around him and until now his life has had very clear goals and purpose, plus doing the things he does every day is a source of deep pleasure and satisfaction. KM deals very badly with very hot weather and for him it is a very stressful time, which he feels disrupts his life and is very bad to his health. He feels very anxious and confused during very hot weather and sees it as a very complex problem. He feels he doesn't have enough assets to efficiently engage in heat prevention measures and behaviours. He would like to have air conditioning fitted in his home, as well as double glazing windows and a new roof as his home lacks insulation. He has thought about going ahead with improving insulation in his home but has not decided to do it yet, but thinks he will do it soon as he feels that heat-related events are becoming more frequent and intense which makes it harder for him to deal with it if his house is not properly insulated. KM feels that cold is predictable, that the challenges it poses are clear and structured, and he deals well with it. He feels he has all the assets needed at his disposal to deal well with the cold, as he has a fireplace in his home that keeps it very warm. He is motivated to dealing with the cold and would like to have more information on how to better protect his health from the impacts of cold.	KM closes all shutters and blinds during the day. He only opens the windows in the evenings. He does not go or stay outdoors when it's very hot, but spends some of his time in a bar close to home which has air conditioning. When it's very hot he stays home more. KM keeps the home warm by using a fireplace which keeps the whole house warm during the day and evening. He installed it because of his wife's illness. He wears more layers but doesn't use scarfs or hats or gloves outdoors.
Combined conclusions	KM finds it hard to deal with very hot weather both due to his health problems and to the lack of insulation in his home. He is motivated to improve the ways to respond to the heat by improving his home insulation with double glazed windows and installing air conditioning. He is able to better respond to very cold weather because his home has a fireplace and he gets free wood to burn making it easier and cheaper to keep warm. Dealing with the heat is in his view highly dependent on installation and energy costs to keep cool.		

Figure 7.8 Participant KM combined portrait and profile

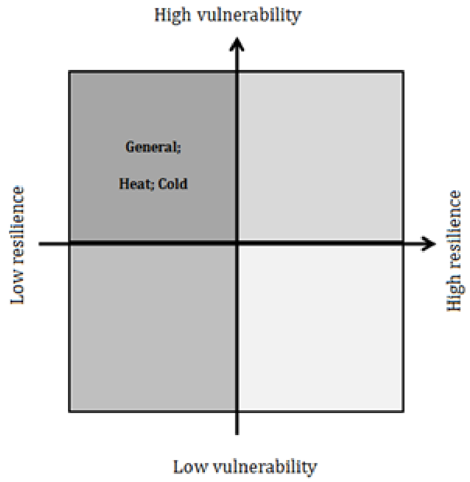
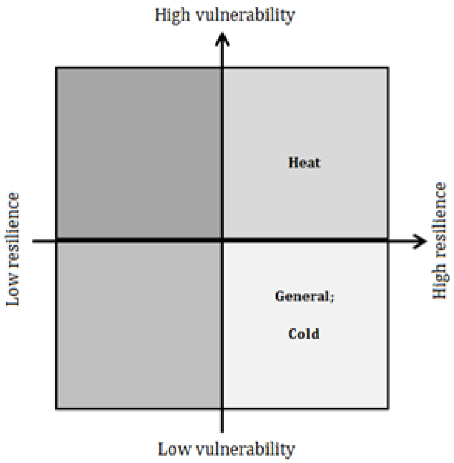
Findings	Vulnerability	Resilience	Adaptation
 ***General Vulnerability: 0.696****; Human assets: 0.554; Financial assets: 0.800; Physical assets: 0.613; Place-based assets: 0.821; Social assets: 0.673;* ***General Resilience: 0.410****; CO: 0.367; MA: 0.333; ME: 0.542;* Type: LLH; Prediction: pressure to move up; ***Heat-related vulnerability: High****; Human assets: High; Financial assets: High; Physical assets: High; Place-based assets: Low; Social assets: High.* ***Heat-related resilience: Low****; CO: High: MA: Low: ME: Low; Type: HLL; Prediction: pressure to move down;* ***Cold-related vulnerability: High****; Human assets: High; Financial assets: High; Physical assets: High; Place-based assets: High; Social assets: High.* ***Cold-related resilience: Low****; CO: High; MA: Low; ME: Low; Type: HLL; Prediction: pressure to move down.*	OM is 65 years old, is single and lives alone with his cat and dog. He does not have any children. He worked as a lorry driver and retired before the official retirement age due to health problems. He rates his health as good but somewhat worse than a year ago. His monthly income is low (£290-415/month). He used to have help from a food bank at his local ward but it has been cancelled for reasons he does not understand, as his financial situation has not improved and has even got worse. He lives in a top floor apartment (4^{th} floor) in an old building (100 years old) without a lift. He lives there since he was born and the house has not seen any improvements since he can remember. Most wooden windows do not have glass, letting the rain, cold and heat in. He says the house lacks insulation. Despite this, the rent is very high. The landlord is refurbishing other apartments in the building to sell them, but not his. OM has resorted to hiring a lawyer to work on his case; this is causing him anxiety and health problems. He does not have family around and lacks social contacts and activities. OM has health problems during very hot and very cold weather which limits his activities. This is due to temperatures problems in his home as it is very hot and very cold during very hot and very cold weather, respectively. He faces difficulties paying all expenses and avoids using an electric fan and heating. He knows about the Heatwave Plan but not about the Cold Weather Plan. He also lacks social contacts.	OM has in the past been surprised by the behaviour of people whom he knew well and frequently has very mixed-up feelings and ideas. He also feels that he doesn't care about what goes on around him. OM sees both very hot and very cold weather as 'seasonal' events that he has to deal with. He feels victim of his life circumstances and finds it difficult to find solutions to his problems with very hot and very cold weather as he feels he does not have enough assets to respond to the challenges they pose. He finds he can only count on himself and feels more affected and less able to respond because of this. He feels he has bigger problems in his life than very hot or very cold weather and emotionally feels drained, consequently feeling helpless and hopeless.	To OM during very hot weather is always the same as other times, with very little differences. He doesn't do anything to protect himself from the heat. He has a fan but does not use it, he just wears less clothes. He feels he can't do anything about the heat as his house is badly insulated. To keep cool outside he drinks a beer and stays in the shade. He said he doesn't need more advice or information as he knows how to protect and what to do during very hot weather, but has no means to do it. Moving to a better home, would definitely be a great improvement in his life to better deal with the heat and the cold. During very cold weather OM wears more layers of clothes and uses a heating device in the evening not because of him but because of his pets that get very cold. Sometimes he drinks a glass of wine to keep warm. At home if he is washing up he wears his coat because the house is very cold not the 18°C it should be, he said. It is very expensive for him to have the heating on as the house is very old, the ceiling are very high and lacks insulation.
Combined conclusions	OM finds it very hard to both keep cool and warm at home during very hot and very cold weather both to the lack of insulation in his home and to the inability to pay for energy bills. He has to look after himself and after his pets, as he does not have anyone and no help from public authorities.		

Figure 7.9 Participant OM combined portrait and profile

<table>
<tr><th>Findings</th><th>Vulnerability</th><th>Resilience</th><th>Adaptation</th></tr>
<tr>
<td>

General Vulnerability: 0.317; Human assets : 0.310; Financial assets : 0.517; Physical assets : 0.319; Place-based assets : 0.179; Social assets : 0.357; General Resilience: 0.705; CO: 0.700; MA: 0.583: ME: 0.833; Type: HHH; Prediction: stable; Heat-related vulnerability: High; Human assets : High; Financial assets : Low; Physical assets : High; Place-based assets : High; Social assets: Low. Heat-related resilience: High; CO: High; MA: High; Type: HHH; Prediction: stable; Cold-related vulnerability: Low; Human assets: Low; Financial assets: Low; Physical assets: Low; Place-based assets: High; Social assets: Low. Cold-related resilience: High; CO: High; MA: High; ME: High; Type: HHH; Prediction: stable</td>
<td>ZF is 79 years old, is widowed and two of her grandchildren live with her during term time as they are at University. She worked as a seamstress and she rates her health as excellent and much better than a year ago. She lives with £660-1240/month pension and despite having many expenses never had difficulties paying for housing expenses. ZF lives on the 1st floor of an old building (60 years old) and she is socially active attending several social activities at her church and at her Lisbon Ward.

ZF feels she is more affected by very hot weather and her health limits what she can do in her everyday life but that does not occur during very cold weather. She never has difficulties paying heating expenses, as her children pay it for her. Her house is hot during hot weather and she does not use a fan. She does not perceive the temperature in her home as a problem during very cold weather, as is able to keep warm at home and keep her warm. This is due to her grandchildren using heating devices. ZF is not aware of the Heatwave Plan or Cold Weather Plan. She has contact with other people every day or almost every day and attends activities at her church and at her Lisbon ward.</td>
<td>ZF finds she sees problems in the right proportion and in unfamiliar situations usually knows what to do. She does not have feels inside she would rather not feel. She is very optimistic person.

ZF finds both heat and cold predictable and are seen as challenges rather than burdens that she has to deal with. She is very positive and confident she can meet the challenges that arise through the need to engage in heat and cold adaptive behaviours. God, faith in God, and being very religious is integral to her life. She mentioned an episode when she was asleep that she heard a voice telling her to drink water, she woke up and went to the kitchen to have a glass of water and is very thankful to God. She perceives having the assets needed to deal with heat and cold, is motivated and interested in engaging in heat and cold adaptive responses.</td>
<td>ZF avoids going outside when it's both very hot and very cold. She likes to have a siesta during the day. She drinks more water and to keep cool she has many showers a day and keeps cool with a hand fan. She closes all windows and blinds during the day and during the evening opens all windows to have a draft and cool the home. In the evenings when it's very hot she wets towels and puts them over her to be able to sleep. She watches the weather forecast to protect herself better and organise her daily activities. If she knows it is going to be very hot the next day, she wakes up early to go out, for example. In her point of view individuals should be smart and intelligent and protect themselves but many people are not aware of the impacts of heat. She reads a lot and gets much information but acknowledges that many people do not read. If she is alone at home she wears less clothes and outside wears natural fibres like linen which are cooler. When her grandchildren are home they use fans, but she doesn't like fans, but they spend most of summer in their parents' home.

During very cold weather ZF puts a hot water bottle in bed before she goes to sleep. Her grandchildren use heating devices in their rooms, but she does not like. The electricity bill is very high but her children pay it. ZF's grandchildren are always cold indoors and have heating devices in their rooms that warm the whole house, despite her not liking heating devices. Outdoors she wears a scarf and a coat with a hoody as she does not like hats.</td>
</tr>
<tr><td>Combined conclusions</td><td colspan="3">ZF finds that her grandchildren suffer more with both heat and cold than she does. They frequently use fans and heating devices to keep cool and warm, respectively. As her children pay the energy bills she does not worry about how much it costs. The home is thus kept cool and warm if her grandchildren are home, but during summer they are not there and she does not use fans.</td></tr>
</table>

Figure 7.10 Participant ZF combined portrait and profile

The figures above (Figures 7.5-7.10) recognise the individuality of participants' circumstances. There is significant individual variability and distinctiveness in vulnerability, resilience and adaptation circumstances between participants which is lost when looking at the whole sample data. These portraits and profiles are thus presented to demonstrate personal circumstances on vulnerability, resilience and adaptation to extreme temperatures taking into account their general vulnerability and resilience circumstances. The data contains great diversity of vulnerability and resilience combinations, and adaptation strategies which help in the understanding and need for development of person-centred strategies and actions for reducing vulnerability, increasing resilience and improving adaptation to extreme temperatures (see Section 8.6).

7.5 Conclusions

This chapter has integrated and discussed the results of combined general and specified vulnerability, resilience and adaptation to extreme temperatures. The approach taken in this chapter in presenting a combined analysis of participants' vulnerability, resilience and adaptation is novel and a contribution to knowledge in the sense that it allows an integrated discussion of the roots and drivers of vulnerability and resilience for understanding adaptation to heat and cold. Participants revealed diverse combinations of vulnerability-resilience and adaptation actions. First, participants revealing comparatively lower levels of vulnerability and higher levels of resilience presented better ways of responding to both heat and cold. Second, participants comparatively demonstrating relatively higher levels of vulnerability and lower levels of resilience were more likely to reveal narrow and limited strategies and responses to both heat and cold. Third, participants revealing somewhat higher vulnerability and resilience felt hope that they would be able to actively respond to heat and cold, despite not having all the assets needed to do that. Fourth, participants demonstrating relatively low vulnerability and resilience were uncommon in this study, and were more likely to be anxious and at the same time show apathy towards acting.

The levels of vulnerability and resilience convey important bases for: targeting at-risk older people (high vulnerability & low resilience); developing vulnerability reduction actions (high vulnerability & high resilience); resilience building actions (low vulnerability & low resilience), and; understanding 'success cases' (low vulnerability & high resilience) and learn from them for developing appropriate policy measures. Generally, planned adaptation options were implemented by low vulnerability & high resilience participants, whilst autonomous adaptation options were more common within other participants. Participants also commented on the links between vulnerability, resilience and adaptation with social justice, equity and austerity, especially to whether participants or trusted ones have the scope to reduce their vulnerability (assets portfolio), enhance resilience (comprehensibility, manageability and meaningfulness) and improve adaptation.

Chapter 8 - Discussion and Conclusions

8.1 Introduction

This concluding chapter discusses the key findings of this research in relation to the literature to understand what shapes human general and specified (i.e. heat- and cold-related) vulnerability and resilience, as well as adaptation to extreme temperatures through an interdisciplinary and multimethodological approach, implementing the conceptual and analytical framework developed in Chapter 2 (Figure 2.2) by addressing the following research questions:

1. Do different assets affect general, extreme heat and extreme cold vulnerability of older people? If so, what are their effects and how do they occur?

2. How are general, extreme heat and extreme cold resilience of older people shaped?

3. What does adaptation to extreme heat and extreme cold look like in practice?

4. How do vulnerability and resilience interplay with adaptation to extreme temperatures and what is the nature of these relationships?

This chapter begins by discussing the main findings of this research (Section 8.2). This is followed by exploring the limitations of this study (Section 8.3) and drawing theoretical and methodological contributions and implications (Section 8.4). It then presents prospects for future research arising from this study (Section 8.5) and draws conclusions on the implications of the findings for policy and practice (Section 8.6). The chapter then closes with some concluding remarks (Section 8.7).

8.2 Main findings of this thesis

This section discusses the empirical findings presented in Chapters 4 to 7, answers the four research questions and indicates were this research advances beyond the current literature.

8.2.1 Vulnerability

Research question 1. Do different assets affect general, extreme heat and extreme cold vulnerability of older people? If so, what are their effects and how do they occur?

Chapter 4 presents the findings of this question and the first central finding of this thesis: that the levels of vulnerability differ between older people as access to and availability of assets shape vulnerability. Additionally, the majority of participants had low general vulnerability (Section 4.5.1), high heat-related vulnerability (Section 4.5.2) and high cold-related vulnerability (Section 4.5.3).

- **General vulnerability**

Older people expressed a moderate general vulnerability, with different assets affecting how general vulnerability is expressed. Greatest vulnerability was found from financial assets, followed by physical assets, social assets, human assets and lastly on place-based assets. It is clear from the findings that having a pension as the only source of income was the major contributing factor to financial assets vulnerability, especially for those older people with low pensions (Section 4.3.2).

The greatest contributors to physical assets vulnerability included living in buildings without lifts, in apartment buildings, and in old houses. Not owning a car, computer, being a tenant and not feeling happy with living conditions also contributed to moderate physical assets vulnerability (Section 4.3.3). In another study in Lisbon many older adults also lived in rented and old houses in need of refurbishments, (Villaverde Cabral et al., 2011).

Additionally, social assets vulnerability was greatly influenced by the lack of participation in voluntary and charitable social activities (Section 4.3.5). According to a study in Lisbon, their findings showed that two thirds of older people have never taken part in voluntary and charitable activities (Villaverde Cabral et al., 2011).

The analysis also showed that participants were moderately vulnerable regarding human assets. Major contributing factors included having had lower supervisory and technical, semi-routine and routine occupations, as well having never worked; living alone, and; having no formal education (Section 4.3.1). Some studies in the city of Lisbon found lower percentages of older people living alone, than what was found in this research. The Census 2011 found that 26.9% of older people (65 year or more) lived alone (INE, 2011) and Villaverde Cabral and colleagues report a sample in which 15.9% of older people (Villaverde Cabral et al., 2011). This latter study also found that the majority of older people had no formal education and many never worked (Villaverde Cabral et al., 2011).

Lastly, lack of access to amenities (e.g. cinema, theatre, cultural centre), post office and public transport facilities close to home were the greatest contributors to place-based assets vulnerability. The low quality of public services provision for older people in general were also contributors (Section 4.3.4).

- **Heat- and cold-related vulnerability**

Older people's human assets vulnerability to heat and cold were mainly shaped by pride in being independent and fear of losing physical and mental abilities (Section 4.3). These findings confirm those of Klinenberg (2002), Vandentorren et al. (2006) and Bouchama et al. (2007), in the US, France and internationally, respectively, who found that lack of mobility was a factor increasing vulnerability to heat. The fear of falls inside the home and outdoors when the pavement is wet and slippery, as well as becoming incapacitated as a result, were frequently mentioned regarding extreme cold. These findings confirm suggestions in the literature that accidents and injuries are contributors to vulnerability, having been linked to low thermally efficient housing and low indoor temperatures, for example in the UK (e.g. Marmot, 2011). Changes in living arrangements, including co-habitation with their children, posed additional constraints for older people, both related to economic (financial assets) and motivational (resilience) considerations.

Illiteracy was mentioned as a factor constraining older people's options and decision making in responding to extreme temperatures, being generally associated with participants' level of education. These results are comparable to those presented by Huisman and colleagues (2005), Wilhelmi and Hayden (2010) and Benzie and colleagues (2011), in Western Europe, internationally and in the UK, respectively, who outlined low level of education as a factor that increases vulnerability to extreme heat. Opportunities to learn more about extreme temperatures (e.g. lifelong education and activities for older people) were welcomed by participants to improve their response to extreme temperatures (adaptation).

As found in the literature, chronic health conditions such as asthma, diabetes, cardiovascular, respiratory and cardiovascular diseases are factors deemed to increase individuals vulnerability to cold in Europe, UK, and internationally (e.g. Analitis et al., 2008; Geddes et al., 2011; Ebi and Mills, 2013, respectively). Additionally, the findings of a recent study in Portugal found an association between cardiovascular mortality and extreme cold (Vasconcelos et al., 2013). Participants mentioned that older people should receive individualized and personalized advice on how to protect themselves from the health impacts of extreme temperatures.

The analysis also revealed that both financial assets vulnerability to heat and cold resulted from increasing electricity, gas and water costs. Participants' financial situation influenced how they prioritized the need to use cooling and heating devices, their motivation to do so (resilience) and how they responded to extreme temperatures (adaptation). These results are comparable to those presented by Sheridan (2007) in the US who argues that individuals only use cooling devices (e.g. air conditioning) (physical assets) if they feel they are able to afford using them. This supports other intenational and US research indicating a relationship between low income and increased risk of experiencing impacts from extreme heat (e.g. Confalonieri et al., 2007; Balbus and Malina, 2009; Wilhelmi and Hayden, 2010). These findings also support suggestions that economic reasons can be one of the drivers of cold homes because of older people's inability to afford warmth (e.g. Marmot, 2011). Low income is considered to be a factor that greatly increases the vulnerability to cold in Europe and New Zealand (e.g. Healy, 2003; O'Sullivan et al., 2011; Hales et al., 2012).

The economic crisis in Portugal may also have resulted in lower consumption of electricity as individuals are more aware and concerned about the costs of using electrical devices to keep cool and warm (Schmidt et al., 2014). The same study also highlighted that such reductions in consumption of energy differed according to income. The financial situation of most participants also made it difficult to insulate their home (see physical assets vulnerability, bellow). Despite this, most participants did not want to ask for help from their social contacts (see social assets vulnerability, bellow).

Older people also had financial difficulties with keeping their homes cool in summer, which was also found in the US literature (e.g. Sheridan, 2007). However, in this research, extreme cold proved to constitute a bigger perceived threat than extreme heat due to increased financial burden in keeping the home warm (adaptation). In addition, these findings confirm suggestions that low incomes impede older people's access to other types of assets, such as physical and place-based assets, as found in the UK (Dominelli, 2013) and that improvements in poverty alleviation would reduce winter mortality as well as other impacts of extreme cold in Europe (Healy 2003).

The findings also highlight that physical assets vulnerability to heat and cold was related to the lack of insulation in participants' homes, being one of the reasons for having problems with hot and cold temperatures due to financial constraints (see financial vulnerability, above). As a result, many participants were not able to keep their homes cool and warm (adaptation), respectively. The findings of this study confirm those of Vandentorren et al. (2006), Confalonieri et al. (2007) and Benzie et al. (2011), in France, internationaly and in the UK, respectively, who found that poor housing conditions (including poor insulation) contributed to vulnerability to heat. Lack of insulation was also a reason for not using cooling and heating devices as it was thought to be a waste of money (financial asset) as the coolness and warmth would only be momentary. These findings also call for action as a cold and damp house with poor thermal efficiency, lack of insulation, high levels of damp, fuel poverty and lack of heating can increase the risk of death when associated with other factors (e.g. age, health status), research in Europe, internationally and in the UK suggests (Healy, 2003; Mercer, 2003; DoH, 2010, respectively). Research on the impacts of cold in Portugal are still scarce but recent findings have highlighted poor housing conditions as reasons for difficulties in keeping the home warm (Vasconcelos et al., 2011; Vasconcelos et al., 2013).

Living on both the top and ground floor of buildings was also thought to be a reason for having more difficulties in both keeping cool and keeping warm. Living on the top floor of a building was also found to be a factor increasing vulnerability to heat in the work conducted by Semenza and colleagues (1996) in the US, as well as Vandentorren and colleagues (2006) in France. Participants renting their homes found it difficult to get their landlords to improve their homes, and owners faced financial constraints (financial assets) to do so. It supports the argument posed by Huisman and colleagues (2005) as well as Benzie and colleagues (2011) that being a tenant increases the vulnerability of individuals to extreme heat, in Western Europe and the UK, respectively. The results are also comparable to those presented by Hales and colleagues (2012) who found that being a tenant was a factor contributing to vulnerability to cold, in New Zealand.

The results in this research certainly suggest that improvements in housing conditions would reduce cold-related health impacts, as found in several European countries (e.g. Healy, 2003). Some participants would like to have these devices but considered them to be very expensive to buy and run (financial assets). In the US, Sheridan (2007) found that owning air conditioning reduced exposure to heat if older people felt able to afford using it.

This research also found that <u>place-based assets vulnerability</u> to heat and cold was linked to participants' difficulty in accessing local infrastructure and amenities due to mobility problems (human assets), distance from their homes and lack of public transport, as well as not having company (social assets). These were then found to have implications for adaptation. Such findings confirm suggestions in the literature, both worldwide and in the UK that urban location and characteristics of the area where older people live impact access to public facilities (Hajat et al., 2007; O'Neill et al., 2009; Benzie et al., 2011; Wistow et al., 2013). It also supports the argument posed by Semenza and colleagues (1996) in his research in the US that not having access to transport is a contributing factor for increased vulnerability to heat.

Using public green spaces (e.g. parks) or their own house gardens were the most cited behaviours to keep cool (adaptation). Lack of shade, lack of trees and safe places close to where they lived were barriers to keeping cool outside. These results support those of Vandentorren and colleagues (2006) as well as Benzie and colleagues (2011) in France and the UK, respectively, which also demonstrated that lack of green spaces increases the vulnerability of individuals to extreme temperatures. The literature in Europe, internationally and in the US also suggest that urban location and characteristics of local environments can increase older people's vulnerability to cold (e.g. Eurowinter, 1997; Barnett et al., 2005; Gerber et al., 2006, respectively). In the UK, Dominelli (2013) argues that weak social networks (social assets) can also have a negative impact in accessing built infrastructure. Some participants had access to some land either in their home garden, in an allotment they rented or in the countryside and mentioned working there during the hottest parts of the day and during very cold weather, which may adversely affect their health (human assets) but enabled them direct access to food, alleviating some of their financial difficulties (financial assets) and perceived vulnerability to cold.

Participants who were regularly visited and supported by family and close neighbours had lower social assets vulnerability to heat and cold. These findings agree with those of Wistow and colleagues (2013) that found that older people were mostly supported by their family and neighbours during extreme weather events (e.g. extreme temperatures). However, they contrast with the findings in Wolf and colleagues (2010) about the role of social networks in the UK. Being part of their ward's activities (place-based assets) helped older people in Lisbon to connect with the staff from the ward and older people but lack of friends or close neighbours were found to be barriers for responding to heat (adaptation). Indeed, the research in this thesis established that most participants found it hard or even impossible to ask for help from their social networks despite having financial difficulties (financial assets) and not being able to keep cool or warm in their homes (physical assets). These findings support those of Semenza et al. (1996) and Klinenberg (2002) in the US on the effect of social isolation in heat-related mortality, and that by Benzie and colleagues (2011) in the UK on how lack of social capital and networks contribute to increased vulnerability to heat. These findings also support those of Dominelli (2013) in the UK on the impacts of poor social networks on access to other types of assets (e.g. financial and physical assets).

Only a minority of participants perceived themselves as vulnerable to extreme temperatures (Section 4.4.5). These results are comparable to those presented by Abrahamson and colleagues (2008), Hitchings and Day (2011) and Tod and colleagues (2012) in the UK who found that older people do not see themselves as old and frail, and do not perceive themselves at risk from extreme temperatures in Australia (Loughnan et al., 2013; Nitschke et al., 2013; Hansen et al., 2014).

Despite this, the majority of participants were well aware of the health risks extreme temperatures pose to human health (Section 4.4.3) and were able to identify vulnerable groups which included older people, frail or ill individuals, those living in hot homes, poor or unemployed, among others (Section 4.4.6). However, they did not relate these risks to themselves. As a result, the lack of recognition of being at risk prevented them from taking action.

These results support international suggestions in the climate change literature that assets play a crucial role in human vulnerability (Haq et al., 2008) and that older people face restrictions in availability and access to assets with impacts in their levels of vulnerability (Filiberto et al., 2009). Notwithstanding, this study takes an interdisciplinary and holistic approach to vulnerability by investigating all five types of assets which is novel in a climate change and developed country context. Exploring both general and specified vulnerability of individuals also contrasts with other research on vulnerability that tends to focus on vulnerability to climate change and does not take into account how general vulnerability is influenced by specific threats such as extreme temperatures. As a result, the development of the general vulnerability index (GVI) and assessments of heat-related vulnerability (HRV) and cold-related vulnerability (CRV) represent a contrasting approach with the existing literature. The bespoke GVI and GRI developed in this research contribute to tackling a gap in assessments to measure and elicit human vulnerability and resilience. In this thesis they served to achieve a better understanding of what shapes vulnerability and resilience bringing together various disciplinary perspectives. Both indices here developed are novel and useful to advance both theoretical and empirical knowledge in the vulnerability and resilience literature.

8.2.2 Resilience

Research question 2. How are general, extreme heat and extreme cold resilience of older people shaped?

Chapter 5 presents the findings of this question and the second central finding of this thesis: that most participants found life in general, extreme heat and extreme cold as being predictable, and explicable (comprehensibility), to which they had (general and extreme heat) / did not have (extreme cold) assets available to deal with (manageability) and in which they invested their energy in order to be able to respond to it (meaningfulness). The vast majority of participants revealed having <u>high general resilience</u> and scored high on meaningfulness, manageability and comprehensibility (Figure 5.5). Additionally, the majority of participants revealed <u>high heat-related resilience</u> (Section 5.4.2) and were also high in heat-related comprehensibility, manageability and meaningfulness. The majority of participants revealed low cold-related resilience (Section 5.4.3) and revealed high cold-related comprehensibility, low cold-related manageability and half of the participants revealed high cold-related meaningfulness.

- **General resilience**

Older people had a mostly high general resilience, which was found to be related to participants' high levels of meaningfulness (which translated into investment, engagement and commitment in dealing with the problems and challenges they faced in their lives), high level of perception that assets were available to them to face the problems and challenges in their lives (manageability). Regarding comprehensibility, there was a widespread belief among the study participants that the problems and challenges in their lives were structured, ordered, explicable and understood (Section 5.2.1 and Table 5.1).

