Universidade Nova de Lisboa

Instituto de Higiene e Medicina Tropical

The relationship between context and health inequalities: Europe and Portugal as case studies

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DISSERTAÇÃO APRESENTADA PARA CUMPRIMENTO DOS REQUISITOS NECESSÁRIOS À OBTENÇÃO DO GRAU DE DOUTOR EM SAÚDE INTERNACIONAL, ESPECIALIDADE DE POLÍTICAS DE SAÚDE E DESENVOLVIMENTO

JUNHO, 2017

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Dissertação apresentada para cumprimento dos requisitos necessários à obtenção do grau de Doutora em Saúde Internacional, especialidade de Políticas de Saúde e Desenvolvimento, de acordo com o Regulamento Geral do 3.º Ciclo de Estudos Superiores Conducentes à Obtenção do Grau de Doutor pelo Instituto de Higiene e Medicina Tropical/Universidade Nova de Lisboa (n.º 474/2012) publicado no Diário da República, 2.ª série, n.º 223 de 19 de novembro de 2012.

Apoio financeiro:

Subsídio para Internos Doutorandos da Fundação para a Ciência e a Tecnologia

Referência SFRH/SINTD/94891/2013

Bolsa Fulbright para Investigação em Saúde Pública da Comissão Fulbright

Dissertação para a obtenção do grau de Doutor em Saúde Internacional
Inês Campos Matos, Junho de 2017

Publications from this dissertation

Campos-Matos I, Kawachi I. Social mobility and health in European countries: does welfare regime type matter? *Social Science and Medicine*. 2015;142:241-248 DOI: https://doi.org/10.1016/j.socscimed.2015.08.035

Campos-Matos I, Subramanian SV, Kawachi I. The 'dark side' of social capital: trust and self-rated health in European countries. *European Journal of Public Health*. 2016;26(1):90-95. DOI: http://dx.doi.org/10.1093/eurpub/ckv089

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Acknowledgements

To my supervisors – Luzia Gonçalves and Giuliano Russo – and other people who supervised my work on this thesis – I. Kawachi, S.V. Subramanian, and J. Perelman. To colleagues and bosses in other areas of my life – in particular Jorge Nunes and Pedro Serrano. To everyone who took the time to teach me, I am deeply grateful.

To my friends, who mostly distracted me from my work, and to whom I profoundly thank for that.

To my family, in particular to my parents, who have always supported me. My love, gratitude, and admiration for you is never-ending.

To Chris. Thanks for all the chocolate, patience, and ranting.

Prevention is the heart of Public Health. But equity is its soul.

Dr Margaret Chan
Opening address at the Executive Board special session on WHO reform, November 2011, when she was Director-General of the World Health Organization

Resumo

As desigualdades socioeconómicas na saúde têm sido observadas há séculos por todo o mundo. Décadas de investigação identificaram múltiplos fatores que determinam estas desigualdades, como educação ou emprego. Recentemente, o foco da investigação sobre desigualdades em saúde mudou de determinantes individuais para determinantes contextuais, como as características físicas e sociais do ambiente. No entanto, a investigação sobre os determinantes contextuais depara-se com a ausência de uma base teórica sobre como estes determinantes influenciam a saúde. Portugal, sendo um dos países Europeus mais desiguais, tanto em rendimento como em saúde, é um caso de estudo interessante para o estudo das desigualdades em saúde. Esta tese procura contribuir para a compreensão do impacto dos determinantes contextuais na saúde e na sua distribuição, utilizando Portugal e a Europa como casos de estudo.

Para cumprir este objetivo, foram selecionados três determinantes contextuais – capital social, regimes de bem-estar e alterações macroeconómicas – e os seus efeitos sobre a saúde e sobre as desigualdades em saúde foram explorados. Fora utilizados dados transversais do *European Social Survey* para analisar a associação entre capital social e saúde auto-declarada em países Europeus entre 2002 e 2012. A mesma base de dados foi utilizada para analisar a associação entre a mobilidade social e saúde auto-declarada em seis tipos de regimes de bem-estar Europeus. Estas análises utilizaram regressões logísticas multinível. Para analisar evidência sobre desigualdades socioeconómicas na saúde em Portugal depois de 2000 foi efetuada uma revisão sistemática da literatura. Dados transversais do *European Union Survey on Income and Living Conditions* foram utilizados para analisar alterações da desigualdade nas limitações em saúde em Portugal entre 2004 e 2014, tendo em conta as alterações macroeconómicas no País. Nesta análise, foram utilizados o índice de concentração e regressões logísticas múltiplas.

O capital social contextual estava associado com pior saúde auto-declarada em indivíduos com pouca confiança interpessoal, influenciando assim a distribuição da saúde. Regimes de bem-estar Europeus estavam associados com a magnitude do impacto da mobilidade social na saúde. A revisão sistemática mostrou que o estudo dos determinantes contextuais em Portugal ainda é incomum. Alterações macroeconómicas em Portugal influenciaram a saúde e a sua distribuição na última década.

Com base nestes resultados, foi delineado um quadro conceptual sobre a influência do contexto na saúde da população e na sua distribuição. O quadro conceptual distingue claramente entre um mecanismo que influencia a saúde da população e outro que influencia a sua distribuição. Este quadro pode ser utilizado como base de análises futuras para clarificar os mecanismos pelos quais o contexto influencia a saúde e as desigualdades em saúde. Pode também apoiar decisões sobre políticas que procurem influenciar a saúde da população e reduzir as desigualdades em saúde.

Apesar das suas limitações, este trabalho produz evidência sobre os determinantes socioeconómicos da saúde em Portugal e sobre o impacto que o contexto pode ter nestes determinantes e nas desigualdades em saúde. O quadro conceptual proposto poderá avançar o debate sobre a influência do contexto na saúde e na sua distribuição.

Palavras-chave: Portugal, Europa, Desigualdades em Saúde, Determinantes da saúde, Contexto e saúde

Abstract

Socioeconomic inequalities in health have been observed for centuries throughout the world. Decades of research have identified multiple factors that determine these inequalities, such as education or employment. More recently, the focus of research in health inequalities shifted from individual to contextual determinants, such as physical and social characteristics of the environment. However, research on contextual determinants has been undermined by the absence of a theoretical basis to explain how these determinants influence health outcomes. Portugal is an interesting case study as it is one of the most unequal European countries both in income and health inequality, with limited academic and political attention to the topic. This dissertation aims to contribute to the understanding of how contextual characteristics can impact population health and health distribution, using Portugal and Europe as case studies.