- **Heat- and cold-related resilience**

This research findings highlight that older people largely had a structured, expected and explicable understanding of the occurrence of extreme heat and cold temperatures in their lives (i.e. high comprehensibility). The vast majority of participants showed high comprehensibility to heat and cold and found extreme temperatures as predictable, expected and not a surprise to them. They were able to make sense of the challenge heat and cold posed to them mainly because they had experience in dealing with it. On the other hand, those participants with low comprehensibility to heat and cold found extreme temperatures to be uncertain, inexplicable, uncontrollable and 'chaotic', adding high levels of stress to their lives. These participants were unable to make sense of the challenges extreme temperatures posed and found it extremely difficult to respond to (adaptation).

Participants with high manageability to heat and cold (57.7% and 32.6%, respectively) perceived having control of assets, or that these assets were under the control of trusted others, making them accessible when necessary. They found these sufficient to deal with extreme heat and cold. Participants with low manageability to heat and cold (42.3% and 67.4%, respectively) revealed not having enough assets to effectively respond (adaptation) and felt they could only count on themselves. These participants felt like victims of extreme temperatures, as they felt more affected by them, less able to deal and respond to them. Overall, responding to extreme cold was more challenging for participants than extreme heat as they found they needed more assets to be able to keep warm (e.g. financial, physical and place-based assets). The findings of this study support suggestions in international and Asian studies that the access to and availability of assets plays a determinant role in the resilience of individuals in adapting to climate change (Haq et al., 2008;

da Silva et al., 2012; Pelling et al., 2012; Traerup, 2012; Royal Society, 2014). The results are also comparable to those presented by Haq and colleagues (2008) who argue that having physical and financial as well as social assets (e.g. social contacts and networks), place-based (e.g. transport) and human assets (e.g. knowledge) contributes to the resilience of older people in adapting to climate change.

Research participants with high meaningfulness to heat and cold (67.3% and 50.0%, respectively) were motivated and interested in adapting to extreme temperatures as they were aware of the demands and challenges they posed to them and had already engaged or invested in adaptation behaviours and felt able to adapt. Participants with low meaningfulness to heat and cold (32.7% and 50.0%, respectively) felt that extreme temperatures posed a burden to their lives and perceived they were not able to emotionally make sense of it. They avoided thinking about extreme temperatures and felt unable to do anything about them (Section 5.3).

The findings obtained in this research on both general and specified resilience integrate different strands of research into human resilience; this contrasts with other research on resilience to climate change which tends to be disciplinary (e.g. mainly psychological, economic or human development perspective). Furthermore, the use of the sense of coherence approach provides a more inclusive perspective that considers cognitive, behavioural and motivational components on the diverse factors and circumstances shaping resilience. Moreover, the development of a general resilience index (GRI) and qualitative assessments of heat-related resilience (HRR) and cold-related resilience (CRR) assessments are novel and also contrast with other literature that investigates resilience as an overall static capacity of individuals. The advantages of using the GRI, HRR and CRR is that they allow explorations of the factors shaping general, heat- and cold-related resilience and understand the factors that shape human resilience.

Additionally, they can also be adapted to other threats, shocks and events which constitutes a broad contribution of this thesis. Researchers and academics should consider the use of such metrics to measure (i.e. GRI) and elicit (i.e. HRR and CRR) human resilience as they constitute a comprehensive approach to resilience that can help the development of policies and actions for increasing resilience to an array of circumstances. Despite having been developed in the late 1970s by Aaron Antonovsky in the field of health, the use of the Sense of Coherence approach is still limited. This may be due to disciplinary boundaries that make the SOC unexplored in other disciplinary contexts and applied only in war settings, chronic diseases and life threatening health conditions. Moreover, some new progress has been made and the SOC has been recently used to measure human resilience in the aftermath of Hurricane Katrina in the US (Glandon et al., 2008). This represents a new development in using the SOC but more needs to be done to make its use more frequent. As a result, therefore this research represents a novel contribution to using the SOC in the context of extreme temperatures. An additional novel contribution of this thesis is the development of qualitative elicitation of specified resilience to extreme temperatures based on the SOC scale (i.e. quantitative measure of resilience) which had not yet been done before.

8.2.3 Adaptation

Research question 3. What does adaptation to extreme heat and extreme cold look like in practice?

Chapter 6 presents the findings of this question and the third central finding of this thesis. Responding to **extreme heat** was found to be 'common sense' and 'normal' to older people (Section 6.2), as they had responded to extreme heat many times in the past. These results support those of Wolf and colleagues (2010) in the UK and of Nogueira and colleagues (2005b) in Portugal. These findings could have two interpretations, one related to pro-active adaptation behaviours, or one related to expressions of constraints or limits to adaptation hiding underlying vulnerabilities and low levels of resilience (see Section 8.6). Participants revealed engaging in more than one adaptation strategy to respond to extreme heat inside their homes and outdoors, both during the day and evening/night (Table 6.1) which included an array of behaviours. Despite this, not all behaviours were found to be protective. For instance, despite the limited use of electric fans they were potentially harmful as participants used fans and kept all windows closed increasing air movement but also the temperature in their homes. The use of electrical devices to keep cool was further reduced both due to unavailability of such devices (physical assets) and also the costs associated to their use (financial assets).

Herein lies also another important contribution of this thesis: to date there have been no studies in Portugal exploring adaptation to **extreme cold**. Older people in this study, with regard to extreme cold, adopted behaviours similar to those adaptation strategies found in the UK and Austria, including wearing warmer, thicker, more layers of clothes both indoors and outdoors (e.g. Wolf et al., 2010; Day and Hitchings, 2011; Hitchings and Day, 2011; Anderson et al., 2012; Brunner et al., 2012); use hot water bottles (e.g. Day and Hitchings, 2011; Anderson et al., 2012); put blankets over legs (e.g. Hitchings and Day, 2011; Brunner et al., 2012); among others (see Table 2.8 for more details). Until now, there have been no studies in Portugal exploring older people's adaptation to extreme cold.

Some participants in this research had misconceptions about detrimental health effects of using cooling and heating devices and fears regarding safety in using electrical and gas devices. As such, participants would welcome information on the best adaptation options. On the other hand, the price of electricity was one of the most mentioned factors that constrained adaptation. Problems using cooling devices (e.g. air conditioning), costs associated with using cooling technologies were also found to be barriers to adaptation in the work conducted by Hansen and colleagues (2011).

Beliefs and misunderstandings in keeping warm were among the most common constraints and limits to adaptation, as most participants did not like using heating devices due to potential detrimental health effects (e.g. only heating one room in the house would be worse for health as differences in temperature could cause colds and pneumonia) (human assets). For example, Brunner and colleagues (2012) in Austria, as well as Tod and colleagues (2013) in the UK argue that social, cultural and financial factors are both enablers and barriers to adaptation to heat. Additionally, in the Portuguese context, Schmidt and colleagues (2014) have found that generation effects exist in Portugal when it comes to energy consumption and saving, with older generations being thriftier due to experiences of scarcity and family financial difficulties in the past. Such past experiences may according to the Schmidt et al. (2014) helped deal with the current economic crisis the country faces and reduce the consumption of energy for money saving reasons.

Fears of gas and electrical problems in the home (physical assets) were also found to be reasons for not owning or using such devices. The prices of electricity and gas were one of the most frequent mentioned factors that constraint adaptation to cold (financial assets). Followed by housing quality and characteristics, such as lack of insulation (physical assets). The literature in the UK and Austria suggests that fuel poverty (e.g. Anderson et al., 2012; Tod et al., 2012) and low income (e.g. Anderson et al., 2012; Hansen et al., 2014) greatly limit the options for adaptation to cold. Energy-inefficient homes and high costs to purchase and use heating devices were also found to limit adaptation to cold in the UK (Wright, 2004; Fuller and Bulkeley, 2013). The findings of this research support those of Tod and colleagues (2012) which also demonstrated that situational or context factors such as income and housing characteristics, as well as attitudes, values and beliefs such as thrift, pride, privacy and independence were found to influence older people's adaptation to extreme cold in the UK. As a result of extreme cold participants mentioned spending more time at home, despite the home being cold, which also contributes to social isolation (social assets).

The findings of this research contradict most of the work in the US and the UK that advocates that more information and advice in the media (i.e. for the general population) is crucial for raising awareness of the risks extreme temperatures pose to the health of older people and for improving protective behaviours (e.g. White-Newsome et al., 2011; Yardley et al., 2011; Tod et al., 2012; Sampson et al., 2013), which represents only a partial solution. Here, it was found that personalised and individualised advice focused on individual characteristics is preferred by older people. However, this does not mean people will act on this information, even if it is formatted according to their preferences. In this research, this was the case as older people had information but did not have the means (assets) to do so.

8.2.4 Interplay between vulnerability, resilience and adaptation

Research question 4. How do vulnerability and resilience interplay with adaptation to extreme temperatures and what is the nature of these relationships?

Chapter 7 presents the findings of this question and the fourth central finding of this thesis: that the levels of combined vulnerability and resilience differ between older people, vulnerability was found not to be a key determinant of resilience, and both vulnerability and resilience were found to be key determinants of adaptation.

- **General vulnerability and general resilience**

This research provided evidence that the great majority of participants fell into the high general resilience group revealing, despite their levels of general vulnerability (low or high), an overall capacity to access the assets available to them, making sense of threats, having feelings of confidence in their lives and ability to act (i.e. high resilience) (Figure 8.1). The analysis also showed that participants with 'high vulnerability & low resilience' faced greater restrictions due to lack of human assets, financial assets, social assets, and to a lower extent lack of physical and place-based assets (Figures 7.2 b) to f)).

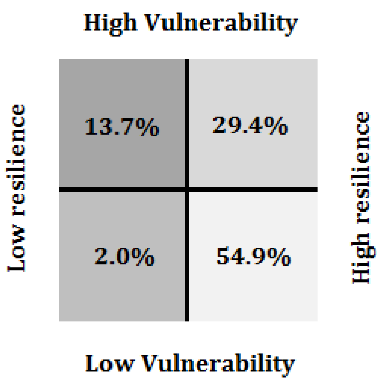


Figure 8.1 Percentage of participants in each overall general vulnerability & general resilience quadrant (modified from Figure 7.2 a))

Overall, assets were found to be a key determinant of vulnerability and resilience. Vulnerability was found not to be a key determinant of resilience (Figure 8.2), as participants showed diverse combined levels of vulnerability and resilience.

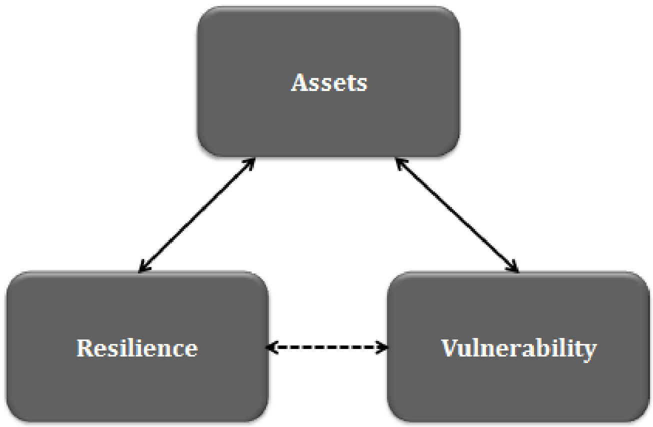


Figure 8.2 Relationship between general assets, general vulnerability and general resilience.

Legend: full arrows represent key determinant relationships; dotted arrow represents a non-key determinant.

Relationships between assets and vulnerability have been explored in sociology for more than three decades (Sen, 1981; Chambers, 2006; Moser, 2011), with an emphasis on the role of inequitable access to assets as sources of vulnerability (Sen, 1981; Sen, 1999). In the disasters literature, access to assets is seen as an important factor in understanding vulnerability (Birkmann et al., 2010). The health literature has also started to show growing interest in understanding the contributing factors to vulnerability, including assets (Morgan and Ziglio, 2007; Marmot, 2011; Marmot, 2013). Despite this, few interdisciplinary studies have been implemented for understanding the role of assets in shaping vulnerability (Fussel, 2007a). As a result, the work in this thesis draws from these existing literatures and introduces a novel interdisciplinary and empirical perspective to understanding the role assets play in shaping vulnerability.

The relationship between resilience and assets has been to date less studied; in the disaster and human development literatures, some authors have highlighted the influence between the resilience of individuals and the places where they live (Luthar et al., 2000; Brown and Westaway, 2011; Romero-Lankao et al., 2012). In exploring this relationship, the results of this thesis show a strong link between access to assets and resilience, which has also been highlighted by the Royal Society (2014). In contrast, however, findings of studies relating vulnerability to resilience have been diverse and less clear cut, with some authors asserting that reducing vulnerability is essential for increasing resilience (e.g. Keim, 2008). However, this research has found that being more vulnerable does not imply being less resilient. Some aspects of vulnerability do affect one dimension of resilience (manageability) but vulnerability is not a key determinant of resilience. These findings emerge from this research because it has used a different approach focusing on broad aspects of vulnerability and resilience, and used particular metrics to elicit these (i.e. GVI and GRI).

- **Vulnerability, resilience and adaptation to extreme temperatures**

This research reports findings on vulnerability to extreme temperatures showed it was primarily shaped by individual characteristics and the places where participants lived (e.g. housing, neighbourhood and ward) (i.e. assets). In addition, an array of adaptation strategies to deal with extreme temperatures were used by research participants. Despite this, they found constraints and limits to adaptation mainly resulting from their high vulnerability and low resilience (Table 7.1). Furthermore, participants also found opportunities to improve their responses to extreme temperatures which implied increasing their asset portfolio for reducing their vulnerability and increasing their resilience (see below Section 8.6).

This research found that the distribution of participants within the <u>extreme heat </u>vulnerability-resilience matrix is not uniform: a high percentage of participants had overall heat-related 'high vulnerability & low resilience' (Figure 8.3 modified from Figure 7.3 a)); these are considered to be the most threatened by extreme heat as: a) they lack assets (high vulnerability) and; b) they have limited understanding and/or; c) feel they are limited in the assets needed to respond and/or; d) they lack the motivation to act (low resilience).

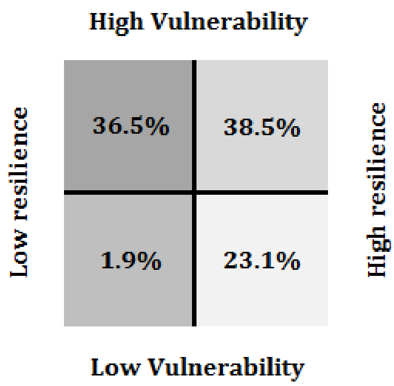


Figure 8.3 Percentage of participants in each heat-related vulnerability & heat-related resilience quadrant (modified from Figure 7.3 a))

The biggest proportion of participants were characterised by ‘high vulnerability & low resilience’ (52.2%) to extreme cold (Figure 8.4 modified from Figure 7.4 a)); these are at high risk from extreme cold as they lack assets, have limited understanding and/or perceive they lack assets to adequately respond and/or lack the motivation to act.

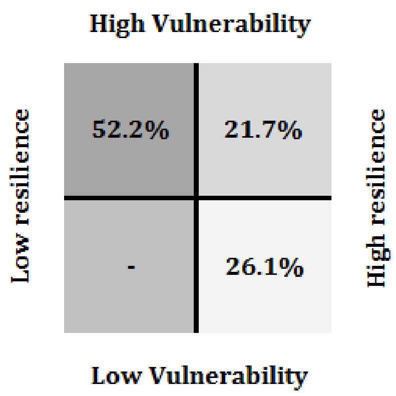


Figure 8.4 Percentage of participants in each cold-related vulnerability & cold-related resilience quadrant (modified from Figure 7.4 a))

Overall, assets were found to be a key determinant of heat- and cold-related vulnerability, resilience and adaptation. Vulnerability was found not to be a key determinant of resilience, which is mostly influenced by an understanding of the challenges posed by threats and feeling motivated to act, thus being a key determinant of adaptation (Figure 8.5).

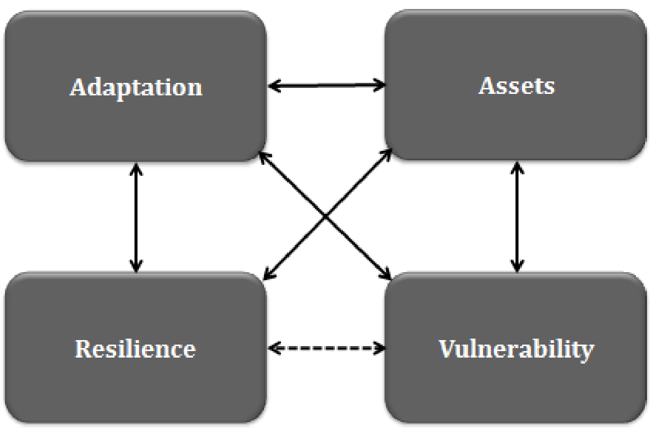


Figure 8.5 Relationship between heat- and cold-related asset, vulnerability, resilience and adaptation.

Legend: straight arrow represents being a key determinant and dotted arrow represents not being a key determinant.

Few have been the empirical studies investigating the relationships among the concepts of vulnerability, resilience and adaptation to extreme temperatures (e.g. Deschenes, 2013), having mainly focused on one of the concepts in isolation or on combinations of two concepts (i.e. assets and vulnerability, vulnerability and adaptation, resilience and adaptation). More recently, a growing number of studies from diverse disciplines have explored the theoretical links between these concepts (e.g. Berkes, 2007; Nelson et al., 2007; Vogel et al., 2007; Miller et al., 2010; Turner, 2010). The literature indicates that different types of assets are key determinants of vulnerability to extreme temperatures (see Tables 2.2 and 2.3). As an example, in their work on heatwaves and adaptation, Wolf and colleagues (2010) found that social assets (i.e. social capital) influence older people's adaptation and assert that social assets may enhance resilience. Research undertaken by Wilhelmi and Hayden (2010) for example has suggested that adaptation to extreme heat can reduce vulnerability and as a result reduce the health impacts of extreme heat. In addition, the IPCC (2014a) has asserted that reductions in vulnerability will result in improved adaptation, as well as increasing resilience, whilst at the same time increasing assets.

This research agrees with the literature, on the role access and availability of assets play in adaptation to extreme temperatures. However, this research has found that vulnerability is not a key determinant of resilience. This is based on the finding that assets have an important role in one of resilience dimensions (manageability) but not in the other two dimensions (comprehensibility and meaningfulness); and in fact participants revealed diverse levels of combined vulnerability-resilience (Sections 7.3.1-7.3.3). Furthermore, the work in this thesis is in agreement with the literature asserting that older people's resilience is an enabler for adaptation (Conlon et al., 2011; Hansen et al., 2011).

Thus, this research contributes to a better understanding of human general and specified (i.e. extreme temperatures) vulnerability and resilience, as well as adaptation to extreme temperatures by building an integrated framework. This research has highlighted the role assets play in shaping human vulnerability, resilience and adaptation. Access to and availability of assets determine the vulnerability, resilience and adaptation of older people. This research also found that vulnerability is not a determinant of resilience, as older people showed great diversity of combined vulnerability and resilience (see Chapter 7). Whilst vulnerability is determined directly by access to and availability of assets, resilience is determined by the ability to make sense of the threat extreme heat and cold pose (comprehensibility dimension), the motivation to act and respond (meaningfulness dimension) and the perception that assets are available for one to use to respond to the threat extreme heat and cold pose (manageability dimension). As a result, individuals may be vulnerable and at the same time resilient to extreme healt and cold. However, adaptation is determined by both vulnerability and resilience. This thesis challenges previous theoretical perspectives, suggesting that increasing assets is essential to reduce vulnerability, increase resilience and improve adaptation (see Sections 8.4 and 8.6).

The work in this thesis also highlights the importance of undertaking more integrated studies and assessments of vulnerability, resilience and adaptation, which builds upon the more singularly focussed analyses of vulnerability, resilience and adaptation found in most research to date.

An important contribution of this thesis is also in the similarities of the relationships between assets, vulnerability, resilience and adaptation to extreme heat and extreme cold found in this empirical research; these suggest some common lessons regarding these two expressions of extreme temperatures can be derived from this work – they are discussed below (Section 8.4 and 8.6).

The following section discusses the limitations of this study; sections 8.4 to 8.6 then outline implications for theory, as well as policy and practice.

8.3 Limitations of this study

This thesis has accomplished its aim of investigating general and specified (i.e. heat- and cold-related) human vulnerability and resilience, as well as adaptation to extreme temperatures, providing an overall picture of how vulnerability, resilience and adaptation are shaped and the links between them. It has shown the role assets play in reducing vulnerability, building resilience and improving adaptation to both extreme heat and extreme cold. Inevitably, this research has also encountered some limitations and challenges. These are discussed here, in relation to the theoretical and methodological choices implemented, as well as the findings.

The justification for using a general and specified approach to both vulnerability and resilience, as well as a focus on adaptation to extreme heat and extreme cold was based on a review of the literature (see Chapter 2). This offered the opportunity to measure and compare the findings on general circumstances and specified threats. A related limitation is the focus on extreme heat and extreme cold, but not on other stresses, shocks or threats; this would have enabled broader comparisons of factors shaping vulnerability and resilience to other specified threats to human health.

The implementation of an inter-seasonal case study in this research meant that to answer the research questions at the individual level required a researcher-intensive methodology, with the implementation of three distinct research phases, which limited the number of participants and also meant greater efforts in ensuring that a high number of participants could be followed-up in all phases of the research. The benefit of interviewing the same participants during the inter-seasonal interviews allowed the creation of an emotional connection with participants, resulting in high levels of engagement and very low drop-out rates between Phase 1 and Phase 2 (0%), and between Phase 2 and Phase 3 of the research (11.5%), respectively.

Another limitation of this study is the focus on the individual, rather than the community, the region or the nation. Researching at the individual level may not give a whole picture of what is happening at higher levels which may influence the vulnerability, resilience and adaptation of individuals. However, this research implemented a strategy aimed at overcoming such issues by using a holistic approach where the individual was considered to be part of a community, region and nation, which included efforts to explore physical assets (i.e. housing type, housing tenure, housing quality, appliances, telecommunication, access to transport), place-based assets (i.e. health and care infrastructures, green spaces, access to amenities and services) and social assets (i.e. social relationships, contacts, networks, connectedness, membership of groups and associations, relationships of trust, support, reciprocity and exchanges). Furthermore, the focus of this research on the city of Lisbon has an intrinsic limitation due to its particular context and characteristics (see Chapter 3), which could be overcome with future research in other geographical settings (within Portugal and between other countries) as discussed in Section 8.5.

While assets are not widely used in developed country contexts to assess human vulnerability, possibly due to lack of interdisciplinarity and use of concepts from other disciplines and operationalise them accordingly, there are explicit benefits to doing so. The development and validation of the general vulnerability index (GVI) based on assets (as outlined in chapter 4) has been used before in the context of development studies (e.g. Sullivan, 2002; UNDP, 2007; Hahn et al., 2009). Its application to the context of this study enabled the provision of an index specific for this research, drawing upon the participants' characteristics. Thus this index is not generalizable to other studies or comparable with other vulnerability indices. Nevertheless, the evidence here suggests that the use of such a vulnerability index is useful for understanding overall vulnerability, as well as the factors influencing the vulnerability of individuals, as shown in this research. This approach would also allow the use of the vulnerability index developed here and implement it in different settings, using the same variables for assessing the access and availability of assets (i.e. human, financial, physical, place-based and social). This would in turn allow comparability of indices values as they would use the same variables.

For the specified vulnerability (i.e. extreme heat and cold temperatures) a comparable approach to the one used in the GVI was used to qualitatively explore the vulnerability of individuals to extreme temperatures, as high or low. The findings of both quantitative (general vulnerability) and qualitative (specified vulnerability) approaches were then compiled into matrices. To allocate individuals in the qualitative matrices a choice was made to focus only on two levels of vulnerability (i.e. high or low). This could be improved in future research by classifying the qualitative data differently to enable more diversity of vulnerability levels using qualitative data.

This research used the Sense of Coherence approach to assess the general resilience of individuals and ultimately for calculating the General Resilience Index (GRI). The development of such an index has potential use beyond the health literature, as results could be easily comparable within and between studies. The development of the GRI through the SOC-13 scale values constitutes a novel contribution of this research and builds on Antonovsky's (1987) work and on composite indices approaches (e.g. Cutter et al., 2008). It should also be mentioned that this research has for the first time transformed the SOC scale (quantitative) to qualitatively assess the human resilience to specified events, namely extreme heat and extreme cold.

The limitations of the application of Sense of Coherence approach are that no examples exist of its use with threats such as extreme temperatures. However, it has been used to access the resilience of individuals to other events such as war (e.g. Almedom et al., 2007; Kimhi et al., 2010) and a hurricane (Glandon et al. 2008). Recently, it is gaining more interest and is considered to be an accepted measure of individual resilience (e.g. Kimhi, 2014). Despite this, interest in the SOC approach is still limited largely to the health research field; it has potential for application to studies focusing on a breadth of stresses, shocks and threats to individuals. An additional limitation results from the fact that due to being the first time that resilience to extreme temperatures has been investigated through a transformation of the SOC scale, there is no possibility to compare the findings of this research with other studies. The findings of both quantitative (general resilience) and qualitative (specified resilience) were also compiled into matrices. To allocate individuals in the qualitative matrices a choice was made to focus only on two levels of resilience (i.e. high or low). This could be improved in future research by classifying the qualitative data differently to enable more diversity of resilience levels using qualitative data.

Additional limitations reside in the way that findings on vulnerability, resilience and adaptation have been integrated (see Chapter 7). The development of the vulnerability – resilience matrices is one example, containing comparable limitations to those of the vulnerability matrices and resilience matrices already mentioned above.

One broad limitation of this research relates to its limited resources and budget. With wider resources more participants could have been recruited from a wider range of settings. This would have allowed achieving a more diverse sample regarding levels of vulnerability and resilience, recruiting participants that might have not been engaged, especially those with low vulnerability and low resilience to both extreme temperatures, as well as from different ethnic populations and religious backgrounds.

Even though the limitations and complexities mentioned above and considerations on how these could be improved, if similar research ought to be conducted in the future, this research has revealed the key role assets play in shaping general and specified (i.e. extreme heat and cold) human vulnerability, resilience and adaptation. Furthermore, this research makes significant theoretical and methodological contributions (Section 8.4), and implications for policy and practice (Section 8.6).

8.4. Theoretical and methodological contributions and implications

The theoretical, methodological and analytical choices made in this study have allowed explorations of both overall sample and individual approaches to general and specified (i.e. heat- and cold-related) vulnerability and resilience, as well as adaptation to extreme temperatures. At the same time it also explored the interactions between them in ways that had not been attempted before, establishing novel contributions from this research.

Overall, this study makes six main **contributions to theory** on human general and specified (i.e. heat- and cold-related) vulnerability and resilience, and adaptation to extreme temperatures of older people living independently stemming from the five main gaps found in the current literature (Chapter 2, Section 2.5). The literature on assets suggests that despite the role of assets having been left out of the health and climate agendas for a long time (Few, 2007) there has been an increasing recent interest in the notion of assets in the health literature with a focus on positive characteristics and capacities of individuals (Morgan and Ziglio, 2007). Different categorizations have been proposed to group assets; these are mostly used in the development context (e.g. Chambers and Conway, 1992; Scoones, 1998; Bebbington, 1999; Rakodi and Lloyd-Jones, 2002; Harrison et al., 2004; Porritt, 2005; Manzi et al., 2010). Despite this, few attempts have been made to use assets in the developed world (e.g. Canadian Women's Foundation, 2001; Oxfam, 2009; IPPR North, 2011; Oxfam, 2013) as discussed in Chapter 2, Section 2.2.4.2. In addition, access to assets (i.e. human, financial, physical, place-based and social) is argued to be the root cause of vulnerability; the bigger and more diverse the asset portfolio of individuals the less vulnerable they are (Moser, 2011). But the role of assets in reducing vulnerability is still very limited in research (Alwang et al., 2001).

The **first contribution of this thesis to theory** therefore relates to using the concept of assets to make connections between the concepts of vulnerability, resilience and adaptation, and to better understand how vulnerability, resilience and adaptation are shaped according to the existing literature (Chapter 2). It did so through a robust evidence based interdisciplinary and multimethodological approach (Chapter 3).

It has been argued that different and often competing conceptualizations of vulnerability in a diversity of disciplinary fields (e.g. Adger, 2006) have in some cases led to an indiscriminate and poorly defined use of the term (e.g. Wisner et al. 2004) in a broad number of settings (e.g. Adger, 2006; Hahn et al., 2009; Gaillard, 2010; Moser, 2011). This has also led to disciplinary divides in vulnerability research despite more authors calling for an interdisciplinary approach for investigating vulnerability (e.g. Alwang et al., 2001; O'Brien et al., 2004). As a result, currently vulnerability can be operationalized in many ways, but there is an increasing interest in the concept of assets and asset approaches as ways of assessing vulnerability (e.g. Birkmann et al., 2010). Assessing vulnerability through assets, as this research does, has allowed different conceptualisations of vulnerability from different disciplines to be brought together aiming at better understanding of how vulnerability is shaped.

Additionally, a further caveat in most vulnerability assessments is the use of secondary data (e.g. Zaidi and Pelling, 2013) which this research has also circumvented through the collection and analysis of primary data. The **second contribution of this thesis to theory** results from the implementation of an interdisciplinary approach which allowed the research of a real-world problem that lies in the intersection between health sciences, environmental science and sociology through a creative and innovative angle (Chapter 3). This research offered an interdisciplinary, multimethodological and comprehensive perspective on vulnerability through the collection of primary data and the development of a vulnerability index (quantitative) as well as heat- and cold-related assessments of vulnerability (qualitative). This allowed a better understanding of how human vulnerability is shaped and the role assets may play in reducing the human mortality and morbidity resulting from extreme temperatures (as discussed below in Section 8.6). The analyses carried out in this research demonstrate that general vulnerability is mostly shaped by financial assets, followed by physical assets, social assets, human assets and place-based assets in decreasing order (Table 4.1). The majority of participants revealed low general overall vulnerability, with high general financial, human and social assets vulnerability, and low place-based and physical assets vulnerability (Figure 4.3). Crucially, vulnerability to extreme heat and cold was found to be higher than general vulnerability among participants, with high vulnerability to heat slightly more frequent than high vulnerability to cold. The main assets shaping heat- and cold-related vulnerability included financial assets and physical assets (Table 4.2). The majority of participants revealed high heat- and cold-related vulnerability, with high heat- and cold-related asset vulnerability for all types of assets (i.e. human, financial, physical, place-based and social) (Figures 4.5 and 4.7).

These results raise implications for the way in which general and specified vulnerability is currently addressed in policy and practice – these focus on vulnerability as a characteristic of older people as a particular group in society. Older people in this research revealed different levels of vulnerability and exposed differences between general vulnerability, extreme heat vulnerability and extreme cold vulnerability. The overwhelming importance of these findings suggest the importance of addressing differently the vulnerability to different stresses, shocks and threats, as individuals can be vulnerable to one type of threat and not to other. These findings highlight the need for the development of individualized and tailored actions for reducing general and specified vulnerability. Here, the findings also refer to vulnerability as being rooted in the context and characteristics of the society more widely where individuals live their lives. An individual's asset portfolio determines his or hers vulnerability and can be assisted through policies and measures aimed at increasing the assets available to old people. Such findings have deep policy implications that can be supported by low-cost ways in which policy makers could identify these different types and levels of vulnerability, in order to address them differently. Otherwise, it may require a huge amount of time and expenditure for them to do so, which in an age of austerity is unlikely. As a result, and despite the austerity context which many countries, including Portugal, currently face (discussed in Chapters 1 to 3), there are still opportunities to reduce older people's general and specified vulnerability (see Section 8.6).

As with vulnerability, the concept of resilience has been widely applied and researched in a range of disciplines (e.g. Gaillard, 2010) giving rise to a diversity of definitions and approaches to measure resilience (Leichenko, 2011). In addition, despite being considered crucial in reducing the health impacts of climate change, it is still not clear analytically how human resilience is shaped (e.g. Kjellstrom and McMichael, 2013). As a result, the IPCC (2014a) has called for more research on human resilience to extreme events; Curtis and Oven (2012) argue for a better understanding of the social factors and processes involved in shaping human resilience.

The **third contribution of this thesis to theory** relates to the implementation of an approach to operationalize human resilience aiming at understanding how it is shaped. This research has used a salutogenic approach to resilience through the use of the 'Sense of Coherence' (SOC) concept and the SOC scale to assess general and specified (i.e. extreme temperatures) resilience. Despite having been used before to assess resilience (Almedom, 2008; Glandon et al., 2008), the 'Sense of Coherence' concept had not been applied before in the context of climate change and extreme temperatures, which represents another novelty of this research. Furthermore, this research takes an additional novel approach by adapting the SOC scale (quantitative) to qualitatively assess resilience to extreme heat and extreme cold. The use of the 'Sense of Coherence' concept has allowed the operationalization of individual resilience, both general and specified, as well as understanding the different dimensions of resilience (comprehensibility, manageability and meaningfulness) and how they are shaped. The findings of this research demonstrate that general resilience is mostly shaped by high meaningfulness followed by high manageability and comprehensibility in decreasing order (Table 5.1).

The majority of participants displayed high general resilience with high meaningfulness followed by high comprehensibility and manageability (Figure 5.5). Additionally, resilience to heat was found to be more frequent than resilience to cold, with participants displaying higher levels of comprehensibility, followed by high levels of meaningfulness and manageability in decreasing order to both heat and cold (Figures 5.7 and 5.9). The main themes shaping heat-related resilience related to the comprehensibility dimension consisted of feelings of predictability of heat and experiences and memories in dealing with it, as well as understanding the health impacts of heat, perceived ability to acclimatize and ability to respond to it. Regarding the manageability dimension, the main themes were directly associated with individuals moderate availability of assets, with special emphasis on assets under one's direct control, as well as the threat extreme heat poses to their asset portfolio (e.g. human, physical and financial assets). The main themes within the meaningfulness dimension of resilience were found to be related to the importance heat has in the lives of individuals as it was found to be a common feature in their lives to which they found the need to invest. Despite this, other areas of life requiring investment (e.g. finances, health status) were found to limit the engagement in responding to extreme heat, affecting their perception of ability to act.

On the other hand, the main themes shaping cold-related resilience regarding its comprehensibility dimension were found to be linked with the lower predictability of cold (as it was considered to be less frequent reason for individuals to recall extensive personal experiences and memories of extreme cold recently), coupled with lack of awareness of the impacts of cold to health and perceived ability to deal with it (as it is not common and was not perceived as being a threat). Additionally, individuals felt they did not have the assets needed to respond to extreme cold, thus calling for improvements in their asset portfolio (extreme cold was considered to be a threat to physical and financial assets, impacting the manageability dimension of resilience.) Finally, the meaningfulness dimension was found to be related to considering cold as important event when it happens but with which individuals struggle as other areas in their lives also require investments, resulting the perception that strategies to deal with cold were lacking (Table 5.2).

These findings also have implications for addressing the resilience of individuals to different stresses, shocks and threats, as individuals revealed different levels of general and specified resilience. As a result, older people can be resilient to one type of threat and not to another. Portugal's context on dissimilar frequency and intensity of extreme heat (i.e. higher) and extreme cold (i.e. lower) temperatures has implications for the degree to which older people feel able to deal with extreme heat and cold temperatures. Having more experience and memories of extreme heat and having dealt with extreme heat many times allows older people to perceive having higher capacity to face and act upon the challenges it poses. On the other hand, being less experienced and feeling limited in assets to keep warm tends to hinder older people's perception of their own ability to respond to extreme cold. These findings also highlight the necessity of developing individualised and tailored actions for increasing general and specified resilience (see Section 8.6) taking into account Portugal's context.

The **fourth contribution of this thesis to theory** thus relates to the critical role assets play in shaping adaptationto extreme temperatures in the Portuguese context (Chapter 6). This research suggests that adaptation to extreme temperatures is mostly shaped by the context and diversity of assets available and accessible to individuals. As such, adaptations based on assets were found to be predominant. According to the different types of assets within the asset portfolio, adaptations based on *human assets* were mainly influenced by the level of education and health status of individuals, whilst adaptations based on *financial assets* were determined by the available income and costs of using cooling and heating devices, as well as past and current financial situation. On the other hand, this research also found that adaptations based on *physical assets* translated into improvements in housing quality and insulation, but tenure influenced both the capacity and ability to do so. Adaptations based on *place-based assets* were greatly influenced by the availability and willingness to participate in Ward activities, as well as distance to and cost of transport and other public infrastructures (i.e. swimming pool). And, last but not least, adaptations based on *social assets* were surprisingly low mainly due to lack of friends and close neighbours, as well as a lack of a sense of community.

These results highlight the importance of a broad focus on assets which impact on both vulnerability and resilience, and ultimately on adaptation to extreme temperatures. Older people revealed that the bigger constraint and limit to responding to extreme heat and extreme cold is the lack of assets. Such findings raise questions regarding the access, availability and distribution of assets among individuals, but also about the roles of their neighbourhoods and communities. Other factors impacting on adaptation include educational, cultural, informational and financial aspects. Under the present economic and financial crisis, older people have faced many challenges to manage their pensions. As a result, many of them had to cut costs, which included reducing cooling and warming their homes, as well as nutrition (i.e. food) and healthcare (e.g. medication). The results also suggest that in the context of Portugal and Lisbon in particular, public policies and measures have failed to raise awareness of both Heat and Cold Weather Plans, their respective measures and actions. Furthermore, direct and personalised advice by health professionals on how to better deal with extreme temperatures is welcomed by older people. Additionally, this emphasises the failure of advice and information campaigns directed to the general population on vulnerable groups (older people do not see themselves as vulnerable) and recommendations. As a result, it will be important to review the role of GPs and GP surgeries in the prevention of health impacts from extreme temperatures.

Despite having emerged and evolved from different disciplinary fields it is agreed that theoretical connections exist between vulnerability, resilience and adaptation and that they are related concepts (e.g. Nelson et al., 2007; Vogel et al., 2007; Miller et al., 2010; Turner, 2010). Despite this, few have been the studies aiming at empirically operationalize this relationship. The **fifth contribution of this thesis to theory** relates to bringing together the concepts of assets, vulnerability, resilience and adaptation and investigating the interactions between them in the Portuguese context. It does so, through independently researching general vulnerability and resilience (Chapter 4), heat-related vulnerability, resilience and adaptation (Chapter 5) and cold-related vulnerability, resilience and adaptation (Chapter 6). This research demonstrates that assets play a crucial role in understanding this relationship, as they are determinant in shaping general and specified (i.e. heat- and cold-related) vulnerability and resilience, and adaptation to extreme temperatures (Figures 8.3, 8.5 and 8.7). The research also demonstrates that the relationship between vulnerability and resilience is not straightforward, as the findings show that individuals can display high vulnerability and high resilience, as well as display low vulnerability and low resilience (Figures 8.2 and 8.4). Vulnerability was also found to be determinant in shaping adaptation, mainly through past experiences, perceptions of warming and cooling weather, perceptions of own and universal vulnerability, and perceptions of health impacts and everyday life disruptions. The findings from the influence of resilience in adaptation to extreme temperatures suggests that resilience plays a determinant role in shaping adaptation, as the ability of individuals to understand the challenges posed by extreme temperatures (*comprehensibility*), feeling one has access and available assets to respond (*manageability*) and feeling motivated to take action (*meaningfulness*) were found to be crucial in implementing adaptation strategies and behaviours to deal with extreme heat and cold (Table 6.4).

The **sixth contribution of this thesis to theory** relates to all other contributions mentioned above as it has provided a conceptual and analytical framework, as well as a methodological approach that can be replicated at the national, regional and local levels, by local authorities, NGOs, Health Trusts, among others to better understand the needs, constraints, limits and opportunities for better understand the relationship between assets, vulnerability, resilience and adaptation for reducing vulnerability, enhancing resilience and improving adaptation to extreme temperatures in particular, and important insights for other threats, shocks and stresses in general. Assets are at the core for understanding vulnerability, resilience and adaptation; they are the root causes of human vulnerability, they impact on the resilience of individuals through their links to all three dimensions of resilience (comprehensibility, manageability and meaningfulness) and determine the strategies and behaviours available to individuals for responding to extreme temperatures in particular (adaptation), and other threats, shocks and stresses in general.

This study makes three broad **theoretical and methodological contributions**. *Firstly*, pure or genuinely interdisciplinary research is considered to be extremely challenging and demanding, making it uncommon (Barry et al., 2008; Petts et al., 2008). Despite this, interdisciplinarity was found to be the most effective way of integrating knowledge on assets, vulnerability, resilience and adaptation which to date has been addressed separately by different disciplines. Interdisciplinarity contributes to providing a broad foundation for research such as this one and allow a more comprehensive portrait of what shapes human vulnerability, resilience and adaptation. It allows the opportunity to explore and reflect on the diverse conceptualisations within and across disciplines, as well as allowing a combination of overall themes and methods throughout the research. As such, based on the experience of work undertaken for this thesis, interdisciplinarity could be promoted as an approach that adds to existing knowledge and practice within and across disciplinary boundaries (Barry et al., 2008; Lyall and Meagher, 2012; Scheff, 2013).

Secondly, the case study design is also considered to be extremely useful for investigating in detail how vulnerability, resilience and adaptation of participants was shaped, whilst also enabling rich and stimulating in-depth understanding of opportunities to reduce vulnerability, increase resilience and improve adaptation to extreme temperatures. The use of case studies allow investigating these topics at the individual level combining different data collection methods, both quantitative and qualitative (Flyvberg, 2006). The planning of the case study design can also provide the opportunity to implement multiple case studies, namely an inter-seasonal research design as implemented in this thesis.

Thirdly, one great advantage of using this multimethodological approach to research is the opportunity and value of combining qualitative and quantitative data collection and analysis (Bryman, 2006) which can fit very well together as they can collect parallel variables aiming at linking all the topics under research. This combination of methods enabled answering research questions through an integrative and complementary approach.

8.5 Future research directions

The research carried out in this study and the findings obtained have highlighted prospects for further research focusing on human vulnerability, resilience and adaptation to extreme temperatures, and to other issues such as climate change, environmental change, as well as cultural, societal changes and individual changes (e.g. health changes). The factors shaping human vulnerability, resilience and adaptation to extreme temperatures have been investigated in this research. Further research could be developed arising from the theoretical contributions, methodological approaches, the conceptual choices and analytical findings in this research.

Several possibilities are explored here. An extension of this research is to encourage additional disciplinary developments (Markson and Stein, 2013) to advance genuine and effective interdisciplinary work e.g. between social and natural sciences, or between other social sciences (Barry et al., 2008; Petts et al., 2008; Lyall and Meagher, 2012), as discussed in Section 8.4. Furthermore, the field of gerontology is ripe for an interdisciplinary approach as

> 'social gerontology, provides an example of an emerging interdisciplinary field, drawing from anthropology, biochemistry, biology, economic, history, medicine, nursing, psychology, social work, and sociology.' (Markson and Stein, 2013: 874).

Further opportunities to develop similar case studies in other locations, settings and with groups of interest are also identified. Additional national and international locations (e.g. cities, countries) could be used to identify similarities and differences to the findings presented here. It would also be interesting to investigate the same topics in different settings other than own homes (i.e. older people living independently) as used in this research, but for example in day care centres, care homes and hospitals.

An extension to this research would then be to investigate other groups of interest in this context which may include: dependent older people in their own homes; independent and dependent older people in day care centres, care homes and hospitals, and; older people with dementia. Other groups of interest could also include children and the chronically ill. In these cases, appropriate ethical considerations would have to be accounted for in implementing such research. An additional avenue which could be further developed and implemented is the use of multimethodological studies using both quantitative and qualitative data collection methods combining methods from different disciplinary perspectives (Lyall and Meagher, 2012; Scheff, 2013).

Further research involving policy makers through the presentation of these findings to them and discussion of how they may be taken forward to inform policy would also be key to transform research into practice for reductions in human vulnerability, increases in resilience and improvements in adaptation. Further work in areas where this research has shown to be in disagreement with the literature (e.g. role of social assets in resilience and adaptation) would improve our understanding of the role different assets play.

In this research emphasis was placed on understanding vulnerability, resilience and adaptation at the individual level. As this research has uncovered how these are shaped at the smallest scale (i.e. individual), further research is needed to address other scales and could include similar studies at the community scale (Berkes and Ross, 2013), regional and national scales. In addition, future research could further investigate in more depth the role of human, financial, physical, place-based and social assets in shaping vulnerability, resilience and adaptation in developed countries, as well as apply the sense of coherence approach through the use of the SOC scale (sense of coherence).

Other potential areas for further research arise from the conceptual choices and analytical findings in this research. Building on these could focus on increasing older people's asset portfolio to: reduce vulnerability, increase resilience, improve adaptation and target the links between vulnerability, resilience and adaptation; through action research, for example. Additionally, interviews and focus groups with national and local government officials, NGOs, health and social care institutions, community, neighbourhood and religious organizations would be a further step in achieving the goals mentioned above.

An additional suggestion for further research includes further implementation of the vulnerability and resilience indices developed in this thesis to work towards improving the basis and applicability of the indices, as well as enabling comparisons of findings in other contexts (i.e. geographical, social, etc.).

Further opportunities for translating the findings of this research into actions to reduce the health impacts of extreme temperatures could include the use of geomedicine which links geography and personal health information using geographic information systems (GIS) (Davenhall, 2012) to integrate individual contextual information (Berke, 2010). As this thesis' research findings have identified high vulnerable and low resilience individuals, geomedicine could be used to locate the most vulnerable and less resilient individuals. This could be achieved by using place and health history assessments to provide valuable evidence to health and social authorities, GPs and nurses in understanding patients surrounding environments (e.g. access to assets) and enabling them to provide personalized information and advice to those more at risk from suffering the impacts of extreme temperatures. This information and advice would reflect individuals location (e.g. address) and proximity to cooling/heated centres or shelters, GP surgeries, hospitals, community and neighbourhood centres, support networks, transport links and parks nearby. The use of geomedicine and technology has implications for both health and social service transformation and could have different applications, ranging from electronic health records used by GPs and nurses, and technology in smartphones, smartwatches and telecare devices for individual use, to improve access to human, financial, physical, place-based and social assets, reduce vulnerability, increase resilience and improve adaptation.

In summary, further research could expand from the conceptual and methodological choices implemented and the findings of this research in enabling progress on the role of assets and reducing the impacts of inequality and injustice in shaping vulnerability, resilience and adaptation. The vision for further research includes two goals: health and social systems that protect the most vulnerable and less resilient through increasing assets enabling them to reduce their vulnerability and increase their resilience for improving their adaptation strategies; whilst at the same time enabling the less vulnerable and more resilient to preserve their status and retain or improve their adaptation strategies to identified threats, shocks and events.

8.6 Implications for policy and practice

Responding to extreme temperatures required adequate information on risk and impacts of heat and cold, in order to identify assets needs and availability to access appropriate and available adaptation options. Adaptation constraints and limits were shaped by participants' high vulnerability and low resilience (Table 7.1). Despite this, research participants revealed that there are a range of opportunities for enhancing their adaptation strategies drawing on assets that they would welcome. The lack of understanding of how individuals will adapt successfully taking into account the accessibility and availability of incentives, resources, knowledge and skills (Fankhauser et al., 1999) have led some authors to argue that it is the access to assets that determines the capacity of individuals to adapt (e.g. Adger, 2003; Grothmann and Patt, 2005). The research undertaken for this thesis supports the call for more work on the breadth of adaptation strategies used by older people and the influence of assets (e.g. White-Newsome et al., 2011), coupled with the need to assess what, how and to what level human adaptation is occurring and can be enhanced in the future (Deschenes, 2013).

The findings of this research provide a range of contributions to policy and practice for reducing the human health impacts of extreme temperatures. This study indicates these can be achieved through the planning, development and implementation of policies and actions aiming at: a) reducing vulnerability; b) increasing resilience and; c) improving adaptation. In order to accomplish this, a core focus on increasing assets, both access and availability, as well as quality and quantity of each type of assets and overall asset portfolio is key (Figure 8.6). An important element is that by increasing assets a simultaneous improvement could be felt in all areas (vulnerability, resilience and adaptation) indicating that these policies and actions can be overlapping and pursued simultaneously.

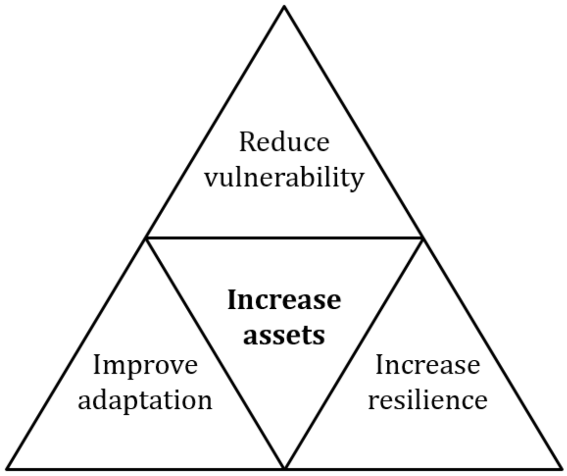


Figure 8.6 Approaches for reducing the health impacts of extreme temperatures focusing primarily on increasing assets across the board to reduce vulnerability, increase resilience and improve adaptation.

The starting point to ensure the robustness of decisions regarding both policies and actions aiming at achieving reductions in the health impacts of extreme temperatures is first of all to understand that '"robust decisions" are defined as decisions that work well (that achieve their goals) even with the inclusion of various uncertainties. In other words, "robust decisions" are decisions that are insensitive to uncertainties known at the time.' (Dessai and Hulme, 2007: 60). As a result, the criteria used in this research to assess robustness that decisions should consider include: the main themes shaping vulnerability (Table 4.2); the themes related to resilience according to the manageability dimension of resilience (Table 5.2), and; the opportunities for improving adaptation based on older people's own views (Table 6.5). All these aspects were taken into account in Chapter 7 as they were found to be crucial for both current and future adaptation. This research highlights that in order to make robust decisions one needs to take into account all types of assets. These would be more robust because by focusing on all types of assets decisions would not ignore other important characteristics of a specific type of assets and would increase opportunities to make good use of assets even in an age of austerity like the one Portugal and other countries are facing. As such, robust decisions made for planning, developing and implementing policies and actions that focus on increasing assets are thought to be possible and deemed necessary.

To increase all types of assets requires an investment in tailored national and local policy decisions and interventions. Sufficient funding and political commitment are needed for the short-, medium- and longer-term to successfully achieve increases in the asset portfolio of older people for reducing vulnerability, increasing resilience and improve adaptation to extreme temperatures in particular, and other threats, events and stress in general. Additionally, Portugal still needs to develop and enhance communication of policies and procedures between government agencies and citizens. Focusing on assets will require a shift in the passive way in which older people living independently in Lisbon, Portugal are currently informed and advised or made aware of the Heatwave and Cold Weather Plans, with no further actions are put in place to ensure they do not suffer the health impacts of extreme temperatures. As a result, new ways in which information is distributed needs to be carefully considered and adjusted to different types of people in order to allow an easy and equitable access to advice. Special attention should also be given to the type of adaptation measures provided in such advice so they are non-exclusionary and suitable to older people's daily lives and rythms.

All in all, and despite living in an age of austerity, the government, its departments, bodies and public bodies, public health and social care authorities could work together with other organizations and institutions including community and voluntary organizations to develop feasible priorities and ensure that an integrated and people-centred approach is put in place for the benefit of older people. This research indicates that local and community organizations and institutions would be more appropriate to implement such measures, as they are closer and more accessible to older people. These organizations and institutions could aim at working together in examining particular aspects and characteristics of older people's lives that are crucial to respond to temperature extremes, such as: health status; capacity of the individual to know what to do in the case of extreme temperatures and to be proactive; the general awareness of vulnerability and resilience by the individual; social networks around the individual, and the medical teams; the cost of going to the GP compared with overall income; the general state of the social networks with whom the targeted individuals are associated. All this to ensure a focus on assets and in increasing older people's agency and empowerment are also essencial for better adaptation (Royal Society, 2014).

The role of social assets (i.e. social capital) should be further explored as a feasible, effective and costless approach to reduce the vulnerability and increase the resilience for improved adaptation of older people to extreme temperatures. Health data is thought to play a crucial role as part of preparedness (Berke, 2010; Davenhall, 2012) and hence a key component of assets, vulnerability, resilience and adaptation. In addition, the individual (i.e. older person) should be seen as part of a series of networks: health, care, social, religious, neighbour, family, etc. Additionally, this research indicates that the above institutions could also work together with the private sector to tackle the challenges of increasing energy costs, lack of housing insulation, and lack of transport, among others, that older people face in their daily lives with impacts to their health, wellbeing and quality of life.

The findings of this research demonstrate how vulnerability, resilience and adaptation are contingent on human, financial, physical, place-based and social assets, as well as on the comprehensibility (i.e. cognitive), manageability (i.e. behavioural/instrumental) and meaningfulness (i.e. motivational) dimensions of resilience. In addition, wider aspects of the Portuguese context, including welfare provision, austerity, the role of family relationships and the role of community, including the residential building stock, services and facilities, traditions which encourage a strong sense of personal independence and also fatalism and resignation to divine will. At the individual level, participants' general and specified (i.e. extreme heat and extreme cold) vulnerability, resilience and adaptation are quite variable and those who are less vulnerable, more resilient and those that most successfully adapt to normally prevailing conditions (i.e. general) are not always those best able to adapt to specified threats such as extreme temperatures. The findings of this research bring out these aspects from a perspective on Portugal and the case study in Lisbon as an original contribution.

In the Portuguese context and arising from the findings of this research, specific policy and practice recommendations is to encourage the role of health and social care professionals in providing individualised advice to older people. This could convey ways forward in reducing vulnerability, increasing resilience and improving adaptation to extreme temperatures. Additionally, the findings of this research also highlighted high levels of trust and support older people receive from the ward offices where they live. Opportunities could thus arise from the restructure and implementation of integrated structures where health and social care professionals, housing officers, layers and solicitors worked together under the 'same roof' in each city ward to provide advice to the whole population, not only to older people.

Examples of **specific recommendations** arising from this study based on research participants views and opinions about opportunities to improve their adaptation to extreme temperatures have been collated. These opportunities could be translated for the development of policies and actions aimed at increasing assets and at the same time reducing general and specified vulnerability, increasing general and specified resilience and improving adaptation to extreme temperatures, and are presented below.

- <u>Human assets:</u>

Education, skills, knowledge: Opportunities arising from life-long education, knowledge sharing and learning (e.g. University of the 3rd Age), personalised advice from healthcare professionals for better understanding the health risks of extreme temperatures and provide personalised advice.

Health and nutritional status: Opportunities arising from free healthcare and medication for low income older people could improve the general health status of older people, whilst at the same time reducing the burden on financial assets. Since 2011, with the implementation of austerity measures the way which free healthcare in Portugal is allocated takes into account not only the value of older people's pensions, but also their savings, home ownership, as well as other members of the family earnings if living in the same address. As such, many older people have seen being taken their past free healthcare which according to participants in this research has meant going to the GP less often. As a result, instead of serving as a health promotion and disease prevention service, as well as a way of operationalising personalized advice to older people from health professionals on health impacts of extreme temperatures, healthcare is now used only when strictly necessary. Exploring additional opportunities arising from agreements with supermarket chains for delivering food that can no longer be sold to organisations and institutions working with older people would also contribute to the reduction of financial assets vulnerability.

Work and occupation: Opportunities arising from volunteer work (e.g. with other older people and intergenerational) within the Ward and community; from growing one's own vegetables, fruits and herbs in one's own home gardens or in city allotments for one's own consumption, exchange or sale, could increase human, financial and social assets.

- <u>Financial assets:</u>

Income and pensions: Opportunities for increasing lower pensions (€350/month) and reduce austerity measures for older people with low pensions.