To achieve its aim, this research selected three contextual determinants – social capital, welfare regimes, and macroeconomic changes – and explored their effect on health and health inequalities. Cross-sectional data from the European Social Survey was used to analyse how social capital was associated with self-assessed health in European countries between 2002 and 2012. The same database was used to analyse the association between social mobility and self-assessed health in six welfare regime types in Europe. These analyses used multilevel logistic regressions. A systematic review of the literature was done to collect and analyse evidence about socioeconomic health inequalities in Portugal after 2000. Cross-sectional data from the European Union Survey on Income and Living Conditions was used to analyse how inequalities in health limitations changed in Portugal between 2004 and 2014, in light of important macroeconomic changes in the country. For this analysis, the concentration index was calculated and a multiple logistic regression model was run for each year.

Contextual social capital was found to have an effect on individuals with low interpersonal trust, thus influencing health distribution. Welfare regime types were associated with the magnitude of the impact of social mobility on health. The systematic review showed that the study of contextual determinants of health inequalities is still uncommon in Portugal. Finally, important contextual changes in Portugal over the last decade seem to have influenced health and its distribution in the country.

Drawing on the findings from these analyses, a conceptual framework was outlined, summarising how context influences population health and health distribution. The framework draws a clear distinction between a mechanism that leads to changes in population health, and another mechanism that leads to changes in health distribution. This framework can be used as a basis for future empirical research, helping clarify the mechanisms by which context influences health and health inequalities. It can also support policies seeking to influence population health and health inequalities.

Despite its limitations, this work provides evidence on the social determinants of health in Portugal and on the impact that contextual characteristics can have on these determinants and on health inequalities. The proposed conceptual framework will hopefully further the debate on how context can influence population health and health distribution.

Keywords: Portugal, Europe, Health Inequalities, Health determinants, Context and health

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List of Abbreviations

BMI	Body Mass Index
CC	Concentration Curve
CHD	Coronary Heart Disease
CIx	Concentration Index
CSDH	Commission on the Social Determinants of Health
DFID	Department for International Development
ESS	European Social Survey
EU	European Union
EU-SILC	European Survey on Income and Living Conditions
GDP	Gross Domestic Product
HI	Health Inequalities
HIV	Human Immunodeficiency Virus
ILO	International Labour Organization
OR	Odds Ratio
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
RII	Relative Index of Inequality
SAH	Self Assessed Health
SDH	Social Determinants of Health
SES	Socioeconomic Status
SII	Slope Index of Inequality
SR	Systematic Review
UK	United Kingdom
US	United States
USSR	Union of Soviet Socialist Republics
WHO	World Health Organisation

1. Introduction

1.1. The Study of Health Inequalities

1.1.1. Four Decades of Politics and Research on Health Inequalities

Academia has a long tradition of seeing itself as an autonomous body, free from ideological thought and from social and political context (1). However, academic work is not done in isolation from its surrounding world. The story of how academic knowledge about health inequalities (HI) and the social determinants of health (SDH) has evolved in the past four decades is a reflection of how this knowledge and dominant political thought go hand in hand, sometimes one pushing forward more vigorously.

The connection between socioeconomic determinants and health has been known for centuries, but there has been a growing interest in the subject in the last four decades. In Europe, this political and academic interest was shaped by a few landmark events. The first political landmark was the publication of the Black Report in the United Kingdom (UK) in 1980 (2). This report was set up by a Labour Secretary of State for Health who was concerned about the dimension of mortality inequalities between social classes (3). The report found that, despite three decades of a National Health Service, HI still existed and could largely be explained by differences in material conditions between social classes (2). But the final document was reported to a Conservative government, elected in 1979 under the commitment to reduce public spending, who dismissed it and failed to properly publish it (3). Despite this, the report played a pivotal role in setting the research agenda for two decades after it was published (3, 4).

The findings of the Black Report were informed by a body of academic work published in the years before. Probably the most noticeable findings came from the Whitehall study (3), a longitudinal study of civil servants working in London that started in 1967 to analyse the ‘power of risk factors and indicators of coronary heart disease (CHD) to predict mortality’ (p. 1165). The Whitehall study showed a clear inverse relationship between grade of employment and CHD mortality that persisted ever after controlling for a wide range of cardiovascular risk factors (5). As one of the authors of the original study, Sir Michael Marmot, later commented in an interview,

this was unexpected, as at the time common sense suggested that heart disease was more common in people with higher-grade, more stressful jobs (6).

Overall, the Whitehall studies together with the Black Report reflected a change in the understanding of the determinants of health. The UK was seen as a success in terms of population health improvement, with extensive state-provided social support and universal healthcare provision. These analyses showed that, over and above the direct effect of the most basic determinants of health – such as diet or healthcare – strong social forces operated to create a health gradient, even among people who had access to all essential living conditions.

The positioning of HI and SDH in the research agenda led to a proliferation of empirical analyses in the years ensuing the publication of the Black Report. In 1991, Dahlgren and Whitehead proposed the 'Wider Determinants of Health Model', probably the most widely known and used framework on this topic (7) (figure 1). This model describes the main influences of health, built in layers, one on top of the other. The structural environment is the overarching layer, which includes 'general socio-economic, cultural and environmental conditions'. This is followed by a layer of living and working conditions, which includes factors like employment and education. The next two layers refer to support from social networks and individual lifestyle, respectively. Finally, the central layer is made of individual unchangeable factors, such as age and sex. This model proved useful in presenting the main determinants of health to broad audiences, and was groundbreaking when it was first published, as it highlighted the importance of broader socioeconomic factors in the production of health. It also emphasized the cumulative nature of the determinants of health and provided a framework upon which to consider policy options, as each layer can be translated into a level of policy intervention.

In 1997, after eighteen years of conservative rule, the UK elected a Labour government. This new government was elected with a strong commitment to reduce social inequalities, and quickly commissioned a report to 'review and summarise inequalities in health in England and to identify priority areas for the development of policies to reduce them' (8: p.5). This was materialized with the publication of the Acheson Inquiry in 1998, which revealed a wide range of HI throughout the life-course, some even increasing over the previous decades. The report clearly stated that HI were a consequence of socioeconomic factors, and as such could only be tackled

by a range of interventions that largely surpassed the responsibilities of the Department of Health (8). Accordingly, its recommendations focused on a wide range of these factors, such as income, education, housing, and gender. These recommendations were welcomed and some were implemented by the government at the time (9).

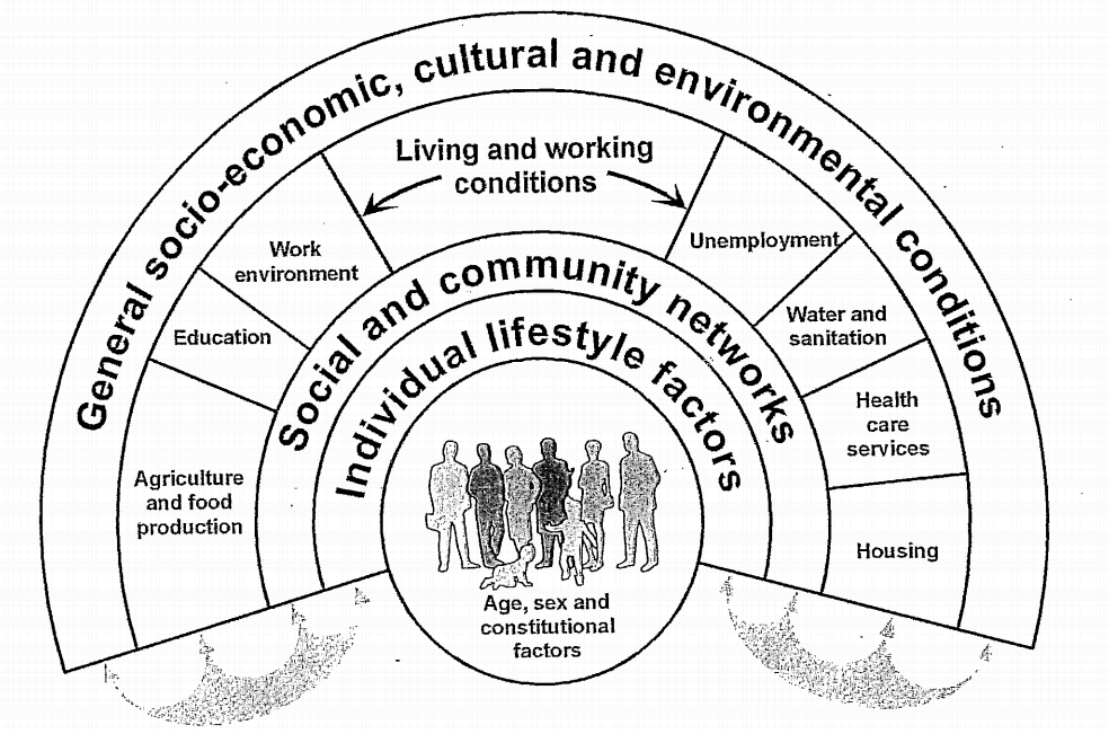

Figure 1. Wider Determinants of Health Model, by Dahlgren and Whitehead. Source: Dahlgren G, Whitehead M. Policies and Strategies to Promote Social 9. Equity in Health Stockholm: Institute for Future Studies. 1991.

The Black Report and the Acheson Inquiry placed the UK in the vanguard of political attention to HI and influenced other European countries' attitudes, such as the Netherlands and Spain, where the topic entered the research and political agendas to varying degrees (10). The World Health Organisation (WHO), which had also shown interest in the topic since the 1980's, established the Commission on the Social Determinants of Health (CSDH) in 2005 'to support countries and global health partners in addressing the social factors leading to ill health and health inequities' (11). Building on accumulated evidence from the previous decades and the growing political interest in the subject, the CSDH published its seminal report in 2008 (12). This report again highlighted the importance of social factors as determinants of

health, however, it moved forward by also considering the social *processes* that lead to the unequal distribution of these factors. This dual meaning of the SDH (including both the social factors that determine health and the processes that determine their unequal distribution) is highlighted in the Commission's conceptual framework (figure 2). In this framework, the socioeconomic and political context (first box on the left) is seen as the driver of social stratification, its nature and degree, influenced by processes of governance, policies and cultural norms and values. These structural drivers determine the magnitude of inequalities in social position, in terms of well-known individual social factors: education, occupation, income, gender and race/ethnicity. Social position then influences individuals' exposure and vulnerability to intermediary factors, such as material circumstances and biology, which directly determine the distribution of health and well-being. The CSDH framework's strongest value probably lies in the distinction made between the drivers of social stratification and the direct determinants of health, as determinants of HI and health, respectively. This is an important distinction in terms of policy-making, since policies that aim to tackle the determinants of health can be different to those tackling the determinants of HI (13). This framework thus suggests that policies that tackle the drivers of social stratification will influence health distribution, while those that tackle the direct determinants of health will influence overall population health.

These landmark publications – the Black Report, the Acheson Inquiry and the report of the CSDH – showed important similarities in both the causes identified and the recommendations given to reduce HI (4). However, whereas the Black Report saw individual material conditions as the main explanation for HI, the Acheson Inquiry focused on individual socioeconomic status (SES), and the CSDH report on the role of contextual factors. Accordingly, the policy recommendations move from improvement of individual SES, to a notion of 'proportionate universalism' – the idea that 'interventions should be both universal and targeted to where there is more need' (4: p.404). Attention was thus shifted from individual characteristics to how contextual drivers, such as policies or cultural norms, influence the distribution of health. This can be seen as a natural evolution, as knowledge about HI accumulates and more determinants of health are explored and described. However, the shift between individual and contextual determinants cannot be dissociated from its social and political context.