Expenses: Opportunities for advice on reducing housing expenses (e.g. water, gas and electricity) and on reducing cooling and heating costs; subsidies from electricity companies to reduce electricity bills (i.e. affordable cooling and heating).

- <u>Physical assets:</u>

Housing quality and insulation: Opportunities for incentives or subsidies to improve housing quality and insulation, install air conditioning and heating devices. Older people have the right to a decent and safe home, one that is not too hot or too cold during extreme heat and extreme cold, respectively. As such, there is a need to focus on building regulations and standards to increase housing standards through the work of housing officers and housing needs departments, social workers and other agencies working with older people.

Housing tenure: Opportunities for enforcing responsibilities and liabilities of landlords to refurbish/repair old homes; enforcing urban planning laws and regulations to improve building standards (e.g. insulation).

Equipment's and goods: Opportunities for home cooling and heating advice from trusted sources, for widespread ownership and use of cooling and heating devices, which would also increase older people's social assets and human assets.

- <u>Place-based assets:</u>

Access to facilities (transport, public infrastructure): Opportunities arising from free transport to low income older people which is not available at any income level, which would increase human assets and social assets; from Ward activities as an alternative strategy to keep cool and warm with a positive impact in increasing social assets and human assets.

Access to green spaces: Opportunities to create quality, clean and safe gardens and parks with shade, benches and toilets as a strategy to keep cool during hot temperatures and to socialize, ensuring also increases in human and social assets.

Quality of public services and programmes: Opportunities arising from Extreme Heat and Cold Health Warning Systems local actions to support older people, providing Ward and community activities, creating better social safety nets and social protection, food banks and distribution of food surplus with benefits to increased human, financial and social assets. Knowledge and awareness of public services and programmes aiming at reducing the health impacts of extreme temperatures would also benefit from improved communication and awareness of public policies.

Access to land: Opportunities for incentivising older adults to grow their own vegetables, fruits, herbs and poultry in their own gardens and city allotments for own consumption, exchange or sale that could bring increases in human assets, financial assets, as well as social assets.

- Social assets:

Social contacts, networks and support: Opportunities arising from the development and provision of community support systems at Ward, community and neighbourhood levels; from receiving advice from health and social care professionals and giving advice to family, neighbours and friends, with positive outcomes to human assets.

Social participation and activities: Opportunities arising from provision of Ward and community activities all year round (including hottest and coolest months) to develop older people and intergenerational participation that would also provide opportunities to increase physical assets. As well as, measures aimed at increasing older people's awareness, knowledge of and participation in social activities.

8.7 Final concluding remarks

As this research unfolded it became more and more an interdisciplinary study of human vulnerability, resilience and adaptation shaped by assets. This interdisciplinarity also allowed the use of concepts such as assets, vulnerability, resilience and adaptation, as well as the implementation of a multimethodological approach and the collection of different types of data (quantitative and qualitative). Bringing together insights from disciplines such as human health, climate, sociology, psychology, human development, environment and disaster allowed exploring what shapes vulnerability, resilience and adaptation in a more rich, full as well as holistic way. Making these connections between disciplines became crucial to answering the research questions. Using a multimethodological approach and collecting different types of data also enriched both research and researcher as it made it possible to bring together disciplinary perspectives to assess linked concepts. This type of integrated methodological and analytical approach to researching all three concepts and the relationships between them has not been attempted before, establishing the novelty of this research.

The theoretical, methodological and empirical novelty and contributions of this research can be summarized in: a) the value of assets in shaping vulnerability, resilience and adaptation, as well as the contribution of using asset based approaches in a developed country context; b) the use of an interdisciplinary and multimethodological approach for the development of quantitative general vulnerability and general resilience indices that further allowed the mapping of participants through the development of general vulnerability and resilience matrices as well as combined general vulnerability-resilience matrices; c) qualitative exploration of participants' vulnerability, resilience and adaptation to extreme heat and extreme cold, used to map the vulnerability and resilience of participants to both heat and cold; d) providing a contribution to the Portuguese and international research on opportunities to reduce vulnerability, increase resilience and improve adaptation to extreme temperatures.

Overall, the findings of this thesis demonstrate that an approach focusing on increasing human, financial, physical, place-based and social assets to reduce human vulnerability, increase resilience and improve adaptation allows an integrated and comprehensive opportunity to reduce the human health impacts of extreme temperatures in particular, and other threats, shocks and stresses in general. This thesis offers an opportunity to theoretically and empirically inform academics, practitioners, policy-makers and society (i.e. individuals) on what shapes vulnerability, resilience and adaptation, how they are expressed, what are the interactions between them, as well as inform the design of policy and actions aiming at increasing assets for reducing vulnerability, increase resilience and improve adaptation. The findings highlight that access and availability of assets are closely linked to equity, namely whether individuals or social contacts (i.e. trusted others) have the scope to improve their resilience and adaptation and reduce the impacts of extreme temperatures (i.e. advice, money, energy and insulation) and whether they are assisted in this by the institutions and contexts within which they live.

Appendices

Appendix 3.1a Information for Participants

Instituto de Ciências Sociais da Universidade de Lisboa

Tyndall°Centre for Climate Change Research

University of East Anglia

Information for participants

Research title: 'Understanding the factors influencing older adults' views and behaviours during very hot and very cold weather'.

Introduction
You are being invited to participate in a research study. The information provided here aims to help you decide whether or not you want to participate in the study. The researcher will be available to answer all your questions and provide any additional information you need. If you decide to participate in this study, you will be asked to sign a Consent Form. A copy of this information and Consent Form will be given to you.

What is the nature and purpose this research study?
The purpose of this study is to investigate the factors that influence the views and behaviours of older adults aged 65 or over living independently in the city of Lisbon, Portugal during very hot and very cold weather. This study represents an opportunity to inform local, national and international governance on the promotion and protection of older people's health and well-being during very hot and very cold weather, and will benefit a growing ageing population.

Why am I being invited to participate?
You are being invited to take part of this study because you are 65 years of age or older, live independently in your house and are able to understand and answer the study questions.

Do I have to participate?
Participation in this study is voluntary, but if you choose not to participate it will not have any negative consequences for you. In choosing to participate you still have the right to end your involvement in the study at any stage and you can also decline to respond to questions or prompts during the interview. The researcher will wait at least 72 hours before contacting you to arrange an interview. When being contacted, you will have the choice to withdraw from participating in the study and this choice will also be given during the interview. There is also the possibility that you may or may not be selected to continue in the study.

What will happen during this study and what do I have to do?
If you are willing to participate in this study you will be asked to give the researcher permission to include you in the study by signing a Consent Form. The study comprises two individual interviews, one during summer and the other during winter, in which you will be asked to answer questions about socio-demographic information, your general health and well-being, your house and neighbourhood general characteristics. During the interviews you will also be asked questions about how you feel and what you do in very hot and very cold days. The interview questions you will be answering have minimal risks. The researcher examined and tried to rule

out risks but is aware that some questions may be stressful or upsetting. Although it is not expected to happen, in the case that this occurs you have the right of declining to answer those questions and you can end your participation at that point. If you have any questions, concerns or worries about your participation in the study, please feel free to contact Professor Luisa Schmidt at Instituto de Ciências Sociais da Universidade de Lisboa (tel: 217 804 700 or email:mlschmidt@ics.ul.pt)

The interview is expected to last about 45-60 minutes and it can be undertaken at a time that is convenient for you on a face-to-face interview in a private space. You will be given the opportunity to suggest a preferred location, or you can choose a telephone interview as well. With your permission, the researcher will digitally record and transcribe the interview.

What happens to the information I give during the interview?
Information regarding this study, including your interview information will be known only to the researcher and researcher's supervisors. All the information obtained during the interview will be treated with the utmost respect and discretion, will be confidential and will be stored securely. All identifying information will be removed in order to protect you from being identified as a participant. Reports or publications resulting from this study will not disclose your identity. If an official organization asks to review your interview information, a copy of the information will be provided but your name and other identifying details (e.g. Telephone number) will be deleted before releasing any information. All data will be kept safe from unauthorized access, loss or destruction and is to be kept for no longer than it is necessary and for a maximum of 5 years.

What will happen to the results of this study?
The results from this study will be analysed and used to produce a thesis to be submitted for the award of the Degree of Doctor of Philosophy and will be publicly available through the University Library. Reports or publications can also be used to disseminate the findings. A brief feedback to participants will also be given to report the most relevant findings.

Who is responsible for the funding and organization of this study?
This study is funded by Fundação para a Ciência e Tecnologia, from Ministério da Educação e Ciência (www.fct.pt). The research is being co-supervised by University of East Anglia (United Kingdom; www.uea.ac.uk) and Universidade de Lisboa, Instituto de Ciências Sociais (www.ics.ul.pt).

Who has approved the study?
The study has ethical approval from the University of East Anglia, Faculty of Medicine and Health Sciences Research Ethics Committee.

Thank you for reading this information and considering taking part of this research study.

____
(Name of researcher and signature)

If you have any more questions please contact me:
Researcher's name: Ana Raquel Nunes
Researcher's contact *(in Lisbon)*: Universidade de Lisboa, Instituto de Ciências Sociais *(to include address and telephone number)*
Researcher's institutions: University of East Anglia and Universidade de Lisboa, Instituto de Ciências Sociais

Appendix 3.1b Informação aos Participantes

Informação aos Participantes

Título da Investigação: 'Coompreender os factores que infuenciam as opiniões e comportamentos dos adultos mais velhos durante o tempo muito quente e muito frio'

Introdução
O(A) Sr.(a) está a ser convidado(a) a participar de um estudo de investigação. As informações aqui fornecidas têm como objectivo ajudá-lo(a) a decidir se deseja ou não participar no estudo. A investigadora estará disponível para responder a todas as suas perguntas e fornecer quaisquer informações adicionais que necessite. Se decidir participar neste estudo, ser-lhe-á solicitado que assine um termo de Consentimento Informado. Ser-lhe-ão dadas uma cópia destas informações e do Consentimento Informado.

Qual é a natureza e o propósito desta investigação?
O objectivo deste estudo é investigar os factores que influenciam as opiniões e comportamentos durante o tempo muito quente e muito frio, em adultos com 65 anos ou mais a viver de forma independente, na cidade de Lisboa, Portugal. Este estudo representa uma oportunidade para informar a governança local, nacional e internacional sobre a promoção e protecção da saúde e bem-estar das pessoas mais velhas, durante o tempo muito quente e muito frio, e vai beneficiar uma crescente população envelhecida.

Por que estou a ser convidado(a) a participar?
Está a ser convidado a participar deste estudo, porque tem 65 anos de idade ou mais, vive de forma independente em sua casa, e é capaz de compreender e responder às perguntas do estudo.

Tenho que participar?
A participação neste estudo é voluntária, mas se optar por não participar, tal não terá quaisquer consequências negativas para si. Ao optar por participar tem ainda o direito de terminar a sua participação no estudo em qualquer fase e pode também recusar responder a perguntas ou solicitações durante a entrevista. A investigadora irá esperar pelo menos 72 horas antes de entrar em contacto consigo para marcar uma entrevista. Ao ser contactado(a), terá a opção de desistir de participar no estudo e esta escolha também ser-lhe-á dada durante a entrevista. Há tambem a possibilidade de ser ou não ser seleccionado para continuar no estudo.

O que vai acontecer durante este estudo e o que tenho de fazer?
Se estiver disponível a participar neste estudo, ser-lhe-á solicitado dar a sua autorização à investigadora para incluí-lo(a) no estudo, assinando um termo de Consentimento Informado. O estudo compreende duas entrevistas individuais, uma durante o verão e outra durante o inverno, nas quais será solicitado a responder a perguntas sobre informações sociodemográficas, a sua saúde geral e bem-estar, a sua casa e características do seu bairro em geral. Durante as entrevistas, ser-lhe-á também perguntado sobre como se sente e o que faz em dias muito quentes e muito frios. As perguntas da entrevista a que responderá têm riscos mínimos. A investigadora examinou e tentou eliminar os riscos, mas está ciente de que algumas perguntas podem ser stressantes ou

perturbadoras. Embora não se espere que aconteça, no caso em que isso ocorra, tem o direito de recusar responder a essas perguntas e pode terminar sua participação naquele momento. A investigadora pode nessa altura dar-lhe informações sobre pessoas capazes de ajudá-lo(a) da melhor forma possível. Se tiver dúvidas ou preocupações sobre a sua participação no estudo, por favor não hesite em contactar a Professora Luísa Schmidt no Instituto de Ciências Sociais da Universidade de Lisboa (tel: 217 804 700 ou e-mail: mlschmidt@ics.ul.pt)
A entrevista está prevista para durar cerca de 60 minutos e pode ser realizada num momento que lhe seja conveniente, numa entrevista cara-a-cara num espaço privado. Terá a oportunidade de sugerir uma localização preferida, ou escolher ainda uma entrevista por telefone. Com a sua permissão, a investigadora irá gravar e transcrever a entrevista.

O que vai acontecer às informações que dou durante a entrevista?
Informações a respeito deste estudo, incluindo as informações da sua entrevista serão conhecidas apenas pela investigadora e seus orientadores. Todas as informações obtidas durante a entrevista serão tratadas com o maior respeito e discrição, serão confidenciais e serão armazenadas de forma segura. Todas as informações de identificação serão removidas, a fim de protegê-lo(a) de ser identificado(a) como participante. Relatórios ou publicações resultantes deste estudo não irão revelar a sua identidade. Se uma organização oficial pedir para rever as informações da sua entrevista, uma cópia das informações será fornecida, mas o seu nome será eliminado antes da disponibilização de qualquer informação. Todos os dados serão mantidos seguros contra o acesso não autorizado, perda ou destruição e serão mantidos por não mais do que o tempo necessário e por um período máximo de 5 anos.

O que acontecerá aos resultados deste estudo?
Os resultados deste estudo serão analisados e utilizados para produzir uma tese a ser apresentada para a atribuição do Grau de Doutor em Filosofia e estará disponível ao público através da Biblioteca da Universidade. Relatórios ou publicações poderão também ser usados para divulgar os resultados. Um sumário breve será facultado aos participantes para relatar as conclusões mais relevantes.

Quem é responsável pelo financiamento e organização deste estudo?
Este estudo é financiado pela Fundação para a Ciência e a Tecnologia, do Ministério da Educação e Ciência (www.fct.pt). A investigação está a ser co-orientada pela Universidade de East Anglia (Reino Unido; www.uea.ac.uk) e Universidade de Lisboa, Instituto de Ciências Sociais (www.ics.ul.pt).

Quem aprovou o estudo?
O estudo tem aprovação ética da Universidade de East Anglia, Comité de Ética da Faculdade de Medicina e Ciências da Saúde, e também do Instituto de Ciências Sociais da Universidade de Lisboa.

Obrigado por ler esta informação e considerar participar neste estudo.

____
(Assinatura da investigadora)

Se tiver mais alguma dúvida, por favor contacte-me:
Nome da Investigadora: Ana Raquel Nunes
Contacto da Investigadora: Instituto de Ciências Sociais da Universidade de Lisboa, Av. Professor Aníbal de Bettencourt, 9. 1600-189 Lisboa. Tel. 217 804 700 E-mail: raquel.nunes@ics.ul.pt
Instituições da Investigadora: Instituto de Ciências Sociais da Universidade de Lisboa e University of East Anglia

Appendix 3.2a Thank you letter

Thank you letter

Dear [Participant's name],

I would like to thank you for your willingness to take part in the study 'Understanding the factors influencing older adults' views and behaviours during very hot and very cold weather' but unfortunately you were not selected to continue in the study.

Thank you again for your time and consideration.

Sincerely,
Ana Raquel Nunes

Appendix 3.2b Carta de Agradecimento

Carta de Agradecimento

Caro(a) [Nome do Participante],

Gostaria de agradecer a sua siponibilidade em participar no estudo ''Coompreender os factores que infuenciam as opiniões e comportamentos dos adultos mais velhos durante o tempo muito quente e muito frio', mas, infelizmente, não foi selecionado(a) para continuar no estudo.

Obrigada novamente pelo seu tempo e consideração.

Com os meus melhores cumprimentos,
Ana Raquel Nunes

Appendix 3.3a Informed Consent

Informed Consent

Research title: 'Understanding the factors influencing older adults' views and behaviours during very hot and very cold weather'.

Researcher's name: Ana Raquel Nunes

Please read this form carefully. Make sure you have already read the Information for Participants sheet. The researcher will be available to answer all your questions about participating in this study and provide any additional information you need. In choosing to participate you still have the right to stop your involvement in the study at any stage and you are also entitled to decline to respond to questions or prompts during the interview.

You are being asked to sign a Consent Form. A copy of this information and Information for Participants sheet will be given to you.

Please answer the following questions by marking a cross in the appropriate response:

1. I confirm that I have read and understood the Information for Participants sheet regarding this study. I had the opportunity to ask questions and see them answered by the researcher. ☐
2. I understand that my participation in this study is voluntary and that I can withdraw from participating at any time without giving any explanation and with no consequences for me. ☐
3. I have been informed that the interview will be digitally recorded and I give my consent for the recording to be made. ☐
4. I understand that all the information I give will be confidential and anonymised. ☐
5. I agree to the use of anonymised transcripts from my interview in publications and presentations arising from this study. ☐
6. I agree to take part in this study. ☐

________________	________________	__ / __ / __
Participant's name	Signature	Date
________________	________________	__ / __ / __
Researcher's name	Signature	Date

Appendix 3.3b Consentimento Informado

Consentimento Informado

Título da Investigação: 'Coompreender os factores que infuenciam as opiniões e comportamentos dos adultos mais velhos durante o tempo muito quente e muito frio'

Nome da investigadora: Ana Raquel Nunes
Por favor, leia cuidadosamente este formulário. Certifique-se que já leu a folha de 'Informação aos Participantes'. A investigadora estará disponível para responder a todas as suas perguntas sobre a participação neste estudo e fornecer quaisquer informações adicionais que necessite. Ao optar por participar, ainda tem o direito de desistir da sua participação no estudo em qualquer fase e tem também o direito de recusar responder a perguntas ou solicitações durante a entrevista.
Está a ser-lhe solicitado assinar um termo de Consentimento Informado. Ser-lhe-á dada uma cópia desta informação e da folha de 'Informação aos Participantes'.
Por favor responda às questões que se seguem colocando uma cruz na resposta apropriada:

1. Confirmo que li e compreendi as 'Informações aos Participantes' sobre este estudo. Tive a oportunidade de fazer perguntas e vê-las respondidas pela investigadora. ☐
2. Eu entendo que minha participação neste estudo é voluntária e que posso desistir de participar a qualquer momento, sem dar qualquer explicação e sem consequências para mim. ☐
3. Fui informado(a) que a entrevista será gravada e dou o meu consentimento para a gravação ser feita. ☐
4. Eu entendo que todas as informações que dou serão confidenciais e anónimas. ☐
5. Eu concordo com o uso de transcrições anónimas da minha entrevista em publicações e apresentações desenvolvidas a partir deste estudo. ☐
6. Eu concordo em participar neste estudo. ☐

____________________	____________________	__ / _ / __
Nome do Participante	Assinatura	Data
____________________	____________________	__ / _ / __
Nome da Investigadora	Assinatura	Data

Appendix 3.4 List of research participants and respective details

Participant	Phase 1	Phase 2	Phase 3	Sex	Age	Ward	Duration: Phase 1 and Phase 2 *(in minutes)*	Duration: Phase 3 *(in minutes)*
AM	√	√	√	Male	65	A	84.78	51.02
AF	√	√	√	Female	79	A	65.26	48.53
BF	√	√	√	Female	80	A	88.05	47.32
CF	√	√	-	Female	87	A	43.59	-
DF	√	√	-	Female	76	A	75.44	-
EF	√	√	√	Female	81	A	79.07	38.18
FF	√	√	√	Female	80	A	49.55	43.46
BM	√	√	√	Male	75	A	107.74	120.73
HF	√	√	√	Female	65	A	52.45	35.46
IF	√	√	√	Female	73	A	48.08	32.46
MF	√	√	√	Female	82	A	53.48	59.52
NF	√	√	-	Female	65	A	53.11	-
GF	√	√	√	Female	69	B	36.00	17.25
CM	√	√	√	Male	68	B	61.13	44.04
JF	√	√	√	Female	83	B	32.48	27.22
KF	√	√	√	Female	65	B	42.59	29.17
LF	√	√	√	Female	71	B	34.05	21.49
DM	√	√	√	Male	83	B	73.12	50.41
PF	√	√	√	Female	76	B	58.14	51.04
QF	√	√	√	Female	74	B	28.01	35.21
RF	√	√	√	Female	79	B	61.48	31.23
SF	√	√	√	Female	75	B	62.53	42.11
EM	√	√	-	Male	78	C	22.49	-
FM	√	√	√	Male	95	C	37.26	20.51
GM	√	√	√	Male	69	C	43.47	45.44
HM	√	√	-	Male	87	C	68.08	-
IM	√	√	√	Male	76	C	47.16	35.51
OF	√	√	√	Female	72	C	53.51	27.10
TF	√	√	√	Female	70	D	60.44	46.09
UF	√	√	√	Female	70	D	68.09	26.34
VF	√	√	-	Female	76	D	61.58	-
JM	√	√	√	Male	80	D	106.41	54.27
XF	√	√	√	Female	80	D	53.43	17.13
KM	√	√	√	Male	65	D	30.37	21.02
ZF	√	√	√	Female	79	D	66.12	35.47
AAF	√	√	√	Female	75	D	43.29	40.05
LM	√	√	√	Male	65	D	37.29	20.40
BBF	√	√	√	Female	74	D	39.21	29.48
CCF	√	√	√	Female	78	D	46.25	26.16
MM	√	√	√	Male	85	D	48.41	28.13

Appendix 3.4 (cont.) List of research participants and respective details

Participant	Phase 1	Phase 2	Phase 3	Sex	Age	Ward	Duration: Phase 1 and Phase 2 *(in minutes)*	Duration: Phase 3 *(in minutes)*
DDF	√	√	√	Female	65	D	43.25	29.04
NM	√	√	√	Male	69	D	49.41	32.11
EEF	√	√	√	Female	72	E	37.43	17.24
FFF	√	√	√	Female	84	E	60.49	26.44
GGF	√	√	√	Female	84	E	76.06	45.03
OM	√	√	√	Male	65	E	49.31	33.10
HHF	√	√	√	Female	76	E	45.12	45.16
IIF	√	√	√	Female	87	E	60.42	43.33
JJF	√	√	√	Female	77	E	57.55	30.32
PM	√	√	√	Male	65	E	55.21	31.38
KKF	√	√	√	Female	71	E	60.44	32.41
QM	√	√	√	Male	65	E	42.26	21.24

Appendix 3.5a Phase 1 and Phase 2 Interview Protocols

Instituto de Ciências Sociais da Universidade de Lisboa

University of East Anglia

Tyndall°Centre for Climate Change Research

GENERAL STRUCTURED AND HEAT-RELATED SEMI-STRUCTURED INTERVIEW PROTOCOL

PHASE 1 - GENERAL
To record before and also after the interview

Interview number _____
Interviewee code ____
Interview date: ___ /___ /____ (day/month/year)
Time of the interview. Start ___:___; End Hour ___:___

Participant telephone number _________
Assessment time point (1, 2)
Interview location: ___________________
No of minutes the interview lasted: ___ minutes

I will read you the questions out loud and it may sound a bit formal but I need to ask them in the same way to other participants. Please let me know what you think, as there is no right or wrong answers. Also remember that you can withdraw from this interview at any time, by letting me know you wish to stop. In addition, if there is a particular question you do not wish to answer, please let me know. Do you have any questions before we start?

[At this point inform the participant that the recorder has been switched on and is recording.]

I am going to ask you some questions about you, your health and wellbeing, your neighbourhood and your home.

SECTION A - SOCIO-DEMOGRAPHIC INFORMATION

1. Record sex as observed: Female (1), Male (2)

2. What is your age? ___ (years)

3. What is your current marital status?

Married	Divorced	Widowed	Single
4	3	2	1

4. Do you live with...?

Spouse	Family members (e.g. children, brothers, sisters, etc)	Other non relatives (e.g. friends, colleagues, etc.)	Alone
4	3	2	1

5. What is the highest level of education you have successfully completed?

elementary education	1
middle school	2
high school	3
college	4
graduate school	5

(The response categories will be named according to the Portuguese educational system)

6. What was your most recent occupation? Job description:

____

SECTION B – HEALTH, QUALITY OF LIFE and SENSE OF COHERENCE
Now I'm going to ask you about your health, wellbeing and your life

7. In general, would you say your health is:

Excellent	Very good	Good	Fair	Poor
5	4	3	2	1

8. Compared to one year ago, how would you rate your health in general now?

Much better now	Somewhat better now	About the same	Somewhat worse	Much worse
5	4	3	2	1

9. Are you hampered in your daily activities in any way by any longstanding illness, or disability, infirmity, mobility problem or mental health problem?

Yes, a lot	Yes, to some extent	No	[DK/N A]
1	2	3	8

9.1. If yes: Which?
____

QUALITY OF LIFE

10. I am going to read out a list of things that some people say are important in their quality of life. Please tell me how important each of these is in your quality of life.

	Very important	Important	Neither important nor unimportant	Not important	Not at all important	DK/NA
10.1. A good education	5	4	3	2	1	8
10.2. A good standard of living						
10.3. Good accommodation						
10.4. A good family life						
10.5. Good health						
10.6. A good social life						

11. Could you please tell me how satisfied you are with each of the following areas of your life.

	Very dissatisfied	Dissatisfied	Neither dissatisfied nor satisfied	Satisfied	Very satisfied	DK/ NA
11.1. Your education	1	2	3	4	5	8
11.2. Your present standard of living						
11.3. Your accommodation						
11.4. Your family life						
11.5. Your health						
11.6. Your social life						

SENSE OF COHERENCE, by Aaron Antonovsky. SOC-13 scale

12.4. Do have the feeling that you don't really care about what goes on around you? R ME	Very seldom or never 1 2 3 4 5 6 7 very often
12.5. Has it happened in the past that you were surprised by the behaviour of people whom you thought you knew well? R CO	Never happened 1 2 3 4 5 6 7 always happened
12.6. Has it happened that people whom you counted on disappointed you? R MA	Never happened 1 2 3 4 5 6 7 always happened
12.8. Until now your life has had: ME	No clear goals or purpose at all 1 2 3 4 5 6 7 very clear goals and purpose
12.9. Do you have the feeling that you're being treated unfairly? MA	Very often 1 2 3 4 5 6 7 very seldom or never
12.12. Do you have the feeling that you are in an unfamiliar situation and don't know what to do? CO	Very often 1 2 3 4 5 6 7 very seldom or never
12.16. Doing the things you do every day is: R ME	A source of deep pleasure and satisfaction 1 2 3 4 5 6 7 a source of pain and boredom
12.19. Do you have very mixed-up feelings and ideas? CO	Very often 1 2 3 4 5 6 7 very seldom or never
12.21. Does it happen that you have feelings inside you would rather not feel? CO	Very often 1 2 3 4 5 6 7 very seldom or never
12.25. Many people – even those with a strong character – sometimes feel like sad sacks (losers) in certain situations. How often have you felt this way in the past? R MA	Never 1 2 3 4 5 6 7 very often
12.26. When something happened, have you generally found that: CO	You overestimated or underestimated its importance 1 2 3 4 5 6 7 you saw things in the right proportion
12.28. How often do you have the feeling that there's little meaning in the things you do in your daily life? ME	Very often 1 2 3 4 5 6 7 very seldom or never.
12.29. How often do you have feelings that you're not sure you can keep under control? MA	Very often 1 2 3 4 5 6 7 very seldom or never

SECTION C - SOCIAL CAPITAL, SOCIAL SUPPORT and SOCIAL PARTICIPATION
Now I'm going to ask you about your family, friends and social activities.

13. Could you please tell me if you agree or disagree with the following statements:

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree	DK/NA
13.1. There are people available who can help me when I am in need.	5	4	3	2	1	8
13.2. There are people who care for me.						