From the mid-20th century onwards, notions of individualism dominated political thought of most industrialized societies (14). This view stressed the importance of personal responsibility, dismissed social structures as a potential cause of HI, and was only reinforced in the 1980's by the advent of neo-liberalism, with the election of Margaret Thatcher in the UK and Ronald Reagan in the United States (US). These prevailing notions of individualism were also reflected on HI research: *conceptually*, as 'risky behaviours' were seen as the explanation for HI, a product of individual choice and responsibility; and *methodologically*, as statistical methods that gave a prominent role to individual characteristics were strongly favoured over the ones that looked at social factors (methodological individualism) (15). But over the past decades, individualistic notions that uphold neo-liberalism have been increasingly challenged, and with it there has also been a shift in the focus of HI research and public health practice (16). The flourishing of social epidemiology as a discipline (17), the increasing use of statistical methods that account for contextual characteristics (18), and the focus of the CSDH's report on social processes are all a reflection of this shift.

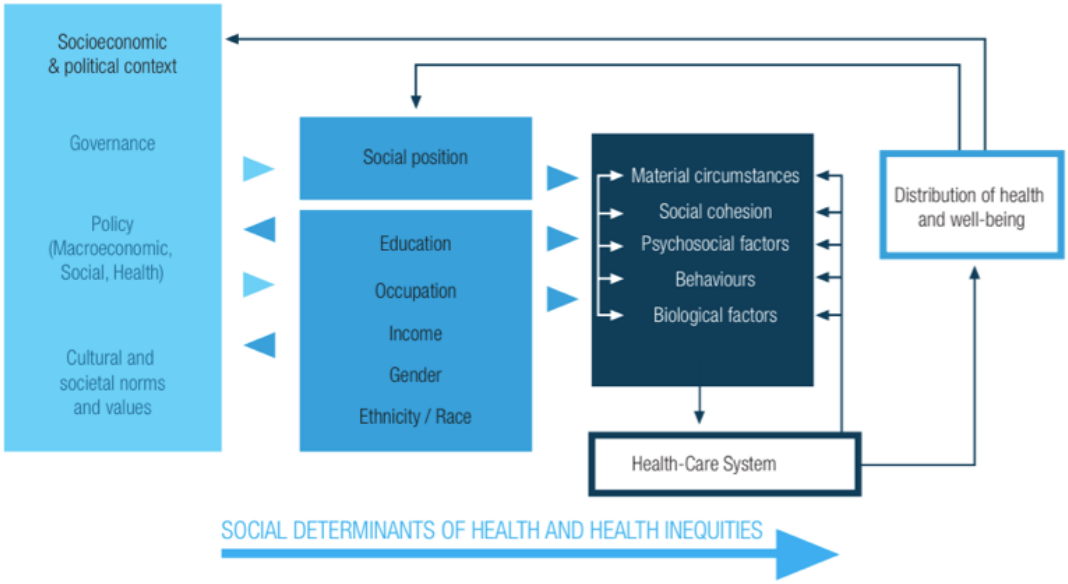

Figure 2. WHO's Commission on the Social Determinants of Health Framework, 2008. Source: Closing the gap in a generation: health equity through action on the social determinants of health. Final Report of the Commission on Social Determinants of Health Geneva: WHO. 2008.

Research on HI is thus a fine example of how academic thought is guided by much more than just the accumulation of evidence. Rather, it reflects, and is sometimes

steered by, political views. This is not to say that it is not valid, but that it must be interpreted under the lens of dominant social values of the time.

1.1.2. Contextual Determinants of Health: An Emerging Paradigm

The focus on individual determinants of health has side lined the importance of context in the production of health and its distribution. Many circumstances have contributed to this. First, as discussed in the previous section, this individual focus follows dominant political views of modern industrialized nations (14). These views are guided by the centrality of individualism, concentrating on personal freedom, choice and responsibility, and depreciating the impact of social, cultural and physical contexts (19). Second, the epidemiological transition in industrialized countries shifted the focus from transmissible to non-transmissible diseases. While social and environmental context is clearly of great importance to transmissible diseases, the connection is less clear for non-transmissible diseases (20). Third, research on SDH has grown from the blossoming of social epidemiology as a discipline (17). In an attempt to gain traction within epidemiologists, social epidemiology has used mainstream epidemiological concepts to focus on individual (social) determinants of health (20, 21). An example of this has been maintaining a 'fear' of the ecological fallacy (inferring individual relationships from ecological relationships) (14, 15), leaving behind the role of context as an important determinant.

This individualistic view of health and illness has important limitations. Despite extensive recognition that disease causation is, except for a few rare exceptions, a multifactorial process, research practices seem 'obsessed' with the study of one single determining factor (20). This fails to recognize the complexities of the real world and strongly limits the scope of effective public health interventions. Indeed, this obsession with individual determinants can lead to ineffective public health interventions that elicit no behavioural change. For example, while there is strong evidence to support smoke free policies to reduce tobacco use (22), evidence of the effectiveness of individual smoking cessation services is a lot less clear (23). This is well illustrated by Frieden (24), who proposes that public health interventions can be classified under a 5-tiered pyramid, from broad actions that address the SDH and the context, gradually to actions focused on the individual. Successful interventions tend to incorporate an aspect of all these tiers and not only individual level actions.

Focusing on individual characteristics has further implications for HI. Common sense might suggest that policies that improve overall health would also improve HI, but it is not necessarily so. A recent review showed that a number of public health policies that specifically aimed to reduce HI not only did not reduce them, but some even increased them (25). These failures are not well understood, and are sometimes attributed to the 'persisting nature' of HI (26) or to lack of political determination (27).

It appears that a limiting individualistic view on the determinants of health has hindered the creation and implementation of effective policies to improve health and tackle HI. However, when reflecting on HI, context is unavoidable for a number of reasons. Diderichsen, Evans and Whitehead suggested, in 2001, four reasons to include context in a framework about HI: measurement, conceptual, etiological, and distributional (28).

Measurement refers to the fact that some risks can only be measured at the group or societal level, as they are not characteristics of the individual. For example, legislation cannot be seen as an individual characteristic and can only be measured at a group level. Furthermore, individual characteristics sometimes interact with contextual characteristics; for example, research has suggested that contextual social capital benefits men and women differently (29). This finding could only be determined by including both contextual and individual variables in the analysis, which shows the importance of measuring context when analysing population health and health distribution.

Conceptually, a population is not merely a collection of independent individuals. Biological agents, just as infectious agents, depend on community dynamics to propagate. This can lead to a patterned distribution of exposure to risk factors and of health outcomes, which is better analysed at a group level.

From an etiological perspective, research has shown that contextual characteristics can be determinants of health. This has included physical characteristics, such as the effects of air pollution on respiratory health (30), and social characteristics, such as how neighbourhood norms and values determine to what extent violence is tolerated (28).

Finally, context is also unavoidable to the extent that an individual's 'social position' can only be defined in relation to the society s/he is in. Social stratification is an inevitable characteristic of a society, but belonging to the 'middle class' has meaning only within a society with a social structure that includes and defines what that 'middle class' is. Moreover, having a particular occupation, gender, race, or other individual characteristic, has different meanings in different societies. In some contexts, gender is a major determinant of social position, whilst in others it plays a small role. In highly industrialized societies, occupation may be a good marker of social position; in agrarian societies, land ownership might be a better reflection of social position. 'Social position' can thus only be defined within a society, within a particular context.

Despite its focus on individual determinants, the birth and growth of social epidemiology is a reflection of how social circumstances are gaining recognition as important determinants of health (17). The role of context has become more prominent in the HI literature, which is easily observable by the steep rise of published papers that look at contextual factors since the 1980's (31). According to Macintyre et al. (14), the resistance to the prevailing 'methodological, conceptual and political individualism' (p. 126) is expressed by what has been called 'The New Public Health', which called on public health professionals 'to look upstream at the causes of poor health and inequalities in health, rather than downstream at their expression in individual behaviours or ill-health' (p. 127). This interest has revealed what other areas of knowledge, such as sociology and geography, knew long before: that context can influence health above and beyond individual characteristics. This, as Diez-Roux put it (32), is an emerging paradigm within public health sciences, the notion that 'not all health determinants are best conceptualized as individual-level attributes' (p. 1783).

1.1.3. Challenges and Opportunities in the Study of Contextual Determinants of Health

Most frameworks that explore the processes of HI and SDH describe both contextual and individual determinants. Dahlgrein and Whitehead's framework (figure 1) described layers of determinants from 'general socioeconomic, cultural and environmental conditions' through to individual characteristics, such as age and gender (7). Almost 20 years later, the CSDH's framework viewed context as

responsible for the distribution of individual determinants of health, such as income or education (figure 2) (12).

But how does context influence health and its distribution? The answer to this question has been undermined by a number of challenges facing this body of literature. As an emerging topic, one of the main issues has been the heterogeneous conceptualization of context (14). Different authors have used different definitions of what context is, including at what physical or geographical level it operates – household, neighbourhood or country will likely all influence health, but probably in different ways. Diderichsen et al. (28), for example, define context as a 'catch-all phrase used to refer to the spectrum of factors in society that cannot be directly measured at the individual level' (p. 19), encompassing the 'structure, culture and function of a social system' (p. 19). This vague definition highlights the difficulty to homogenise the concept. Porta's dictionary of Epidemiology (33), on the other hand, defines context as 'the location of a person by time and place', referring to both 'geographical location and to group membership' (p. 58). This definition brings to focus two components of context that are commonly identified: the physical and the social environment. These environments can not only influence health, but may also influence each other (34). For example, the extent of physical space a community has available will influence how its individuals interact. This distinction brings to light that, by being physical *or* social, context is not restricted to a geographical definition; contextual characteristics can be defined within a network of peers who interact exclusively online, but who nonetheless share social norms that shape their elements' health.

Another common conceptualization of context distinguishes between 'compositional' and 'contextual' effects. This distinction arose from geographical analyses that think of place effects as a consequence of the characteristics of the people who reside in a certain place ('compositional') and of the characteristics of the place itself ('contextual'). However, as Macintyre et al. (14) and Frohlich et al. (21) argue, this distinction is not necessarily useful nor correct. In fact, there are complex interdependencies between people ('composition') and places ('context'), as individuals are not placed at random where they live or where they work. As Macintyre (35) put it: 'people make places and places make people' (p. 12).

Another factor hampering the appropriate analysis of contextual influences on health is the lack of clear theorizing about the mechanisms by which context operates (14). This leads to a search for contextual determinants of health that has no basis on a strong theory of how these determinants operate. As Mitchell et al. (36) comment, 'lack of theory has often resulted in a choice of variables with which to characterize an area which is guided more by what is available 'off the shelf' than by careful theoretical consideration' (p. 68). As a result of unclear definition and theorizing, measurement of context has been, in the least, heterogeneous.

This has also dismissed important questions such as which spatial or time scales are appropriate. Indeed, contextual influences can be measured as characteristics of a street, neighbourhood, city, or country, just to name a few. Pathways that link these characteristics to population health and HI will differ according to the geographical scale they are being measured at. For example, while a universal healthcare policy might be a good measure of healthcare access, it does not take into account regional inequalities in the distribution of healthcare services, which can only be detected with a smaller scale analysis. On the other hand, ideological views such as racism and other forms of discrimination may not be detected at such a small scale, but nonetheless be prominent in the country and have an important effect on the health of that population (37). Time scales are also oftentimes dismissed: most analyses measure contextual exposure and health outcome at the same moment in time, but this is often implausible, as exposures can take time to have an effect. For example, air pollution may take decades to have an impact on adult mortality, and this biological plausibility must be taken into account (14).

Finally, as described in the first section, context has also been pushed aside from research as a consequence of dominant political views. As Margaret Thatcher famously put it, "there is no such thing as society" (38).

Unclear definition, operationalization, and theorizing have considerably complicated the construction of a coherent theory on the influence of context on health and HI. This has led to important critiques, even comparisons with medieval medical theory – Sloggett and Joshi (39) called the contextual influence a 'social miasma' (p. 1473). However, despite the weaknesses in the current evidence on this topic, and the critiques of its existence as an issue at all, researchers would tend to agree that where people live matters for their health (40). In a brief review of the evidence, Macintyre

et al. (14) conclude that 'rather than there being one single, universal 'area effect on health' there appear to be some area effects on some health outcomes, in some population groups, and in some types of areas' (p. 128). This conclusion suggests that context can sometimes have little impact on overall population health, and a tremendous impact on its distribution between population groups, and hence on HI.