14. On average, how often do you have direct (face-to-face) contact with…

	More than once a day	Every day or almost everyday	At least once a week	Once or twice a month	Several times a year	Less often	Don't have such relatives	DK/ NA
14.1. Any of your children	6	5	4	3	2	1	0	8
14.2. Any brother, sister or other relative								
14.3. Any of your friends or neighbours								

15. And on average, how often do you have contact by phone, email or by post with ...?

	More than once a day	Every day or almost everyday	At least once a week	Once or twice a month	Several times a year	Less often	Don't have such relatives	[DK/ NA]
15.1. Any of your children	6	5	4	3	2	1	0	8
15.2. Any brother, sister or other relative								
15.3. Any of your friends or neighbours								

16. Compared to other people of your age, how often would you say you take part in social activities?

Much less than most	Less than most	About the same	More than most	Much more than most	[DK/N A]
1	2	3	4	5	8

17. How often are you involved in any of the following activities?

	Every day	Several times a week	Once or twice a week	Less often than once a week	Less often	Never	[DK/NA]
17.1. Caring for and educating children	6	5	4	3	2	1	8
17.2. Cooking and housework							
17.3. Caring for elderly/ disabled relatives							
17.4. Voluntary and charitable activities							
17.5. Activities organised in your local area							

18. I am going to read out some areas of daily life in which you can spend your time. Could you tell me if you think you spend too much, too little or just the right amount of time in each area.

	Too much	Just right	Too little	Not applicable	[DK/ N A]
18.1. Contact with family members living in your house or elsewhere	3	2	1	0	8
18.2. Other social contact (not family)					
18.3. Own hobbies / interests					
18.4. Taking part in voluntary work or political activities					

SECTION D - HOUSING and APPLIANCES INFORMATION

Just a few questions about your home and neighbourhood

19. What best describes the house you live in?

Detached single-family house	Semi-detached house or duplex	Terraced housing unit	Apartment building with up to 3 storeys	Apartment building with 4 to 8 storeys	Apartment building with 9 or more storeys
1	2	3	4	5	6

20. What floor do you live on? _______

21. Is there a lift in the building?

No	Yes, and it works	Yes, but it doesn't work	[DK/N A]
1	2	3	8

22. What is the age of the building or house you live in?

Under 10 years	10-19	20-29	30-39	40-49	50-59	60-74	75-99	100 and more	[DK/N A]
1	2	3	4	5	6	7	8	9	

23. On a scale from 1 to 5, how satisfied are you with your house?

Highly dissatisfied				Highly satisfied
1	2	3	4	5

24. Is the house you live in ...?

Owned	Rented	Social housing
1	2	3

25. Are you happy with your current living conditions or would you move if you had the chance?

Am happy	Would move
1	2

25.1. If would move: Why would you move?

____

26. Which of the following equipments/goods do you have? 26.7. If yes: Do you use them?

	Yes	No	Yes	No
26.1. Fixed telephone	1	2	1	2
26.2. Mobile telephone				
26.3. Television				
26.4. Radio				
26.5. Computer				
26.6. Car				

SECTION E – NEIGHBOURHOOD, CITY AND COUNTRY INFORMATION

Still thinking about your neighbourhood, city and country, please tell me

27. What is the name of the neighbourhood where you live?

____

28. Are there any of the following facilities available within walking distance?

	Yes	No	[DK/N A]
28.1. A food store or supermarket	1	2	8
28.2. Post office			
28.3. Banking facilities			
28.4. Cinema, theatre or cultural centre			
28.5. Public transport facilities (bus, metro, etc)			

29. Are there any private and public spaces close to your house, where you can sit and relax, have a coffee, or talk peacefully to neighbours, acquaintances and friends?

Yes	No	[DK/N A]
1	2	8

If yes: 29.1. Which? ___________________________________

29.2. Do you go there?

Yes	No	[DK/N A]
1	2	8

29.2.1. If no: Why not?____

30. Are there any public facilities close to your house where you can practice physical activity (such as playgrounds, parks, sport centres, swimming pools, etc.)?

Yes	No	[DK/N A]
1	2	8

If yes: 30.1. Which? ____________________________

30.2. Do you go there?

Yes	No	[DK/N A]
1	2	8

30.2.1. If no: Why not?____

31. What would be the first thing you would change in your neighbourhood? ____________

[DK/N A]
8

32. On a scale from 1 to 5, how do you rate your neighbourhood overall as a place to live?

Very bad	Bad	Neither bad nor good	Good	Very good	[DK/N A]
1	2	3	4	5	8

33. In general, how would you rate each of the following public services?

	Very bad	Bad	Neither bad nor good	Good	Very good	DK/NA	
33.1. Health services	1	2	3	4	5	8	Why?
33.2. Public transport							Why?
33.3. Care services for elderly							Why?
33.4. State pension system							Why?

33.5. (prompt for local and national level) Do you use them?

SECTION F - FINANCE/INCOME

34. How would you describe the current financial situation of your household?

Very comfortable	Comfortable	We have to be careful, but we manage	We have difficulties making ends meet	Things are very difficult	[DK/N A]
5	4	3	2	1	8

35. Please can you tell me how much your household's average income per month is (after taxes)? If you don't know the exact figure, please give an estimate.

≤ 350 euros	351-500	501-800	801-1500	1501-2500	> 2500 euros	[DK/N A]
1	2	3	4	5	6	8

36. Have you or someone else in your household received any of the following types of income over the past 12 months?

	Yes	No	[DK/N A]
36.1. Wages or salaries	1	2	8
36.2. Income from self-employment or farming			
36.3. Pension			
36.4. Unemployment benefit, disability benefit or any other social benefits			
36.5. Other income (e.g. from savings, property or stocks, etc.)			

37. In the past 2 years, have there been difficulties paying the housing expenses? (i.e. rent or mortgage payments for accommodation, utility bills, such as electricity, water, gas)

No, never	Yes, sometimes	Yes, often	[DK/N A]
3	2	1	8

If yes: 37.1. Which ones? ____________________
37.2. Why?___________________________

38. Has your household at any time during the past 12 months had difficulties in paying for food?

Yes	No	[DK/N A]
1	2	8

38.1. If yes: Can you tell me a bit more about it?

39. Has your household at any time during the past 12 months had difficulties in paying for healthcare or medication?

Yes	No	[DK/N A]
1	2	8

39.1. If yes: Can you tell me a bit more about it?

40. If for some reason you were in serious financial difficulties and had to borrow money to make ends meet, how difficult or easy would that be?

Very difficult	Quite difficult	Neither easy nor difficult	Quite easy	Very easy	[DK/N A]
1	2	3	4	5	8

40.1. Why? ____
40.2. Whom would you ask for money? *[note relationship with participant]*___________________________________

PHASE 2 – Extreme Heat

Record before the interview
Weather on the day [cloudy, sunny, rainy, muggy, thunderstorm] Outdoor temperature: ___ °C [thermometer]
Most recent heat alert: ___ /___ /_____ (day/month/year) (DoH website) Indoor temperature: ___ °C [thermometer]

SECTION G – EXPERIENCES OF HEAT, EVERYDAY BEHAVIOURS AND RESPONSES TO HEAT
Now I am going to ask you some questions about how you feel and what you do when the weather is very hot. At the end I'll also ask you a few questions about your home and your health during very hot weather.

41. How do you think the weather is today?

Very cold	Cold	Neither cold nor warm	Warm	Very warm	[DK/N A]
1	2	3	4	5	8

42. When was the last time it was very hot in recent years?

43. Where were you at the time?

44. Was there anything you started doing to protect yourself from very hot weather?

Yes	No	[DK/N A]
1	2	8

44.1. If yes: What did you start doing? Inside your home? When you're outside? (Things to do with your house? Things to do with what you wear? Things to do with what you eat?)

45. Was there anything you wanted to do but were unable to do?

Yes	No	[DK/N A]
1	2	8

45.1. If yes: What?
Why were you unable to do it?

46. When it's very hot how do you keep cool inside your house during the day?
What do you do?
Where do you go?

47. And during the night?
What do you do?
Where do you go?

48. When it's very hot how do you keep cool outside?
What do you do?
Where do you go?

49. Do you think you're more affected by very hot weather than other people?

Yes	No	[DK/N A]
1	2	8

49.1. If yes: Can you tell me why? In what way?

50. Can you think of any other groups of people who may be more affected by very hot weather?

Yes	No	[DK/N A]
1	2	8

50.1. If yes: Who are you thinking about? Can you tell me why?

51. Can you think of any ways that very hot weather can affect people's health?

Yes	No	[DK/N A]
1	2	8

51.1. If yes: Can you say a bit more about that?

52. Does very hot weather stop you from doing the things you usually do in your everyday life?

Yes	No	[DK/N A]
1	2	8

52.1. If yes: Why?
What things would you like to do but can't because of very hot weather?

SECTION H –INFORMATION

53. Have you received any information, or advice on what to do during very hot weather?

Yes	No	[DK/N A]
1	2	8

53.1. If yes: Did you ask for this information, advice or support?

Yes	No	[DK/N A]
1	2	8

53.1.1. If yes: A1) Whom did you ask for information or advice?
A2) What did they say?
A3) When / Where?
A4) Was it helpful? In what way?

53.1.2. If no: B1)Who gave you the information or advice?
B2) What did they say?
B3) When / Where?
B4) Why do you think you were given that information or advice?
B5) Was it helpful? In what way?

54. Have you provided any information or advice to someone about what to do during very hot weather?

Yes	No	[DK/N A]
1	2	8

54.1. If yes: To whom?
What did you say?

55. How much information do you think you have about what to do during very hot weather?

Much	Some	Little	[DK/N A]
3	2	1	8

56. Would you like to have more information or advice about what to do during very hot weather?

Yes	No	[DK/N A]
1	2	8

56.1. If yes: What source(s) of information would you prefer?

Social contacts (family, friends, neighbours)	Health professional	Radio	TV	Newspaper	Internet	Other	[DK/N A]
1	2	3	4	5	6	7	8

56.2. Why?

57. Do you think the weather is getting hotter year on year?

Yes	No	[DK/N A]
1	2	8

57.1. If yes: Can you say a bit more about that?

SECTION I – SOCIAL CONTACTS AND HEALTH DURING VERY HOT WEATHER
Now I'm going to ask you about your family and friends during very hot weather.

58. How often do you have contact with other people during very hot weather?

More than once a day	Every day or almost everyday	At least once a week	Once or twice a month	Less often	[DK/N A]
5	4	3	2	1	8

59. When you're concerned or need help with anything during very cold weather who do you ask and rely on? *[note relationship with participant]*

Now I'm going to ask you about your health during very hot weather.

60. Does your physical health limit what you can do during very hot weather?

Yes	No	[DK/N A]
1	2	8

60.1. If yes: Why is that?
In what way?

61. What would you do if you felt unwell during very hot weather? *(Anything else?)*

SECTION J – RESIDENTIAL CHARACTERISTICS
Just a few questions about your home during summer

62. Do you perceive the temperature in your home during the summer season as a problem?

Yes	No	[DK/N A]
1	2	8

63. Are you able to keep cool in your house during summer?

Yes	No	[DK/N A]
1	2	8

63.1. If yes: How?
63.2. If not: Why not?

64. Are you able to keep your house cool during summer?

Yes	No	[DK/N A]
1	2	8

64.1. If yes: How is your house kept cool?

64.2. If not: 64.2.1. Why not?
64.2.2. Do you think that being hot at home has effects on your life in general?

Yes	No	[DK/N A]
1	2	8

64.2.2.1.If yes: Why?
64.2.2.2. If not: Why not?

64.2.3. And on your health?

Yes	No	[DK/N A]
1	2	8

64.2.3.1. If yes: Why?
64.2.3.2. If not: Why not?

SECTION K – HEATWAVE PLAN

65. Do you know about the Heatwave Plan?

Yes	No	[DK/N A]
1	2	8

65.1. If yes: 65.1.1.How important do you think it is?

Very important	Important	Moderately important	Of little importance	Unimportant
5	4	3	2	1

65.1.2. What do you know about the Heatwave Plan?
65.1.3. Would you like to know more?

Yes	No	[DK/N A]
1	2	8

65.1.3.1. If yes: What would you like to know more?

65.2. If no: Would you like to know about the Heatwave Plan?

Yes	No	[DK/N A]
1	2	8

65.2.1. If yes: What would you like to know?

66. Is there anything else you'd like to add or say about coping during very hot weather?

END OF INTERVIEW

Thank you for taking the time to participate in this interview. Do you have further questions arising from this interview? Ask the participant if he/her can be contacted again during winter season.

Yes	No	[DK/N A]
1	2	8

[Notify the participant that the recorder has been switched off and is no longer recording.]

Appendix 3.5b Protocolo de Entrevista das Fases 1 e 2

PROTOCOLO DE ENTREVISTA GERAL ESTRUTURADA E DE CALOR SEMI-ESTRUTURADA

FASE 1 - GERAL
Para anotar antes e também depois da entrevista

Entrevista número ____ Número de telefone do participante ____________
Número de Identificação do Respondente ___ Ponto de avaliação (1, 2)
Data da entrevista: ___/___/____ (dia/mês/ano) Local da entrevista: __________________________
Tempo da entrevista. Início ___:___; Fim ___:___ Tempo de duração da entrevista: ____ minutos

Vou fazer-lhe algumas perguntas sobre si, a **sua saúde e bem-estar**, o seu bairro **e a sua casa. Eu vou ler-lhe as perguntas em voz alta e por isso pode parecer um pouco formal mas eu tenho de perguntar exactamente da mesma maneira a todos** os participantes**. Por favor, diga-me apenas o que pensa, pois não existem respostas certas ou erradas a estas perguntas. Lembre-se que é livre de terminar esta entrevista a qualquer momento**, diga-me apenas **que deseja parar. Além disso, se existir uma pergunta em particular** que **não queira responder, por favor avise-me**. **Tem alguma pergunta antes de começar?**
[Notificar o participante que o gravador foi ligado e está a gravar.]

Vou fazer-lhe algumas perguntas sobre si, a sua saúde e bem-estar, o ser bairro e a sua casa.

SECÇÃO A – INFORMAÇÃO SÓCIO-DEMOGRÁFICA

1. Anotar o sexo observado: Feminino (1), Masculino (2)

2. Qual é a sua idade? ___ (anos)

3. Qual é o seu estado civil actual?

Casado(a)	Divorciado(a)	Viúvo(a)	Solteiro(a)
4	3	2	1

4. Vive com ...?

Esposo(a)	Outros familiares (filhos, irmãos, irmãs, etc)	Outros não-familiares (amigos, colegas)	Sozinho(a)
4	3	2	1

5. Qual o nível de ensino mais elevado que completou?

Sem nível de ensino	1
1º Ciclo	2
2º Ciclo	3
3º Ciclo	4
Secundário	5
Bacharelato	6
Licenciatura	7
Mestrado	8
Doutoramento	9
Nenhum dos anteriores	10
Não sabe	11

6. Qual foi a sua mais recente ocupação? Descrição: ______________________________

SECÇÃO B – ESTADO DE SAÚDE, QUALIDADE DE VIDA E SENTIDO DE COERÊNCIA
Agora vou perguntar-lhe sobre a **sua saúde**, bem-estar e a **sua vida**

7. Em geral, diria que a sua saúde é:

Óptima	Muito boa	Boa	Razoável	Fraca
5	4	3	2	1

8. Comparando com o que acontecia há um ano, como descreve o seu estado geral actual:

Muito melhor	Com algumas melhoras	Aproximadamente igual	Um pouco pior	Muito pior
5	4	3	2	1

9. Está de alguma forma limitado(a) nas suas actividades diárias devido a uma doença prolongada, uma deficiência, um problema de mobilidade, ou problema de saúde do foro psicológico?

Sim, muito	Sim, de alguma forma	Não	NS/NR
1	2	3	8

9.1. Se sim: Qual? ______________________

QUALIDADE DE VIDA

10. Vou ler-lhe uma lista de coisas que algumas pessoas consideram importantes para a sua qualidade de vida. Diga-me, por favor, em que medida cada uma destas coisas é importante ou não para a sua qualidade de vida.

	Muito importante	Importante	Nem muito nem pouco importante	Pouco importante	Nada importante	NS/NR
10.1. Uma boa educação	5	4	3	2	1	8
10.2. Um bom nível de vida actual						
10.3. Uma boa casa						
10.4. Uma boa vida familiar						
10.5. Uma boa saúde						
10.6. Uma boa vida social						

11. Poderia dizer-me em que medida está satisfeito(a) com cada um dos seguintes áreas da sua vida.

	Muito insatisfeito	Pouco satisfeito (a)	Nem muito nem pouco satisfeito(a)	Satisfeito	Muito satisfeito(a)	NS/NR
11.1. A sua educação	1	2	3	4	5	8
11.2. O seu nível de vida actual						
11.3. A sua casa						
11.4. A sua vida familiar						
11.5. A sua saúde						
11.6. A sua vida social						

SENTIDO DE COERÊNCIA, Aaron Antonovsky. Escala SOC-13

12.4. Tem a sensação que não se interessa pelo que se passa à sua volta? R ME	Muito raramente ou nunca 1 2 3 4 5 6 7 Muito frequentemente
12.5. Já aconteceu no passado ter ficado surpreendido(a) com o comportamento de pessoas que pensava conhecer bem? R CO	Nunca aconteceu 1 2 3 4 5 6 7 Aconteceu sempre
12.6. Já aconteceu ter sido desapontado(a) por pessoas com quem contava? R MA	Nunca aconteceu 1 2 3 4 5 6 7 Aconteceu sempre
12.8. Até agora a sua vida: ME	Não teve nem objectivos nem rumo próprio 1 2 3 4 5 6 7 Teve objectivos e rumo próprio
12.9. Tem a sensação de que é tratado(a) com injustiça? MA	Muito frequentemente 1 2 3 4 5 6 7 Muito raramente ou nunca
12.12. Tem a sensação de que se encontra numa situação não habitual e não sabe o que fazer? CO	Muito frequentemente 1 2 3 4 5 6 7 Muito raramente ou nunca
12.16. Fazer as coisas que faz diariamente é: R ME	Uma fonte de profunda satisfação e prazer 1 2 3 4 5 6 7 Uma fonte de sofrimento e aborrecimento
12.19. Tem sentimentos e ideias muito confusos? CO	Muito frequentemente 1 2 3 4 5 6 7 Muito raramente ou nunca
12.21. Acontece-lhe ter sentimentos dentro de si que gostaria não ter? CO	Muito frequentemente 1 2 3 4 5 6 7 Muito raramente ou nunca
12.25. Muitas pessoas - mesmo as que têm carácter forte - por vezes, em certas situações, sentem-se uns perdedores. Com que frequência já se sentiu assim no passado? R MA	Nunca 1 2 3 4 5 6 7 Muitas vezes
12.26. Quando teve de enfrentar algum problema, você geralmente acabou por verificar que: CO	Avaliou mal a importância do problema 1 2 3 4 5 6 7 Avaliou correctamente a importância do problema
12.28. Com que frequência sente que as coisas que faz na sua vida diária têm pouco sentido? ME	Muito frequentemente 1 2 3 4 5 6 7 Muito raramente ou nunca
12.29. Com que frequência tem sentimentos que não tem a certeza poder controlar? MA	Muito frequentemente 1 2 3 4 5 6 7 Muito raramente ou nunca

SECÇÃO C – CAPITAL SOCIAL, SUPPORTE SOCIAL e PARTICIPAÇÃO SOCIAL
Agora vou perguntar-lhe sobre a **sua família, amigos e actividades sociais**.

13. Poderia dizer-me em que medida concorda ou discorda com as seguintes afirmações:

	Concordo forte/	Concordo	Não concordo nem discordo	Discordo	Discordo forte/	NS/NR
13.1. Existem pessoas disponiveis que me podem ajudar quando necessito.	5	4	3	2	1	8
13.2. Existem pessoas que se importam comigo.						

14. Em média, com que frequência tem contacto directo (em pessoa) com…?

	Mais do que uma vez por dia	Todos os dias ou quase todos os dias	Pelo menos uma vez por semana	Uma ou duas vezes por mês	Várias vezes por ano	Pouca frequência	Não tem estes familiares	NS/NR
14.1. Algum dos seus filhos	6	5	4	3	2	1	0	8
14.2. Alguma irmã(o) ou outro membro da família								
14.3. Algum dos seus amigos ou vizinhos								

15. E em média, com que frequência tem contacto directo com amigos ou familiares por telefone, email ou correio?

	Mais do que uma vez por dia	Todos os dias ou quase todos os dias	Pelo menos uma vez por semana	Uma ou duas vezes por mês	Várias vezes por ano	Pouca frequência	Não tem estes familiares	NS/NR
15.1. Algum dos seus filhos	6	5	4	3	2	1	0	8
15.2. Alguma irmã(o) ou outro membro da família								

15.3. Algum dos seus amigos ...								

16. Comparando com outras pessoas da sua idade, com que regularidade é que acha que participa em actividades sociais?

Muito menos que a maioria	Menos que a maioria	O mesmo que a maioria	Mais que a maioria	Muito mais que a maioria	NS/NR
1	2	3	4	5	8

17. Com que frequência participa nas seguintes actividades?

	Todos os dias	Várias vezes por semana	1 ou 2 vezes por semana	Menos que uma vez por semana	Menos frequente/	Nunca	NS/NR
17.1. Cuidar e educar crianças	6	5	4	3	2	1	8
17.2. Cozinhar e fazer trabalhos domésticos							
17.3. Cuidar de familiares idosos ou com alguma deficiência							
17.4. Fazer actividades voluntárias ou de caridade							
17.5. Actividades organizadas na área de residência							

18. Vou ler-lhe algumas áreas da vida diária nas quais pode dispender o seu tempo. Poderia dizer-me se pensa que passa demasiado tempo, menos tempo do que deveria ou o tempo certo em cada uma das seguintes áreas?

	Demasiado tempo	O tempo certo	Menos tempo do que deveria	Não se aplica	NS/NR
18.1. A contactar com os membros da sua família, que vivem na sua casa ou noutro local	3	2	1	0	8
18.2. Noutros contactos sociais (sem ser da família)					
18.3. Nos seus passatempos/interesses					
18.4. A participar em trabalho voluntário ou em actividades politicas					

SECÇÃO D – INFORMAÇÃO sobre HABITAÇÃO e EQUIPAMENTOS
Apenas algumas perguntas sobre a sua casa e bairro

19. Qual a opção que melhor descreve a sua casa?

Moradia unifamiliar independente	Moradia multifamiliar ou duplex	Moradia em banda	Apartamento num prédio até 3 andares	Apartamento num prédio com 4 até 8 andares	Apartamento num prédio com 9 ou mais andares
1	2	3	4	5	6

20. Em que andar está situada a sua casa? ______

21. Existe elevador no edifício?

Não	Sim, e funciona	Sim, mas não funciona	NS/NR
1	2	3	8

22. Qual a idade do edifício onde vive?

Menos de 10 anos	10-19	20-29	30-39	40-49	50-59	60-74	75-99	100 e mais	NS/NR
1	2	3	4	5	6	7	8	9	

23. Numa escala de 1 a 5, qual a satisfação com a sua casa?

Muito insatisfeito				Muito satisfeito
1	2	3	4	5

24. A casa onde reside é ...?

Própria	Arrendada	Habitação Municipal
1	2	3

25. Está contente com as actuais condições da sua casa ou mudava de casa se tivesse possibilidade?

Estou contente	Mudava
1	2

25.1. Se mudava: Porque mudava?______________________________

26. Qual(is) dos seguintes equipamentos/bens possui?

	Sim	Não
26.1.Telefone fixo	1	2
26.2. Telemóvel		
26.3. Televisão		
26.4. Rádio		
26.5. Computador		
26.6. Carro		

26.7. Se sim: Usa-os?

Sim	Não
1	2

SECÇÃO E: INFORMAÇÃO SOBRE O SEU BAIRRO, CIDADE E PAÍS
Ainda a pensar no seu bairro, cidade e país, por favor diga-me

27. Qual é o nome do bairro e freguesia onde vive?

____

28. Estão disponíveis a curta distância (a pé) alguma das seguintes infraestruturas?

	Sim	Não	NS/NR
28.1. Uma mercearia ou um supermercado	1	2	8
28.2. Um balcão dos correios			
28.3. Bancos			
28.4. Um cinema, um teatro ou um centro cultural			
28.5. Transportes públicos (autocarro, metro, comboio, etc.)			

29. Existem espaços públicos e privados perto de sua casa, onde se possa sentar e relaxar, tomar um café ou falar calmamente com os seus vizinhos, conhecidos e amigos?

Sim	Não	NS/NR
1	2	8

Se sim: 29.1. Quais?

____

29.2. Frequenta esses espaços?

Sim	Não	NS/NR
1	2	8

29.2.1. Se não: Porque não?____________________________________

30. Existem espaços públicos perto de sua casa onde possa praticar actividade física (como jardins, parques, centros desportivos, piscinas, etc.)?

Sim	Não	NS/NR
1	2	8

Se sim: 30.1. Quais?

____

30.2. Frequenta esses espaços?

Sim	Não	NS/NR
1	2	8

30.2.1. Se não: Porque não?______________________________________

31. Qual seria a primeira coisa que mudaria no seu bairro?

____

NS/NR
8

32. Numa escala de 1 a 5, como classifica o bairro onde reside como local para viver?

Muito mau	Mau	Nem bom nem mau	Bom	Muito bom	NS/NR
1	2	3	4	5	8

33. Em geral, como avalia cada um dos seguintes serviços públicos?

	Muito mau	Mau	Nem bom nem mau	Bom	Muito bom	NS/NR
33.1. Os serviços de saúde	1	2	3	4	5	
33.2. Os transportes públicos						
33.3. Os centros de acolhimento para pessoas idosas						
33.4. O sistema de reformas						

Porquê?

Porquê?

Porquê?

Porquê?

33.5. (perguntar por nível local e nacional) Usa-os?

SECÇÃO F – FINANÇAS/RENDIMENTOS

34. Como descreveria a actual situação financeira da sua família?

Muito confortável	Confortável	Temos de ter cuidado, mas conseguimos aguentar-nos	Temos dificuldade em chegar ao fim do mês com dinheiro	As coisas estão muito difíceis	NS/NR
5	4	3	2	1	

35. Por favor, pode dizer-me qual o rendimento médio mensal do seu agregado familiar (depois dos importos)? Se não souber o valor exacto, por favor diga uma estimativa.

≤ 350 euros	351-500	504-800	801-1500	1501-2500	> 2500 euros
1	2	3	4	5	6

36. Nos últimos 12 meses o(a) Sr.(a) ou alguém do seu agregado recebeu algum dos seguintes tipos de rendimento?

	Sim	Não	NS/NR
36.1. Uma remuneração ou um salário	1	2	8
36.2. O rendimento de uma profissão liberal ou de uma exploração agrícola			
36.3. Uma pensão			
36.4. Um subsídio de desemprego, subsídio para deficientes ou outro benefício social			
36.5. Outro rendimento (ex: poupanças, propriedade, investimentos, etc.)			

37. Nos últimos 2 anos, teve dificuldades em pagar a totalidade das despesas da casa? (i.e. renda ou amortização da casa, contas de electricidade, água, gás)

Não, nunca	Sim, às vezes	Sim, frequentemente	NS/NR
3	2	1	8

Se sim: 37.1. Quais?_________ 37.2. Porquê?_________

38. Alguma vez durante os últimos 12 meses, houve dificuldades para comprar comida?

Sim	Não	NS/NR
1	2	8

38.1. Se sim: Pode falar um pouco sobre isso?

39. Alguma vez durante os últimos 12 meses, houve dificuldades em pagar serviços de saúde ou medicamentos?

Sim	Não	NS/NR
1	2	8

39.1. Se sim: Pode falar um pouco sobre isso?

40. Se, por alguma razão, tivesse sérias dificuldades financeiras e tivesse de pedir dinheiro emprestado para conseguir viver, quão difícil ou fácil acha que isso seria:

Muito difícil	Difícil	Nem fácil nem difícil	Fácil	Muito fácil	NS/NR
1	2	3	4	5	8

40.1. Porquê?____
40.2. A quem pediria dinheiro? *(anotar relação com o participante)*
____

FASE 2 - CALOR
Para anotar antes da entrevista
Tempo hoje [nublado, ensolarado, chuvoso, quente e húmido, tempestade]
Temperatura exterior ___ °C; T. interior ___ °C
Alerta de calor mais recente? ___/___/_____ (site da Direcção Geral da Saúde)

SECÇÃO G – EXPERIÊNCIAS DE CALOR, PRÁTICAS QUOTIDIANAS E RESPOSTAS AO CALOR
Agora vou fazer-lhe algumas perguntas sobre como se sente e o que faz quando o tempo está muito quente. Vou também fazer-lhe algumas perguntas sobre a sua casa e sua saúde durante o tempo muito quente.