Thus, context appears to have an important influence on health and its distribution within a society, but current knowledge is considerably hampered by a number of issues, such as heterogeneous conceptualization and measurement. Additionally, context can have different effects depending on the individual, place, and time. This differential effect suggests that not only it is necessary to take context into account when studying HI, but that it may be key to their understanding. An appropriate theoretical framework that summarizes these relationships would provide the much needed basis on which empirical analysis could build evidence.

1.1.4. Summary

Research in HI and the SDH has grown exponentially in Europe since the 1980s, when political interest in the topic first emerged. Academic and political interest in HI evolved through this period of time, with a clear shift of focus from individual determinants, individualistic methodology and 'risky behaviours', to social processes and context as determinants of HI. This shift is reflected not only on dominant political thought of industrialized societies, but also on dominant academic thought. This parallel course shows how the academic discourse is not separate from the world that surrounds it, as the views of researchers can be shaped by dominant normative views of the society they are in.

The individualist approach that has dominated research on HI has constrained knowledge and hindered the creation of policies that effectively reduce them. This has happened because issues of heterogeneous conceptualization, measurement, and theoretical definition have undermined the study of contextual determinants, which has opened the field to considerable critique. However, contextual determinants are unavoidable, particularly when exploring HI, namely for measurement and conceptual issues. Ultimately, it is likely that context has a complex differential effect that interacts with individual characteristics. This makes context key in the understanding of HI.

The notion that not all determinants of health are best conceptualized at the individual level has been called the new paradigm of public health. As a new idea, it is still in developing stage, and would benefit greatly from a solid theoretical basis that would allow build-up of knowledge and adequate policy choices.

1.2. Measurement of Health Inequalities

1.2.1. Which Determinants?

For a long time and across many countries, the poor have had worse health and shorter lives than the wealthy (41). This consistency is seen regardless of the major causes of death in society: it is true when communicable diseases are the main killers, and it is true for non-communicable diseases (42). It is seen through the life course, from gestation to birth, childhood, adolescence, adulthood and old age (43). It is seen using a number of different statistical methods and measurements, and it is seen by a number of individual SES measures, like income, education or occupation (44). But the study of contextual determinants has raised both conceptual and methodological questions that cannot be answered by traditional views of individual characteristics and traditional statistical methods alone.

Conceptually, recognizing contextual effects on individual health implies a shift in the understanding of how risk factors operate. In traditional epidemiology, individual characteristics are identified as causes or risk factors for ill health, implying that interventions should be focused on the individual. Some critiques of this approach claim that an exclusive focus on the individual can lead to counterproductive processes of victim blaming (45). The new paradigm of contextual effects on health recognizes that the context can be, in and of itself, a determinant of health. Additionally, the acknowledgement of context as having an influence on health also implies that individual characteristics must be framed by the context they are in. In this sense, having a certain amount of money matters not only in absolute terms, but also considering the average wealth of everyone else, i.e., what you have matters, but what others around you have matters too. This implies that HI can be created, in part, of psychosocial mechanisms. Indeed, a noticeable finding in HI research has been that HI do not occur in a threshold effect. Systematic differences are not seen just below a certain point of income, wealth or occupational rank. Rather, there is a socioeconomic gradient in health, in which the poorest have worse health than the ones who earn an average income, who in turn have worse health than the richest (41). This gradient is seen for all SES determinants: financial resources, education and occupation. This gradient shows that socioeconomic determinants do not influence health only because they provide access to essential resources, otherwise there would be no difference once those essential resources were present (44). Rather, there are other effects at

work through the social spectrum that produce systematic differences in health outcomes. These effects are a consequence of psychosocial mechanisms.

While material conditions are widely recognized and important for the health gradient, as they are directly related to access to health promoting resources, such as quality food and housing, extensive research has shown that adverse social conditions can directly lead to adverse biological effects, regardless of access to resources (46). This view helps understand the socioeconomic health gradient. Within a structure of a society, everyone is beneath someone else by some measure – be it money, prestige, cultural capital, or others. This social hierarchy can create stress responses, as being of a lower social status may lead to feelings of inadequacy and lack of control (47). As such, since there is always someone better off, everyone suffers the consequences of this gradient, not only the poorest. These stress responses have a direct impact on biological functioning, and can lead to more health damaging behaviour, such as drinking and smoking. This leads to a health gradient that affects everyone, even after basic material conditions for a healthy life are satisfied. Noticeably, rather than being opposite explanations, material and psychosocial mechanisms act together to help explain the socioeconomic health gradient (44).

Psychosocial explanations highlight that, further than being a question of absolute poverty, HI are also a question of relative deprivation. The international glossary of poverty defines relative poverty as the 'absence or inadequacy of those diets, amenities, standards, services and activities which are common or customary in society' (48: p. 169). This notion of poverty implies that it can be a socially defined concept, measured within the group the individual is in, as it depends on what is 'customary in society'.

The health gradient and psychosocial explanations show that the creation of HI is complex and a product of multiple determinants operating at the same time. Importantly, these determinants occur at both the individual and contextual level simultaneously, and neither should be ignored.

a) Individual Determinants

Historically, income, education, occupation and employment have dominated the analysis of HI as determinants of individual SES. These determinants are often used

interchangeably, but research has shown that this is not necessarily correct, as they can reflect different underlying causal processes (49).

i. Education

Education is probably the most commonly used measure of SES and has extensively been related to various health outcomes. Comparative analyses between European countries show strong associations of education with cause-specific mortality (50), self-assessed health (SAH) (51), limiting long-standing illness (52), chronic conditions (53), smoking (54, 55) and obesity (56). As a measure of SES, education has a number of important advantages: it is easy to measure, shows high response rates in surveys, is fairly comparable across countries, applicable to both working and non-working individuals, tends to remain stable through life, and is not likely to be affected by reverse causation, since it is usually determined in young adulthood and remains stable throughout life (57). However, reverse causation cannot be completely excluded, since a healthy life expectancy might induce higher investments in education and ill children might be less able to complete education (58). Nonetheless, analyses of compulsory schooling laws in the US and Europe, which 'force' most people into education, regardless of their health prospects, suggest that education causes better health, despite the opposite also being true (59-61).