41. Como acha que o tempo está hoje?

Muito frio	Frio	Nem frio nem quente	Quente	Muito quente	NS/NR
1	2	3	4	5	8

42. Quando foi a última vez que esteve muito calor nos últimos anos?

43. Onde estava nesse momento?

44. Houve alguma coisa que tenha começado a fazer para se proteger do tempo muito quente?

Sim	Não	NS/NR
1	2	8

44.1. Se sim: O que começou a fazer? Em sua casa? Na rua? (Coisas relacionadas com a sua casa? Coisas relacionadas com o que veste? Coisas relacionadas com o que come?)

45. Houve alguma coisa que quisesse fazer mas não podesse fazer?

Sim	Não	NS/NR
1	2	8

45.1. Se sim: O quê?
Porque é que não pôde fazer?

46. Quando está muito calor, como se mantém fresco(a) em sua casa durante dia?
O que faz?
Onde vai?

47. E durante a noite?
O que faz?
Onde vai?

48. Quando está muito calor, como se mantém fresco(a) na rua?
O que faz?
Onde vai?

49. Acha que é mais afectado(a) pelo tempo muito quente que outras pessoas?

Sim	Não	NS/NR
1	2	8

49.1. Se sim: Pode dizer-me porquê? De que maneira?

50. Consegue pensar em quaisquer outros grupos de pessoas que podem ser mais afectados pelo tempo muito quente?

Sim	Não	NS/NR
1	2	8

50.1. Se sim: Em quem está a pensar?
Pode dizer-me porquê?

51. Consegue pensar em algumas formas que o tempo muito quente pode afectar a saúde das pessoas?

Sim	Não	NS/NR
1	2	8

51.1. Se sim: Pode falar um pouco mais sobre isso?

52. O tempo muito quente impede-o(a) de fazer coisas que costuma fazer na sua vida diária?

Sim	Não	NS/NR
1	2	8

52.1. Se sim: Porquê?
Quais as coisas que gostaria de fazer, mas não pode por causa do tempo muito quente?

SECTION H – INFORMAÇÃO

53. Recebeu alguma informação ou conselho sobre o que fazer durante o tempo muito quente?

Sim	Não	NS/NR
1	2	8

53.1. Se sim: Foi você que pediu essa informação ou conselho?

Sim	Não	NS/NR
1	2	8

53.1.1. Se sim: A1) A quem pediu informação ou conselho?
A2) O que lhe disseram?
A3) Quando / Onde?
A4) Foi útil? De que maneir

53.1.2. Se não: B1) Quem lhe deu a informação ou o conselho?
B2) O que lhe disseram?
B3) Quando / Onde?
B4) Por que acha que lhe foi dada essa informação ou conselho?
B5) Foi útil? De que maneira?

54. Forneceu alguma informação ou conselho a alguém sobre o que fazer durante o tempo muito quente?

Sim	Não	NS/NR
1	2	8

54.1. Se sim: A quem?
O que disse?

55. Quanta informação acha que tem?

Muita	Alguma	Pouca	NS/NR
3	2	1	8

56. Gostaria de ter (mais) informação ou conselhos sobre o que fazer durante o tempo muito quente?

Sim	Não	NS/NR
1	2	8

56.1. Se sim: Que fonte(s) de informação preferiria?

Contactos sociais (família, amigos, vizinhos)	Professional de saúde	Rádio	TV	Jornal	Internet	Outra	NS/NR
1	2	3	4	5	6	7	8

56.2. Porquê?

57. Acha que o tempo está a ficar mais quente de ano para ano?

Sim	Não	NS/NR
1	2	8

57.1. Se sim: Pode falar um pouco mais sobre isso?

SECTION I – CONTACTOS SOCIAIS E SAÚDE DURANTE O TEMPO MUITO QUENTE
Agora vou perguntar-lhe sobre a **sua família e amigos durante o tempo muito quente.**

58. Com que frequência tem contacto com outras pessoas durante o tempo muito quente?

Mais do que uma vez por dia	Todos os dias ou quase todos os dias	Pelo menos uma vez por semana	Uma ou duas vezes por mês	Menos frequentemente	NS/NR
5	4	3	2	1	8

59. Quando está preocupado ou necessita de ajuda durante o tempo muito quente, a quem pede ajuda ou em quem pode confiar? *[anotar a relação com o participante]*

Agora vou perguntar-lhe sobre a **sua saúde durante o tempo muito quente**.

60. A sua saúde física limita o que pode fazer durante o tempo muito quente?

Sim	Não	NS/NR
1	2	8

60.1 Se sim: Porquê?

De que forma?

61. O que faria se se sentisse mal/doente durante o tempo muito quente? *(Mais alguma coisa?)*

SECTION J – CARACTERÍSTICAS DA RESIDÊNCIA
Apenas algumas perguntas sobre a sua casa durante o verão

62. Considera que a temperatura dentro de sua casa no Verão é um problema?

Sim	Não	NS/NR
1	2	8

63. Consegue manter-se fresco(a) em sua casa durante o verão?

Sim	Não	NS/NR
1	2	8

63.1. Se sim: Como?
63.2. Se não: Porque não?

64. Consegue manter a sua casa fresca durante o verão?

Sim	Não	NS/NR
1	2	8

64.1. Se sim: Como mantém a sua casa fresca?

64.2. Se não: 64.2.1. Porque não?

64.2.2. Acha que sentir calor em sua casa tem efeitos na sua vida em geral?

Sim	Não	NS/NR
1	2	8

64.2.2.1. Se sim: Porquê?

64.2.2.2. Se não: Porque não?

64.2.3. E na sua saúde?

Sim	Não	NS/NR
1	2	8

64.2.3.1. Se sim: Porquê?
64.2.3.2. Se não: Porque não?

SECÇÃO K – PLANO DE CONTINGÊNCIA DE ONDAS DE CALOR

65. Sabe da existência do Plano de Contigência de Ondas de Calor?

Sim	Não	NS/NR
1	2	8

65.1. Se sim: 65.1.1. Quão importante acha que é?

Muito importante	Importante	Nem muito nem pouco importante	Pouco importante	Nada importante
5	4	3	2	1

65.1.2. O que sabe acerca do Plano de Contigência de Ondas de Calor?
65.1.3. Gostaria de saber mais?

Sim	Não	NS/NR
1	2	8

65.1.3.1. Se sim: O que gostaria de saber mais?

65.2. Se não: Gostaria de saber acerca do Plano de Contigência de Ondas de Calor?

Sim	Não	NS/NR
1	2	8

65.2.1. Se sim: O que gostaria de saber?

66. Existe alguma coisa que gostaria de acrescentar ou dizer sobre o que fazer durante o tempo muito quente?

FIM DA ENTREVISTA

Obrigada pelo tempo dispensado para participar nesta entrevista. Tem alguma pergunta resultante desta entrevista?
Pergunte ao participante se ele/ela pode ser contactado novamente durante o inverno.

Sim	Não	NS/NR
1	2	8

[Informe o participante que o gravador foi desligado e já não está a gravar.]

Appendix 3.6a Phase 3 Interview Protocol

Instituto de Ciências Sociais da Universidade de Lisboa

University of East Anglia

Tyndall°Centre® for Climate Change Research

EXTREME COLD SEMI-STRUCTURED INTERVIEW PROTOCOL

To record before and also after the interview

Interview number _____ Participant telephone number __________

Interviewee code ____ Assessment time point (1, 2)

Interview date: __ /__ /____ (day/month/year) Interview location: _________________________

Time of the interview. Start __:__; End Hour __:__ Number of minutes the interview lasted: ____ minutes

Weather on the day [cloudy, sunny, rainy, muggy, thunderstorm]

Most recent cold alert: __ /__ /____ (day/month/year) (DoH website)

In the summer we spoke about very hot weather and about you, your health and wellbeing, your neighbourhood and your home. Today I would like to ask questions about very cold weather.

I will read you the questions out loud and it may sound a bit formal but I need to ask them in the same way to other participants. Please let me know what you think, as there is no right or wrong answers. Also remember that you can withdraw from this interview at any time, by letting me know you wish to stop. In addition, if there is a particular question you do not wish to answer, please let me know. Do you have any questions before we start?

[At this point inform the participant that the recorder has been switched on and is recording.]

PART I – Updated information since summer interview

I would like to ask you if there were any changes related to you, your health and quality of life, your social contacts and activities, your neighbourhood and your home since we talked in the summer. For example concerning:

- Socio-demographic information: marital status; living arrangements
- Health status
- Quality of Life: standard of living; accommodation; family life; health; social life
- Social contacts: children, family, friends and neighbours
- Housing characteristics
- Neighbourhood characteristics
- Income and financial situation: paying housing expenses (rent or mortgage, electricity, water, gas), food, healthcare or medication

* How have you prepared for winter? *(Flu jab?)*

* Do you think your social and leisure activities change from summer to winter? ***If yes:*** *Why is that? In what way?*

PART II – COLD

SECTION A – EXPERIENCES OF COLD, EVERYDAY BEHAVIOURS AND RESPONSES TO COLD

Now I am going to ask you some questions about how you feel and what you do when the weather is very cold. At the end I'll also ask you a few questions about your home and your health during very cold weather.

1. How do you think the weather is today?

Very cold	Cold	Neither cold nor warm	Warm	Very warm	[DK/N A]
1	2	3	4	5	8

2. When was the last time it was very cold in recent years?

3. Where were you at the time?

4. Was there anything you started doing to protect yourself from very cold weather?

Yes	No	[DK/N A]
1	2	8

4.1. If yes: What did you start doing? Inside your home? When you're outside? (Things to do with your house? Things to do with what you wear? Things to do with what you eat?)

5. Was there anything you wanted to do but were unable to do to cope with very cold weather?

Yes	No	[DK/N A]
1	2	8

5.1. If yes: What?
Why were you unable to do it?

6. When it's very cold how do you keep warm inside your house during the day?
What do you do? Where do you go?

7. And during the night?
What do you do? Where do you go?

8. When it's very cold how do you keep warm outside?
What do you do? Where do you go?

9. Do you think you're more affected by very cold weather than other people?

Yes	No	[DK/N A]
1	2	8

9.1. **If yes:** Can you tell me why? In what way?

10. Can you think of any groups of people who may be more affected by very cold weather?

Yes	No	[DK/N A]
1	2	8

10.1 **If yes:** Who are you thinking about?
Can you tell me why?

11. Can you think of any ways that very cold weather can affect people's health?

Yes	No	[DK/N A]
1	2	8

11.1. **If yes:** Can you say a bit more about that?

12. Does very cold weather stop you from doing the things you usually do in your everyday life?

Yes	No	[DK/N A]
1	2	8

12.1. **If yes:** Why?
What things would you like to do but can't because of very cold weather? *(Please specify)*

SECTION B –INFORMATION

13. Have you received any information, or advice on what to do during very cold weather?

Yes	No	[DK/N A]
1	2	8

13.1. **If yes:** Did you ask for this information, advice or support?

Yes	No	[DK/N A]
1	2	8

13.1.1. **If yes:** A1) Whom did you ask for information or advice?
A2) What did they say?
A3) When / Where?
A4) Was it helpful? In what way?

13.1.2. **If no:** B1) Who gave you the information or advice?
B2) What did they say?
B3) When / Where?
B4) Why do you think you were given that information or advice?
B5) Was it helpful? In what way?

14. Have you provided any information or advice to someone about what to do during very cold weather?

Yes	No	[DK/N A]
1	2	8

14.1. **If yes:** To whom?

15. How much information do you think you have about what to do during very cold weather?

Much	Some	Little	[DK/N A]
3	2	1	8

16. Would you like to have (more) information or advice about what to do during very cold weather?

Yes	No	[DK/N A]
1	2	8

16.1. **If yes:** What source(s) of information would you prefer?

Social contacts (family, friends, neighbours)	Health professional	Radio	TV	Newspaper	Internet	Other	[DK/N A]
1	2	3	4	5	6	7	8

16.2. Why?

17. Do you think the weather is getting colder year on year?

Yes	No	[DK/N A]
1	2	8

17.1. **If yes:** Can you say a bit more about that?

SECTION C – SOCIAL CONTACTS AND HEALTH DURING VERY COLD WEATHER
Now I'm going to ask you about your family and friends.

18. How often do you have contact with other people during very cold weather?

More than once a day	Every day or almost everyday	At least once a week	Once or twice a month	Less often	[DK/N A]
5	4	3	2	1	8

19. When you're concerned or need help with anything during very cold weather who do you ask and rely on? *[note relationship with participant]*

Now I'm going to ask you about your health

20. Does your physical health limit what you can do during very cold weather?

Yes	No	[DK/N A]
1	2	8

20.1. **If yes:** Why is that?
In what way?

21. What would you do if you felt unwell during very cold weather? *(Anything else?)*

SECTION D – RESIDENTIAL CHARACTERISTICS
Just a few questions about your home during winter

22. Do you perceive the temperature in your home during the winter season as a problem?

Yes	No	[DK/N A]
1	2	8

23. Are you able to keep warm in your house during winter?

Yes	No	[DK/N A]
1	2	8

If yes: How?
If not: Why not?

24. Are you able to keep your house warm during winter?

Yes	No	[DK/N A]
1	2	8

- 24.1. **If yes:** How is your house kept warm? *(Do you use fixed or installed heating system, heating devices and heat sources? What energy sources do they use? Double or single glazing?)*

- 24.2. **If not:** 24.2.1. Why not? What are the reasons? *(Do you use fixed or installed heating system, heating devices and heat sources? What energy sources do they use? Double or single glazing? Cannot afford heating?)*
  24.2.2. Do you think that being cold at home has effects on your life in general?

Yes	No	[DK/N A]
1	2	8

24.2.2.1. **If yes:** Why?
24.2.2.2. **If not:** Why not?

24.2.3. And on your health?

Yes	No	[DK/N A]
1	2	8

25.2.3.1. **If yes:** Why?
25.2.3.2. **If not:** Why not?

25. In the past 2 years, have there been difficulties paying the heating expenses?

Yes, often	Yes, sometimes	No, never	[DK/N A]
1	2	3	8

SECTION E – COLD WEATHER PLAN

26. Do you know about the Cold Weather Plan?

Yes	No	[DK/N A]
1	2	8

- 26.1. **If yes:** 26.1.1. How important do you think it is?

Very important	Important	Moderately important	Of little importance	Unimportant
5	4	3	2	1

26.1.2. What do you know about the Cold Weather Plan?
26.1.3. Would you like to know more?

Yes	No	[DK/N A]
1	2	8

26.1.3.1. **If yes:** What would you like to know more?

- 26.2. **If no:** Would you like to know about the Cold Weather Plan?

Yes	No	[DK/N A]
1	2	8

26.2.1. **If yes:** What would you like to know?

SECTION F – PERCEPTIONS OF OWN ADAPTATION AND RESILIENCE (very cold and very hot weather)
The next questions focus on your views about very cold and very hot weather.

27. How do you feel you cope/deal with very cold weather? *(Anything else?)*

28. Is there anything that you **could** do to improve the way you cope/deal with very cold weather?

Yes	No	[DK/N A]
1	2	8

If yes: What? Have you done it? (Anything else?)
If no: Why not? Anything to do with your house, clothing, nutrition?

29. Is there anything that you **would like** to do to improve the way you cope/deal with very cold weather?

Yes	No	[DK/N A]
1	2	8

If yes: What? Have you done it? (Anything else?)
If no: Why not? Anything to do with your house, clothing, nutrition?

30. Is there anything that **could** be done for you to improve the way you cope/deal with very cold weather?

Yes	No	[DK/N A]
1	2	8

If yes: What? (Anything else?)
If no: Why not? Anything to do with your house, clothing, nutrition?

31. Is there anything that you **<u>would like</u>** to be done for you to improve the way you cope/deal with very cold weather?

Yes	No	[DK/N A]
1	2	8

If yes: What? (Anything else?)
If no: Why not? Anything to do with your house, clothing, nutrition?

32. Do you think you *<u>(will)</u>* have the means/resources to be able to cope/deal with very cold weather **now?** And in the **future**?

Yes	No	[DK/N A]
1	2	8

Yes	No	[DK/N A]
1	2	8

If yes: Why? Which?
If no: Why not?

33. Is there anything that **could** improve the means/resources you have to be able to cope/deal with very cold weather **now**?

Yes	No	[DK/N A]
1	2	8

And in the **future**?

Yes	No	[DK/N A]
1	2	8

If yes: Why? What?
If no: Why not? Anything to do with your house, clothing, nutrition?

<u>Done by oneself or by 'others'?</u>

34. How do you feel you cope/deal with very hot weather? *(Anything else?)*

35. Is there anything that you **<u>could</u>** do to improve the way you cope/deal with very hot weather?

Yes	No	[DK/N A]
1	2	8

If yes: What? Have you done it? (Anything else?)
If no: Why not? Anything to do with your house, clothing, nutrition?

36. Is there anything that you **<u>would like</u>** to do to improve the way you cope/deal with very hot weather?

Yes	No	[DK/N A]
1	2	8

If yes: What? Have you done it? (Anything else?)
If no: Why not? Anything to do with your house, clothing, nutrition?

37. Is there anything that **<u>could</u>** be done for you to improve the way you cope/deal with very hot weather?

Yes	No	[DK/N A]
1	2	8

If yes: What? (Anything else?)
If no: Why not? Anything to do with your house, clothing, nutrition?

38. Is there anything that you **<u>would like</u>** to be done for you to improve the way you cope/deal with very hot weather?

Yes	No	[DK/N A]
1	2	8

If yes: What? (Anything else?)
If no: Why not? Anything to do with your house, clothing, nutrition?

39. Do you think you *(will)* have the means/resources to be able to cope/deal with very hot weather **now?** And in the **future**?

Yes	No	[DK/N A]
1	2	8

Which? *If yes: Why?*

Yes	No	[DK/N A]
1	2	8

If no: Why not?

40. Is there anything that **could** improve the means/resources you have to be able to cope/deal with very hot weather **now**?

Yes	No	[DK/N A]
1	2	8

And in the **future**?

Yes	No	[DK/N A]
1	2	8

If yes: Why? What?

If no: Why not? Anything to do with your house, clothing, nutrition?

Done by oneself or by 'others'?

41. What are your views about how you personally cope/deal with very cold weather or very hot weather? *(Anything else?)*

42. Would you like to add anything else?

END OF INTERVIEW

Thank you for taking the time to participate in this interview. Do you have further questions arising from this interview?

[Notify the participant that the recorder has been switched off and is no longer recording.]

Appendix 3.6b Protocolo de Entrevista da Fase 3

Instituto de Ciências Sociais da Universidade de Lisboa
University of East Anglia
Tyndall°Centre® for Climate Change Research

PROTOCOLO DE ENTREVISTA

Para anotar antes e depois da entrevista

Entrevista número ____
Número de telefone do participante ______________
Identificação do Respondente _____ Ponto de avaliação (1, 2)
Data da entrevista: ___/___/_____ (dia/mês/ano) Local da entrevista: ______________________
Tempo da entrevista. Início __:__; Fim __:__ Tempo de duração da entrevista: ____ minutos

Tempo hoje [nublado, ensolarado, chuvoso, quente e húmido, tempestade]
Alerta de frio mais recente? ___/___/____ (site da Direcção Geral da Saúde)

Vou fazer-lhe algumas perguntas sobre si, a sua saúde e bem-estar, o seu bairro e a sua casa. Eu tenho que fazer as perguntas exactamente da mesma maneira a todos os participantes por isso pode parecer um pouco formal, mas diga apenas o que você pensa. Não existem respostas certas ou erradas a estas perguntas. Lembre-se que é livre de terminar esta entrevista a qualquer momento, diga-me apenas que deseja parar. Além disso, se existir uma questão em particular que não queira responder, por favor avise-me. Tem algumas questões antes de começar? *[Informar o participante que o gravador foi ligado e está a gravar]*

PARTE I – Atualização de informações desde a entrevista de verão

Gostaria de lhe perguntar se existem algumas alterações relacionadas consigo, a sua saúde e qualidade de vida, os seus contatos, o seu bairro e a sua casa desde que conversamos no verão. Por exemplo em matéria de:

- Informação sócio-demográfica: estado civil; condições de vida
- Estado de saúde
- Qualidade de vida: padrão de vida, alojamento, vida familiar, saúde, vida social
- Relações sociais: filhos, família, amigos e vizinhos
- Características da habitação
- Características do bairro e vizinhança
- Rendimento e situação financeira - pagar despesas com: a habitação (aluguer, prestação da casa, eletricidade, água, gás), alimentação, cuidados de saúde ou medicamentos

* Como é que se preparou para este inverno? *(vacina da gripe?)*

* Considera que as suas atividades sociais e de lazer se alteram do verão para o inverno? ***Se sim:*** *Porquê? De que forma?*

PARTE II – FRIO

SECÇÃO A – EXPERIÊNCIAS DE CALOR, PRÁTICAS QUOTIDIANAS E RESPOSTAS AO FRIO

Agora vou fazer-lhe algumas perguntas sobre como se sente o que faz quando o tempo está muito frio. No final vou também fazer-lhe algumas perguntas sobre a sua casa e sua saúde durante o tempo muito quente.

1. Como acha que o tempo está hoje?

Muito frio	Frio	Nem frio nem quente	Quente	Muito quente	NS/NR
1	2	3	4	5	8

2. Quando foi a última vez que esteve muito frio nos últimos anos?

3. Onde estava nesse momento?

4. Houve alguma coisa que tenha começado a fazer para se proteger do tempo muito frio?

Sim	Não	NS/NR
1	2	8

4.1. **Se sim:** O que começou a fazer? Em sua casa? Na rua? (Coisas relacionadas com a sua casa? Coisas relacionadas com o que veste? Coisas relacionadas com o que come?)

5. Houve alguma coisa que quisesse fazer mas não pudesse fazer?

Sim	Não	NS/NR
1	2	8

5.1. **Se sim:** O quê?
Porque é que não pôde fazer?

6. Quando está muito frio, como se mantém quente em sua casa durante dia?
O que faz? Onde vai?

7. E durante a noite?
O que faz? Onde vai?

8. Quando está muito frio, como se mantém quente na rua?
O que faz? Onde vai?

9. Acha que é mais afetado(a) pelo tempo muito frio que as outras pessoas?

Sim	Não	NS/NR
1	2	8

9.1. **Se sim:** Pode dizer-me porquê? De que maneira?

10. Consegue pensar em quaisquer grupos de pessoas que possam ser mais afetados pelo tempo muito frio?

Sim	Não	NS/NR
1	2	8

10.1. **Se sim:** Em quem está a pensar? Pode dizer-me porquê?

11. Consegue pensar em algumas formas que o tempo muito frio possa afectar a saúde das pessoas?

Sim	Não	NS/NR
1	2	8

11.1. **Se sim:** Pode falar um pouco mais sobre isso?

12. O tempo muito frio impede-o(a) de fazer as coisas que costuma fazer na sua vida diária?

Sim	Não	NS/NR
1	2	8

12.1.**Se sim:** Porquê?
Quais as coisas que gostaria de fazer, mas não pode por causa do tempo muito frio?

SECTION B –INFORMAÇÃO

13. Recebeu alguma informação ou conselho sobre o que fazer durante o tempo muito frio?

Sim	Não	NS/NR
1	2	8

13.1. **Se sim:** Foi você que pediu essa informação ou conselho?

13.1.1.

Sim	Não	NS/NR
1	2	8

Se sim: A1) A quem pediu informação ou conselho?
A2) O que lhe disseram?
A3) Quando / Onde?
A4) Foi útil? De que maneira?

13.1.2. **Se não:** B1) Quem lhe deu a informação ou o conselho?
B2) O que lhe disseram?
B3) Quando / Onde?
B4) Por que acha que lhe foi dada essa informação ou conselho?
B5) Foi útil? De que maneira?

14. Forneceu alguma informação ou conselho a alguém sobre o que fazer durante o tempo muito frio**?**

Sim	Não	NS/NR
1	2	8

14.1. **Se sim:** A quem? O que disse?

15. Quanta informação acha que tem?

Muita	Alguma	Pouca	NS/NR
3	2	1	8

16. Gostaria de ter (mais) informação ou conselhos sobre o que fazer durante o tempo muito frio?

Sim	Não	NS/NR
1	2	8

16.1. **Se sim:** Que fonte(s) de informação preferiria?

Contactos sociais (família, amigos, vizinhos)	Professional de saúde	Rádio	TV	Jornal	Internet	Outra	NS/NR
1	2	3	4	5	6	7	8

16.2. Porquê?

17. Acha que o tempo está a ficar mais frio de ano para ano?

Sim	Não	NS/NR
1	2	8

17.1. **Se sim:** Pode falar um pouco mais sobre isso?

SECTION C –CONTACTOS SOCIAIS E SAÚDE DURANTE O TEMPO MUITO FRIO

Agora vou perguntar-lhe sobre a sua família e amigos.

18. Com que frequência tem contacto com outras pessoas durante o tempo muito frio?

Mais de uma vez por dia	Todos os dias ou quase todos os dias	Pelo menos uma vez por semana	Uma ou duas vezes por mês	Menos frequentemente	NS/NR
5	4	3	2	1	8

19. Quando está preocupado ou necessita de alguma ajuda durante o tempo muito frio, a quem pede ajuda ou em quem pode confiar? *[anotar a relação com o participante]*

Agora vou perguntar-lhe sobre a sua saúde

20. A sua saúde física limita o que pode fazer durante o tempo muito frio?

Sim	Não	NS/NR
1	2	8

21. O que faria se se sentisse mal/doente durante o tempo muito frio? *(Mais alguma coisa?)*

SECTION D – CARACTERÍSTICAS DA RESIDÊNCIA

Apenas algumas perguntas sobre a sua casa durante o inverno

22. Considera que a temperatura dentro de sua casa no Inverno é um problema?

Sim	Não	NS/NR
1	2	8

23. Consegue manter-se quente em casa durante o inverno?

Sim	Não	NS/NR
1	2	8

Se sim: Como?
Se não: Porque não?

24. Consegue manter a casa quente durante o inverno?

Sim	Não	NS/NR
1	2	8

- 24.1. **Se sim:** Como mantém a casa quente? *(sistema de aquecimento fixo, dispositivos de aquecimento e fontes de calor? Quais as fontes de energia que eles usam? vidros duplos ou simples?*

- 24.2. **Se não**: 24.2.1. Porque não?
  24.2.2.Acha que sentir/ter frio em casa tem efeitos na sua vida em geral?

Sim	Não	NS/NR
1	2	8

24.2.2.1. **Se sim:** Porquê?
24.2.2.2. **Se não:** Porque não?

24.2.3. E na sua saúde?

Sim	Não	NS/NR
1	2	8

24.2.3.1.**Se sim:** Porquê?
24.2.3.2. **Se não:** Porque não?

25. Nos últimos 2 anos, teve dificuldades em pagar as despesas de aquecimento?

Sim, frequentemente	Sim, as vezes	Não, nunca	NS/NR
1	2	3	8

SECÇÃO E – PLANO DE CONTINGÊNCIA PARA AS VAGAS DE FRIO

26. Sabe da existência do Plano de Contigência para as Vagas de Frio?

Sim	Não	NS/NR
1	2	8

❖ 26.1. **Se sim:** Quão importante acha que é?

Muito importante	Importante	Nem muito nem pouco importante	Pouco importante	Nada importante
1	2	3	4	5

26.1.2. O que sabe acerca do Plano de Contigência para as Vagas de Frio?

26.1.3. Gostaria de saber mais?

Sim	Não	NS/NR
1	2	8

26.1.3.1. **Se sim:** O que gostaria de saber mais?

❖ 26.2. **Se não:** Gostaria de saber acerca do Plano de Contigência de Vagas de Frio?