Several mechanisms explain the pathway linking education to health. The effect seems to be mediated in part by income and occupation, although analyses show an educational gradient even after controlling for these factors (58). The remaining health differences can be strongly explained by behavioural factors, which in turn seem to be a consequence of better information and better cognitive abilities, which affects the ability to process information regarding healthy behaviours and disease management (62). Preferences also seem to play a part, as they vary systematically across educational groups (62). Finally, education can also provide an individual with a social network of similarly educated peers, which can have substantial health benefits (41).

ii. Financial resources

Financial resources, such as income or wealth, are also strongly correlated with health, independently of education. They can have an impact on health to the extent that they allow individuals to access health-producing resources, such as healthcare or

better living conditions. However, assessing causality is difficult, since health strongly increases one's ability to earn money and several confounding factors – such as education or preferences – might determine both better health and better income. Whereas the effect of health on income has been extensively shown in a number of societies, the effect of income on health remains more of an 'open question' (41, 58).

Unlike education, financial resources can be more difficult to measure, as people may not be as happy to share this information, there are many components involved (income, wealth, savings, property, etc.), and comparability can be hampered by different currencies and differences in currency value, for example. Nonetheless, income-related health gradients have been shown for SAH (63, 64), functional limitations (64, 65) and smoking (55) in European countries.

iii. Employment

Employment, or lack of it, is central to most adults' life and has been associated with health in a number of settings. This association is not surprising. First of all, employment provides income, which is essential for access to basic goods. Unemployment can lead not only to financial strain, but also uncertainty about the future. This leads to a second mechanism: stress. Unemployment, with the uncertainty it brings, leads to a feeling of lack of control, which has been extensively associated with adverse health outcomes (66). Employment also provides psychological benefits – like providing a structure to the day, self-esteem, status and a sense of contribution to a collective cause – that are absent in unemployment (67). Opportunities to socialize are also more common when one is employed, and social support and integration have extensively been linked to health (68). Finally, unemployed individuals seem to have an increased risk of health-damaging behaviours, such as smoking and drinking (69). This might occur because people who drink and smoke are more likely to become unemployed, because people who become unemployed drink and smoke more to deal with their stressful situation, as a consequence of a common causal factor, or a combination of any of these. Regardless, employment is a major factor in HI among working-age adults.

Analyses in European countries have shown that unemployment is associated with worse SAH (63), chronic health conditions (70) and mortality (71).

iv. Occupation

The International Labour Organisation (ILO) (72) defines occupation as 'a set of jobs whose main tasks and duties are characterised by a high degree of similarity' (p. 1). Accordingly, occupational grades are usually classified according to tasks and responsibilities involved. Probably the most commonly used classification is ILO's International Standard Classification of Occupations, which defines ten major occupational groups, from elementary occupations to managers, defined in terms of skill level and specialisation required for each occupation (73). Other classifications, such as manual and non-manual (53), administrators, professionals, executives and clerks (74) or white collar and blue collar (75) are sometimes used, but all reflect different degrees of skills that are required for the job.

Occupational grade has been strongly associated with health outcomes. In European countries, it has been associated with overall mortality (53, 76), stroke and ischaemic heart disease mortality (77), infant mortality (78), child health (78), SAH, long term limitations and chronic conditions (79). The Whitehall studies are one of the most important contributions to the understanding of this relationship. These studies showed that people in higher ranks had a stronger sense of control over their health, their jobs and their lives (74), which is strongly associated with better health (66). However, occupation can also reflect an individual's place in society, to a greater extent than financial resources, education or employment do. Having an occupation will usually grant adequate earnings and a certain degree of job security, so the health differences that remain can also be explained by the effect of social standing (rank) and subjective feelings towards one's position in society (59). In fact, a number of authors have used occupation as a marker of 'social class' (80-82), possibly based on the understanding that occupation reflects more than just skill levels and specialisation.

v. Social Mobility

The SES of an individual can have an impact on their health at any given time and the movement between different social strata can too. Social mobility is the process of moving between social strata, either between generations (parents and children) or within the life-course of the individual (inter- and intragenerational social mobility, respectively).

Social mobility has been associated with health in a variety of contexts (83, 84), but the way it operates can be difficult to tease out. One possibility is that it is an accumulation effect. Power et al. (85), for example, showed that in a birth cohort from the UK, the accumulation of unfavourable social circumstances was more important than social mobility per se in determining adult health. This means that, when comparing two people with the same SES, one of whom 'moves down' the social ladder and another who remains stable, the first will have worse health outcomes. However, this is not a consequence of the downward social movement itself, rather a consequence of having a lower SES at a given moment in life. Another explanation for the association between social mobility and health is an opposite causal effect: extensive empirical analysis has shown a 'health selection effect' that pushes people who are unhealthier down the social ladder (84, 86). This is not surprising, as people who are ill can be less capable to study and work, thus reducing their potential earnings and social position. Finally, some evidence also suggests that social movement in and of itself has some effect on health (41, 83). Surprisingly, it is not just the downward movement that seems to have a negative impact, but also upward movement, particularly within short periods of time, can also have a deleterious effect (41). This unexpected effect may be a consequence of an increase in unhealthy behaviour (such as smoking more because one has more available income), or of physiological and behavioural adaptations to a different social setting.

b) Contextual Determinants

A multitude of contextual characteristics have been analysed in the literature as potential determinants of health. Building on the definition of context outlined in the previous chapter, these can be classified as physical or social determinants – with the caveat that this is an oversimplified characterisation, as physical and social contextual characteristics often interact with each other.

Physical determinants can be thought of in terms of natural environment – air, water, noise, green spaces – and of the built environment – houses, roads, infrastructures, and transport systems. Extensive research has shown a strong connection between the built environment and health. Examples include impacts on mental health (87), physical activity (88), eating habits (89), obesity (90), and drinking (91). This influence can work through the availability of green spaces that allow people to have a more physically active life, walkability of neighbourhoods that help provide a safe

space, or closeness of stores with fresh produce or alcoholic beverages that influence people's diet.