Sim	Não	NS/NR
1	2	8

26.2.1. **Se sim:** O que gostaria de saber?

SECÇÃO F – PERCEÇÕES DE ADAPTAÇÃO E RESILIÊNCIA (tempo muito frio e muito quente)
Agora gostaria de lhe perguntar sobre a forma como lida com o tempo muito frio

27. Como sente que lida com o tempo muito frio? *(Mais alguma coisa?)*

28. Existe alguma coisa que você **possa** fazer para melhorar a forma como lida com o tempo muito frio?

Sim	Não	NS/NR
1	2	8

Se sim: O quê? Já fez isso? *(Mais alguma coisa?)*
Se não: Porque não? *Alguma coisa relacionada com a sua casa, alimentação, vestuário?*

29. Existe alguma coisa que você **gostasse** de fazer para melhorar a forma como lida com o tempo muito frio?

Sim	Não	NS/NR
1	2	8

Se sim: O quê? Já fez isso? *(Mais alguma coisa?)*
Se não: Porque não? *Alguma coisa relacionada com a sua casa, alimentação, vestuário?*

30. Existe alguma que **<u>possa</u>** ser feito para si para melhorar a forma como lida com o tempo muito frio?

Sim	Não	NS/NR
1	2	8

Se sim: O quê? Já fez isso? *(Mais alguma coisa?)*
Se não: Porque não? *Alguma coisa relacionada com a sua casa, alimentação, vestuário?*

31. Existe alguma coisa que você **<u>gostasse</u>** que fosse feito para si para melhorar a forma como lida com o tempo muito frio?

Sim	Não	NS/NR
1	2	8

Se sim: O quê? Já fez isso? *(Mais alguma coisa?)*
Se não: Porque não? *Alguma coisa relacionada com a sua casa, alimentação, vestuário?*

32. Acha que **tem *<u>(terá)</u>*** os meios/recursos para ser capaz de lidar com o tempo muito frio **agora**?

Sim	Não	NS/NR
1	2	8

E no **futuro**?

Sim	Não	NS/NR
1	2	8

Se sim: Porquê? Quais? *(Mais alguma coisa?)*

Se não: Porque não?

33. Existe alguma coisa que **<u>possa</u>** melhorar os meios/recursos para ser capaz de lidar com o tempo muito frio **agora**?

Sim	Não	NS/NR
1	2	8

<u>Feito pelo próprio ou por outros?</u>

E no **futuro**?

Sim	Não	NS/NR
1	2	8

Se sim: Porquê? O quê? *(Mais alguma coisa?)*

Se não: Porque não?

Agora vou perguntar-lhe sobre a forma como lida com o tempo muito quente
34. Como sente que lida com o tempo muito quente? *(Mais alguma coisa?)*

35.A) Existe alguma coisa que você **<u>possa</u>** fazer para melhorar a forma como lida com o tempo muito quente?

Sim	Não	NS/NR
1	2	8

Se sim: O quê? Já fez isso? *(Mais alguma coisa?)*
Se não: Porque não? *Alguma coisa relacionada com a sua casa, alimentação, vestuário?*

36. Existe alguma coisa que você **<u>gostasse</u>** de fazer para melhorar a forma como lida com o tempo muito quente?

Sim	Não	NS/NR
1	2	8

Se sim: O quê? Já fez isso? *(Mais alguma coisa?)*
Se não: Porque não? *Alguma coisa relacionada com a sua casa, alimentação, vestuário?*

37. Existe alguma que **possa** ser feito para si para melhorar a forma como lida com o tempo muito quente?

Sim	Não	NS/NR
1	2	8

Se sim: O quê? Já fez isso? *(Mais alguma coisa?)*
Se não: Porque não? *Alguma coisa relacionada com a sua casa, alimentação, vestuário?*

38. Existe alguma coisa que você **gostasse** que fosse feito para si para melhorar a forma como lida com o tempo muito quente?

Sim	Não	NS/NR
1	2	8

Se sim: O quê? Já fez isso? *(Mais alguma coisa?)*
Se não: Porque não? *Alguma coisa relacionada com a sua casa, alimentação, vestuário?*

39. Acha que tem ***(terá)*** os meios/recursos para ser capaz de lidar com o tempo muito quente **agora**? E no **futuro**?

Sim	Não	NS/NR
1	2	8

Se sim: Porquê? Quais? *(Mais alguma coisa?)*
Se não: Porque não?

Sim	Não	NS/NR
1	2	8

40. Existe alguma coisa que **possa** melhorar os meios/recursos que tem para ser capaz de lidar com o tempo muito quente **agora**?

Sim	Não	NS/NR
1	2	8

E no **futuro**?

Sim	Não	NS/NR
1	2	8

Se sim: Porquê? O quê? *(Mais alguma coisa?)*
Se não: Porque não?

Feito pelo próprio ou por 'outros'?

41. Qual e a sua opinião sobre como pessoalmente lida com o tempo muito frio ou muito quente? *(Mais alguma coisa?)*

42. Gostaria de acrescentar mais alguma coisa?

FIM DA ENTREVISTA

Obrigada por ter disponibilizado o seu e tempo e ter participado nesta entrevista. Tem alguma duvida decorrente da entrevista?

Informe o participante que o gravador foi desligado e já não está a gravar

Appendix 3.7 Indicators and sub-indicators included in the General Vulnerability Index (GVI)

Indicators	Sub- indicators	Survey question
Human assets	Percentage of individuals living alone	Do you live with...?
	Percentage of individuals that have no formal education	What is the highest level of education you have successfully completed?
	Percentage of individuals in lower supervisory and technical occupations, semi-routine and routine occupations, or never worked	What was your most recent occupation?
	Percentage of individuals with poor health	In general, would you say your health is:
	Percentage of individuals with current health worse than a year ago	Compared to one year ago, how would you rate your health in general now?
	Percentage of individuals hampered in their daily activities	Are you hampered in your daily activities in any way by any longstanding illness, or disability, infirmity, mobility problem or mental health problem?
Financial assets	Percentage of individuals that have financial difficulties	How would you describe the current financial situation of your household?
	Percentage of individuals with monthly income ⩽500 euros	Please can you tell me how much your household's average income per month is (after taxes)? If you don't know the exact figure, please give an estimate.
	Percentage of individuals that have pensions as source of income	Have you or someone else in your household received any of the following types of income over the past 12 months?
	Percentage of individuals that have difficulties paying the housing expenses	In the past 2 years, have there been difficulties paying the housing expenses? (i.e. rent or mortgage payments for accommodation, utility bills, such as electricity, water, gas)
	Percentage of individuals that have difficulties paying for food	Has your household at any time during the past 12 months had difficulties in paying for food?
	Percentage of individuals that have difficulties paying for healthcare or medication	Has your household at any time during the past 12 months had difficulties in paying for healthcare or medication?

Indicators	Sub- indicators	Survey question
Physical assets	Percentage of individuals that live in apartment buildings	What best describes the house you live in?
	Percentage of individuals that live on the first floor or above	What floor do you live on?
	Percentage of individuals that do not have lift in the building	Is there a lift in the building?
	Percentage of individuals that live in houses with 50 years or older	What is the age of the building or house you live in?
	Percentage of individuals that are not satisfied with their house	On a scale from 1 to 5, how satisfied are you with your house?
	Percentage of individuals that live in rented homes or social housing	Is the house you live in ...?
	Percentage of individuals that are not happy with their living conditions	Are you happy with your current living conditions or would you move if you had the chance?
	Percentage of individuals that do not own a landline phone	Which of the following equipments/goods do you have? – landline phone
	Percentage of individuals that do not own a mobile phone	Which of the following equipments/goods do you have? – mobile phone
	Percentage of individuals that do not own a TV	Which of the following equipments/goods do you have? - TV
	Percentage of individuals that do not own a radio	Which of the following equipments/goods do you have? - radio
	Percentage of individuals that do not own a computer	Which of the following equipments/goods do you have? - computer
	Percentage of individuals that do not own a car	Which of the following equipments/goods do you have? - car

Indicators	Sub- indicators	Survey question
Place-based assets	Percentage of individuals that do not have a food store or supermarket within walking distance	Are there any of the following facilities available within walking distance? - food store or supermarket
	Percentage of individuals that do not have a post office within walking distance	Are there any of the following facilities available within walking distance? - post office
	Percentage of individuals that do not have banking facilities within walking distance	Are there any of the following facilities available within walking distance? - banking facilities
	Percentage of individuals that do not have a cinema, theatre or cultural centre within walking distance	Are there any of the following facilities available within walking distance? - cinema, theatre or cultural centre
	Percentage of individuals that do not have public transport facilities within walking distance	Are there any of the following facilities available within walking distance? - public transport facilities
	Percentage of individuals that do not have access to private and public spaces close to their house, where they can sit and relax, have a coffee, or talk peacefully to neighbours, acquaintances and friends	Are there any private and public spaces close to your house, where you can sit and relax, have a coffee, or talk peacefully to neighbours, acquaintances and friends?
	Percentage of individuals that do not go to private and public spaces	Do you go there?
	Percentage of individuals that do not have access to public facilities close to their house where they can practice physical activity (such as playgrounds, parks, sport centres, swimming pools, etc.)	Are there any public facilities close to your house where you can practice physical activity?
	Percentage of individuals that do not go to public facilities for physical activities	Do you go there?
	Percentage of individuals that rate their neighbourhood as bad or very bad	On a scale from 1 to 5, how do you rate your neighbourhood overall as a place to live?
	Percentage of individuals that rate health services as bad or very bad	In general, how would you rate each of the following public services? - health services
	Percentage of individuals that rate public transport as bad or very bad	In general, how would you rate each of the following public services? - public transport
	Percentage of individuals that rate care services for the elderly as bad or very bad	In general, how would you rate each of the following public services? - care services for the elderly
	Percentage of individuals that rate state pension system as bad or very bad	In general, how would you rate each of the following public services? - state pension system

Indicators	Sub- indicators	Survey question
Social assets	Percentage of individuals that do not have people available who can help them when they need	Could you please tell me if you agree or disagree with the following statements: There are people available who can help me when I am in need.
	Percentage of individuals that do not have people that care for them	Could you please tell me if you agree or disagree with the following statements: There are people who care for me.
	Percentage of individuals that have direct social contact with any of their children once or twice a month or less	On average, how often do you have direct (face-to-face) contact with any of your children?
	Percentage of individuals that have direct social contact with any brother, sister or other relative once or twice a month or less	On average, how often do you have direct (face-to-face) contact with any brother, sister or other relative?
	Percentage of individuals that have direct social contact with any friends or neighbours once or twice a month or less	On average, how often do you have direct (face-to-face) contact with any friends or neighbours?
	Percentage of individuals that have indirect social contact with any of their children once or twice a month or less	And on average, how often do you have contact by phone, email or by post with any brother, sister or other relative?
	Percentage of individuals that have indirect social contact with any brother, sister or other relative once or twice a month or less	And on average, how often do you have contact by phone, email or by post with any of your children?
	Percentage of individuals that have indirect social contact with any friends or neighbours once or twice a month or less	And on average, how often do you have contact by phone, email or by post with any friends or neighbours?
	Percentage of individuals that take part in social activities less or much less than most people their age	Compared to other people of your age, how often would you say you take part in social activities?
	Percentage of individuals that take part in caring for and educating children less often than once a week	How often are you involved in any of the following activities? - caring for and educating children
	Percentage of individuals that take part in cooking and housework less often than once a week	How often are you involved in any of the following activities? - cooking and housework
	Percentage of individuals that take part in caring for elderly/disabled relatives at least once a week	How often are you involved in any of the following activities? - caring for elderly/disabled relatives

Indicators	Sub- indicators	Survey question
Social assets	Percentage of individuals that take part in voluntary and charitable activities less often than once a week	How often are you involved in any of the following activities? - voluntary and charitable activities
	Percentage of individuals that take part in activities organized in their local area less often than once a week	How often are you involved in any of the following activities? - activities organised in your local area
	Percentage of individuals that spend too little time in contact with family members	I am going to read out some areas of daily life in which you can spend your time. Could you tell me if you think you spend too much, too little or just the right amount of time in each area.
	Percentage of individuals that spend too little time in other social contact (not family)	I am going to read out some areas of daily life in which you can spend your time. Could you tell me if you think you spend too much, too little or just the right amount of time in each area.
	Percentage of individuals that spend too little time in their own hobbies/interests	I am going to read out some areas of daily life in which you can spend your time. Could you tell me if you think you spend too much, too little or just the right amount of time in each area.
	Percentage of individuals that spend too little time taking part in voluntary work or political activities	I am going to read out some areas of daily life in which you can spend your time. Could you tell me if you think you spend too much, too little or just the right amount of time in each area.
	Percentage of individuals that would find it difficult or very difficult to borrow money, if in serious financial difficulties	If for some reason you were in serious financial difficulties and had to borrow money to make ends meet, how difficult or easy would that be?

Appendix 3.8 Sense of Coherence scale (SOC-13): indicators and sub-indicators used to construct the GRI

Indicators	Sub-indicators (Survey question)	Answer options
Meaningfulness	1. *Do have the feeling that you don't really care about what goes on around you?	1 (very seldom or never) 2 3 4 5 6 7 (very often)
	4. Until now your life has had:	1 (no clear goals or purpose at all) 2 3 4 5 6 7 (very clear goals and purpose)
	7. Doing the things you do every day is:	1 (a source of deep pleasure and satisfaction) 2 3 4 5 (a source of pain and boredom)
	11. When something happened, have you generally found that:	1 (you overestimated or underestimated its importance) 2 3 4 5 6 7 (you saw things in the right proportion)
	12. How often do you have the feeling that there's little meaning in the things you do in your daily life?	1 (very often) 2 3 4 5 6 7 (very seldom or never)
Comprehensibility	2. *Has it happened in the past that you were surprised by the behaviour of people whom you thought you knew well?	1 (never happened) 2 3 4 5 6 7 (always happened)
	6. Do you have the feeling that you are in an unfamiliar situation and don't know what to do?	1 (very often) 2 3 4 5 6 7 (very seldom or never)
	8. Do you have very mixed-up feelings and ideas?	1 (very often) 2 3 4 5 6 7 (very seldom or never)
	9. Does it happen that you have feelings inside you would rather not feel?	1 (very often) 2 3 4 5 6 7 (very seldom or never)
Manageability	3. *Has it happened that people whom you counted on disappointed you?	1 (never happened) 2 3 4 5 6 7 (always happened)
	5. Do you have the feeling that you're being treated unfairly?	1 (very often) 2 3 4 5 6 7 (very seldom or never)
	10. *Many people – even those with a strong character – sometimes feel like sad sacks (losers) in certain situations. How often have you felt this way in the past?	1 (never) 2 3 4 5 6 7 (very often)
	13. How often do you have feelings that you're not sure you can keep under control?	1 (very often) 2 3 4 5 6 7 (very seldom or never)

* Reverse score

Appendix 3.9 Coding of resilience dimensions, resilience types and predictions

Comprehensibility	Manageability	Meaningfulness	Types	Prediction
High	High	High	HHH	Stable
Low	High	High	LHH	Rare
High	Low	High	HLH	Pressure to move up
Low	Low	High	LLH	Pressure to move up
High	High	Low	HHL	Pressure to move down
High	Low	Low	HLL	Pressure to move down
Low	High	Low	LHL	Rare
Low	Low	Low	LLL	Stable

Adapted from Antonovsky, 1987

Appendix 3.10 Ethics Approval Letter – University of East Anglia

Faculty of Medicine and Health Sciences Research Ethics Committee

University of East Anglia

Ana Raquel Nunes
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22nd March 2012

Dear Ana

Title: Dimensions of resilience in adapting to extreme heat and cold risks.
Reference 2011/2012 - 30

The amendments to your above proposal have been considered by the Chair of the Faculty Research Ethics Committee and we can confirm that your proposal has been approved.

Please could you ensure that any further amendments to either the protocol or documents submitted are notified to us in advance and also that any adverse events which occur during your project are reported to the Committee. Please could you also arrange to send us a report once your project is completed.

The Committee would like to wish you good luck with your project

Yours sincerely

Yvonne Kirkham

Yvonne Kirkham
Project Officer

Appendix 3.11 Ethics Approval Letter – University of Lisbon

Laboratório Associado

Instituto de Ciências Sociais da Universidade de Lisboa

Ethical Commission
University of East Anglia,
Norwich Research Park
Norwich NR4 7TJ
United Kingdom

Subject: Ethical Approval for a Research Project for the PhD candidate Ana Raquel Almeida dos Reis Nunes

To whom it may concern,

Ana Raquel Nunes is currently enrolled in Instituto de Ciências Sociais da Universidade de Lisboa as a PhD student, preparing a dissertation on "Dimensions of resilience in adapting to extreme heat and cold risks", jointly supervised by Professor Luísa Schmidt at ICS-UL and Dr. Irene Lorenzoni at UEA.

The Instituto de Ciências Sociais (ICS-UL) has reviewed Ana Raquel's research project and I hereby confirm that we have granted Ethical Approval for conducting the research.

Lisbon, ICS, 2 February 2012

Professor Doutor José Luís Cardoso,

Chairman of Graduate Studies

Appendix 4.1 General Vulnerability Index sub-indicators values, minimum and maximum sub-indicators values

Indicators	Sub- indicators	Units	Sub-indicator value	Maximum sub-indicator value	Minimum sub-indicator value	Sub-indicators index value	Indicators index value
Human assets	Percentage of individuals living alone	Percent	57.7	100	0	0.577	0.407
	Percentage of individuals that have no formal education	Percent	17.3	100	0	0.173	
	Percentage of individuals in lower supervisory and technical occupations, semi-routine and routine occupations, or never worked	Percent	71.1	100	0	0.711	
	Percentage of individuals with poor health	Percent	19.2	100	0	0.192	
	Percentage of individuals with current health worse than a year ago	Percent	30.8	100	0	0.308	
	Percentage of individuals hampered in their daily activities	Percent	48.1	100	0	0.481	
Financial assets	Percentage of individuals that have financial difficulties	Percent	42.4	100	0	0.424	0.449
	Percentage of individuals with monthly income ⩽ 500 euros	Percent	46.1	100	0	0.461	
	Percentage of individuals that have pensions as source of income	Percent	94.2	100	0	0.942	
	Percentage of individuals that have difficulties paying the housing expenses	Percent	28.8	100	0	0.288	
	Percentage of individuals that have difficulties paying for food	Percent	26.9	100	0	0.269	
	Percentage of individuals that have difficulties paying for healthcare or medication	Percent	30.8	100	0	0.308	

Appendix 4.1 (cont.) General Vulnerability Index sub-indicators values, minimum and maximum sub-indicators values

Indicators	Sub- indicators	Units	Sub-indicator value	Maximum sub-indicator value	Minimum sub-indicator value	Sub-indicators index value	Indicators index value
Physical assets	Percentage of individuals that live in apartment buildings	Percent	76.9	100	0	0.769	0.448
	Percentage of individuals that live on the first floor or above	Percent	53.8	100	0	0.538	
	Percentage of individuals that do not have lift in the building	Percent	82.7	100	0	0.827	
	Percentage of individuals that live in houses with 50 years or older	Percent	69.3	100	0	0.693	
	Percentage of individuals that are not satisfied with their house	Percent	11.5	100	0	0.115	
	Percentage of individuals that live in rented homes or social housing	Percent	61.5	100	0	0.615	
	Percentage of individuals that are not happy with their living conditions	Percent	59.6	100	0	0.596	
	Percentage of individuals that do not own a landline phone	Percent	13.5	100	0	0.135	
	Percentage of individuals that do not own a mobile phone	Percent	15.4	100	0	0.154	
	Percentage of individuals that do not own a TV	Percent	0.0	100	0	0.000	
	Percentage of individuals that do not own a radio	Percent	3.8	100	0	0.038	
	Percentage of individuals that do not own a computer	Percent	65.4	100	0	0.654	
	Percentage of individuals that do not own a car	Percent	69.2	100	0	0.692	

Appendix 4.1 (cont.) General Vulnerability Index sub-indicators values, minimum and maximum sub-indicators values

Indicators	Sub- indicators	Units	Sub-indicator value	Maximum sub-indicator value	Minimum sub-indicator value	Sub-indicators index value	Indicators index value
Place-based assets	Percentage of individuals that do not have a food store or supermarket within walking distance	Percent	11.5	100	0	0.115	0.358
	Percentage of individuals that do not have a post office within walking distance	Percent	50	100	0	0.500	
	Percentage of individuals that do not have banking facilities within walking distance	Percent	32.7	100	0	0.327	
	Percentage of individuals that do not have a cinema, theatre or cultural centre within walking distance	Percent	60.8	100	0	0.608	
	Percentage of individuals that do not have public transport facilities within walking distance	Percent	0.0	100	0	0.000	
	Percentage of individuals that do not have access to private and public spaces close to their house, where they can sit and relax, have a coffee, or talk peacefully to neighbours, acquaintances and friends	Percent	13.5	100	0	0.135	
	Percentage of individuals that do not have access to public facilities close to their house where they can practice physical activity (such as playgrounds, parks, sport centres, swimming pools, etc.)	Percent	42.3	100	0	0.423	
	Percentage of individuals that rate their neighbourhood as bad or very bad	Percent	15.4	100	0	0.154	
	Percentage of individuals that rate health services as bad or very bad	Percent	26.9	100	0	0.269	
	Percentage of individuals that rate public transport as bad or very bad	Percent	35.3	100	0	0.353	
	Percentage of individuals that rate care services for the elderly as bad or very bad	Percent	26.4	100	0	0.264	

Appendix 4.1 (cont.) General Vulnerability Index sub-indicators values, minimum and maximum sub-indicators values

Indicators	Sub- indicators	Units	Sub-indicator value	Maximum sub-indicator value	Minimum sub-indicator value	Sub-indicators index value	Indicators index value
Place-based assets (cont.)	Percentage of individuals that rate state pension system as bad or very bad	Percent	64.7	100	0	0.647	0.358
	Percentage of individuals that do not go to private and public spaces	Percent	50.0	100	0	0.500	
	Percentage of individuals that do not go to public facilities for physical activities	Percent	71.2	100	0	0.712	
Social assets	Percentage of individuals that do not have people available who can help them when they need	Percent	25.5	100	0	0.255	0.421
	Percentage of individuals that do not have people that care for them	Percent	2.0	100	0	0.020	
	Percentage of individuals that have direct social contact with any of their children once or twice a month or less	Percent	36.5	100	0	0.365	
	Percentage of individuals that have direct social contact with any brother, sister or other relative once or twice a month or less	Percent	88.5	100	0	0.885	
	Percentage of individuals that have direct social contact with any friends or neighbours once or twice a month or less	Percent	11.5	100	0	0.115	
	Percentage of individuals that have indirect social contact with any of their children once or twice a month or less	Percent	5.7	100	0	0.057	
	Percentage of individuals that have indirect social contact with any brother. sister or other relative once or twice a month or less	Percent	48.1	100	0	0.481	

Appendix 4.1 (cont.) General Vulnerability Index sub-indicators values, minimum and maximum sub-indicators values

Indicators	Sub- indicators	Units	Sub-indicator value	Maximum sub-indicator value	Minimum sub-indicator value	Sub-indicators index value	Indicators index value
Social assets (cont.)	Percentage of individuals that have indirect social contact with any friends or neighbours once or twice a month or less	Percent	54.9	100	0	0.549	0.421
	Percentage of individuals that take part in social activities less or much less than most people their age	Percent	36.5	100	0	0.365	
	Percentage of individuals that take part in caring for and educating children less often than once a week	Percent	82.7	100	0	0.827	
	Percentage of individuals that take part in cooking and housework less often than once a week	Percent	11.6	100	0	0.116	
	Percentage of individuals that take part in caring for elderly/disabled relatives at least once a week	Percent	5.8	100	0	0.058	
	Percentage of individuals that take part in voluntary and charitable activities less often than once a week	Percent	92.3	100	0	0.923	
	Percentage of individuals that take part in activities organized in their local area less often than once a week	Percent	23.1	100	0	0.231	
	Percentage of individuals that spend too little time in contact with family members	Percent	60	100	0	0.600	
	Percentage of individuals that spend too little time in other social contact (not family)	Percent	44.2	100	0	0.442	
	Percentage of individuals that spend too little time in their own hobbies/interests	Percent	32.7	100	0	0.327	
	Percentage of individuals that spend too little time taking part in voluntary work or political activities	Percent	78.8	100	0	0.788	
	Percentage of individuals that would find it difficult or very difficult to borrow money. if in serious financial difficulties	Percent	60	100	0	0.600	

Below is presented the way of calculating the human assets (HA) index value and GVI Composite Index value:

1) $index_{HA_i} = \frac{s_i - s_{min}}{s_{max} - s_{min}} = \frac{57.7-0}{100-0} = 0.577$

(repeat this step for all sub-indicators of HA and all other sub-indicators of other indicators)

2) $M_i = \frac{\sum_{i=1}^{n} index_{s_i}}{n} = \frac{0.577+0.173+0.711+0.192+0.308+0.481}{6} = 0.407$

(repeat this step for all other indicators: FA, PA, PBA and SA)

3) $GVI_i = \frac{\sum_{i=1}^{5} w_{M_i} M_i}{\sum_{i=1}^{5} w_{M_i}} = \frac{(6*0.407)+(6*0.449)+(13*0.448)+(14*0.358)+(19*0.421)}{6+6+13+14+19} = 0.413$

Below is presented the way of calculating the contribution of human assets (HA) index value to the GVI Composite Index value:

$$HA_{contribution} = \frac{HA(M_i)}{HA(M_i) + FA(M_i) + PA(M_i) + PBA(M_i) + SA(M_i)} = \frac{0.407}{2.083} = 19.5\%$$

(repeat this step for all other indicators: FA, PA, PBA and SA)

Appendix 4.2 General vulnerability indices values per study participant, according to specific asset types and overall (GVI)

Participants	Human	Financial	Physical	Place-based	Social	GVI
AM (65)	0.591	0.475	0.410	0.321	0.655	0.494
AF (79)	0.754	0.550	0.456	0.482	0.592	0.548
BF (80)	0.921	0.917	0.454	0.446	0.610	0.599
CF (87)	0.671	0.875	0.579	0.464	0.511	0.569
DF (76)	0.754	0.875	0.430	0.268	0.490	0.490
EF (81)	0.605	0.583	0.344	0.536	0.425	0.468
FF (80)	0.440	0.408	0.257	0.554	0.532	0.453
BM (75)	0.454	0.450	0.242	0.482	0.450	0.412
GF (69)	0.421	0.550	0.367	0.804	0.439	0.521
CM (68)	0.619	0.925	0.449	0.393	0.625	0.560
HF (65)	0.474	0.367	0.404	0.500	0.461	0.449
IF (73)	0.692	0.833	0.565	0.536	0.616	0.616
JF (83)	0.754	0.925	0.440	0.607	0.671	0.639
KF(65)	0.768	0.542	0.413	0.482	0.575	0.533
LF (71)	0.522	0.817	0.335	0.643	0.553	0.550
DM (83)	0.776	0.592	0.540	0.643	0.684	0.642
EM (78)	0.357	0.483	0.430	0.304	0.549	0.437
MF (82)	0.504	0.517	0.429	0.643	0.265	0.444
NF (65)	0.532	0.633	0.626	0.786	0.522	0.622
FM (95)	0.333	0.442	0.251	0.482	0.464	0.405
GM (69)	0.319	0.408	0.430	0.268	0.576	0.425
HM (87)	0.433	0.508	0.235	0.268	0.604	0.413
IM (76)	0.333	0.408	0.258	0.339	0.434	0.359
OF (72)	0.415	0.408	0.258	0.339	0.466	0.377
PF (76)	0.371	0.608	0.414	0.607	0.493	0.502
QF (74)	0.665	0.483	0.383	0.393	0.496	0.462
RF (79)	0.712	0.925	0.585	0.536	0.496	0.592
SF (75)	0.823	0.508	0.473	0.607	0.393	0.519
TF (70)	0.304	0.525	0.260	0.107	0.539	0.346
UF (70)	0.504	0.433	0.456	0.321	0.566	0.462
VF (76)	0.796	0.883	0.394	0.625	0.541	0.590
JM (80)	0.409	0.442	0.288	0.500	0.511	0.441
XF (80)	0.466	0.883	0.357	0.250	0.538	0.456
KM (65)	0.373	0.442	0.106	0.089	0.446	0.276
ZF (79)	0.310	0.517	0.319	0.179	0.357	0.317
AAF (75)	0.526	0.483	0.424	0.107	0.426	0.365
LM (65)	0.218	0.417	0.213	0.250	0.315	0.277
BBF (74)	0.581	0.400	0.373	0.321	0.356	0.379
CCF (78)	0.361	0.442	0.287	0.125	0.382	0.302
MM (85)	0.343	0.408	0.428	0.268	0.561	0.422
DDF (65)	0.218	0.417	0.194	0.250	0.333	0.279
NM (69)	0.450	0.483	0.353	0.107	0.445	0.347
EEF (72)	0.629	0.633	0.427	0.393	0.436	0.464
FFF (84)	0.706	0.583	0.565	0.393	0.525	0.527
GGF (84)	0.657	0.550	0.508	0.661	0.568	0.584
OM (65)	0.554	0.800	0.613	0.821	0.673	0.696
HHF (76)	0.754	0.625	0.546	0.482	0.539	0.558
IIF (87)	0.405	0.517	0.485	0.446	0.522	0.483
JJF (77)	0.657	0.600	0.491	0.143	0.475	0.430
PM (65)	0.425	0.967	0.478	0.446	0.689	0.584
KKF (71)	0.415	0.483	0.491	0.286	0.481	0.429
QM (65)	0.748	0.750	0.709	0.179	0.609	0.556

Legend: Range [0-1], [least vulnerable to most vulnerable]

Appendix 4.3 Heat-related vulnerability (general and asset-based)

Participants	Human assets	Financial assets	Physical assets	Place-based assets	Social assets	Overall Heat Vulnerability
AM (65)	⇧	⇧	⇧	⇧	⇧	High
AF (79)	⇧	⇧	⇧	⇧	⇧	High
BF (80)	⇧	⇧	⇧	⇧	⇧	High
CF (87)	⇧	⇧	⇧	⇧	⇧	High
DF (76)	⇧	⇧	⇧	⇧	⇩	High
EF (81)	⇧	⇧	⇧	⇧	⇩	High
FF (80)	⇩	⇩	⇧	⇩	⇩	Low
BM (75)	⇩	⇧	⇧	⇩	⇩	Low
GF (69)	⇧	⇩	⇧	⇧	⇧	High
CM (68)	⇧	⇧	⇧	⇩	⇧	High
HF (65)	⇩	⇩	⇧	⇧	⇧	High
IF (73)	⇧	⇧	⇧	⇩	⇧	High
JF (83)	⇧	⇧	⇧	⇧	⇧	High
KF (65)	⇧	⇧	⇧	⇩	⇧	High
LF (71)	⇧	⇧	⇧	⇧	⇧	High
DM (83)	⇧	⇧	⇧	⇧	⇧	High
EM (78)	⇩	⇧	⇧	⇧	⇧	High
MF (82)	⇩	⇩	⇧	⇧	⇩	Low
NF (65)	⇧	⇧	⇧	⇧	⇧	High
FM (95)	⇧	⇩	⇩	⇧	⇩	Low
GM (69)	⇩	⇩	⇧	⇧	⇧	High
HM (87)	⇩	⇧	⇧	⇧	⇧	High
IM (76)	⇧	⇩	⇩	⇧	⇩	Low
OF (72)	⇧	⇩	⇩	⇩	⇩	Low
PF (76)	⇧	⇧	⇧	⇧	⇩	High
QF (74)	⇧	⇧	⇧	⇧	⇧	High
RF (79)	⇧	⇧	⇧	⇩	⇧	High
SF (75)	⇧	⇧	⇧	⇩	⇩	High
TF (70)	⇩	⇩	⇩	⇧	⇩	Low
UF (70)	⇩	⇧	⇧	⇩	⇩	Low
VF (76)	⇧	⇧	⇧	⇩	⇧	High
JM (80)	⇧	⇩	⇩	⇧	⇩	Low
XF (80)	⇩	⇧	⇧	⇩	⇧	High
KM (65)	⇧	⇩	⇧	⇩	⇩	Low
ZF (79)	⇧	⇩	⇧	⇧	⇩	High
AAF (75)	⇧	⇩	⇧	⇧	⇩	High
LM (65)	⇩	⇩	⇩	⇧	⇩	Low
BBF (74)	⇧	⇩	⇩	⇧	⇩	Low
CCF (78)	⇧	⇩	⇧	⇧	⇩	High
MM (85)	⇧	⇧	⇧	⇧	⇩	High
DDF (65)	⇩	⇩	⇩	⇩	⇩	Low
NM (69)	⇧	⇧	⇧	⇧	⇧	High
EEF (72)	⇩	⇧	⇧	⇧	⇧	High
FFF (84)	⇧	⇧	⇧	⇩	⇩	High
GGF (84)	⇧	⇧	⇧	⇩	⇩	High
OM (65)	⇧	⇧	⇧	⇩	⇧	High
HHF (76)	⇧	⇧	⇧	⇧	⇧	High
IIF (87)	⇧	⇧	⇧	⇧	⇧	High
JJF (77)	⇧	⇧	⇧	⇩	⇧	High
PM (65)	⇧	⇧	⇧	⇧	⇧	High
KKF (71)	⇧	⇧	⇧	⇧	⇩	High
QM (65)	⇧	⇧	⇧	⇩	⇧	High

Legend: ⇧ High; ⇩Low;

Appendix 4.4 Cold-related vulnerability (general and asset-based)

Participants	Human assets	Financial assets	Physical assets	Place-based assets	Social assets	Overall Cold Vulnerability
AM (65)	⇧	⇧	⇧	⇧	⇧	High
AF (79)	⇧	⇧	⇧	⇧	⇩	High
BF (80)	⇧	⇧	⇧	⇧	⇧	High
CF (87)	NA	NA	NA	NA	NA	NA
DF (76)	NA	NA	NA	NA	NA	NA
EF (81)	⇧	⇧	⇧	⇧	⇧	High
FF (80)	⇩	⇩	⇩	⇧	⇩	Low
BM (75)	⇧	⇧	⇧	⇩	⇧	High
GF (69)	⇧	⇧	⇧	⇧	⇧	High
CM (68)	⇧	⇧	⇧	⇩	⇧	High
HF (65)	⇧	⇧	⇧	⇧	⇧	High
IF (73)	⇧	⇧	⇧	⇧	⇧	High
JF (83)	⇧	⇧	⇧	⇧	⇧	High
KF (65)	⇧	⇧	⇧	⇩	⇧	High
LF (71)	⇧	⇧	⇧	⇧	⇧	High
DM (83)	⇧	⇧	⇧	⇩	⇧	High
EM (78)	NA	NA	NA	NA	NA	NA
MF (82)	⇧	⇩	⇩	⇧	⇩	Low
NF (65)	NA	NA	NA	NA	NA	NA
FM (95)	⇩	⇩	⇩	⇧	⇩	Low
GM (69)	⇩	⇩	⇧	⇧	⇧	High
HM (87)	NA	NA	NA	NA	NA	NA
IM (76)	⇧	⇩	⇩	⇧	⇩	Low
OF (72)	⇧	⇩	⇩	⇧	⇩	Low
PF (76)	⇧	⇧	⇧	⇧	⇩	High
QF (74)	⇧	⇧	⇧	⇧	⇩	High
RF (79)	⇧	⇧	⇧	⇩	⇧	High
SF (75)	⇧	⇧	⇧	⇧	⇧	High
TF (70)	⇩	⇩	⇩	⇧	⇩	Low
UF (70)	⇧	⇩	⇩	⇧	⇧	High
VF (76)	NA	NA	NA	NA	NA	NA
JM (80)	⇧	⇩	⇩	⇧	⇩	Low
XF (80)	⇧	⇧	⇧	⇧	⇩	High
KM (65)	⇩	⇩	⇩	⇧	⇩	Low
ZF (79)	⇩	⇩	⇩	⇧	⇩	Low
AAF (75)	⇧	⇧	⇧	⇧	⇩	High
LM (65)	⇩	⇩	⇩	⇧	⇩	Low
BBF (74)	⇧	⇩	⇩	⇧	⇩	Low
CCF (78)	⇧	⇧	⇧	⇧	⇩	High
MM (85)	⇧	⇧	⇧	⇧	⇩	High
DDF (65)	⇩	⇩	⇩	⇩	⇩	Low
NM (69)	⇧	⇧	⇧	⇧	⇩	High
EEF (72)	⇧	⇧	⇧	⇧	⇧	High
FFF (84)	⇧	⇧	⇧	⇧	⇧	High
GGF (84)	⇧	⇧	⇧	⇧	⇧	High
OM (65)	⇧	⇧	⇧	⇧	⇧	High
HHF (76)	⇧	⇧	⇧	⇧	⇧	High
IIF (87)	⇧	⇧	⇧	⇧	⇧	High
JJF (77)	⇧	⇧	⇧	⇩	⇧	High
PM (65)	⇧	⇧	⇧	⇩	⇧	High
KKF (71)	⇧	⇧	⇧	⇧	⇧	High
QM (65)	⇧	⇧	⇧	⇧	⇧	High

Legend: ⇧ High; ⇩Low; NA data not available (participants were not involved in cold-related interviews)

Appendix 5.1 Individual participants' general resilience values

Participants	GRI	CO	MA	ME	Types	Prediction
AM (65)	0.474	0.500	0.375	0.542	HLH	☝
AF (79)	0.705	0.800	0.708	0.583	HHH	☺
BF (80)	0.410	0.333	0.333	0.583	LLH	☝
CF (87)	0.705	0.633	0.792	0.708	HHH	☺
DF (76)	0.462	0.400	0.458	0.542	LLH	☝
EF (81)	0.526	0.533	0.542	0.500	HHH	☺
FF (80)	0.667	0.667	0.708	0.625	HHH	☺
BM (75)	0.795	0.800	0.708	0.875	HHH	☺
GF (69)	0.500	0.400	0.417	0.708	LLH	☝
CM (68)	0.615	0.500	0.500	0.875	HHH	☺
HF (65)	0.551	0.433	0.375	0.875	LLH	☝
IF (73)	0.321	0.400	0.208	0.333	LLL	☹
JF (83)	0.654	0.700	0.583	0.667	HHH	☺
LF (71)	0.564	0.667	0.292	0.708	HLH	☝
DM (83)	0.692	0.700	0.667	0.708	HHH	☺
EM (78)	0.641	0.433	0.667	0.875	LHH	Rare
MF (82)	0.821	0.767	0.708	1.000	HHH	☺
NF (65)	0.577	0.533	0.667	0.542	HHH	☺
FM (95)	0.859	0.800	0.917	0.875	HHH	☺
GM (69)	0.885	0.900	0.833	0.917	HHH	☺
HM (87)	0.667	0.567	0.583	0.875	HHH	☺
IM (76)	0.603	0.700	0.500	0.583	HHH	☺
OF (72)	0.577	0.567	0.458	0.708	HLH	☝
PF (76)	0.654	0.400	0.792	0.833	LHH	Rare
QF (74)	0.692	0.533	0.750	0.833	HHH	☺
RF (79)	0.641	0.733	0.542	0.625	HHH	☺
SF (75)	0.808	0.733	0.750	0.958	HHH	☺
TF (70)	0.654	0.567	0.500	0.917	HHH	☺
UF (70)	0.731	0.633	0.708	0.875	HHH	☺
VF (76)	0.462	0.433	0.417	0.542	LLH	☝
JM (80)	0.756	0.633	0.708	0.958	HHH	☺
XF (80)	0.769	0.667	0.833	0.833	HHH	☺
KM (65)	0.692	0.567	0.625	0.917	HHH	☺
ZF (79)	0.705	0.700	0.583	0.833	HHH	☺
AAF (75)	0.782	0.833	0.792	0.708	HHH	☺
LM (65)	0.833	0.767	0.917	0.833	HHH	☺
BBF (74)	0.705	0.800	0.708	0.583	HHH	☺
CCF (78)	0.756	0.733	0.625	0.917	HHH	☺
MM (85)	0.654	0.433	0.792	0.792	LHH	Rare
DDF (65)	0.782	0.633	0.875	0.875	HHH	☺
NM (69)	0.603	0.600	0.542	0.667	HHH	☺
EEF (72)	0.603	0.500	0.542	0.792	HHH	☺
FFF (84)	0.641	0.600	0.583	0.750	HHH	☺
GGF (84)	0.692	0.700	0.708	0.667	HHH	☺
OM (65)	0.410	0.367	0.333	0.542	LLH	☝
HHF (76)	0.551	0.433	0.583	0.667	LHH	Rare
IIF (87)	0.795	0.700	0.708	1.000	HHH	☺
JJF (77)	0.667	0.467	0.750	0.833	LHH	Rare
PM (65)	0.577	0.567	0.500	0.667	HHH	☺
KKF (71)	0.667	0.600	0.542	0.875	HHH	☺
QM (65)	0.423	0.633	0.375	0.208	HLL	☟

Legend: GRI (general resilience index); CO (comprehensibility); MA (manageability); ME (meaningfulness). Range [0-1], [least resilient-most resilient]. The three letters in the types of resilience represent each of its dimensions (sequentially: comprehensibility, manageability and meaningfulness,). ☺ High resilience (stable); ☹ Low resilience (stable); ☝Pressure to move up; ☟ Pressure to move down.

Appendix 5.2 Individual participants' heat-related resilience values

Participants	HRR	CO	MA	ME	Types	Prediction
AM (65)	High	⇧	⇩	⇧	HLH	☝
AF (79)	Low	⇩	⇩	⇩	LLL	☹
BF (80)	Low	⇧	⇩	⇩	HLL	☟
CF (87)	Low	⇧	⇩	⇩	HLL	☟
DF (76)	High	⇧	⇧	⇩	HHL	☟
EF (81)	High	⇧	⇩	⇧	HLH	☝
FF (80)	High	⇧	⇧	⇧	HHH	☺
BM (75)	High	⇧	⇧	⇧	HHH	☺
GF (69)	Low	⇧	⇩	⇧	HLH	☝
CM (68)	Low	⇧	⇩	⇩	HLL	☟
HF (65)	High	⇧	⇧	⇧	HHH	☺
IF (73)	Low	⇧	⇩	⇧	HLH	☝
JF (83)	Low	⇧	⇩	⇩	HLL	☟
KF(65)	Low	⇧	⇧	⇩	HLL	☟
LF (71)	Low	⇧	⇩	⇩	HLL	☟
DM (83)	Low	⇩	⇧	⇩	LHL	Rare
EM (78)	Low	⇧	⇩	⇩	HLL	☟
MF (82)	High	⇧	⇧	⇧	HHH	☺
NF (65)	Low	⇩	⇩	⇩	LLL	☹
FM (95)	High	⇧	⇧	⇧	HHH	☺
GM (69)	High	⇧	⇧	⇧	HHH	☺
HM (87)	Low	⇧	⇩	⇩	HLL	☟
IM (76)	High	⇧	⇧	⇧	HHH	☺
OF (72)	High	⇧	⇧	⇧	HHH	☺
PF (76)	High	⇧	⇧	⇧	HHH	☺
QF (74)	High	⇧	⇧	⇧	HHH	☺
RF (79)	Low	⇩	⇩	⇩	LLL	☹
SF (75)	High	⇧	⇧	⇧	HHH	☺
TF (70)	High	⇧	⇧	⇧	HHH	☺
UF (70)	High	⇧	⇧	⇧	HHH	☺
VF (76)	Low	⇧	⇩	⇩	HLL	☟
JM (80)	High	⇧	⇧	⇧	HHH	☺
XF (80)	High	⇧	⇧	⇧	HHH	☺
KM (65)	Low	⇩	⇩	⇧	LLH	☝
ZF (79)	High	⇧	⇧	⇧	HHH	☝
AAF (75)	High	⇧	⇧	⇧	HHH	☺
LM (65)	High	⇧	⇧	⇧	HHH	☺
BBF (74)	High	⇧	⇧	⇧	HHH	☺
CCF (78)	High	⇧	⇧	⇧	HHH	☺
MM (85)	High	⇧	⇩	⇧	HLH	☝
DDF (65)	High	⇧	⇧	⇧	HHH	☺
NM (69)	High	⇧	⇩	⇧	HLH	☝
EEF (72)	High	⇧	⇧	⇧	HHH	☺
FFF (84)	High	⇧	⇧	⇧	HHH	☺
GGF (84)	High	⇧	⇧	⇧	HHH	☺
OM (65)	Low	⇧	⇩	⇩	HLL	☟
HHF (76)	High	⇧	⇧	⇧	HHH	☺
IIF (87)	High	⇧	⇧	⇧	HHH	☺
JJF (77)	High	⇧	⇧	⇧	HHH	☺
PM (65)	Low	⇧	⇩	⇩	HLL	☟
KKF (71)	Low	⇧	⇩	⇩	HLL	☟
QM (65)	Low	⇩	⇩	⇩	LLL	☹

Legend: HRR (Heat-related resilience); CO (comprehensibility); MA (manageability); ME (meaningfulness). ⇧ High; ⇩ Low; The three letters in the types of resilience represent each of its dimensions (sequentially: comprehensibility, manageability and meaningfulness,). ☺ High resilience (stable); ☹ Low resilience (stable); ☝ Pressure to move up; ☟Pressure to move down

Appendix 5.3 Individual participants' cold-related resilience values

Participants	CRR	CO	MA	ME	Types	Prediction
AM (65)	Low	⇧	⇩	⇩	HLL	☟
AF (79)	Low	⇧	⇩	⇩	HLL	☟
BF (80)	Low	⇩	⇩	⇩	LLL	☹
CF (87)	NA	NA	NA	NA	NA	NA
DF (76)	NA	NA	NA	NA	NA	NA
EF (81)	Low	⇧	⇩	⇩	HLL	☟
FF (80)	High	⇧	⇧	⇧	HHH	☺
BM (75)	Low	⇧	⇩	⇩	HLL	☟
GF (69)	High	⇧	⇧	⇩	HHL	☟
CM (68)	Low	⇩	⇩	⇩	LLL	☹
HF (65)	Low	⇩	⇩	⇧	LLH	☝
IF (73)	Low	⇧	⇩	⇩	HLL	☟
JF (83)	Low	⇧	⇩	⇩	HLL	☟
KF (65)	Low	⇧	⇩	⇩	HLL	☟
LF (71)	Low	⇧	⇩	⇩	HLL	☟
DM (83)	Low	⇧	⇩	⇩	HLL	☟
EM (78)	NA	NA	NA	NA	NA	NA
MF (82)	High	⇧	⇧	⇧	HHH	☺
NF (65)	NA	NA	NA	NA	NA	NA
FM (95)	High	⇧	⇧	⇧	HHH	☺
GM (69)	High	⇧	⇧	⇧	HHH	☺
HM (87)	NA	NA	NA	NA	NA	NA
IM (76)	High	⇧	⇧	⇧	HHH	☺
OF (72)	High	⇧	⇧	⇧	HHH	☺
PF (76)	High	⇧	⇩	⇧	HLH	☝
QF (74)	High	⇧	⇩	⇧	HLH	☝
RF (79)	High	⇧	⇩	⇧	HLH	☝
SF (75)	High	⇧	⇩	⇧	HLH	☝
TF (70)	High	⇧	⇧	⇧	HHH	☺
UF (70)	Low	⇩	⇩	⇧	LLH	☝
VF (76)	NA	NA	NA	NA	NA	NA
JM (80)	High	⇧	⇧	⇧	HHH	☺
XF (80)	High	⇧	⇩	⇧	HLH	☝
KM (65)	High	⇧	⇧	⇧	HHH	☺
ZF (79)	High	⇧	⇧	⇧	HHH	☺
AAF (75)	High	⇧	⇩	⇧	HLH	☝
LM (65)	High	⇧	⇧	⇧	HHH	☺
BBF (74)	High	⇧	⇧	⇧	HHH	☺
CCF (78)	High	⇧	⇧	⇧	HHH	☺
MM (85)	High	⇩	⇩	⇩	LLL	☹
DDF (65)	High	⇧	⇧	⇧	HHH	☺
NM (69)	Low	⇩	⇩	⇧	LLH	☝
EEF (72)	Low	⇧	⇩	⇩	HLL	☟
FFF (84)	Low	⇧	⇩	⇩	HLL	☟
GGF (84)	Low	⇧	⇩	⇩	HLL	☟
OM (65)	Low	⇧	⇩	⇩	HLL	☟
HHF (76)	Low	⇧	⇩	⇩	HLL	☟
IIF (87)	Low	⇧	⇩	⇩	HLL	☟
JJF (77)	Low	⇧	⇩	⇩	HLL	☟
PM (65)	Low	⇧	⇩	⇩	HLL	☟
KKF (71)	Low	⇧	⇩	⇩	HLL	☟
QM (65)	Low	⇧	⇩	⇩	HLL	☟

Legend: CRR (Cold-related resilience); CO (comprehensibility); MA (manageability); ME (meaningfulness). The three letters in the types of resilience represent each of its dimensions (sequentially: comprehensibility, manageability and meaningfulness,). ☺ High resilience (stable); ☹ Low resilience (stable); ⇧Pressure to move up; ⇩Pressure to move down

Appendix 7.1 General resilience and vulnerability

Participants	General Resilience Index	General Vulnerability Index
AM (65)	0.474	0.494
AF (79)	0.705	0.548
BF (80)	0.410	0.599
CF (87)	0.705	0.569
DF (76)	0.462	0.490
EF (81)	0.526	0.468
FF (80)	0.667	0.453
BM (75)	0.795	0.412
GF (69)	0.500	0.521
CM (68)	0.615	0.560
HF (65)	0.551	0.449
IF (73)	0.321	0.616
JF (83)	0.654	0.639
KF (65)	-	0.533
LF (71)	0.564	0.550
DM (83)	0.692	0.642
EM (78)	0.641	0.437
MF (82)	0.821	0.444
NF (65)	0.577	0.622
FM (95)	0.859	0.405
GM (69)	0.885	0.425
HM (87)	0.667	0.413
IM (76)	0.603	0.359
OF (72)	0.577	0.377
PF (76)	0.654	0.502
QF (74)	0.692	0.462
RF (79)	0.641	0.592
SF (75)	0.808	0.519
TF (70)	0.654	0.346
UF (70)	0.731	0.462
VF (76)	0.462	0.590
JM (80)	0.756	0.441
XF (80)	0.769	0.456
KM (65)	0.692	0.276
ZF (79)	0.705	0.317
AAF (75)	0.782	0.365
LM (65)	0.833	0.277
BBF (74)	0.705	0.379
CCF (78)	0.756	0.302
MM (85)	0.654	0.422
DDF (65)	0.782	0.279
NM (69)	0.603	0.347
EEF (72)	0.603	0.464
FFF (84)	0.641	0.527
GGF (84)	0.692	0.584
OM (65)	0.410	0.696
HHF (76)	0.551	0.558
IIF (87)	0.795	0.483
JJF (77)	0.667	0.430
PM (65)	0.577	0.584
KKF (71)	0.667	0.429
QM (65)	0.423	0.556

Appendix 7.2 Heat-related resilience and vulnerability

Participants	Heat-related Resilience	Overall Heat Vulnerability
AM (65)	High	High
AF (79)	Low	High
BF (80)	Low	High
CF (87)	Low	High
DF (76)	High	High
EF (81)	High	High
FF (80)	High	Low
BM (75)	High	Low
GF (69)	Low	High
CM (68)	Low	High
HF (65)	High	High
IF (73)	Low	High
JF (83)	Low	High
KF(65)	Low	High
LF (71)	Low	High
DM (83)	Low	High
EM (78)	Low	High
MF (82)	High	Low
NF (65)	Low	High
FM (95)	High	Low
GM (69)	High	High
HM (87)	Low	High
IM (76)	High	Low
OF (72)	High	Low
PF (76)	High	High
QF (74)	High	High
RF (79)	Low	High
SF (75)	High	High
TF (70)	High	Low
UF (70)	High	Low
VF (76)	Low	High
JM (80)	High	Low
XF (80)	High	High
KM (65)	Low	Low
ZF (79)	High	High
AAF (75)	High	High
LM (65)	High	Low
BBF (74)	High	Low
CCF (78)	High	High
MM (85)	High	High
DDF (65)	High	Low
NM (69)	High	High
EEF (72)	High	High
FFF (84)	High	High
GGF (84)	High	High
OM (65)	Low	High
HHF (76)	High	High
IIF (87)	High	High
JJF (77)	High	High
PM (65)	Low	High
KKF (71)	Low	High
QM (65)	Low	High

Appendix 7.3 Cold-related resilience and vulnerability

Participants	Cold-related Resilience	Overall Cold Vulnerability
AM (65)	Low	High
AF (79)	Low	High
BF (80)	Low	High
CF (87)	NA	NA
DF (76)	NA	NA
EF (81)	Low	High
FF (80)	High	Low
BM (75)	Low	High
GF (69)	High	High
CM (68)	Low	High
HF (65)	Low	High
IF (73)	Low	High
JF (83)	Low	High
KF (65)	Low	High
LF (71)	Low	High
DM (83)	Low	High
EM (78)	NA	NA
MF (82)	High	Low
NF (65)	NA	NA
FM (95)	High	Low
GM (69)	High	High
HM (87)	NA	NA
IM (76)	High	Low
OF (72)	High	Low
PF (76)	High	High
QF (74)	High	High
RF (79)	High	High
SF (75)	High	High
TF (70)	High	Low
UF (70)	Low	High
VF (76)	NA	NA
JM (80)	High	Low
XF (80)	High	High
KM (65)	High	Low
ZF (79)	High	Low
AAF (75)	High	High
LM (65)	High	Low
BBF (74)	High	Low
CCF (78)	High	High
MM (85)	High	High
DDF (65)	High	Low
NM (69)	Low	High
EEF (72)	Low	High
FFF (84)	Low	High
GGF (84)	Low	High
OM (65)	Low	High
HHF (76)	Low	High
IIF (87)	Low	High
JJF (77)	Low	High
PM (65)	Low	High
KKF (71)	Low	High
QM (65)	Low	High

Glossary

Adaptation	Action, response, strategy, or behaviour individuals implement in pre-emption or response to threats.
Asset	Human, financial, physical, social, place-based factors or characteristics directly or indirectly available to individuals in anticipating or responding to threats.
Asset portfolio	The access, availability and accumulation of a diverse and complex range of assets individuals manage in their daily lives.
Cold- related resilience	The resilience of individuals to extreme cold.
Cold- related vulnerability	The vulnerability of individuals to extreme cold.
Extreme temperatures	Period of abnormally hot or cold temperatures.
Extreme cold	Period of abnormally cold temperatures.
Extreme heat	Period of abnormally hot temperatures.
General resilience	The resilience of individuals to all daily life circumstances. The resilience to a wide range of disturbances, shocks or threats.
General vulnerability	The vulnerability of individuals to all daily life circumstances. Baseline characteristics of individuals. Baseline vulnerability.
Heat-related resilience	The resilience of individuals to extreme heat.
Heat-related vulnerability	The vulnerability of individuals to extreme heat.

Human asset	Health status, wellbeing, education level, skills, knowledge, living arrangements, occupation, nutrition status, marital status.
Financial asset	Income, savings, pensions, expenses.
Physical asset	Housing type, housing tenure, housing quality, appliances, telecommunication, access to transport.
Place-based asset	Health and care infrastructures, access to land, green spaces, access to amenities and services.
Resilience	The ability or capacity to actively access, mobilise and use the available assets to positively adapt. Is a function of: 1) ability to make sense of threats; 2) assets availability, access and use; 3) the perception of the ability to cope and act.
Social asset	Social relationships, contacts, networks, connectedness, membership of groups and associations, relationships of trust, support, reciprocity and exchanges.
Specified resilience	The resilience of individuals to a particular type of threat, stress or event. The resilience to individual disturbances, shocks or threats, such as extreme temperatures.
Specified vulnerability	The vulnerability of individuals to a particular type threat, stress or event. Vulnerability influenced by external events, such as extreme temperatures.
Vulnerability	The degree of susceptibility to harm determined by the availability of assets.

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