The built environment works together with contextual social factors to influence health distribution. Stores with cheap alcohol may be accessible, but if dominant social views look down on alcohol consumption, these may mitigate the negative effect of the built environment. Similarly, easy access to a park will only lead to more exercise and better health outcomes if people feel safe in these places.

Social determinants, on the other hand, can be defined as 'factors, such as culture, political systems, economics, and processes of migration or urbanization (…), that are beyond the individual and are explicitly a function of population systems' (20: p.9). These factors can shape the health and health distribution of a population, or modify the effects of other determinants. Three examples of contextual characteristics that have been studied as macrossocial determinants of health are described: social capital, welfare states and economic cycles.

i. Social Capital

Social capital has been the target of researchers from a multitude of disciplines. As a consequence, its conceptualization has been somehow heterogeneous, but tends to include two things: it is a resource and it is obtained from social interactions (92). Kawachi et al. (93), for example, define social capital as the resources that are accessed by individuals and groups through their social network connections.

Pierre Bourdieu produced the first analysis of social capital, who identified it as one of the three forms of capital (together with cultural and economic capital), that define how individuals are placed within a society structure (94). Social capital was thus seen as a characteristic of the individual or of the relationship between individuals. Political scientists, however, gave it a 'twist', by looking at social capital as a characteristic of a social organization (95). Probably the most well-known proponent of this view is Robert Putnam (96), who defined social capital as 'features of social organization, such as networks, norms, and trust, that facilitate coordination and cooperation for mutual benefit' (p. 35).

Thus, social capital can be seen as an individual level or a group level construct. From an individual perspective, social capital can provide people with information (such as where to get fresh produce), instrumental assistance (such as help in securing a job),

or emotional support. The benefits from individual social capital can come both from strong social ties (close, enduring relationships) and weak social ties (such as acquaintances) (92). As a group level construct, social capital is a property of the whole network of individuals. It can work in many ways, such as through social contagion (spread of behavioural norms through a network), collective social action (when individuals come together to face adversity or to fight for a common cause), or informal social control (when adults 'police' the behaviour of youths in a neighbourhood) (92).

However, the same close ties that produce health-promoting social capital can also have negative consequences. Rostila (97) delves into this topic by reflecting on the consequences of network closure. Strong ties can lead to strongly closed networks, which limit the access of other members to their social capital; for example, a dominant ethnic group may discriminate against an ethnic minority, excluding them from the resources obtained through social capital produced within their social networks. Additionally, social capital is not always health promoting. 'Negative' social capital can be reinforced within a closed network, such as when teenagers are led to start smoking because of peer pressure. For example, an analysis of adolescents with migrant backgrounds showed that social ties with non-migrant adolescents were associated with increased use of cannabis and alcohol (98).

All these characteristics of social capital have made it challenging to operationalize. According to Kawachi and Berkman (92), measurement of social capital has generally followed one of two perspectives: network-based or social cohesion-based. Both can be measured at either the individual or group level, but the first tends to measure network characteristics (such as the number of people a person knows, or the strength of a network), whereas the second is based on social cohesion measures. These measures include perceptions and attitudes, such as interpersonal trust ('Do you think the people in this neighbourhood are, in general, trustworthy?'), and behaviours, such as participation in collective action.

Trust is one of the most commonly used measures of social capital, probably because it is frequently and easily assessed in surveys. Trust can facilitate the exchange of information, can promote participation in communal activities, and can improve the chances of receiving a loan, to name a few examples. It's not surprising, then, that

being a trusting individual and living in a trusting community can improve individual health (99).

ii. Welfare States

In his seminal work about the classification of welfare state regimes, Esping-Andersen (100) defines the welfare state as a system of social stratification. The author classified welfare state regimes in three categories (conservative, liberal, and social democratic) according to three principles: de-commodification (the degree to which people make their living standards independent of pure market forces (101)), social stratification (the welfare state's role in social stratification), and the public-private mix (the relative roles of the state, the market, and the family in the provision of welfare) (102).

This classification has been highly debated, both for the typologies proposed, and for the principles chosen (90). One of the criticisms has been the classification of southern European countries as having an 'immature conservative' welfare regime (103). This led Ferrera (104) to propose a slightly different classification in four regime types: Scandinavian, Anglo-Saxon, Bismarckian, and Southern.

Important changes within Europe and the European Union (EU) also warranted the inclusion of Central and Eastern European countries in this classification. The historical trajectories of these countries can be separated in two, depending on the extent to which the welfare effort collapsed in the 1990's (105). This distinction was outlined by Fenger (106), who showed a clear distinction between Post-Communist European and Former-USSR countries, based on variables that reflect government spending, social situation and political participation.

The characteristics of these six European welfare regime types are described in table 1. It is important to note that countries tend to have a predominant welfare regime type, but can have characteristics of more than one. As such, this classification cannot be seen as an absolute description of each country.

It is intuitive to think that welfare regime type, as it is strongly related to levels of social stratification and well-being, would have a strong impact on overall population health and HI. In fact, variations of population health under welfare regime types have been widely analysed (52, 64, 102, 107) and a recent review of the literature concluded that there was not one welfare regime type that consistently showed better

or worse health or lower or higher levels of HI (108). This can be a reflection of the variety of health outcomes and methods used, or a hint that other characteristics, not welfare regime types, are important for health and HI.

Table 1. Welfare regime types of European countries, their main characteristics, and example countries

Welfare regime type	Main characteristics	Example countries
Scandinavian	Universal and generous benefits and a strong redistributive social security system (42, 94)	Denmark, Finland, Norway, Sweden, Iceland
Anglo-Saxon	Low level of government spending on social protection, tax-based health financing, public healthcare free at the point of use, modest benefits, usually means-tested (42, 94)	United Kingdom, Ireland
Bismarckian	Benefits tied to employment, financed mainly by employer and employee, and minimal redistribution (42)	Austria, Belgium, Switzerland, Germany, France, Luxembourg, Netherlands
Southern/Mediterranean	Dualist system of welfare provision, which strongly protects part of the population (typically workers of the 'institutional' labour market) while under-protecting another (92)	Spain, Greece, Italy, Portugal
Former USSR	Generally low governmental spending on social programs, mostly financed through social contributions; noticeably poor social well-being and high levels of inequality (94)	Estonia, Latvia, Lithuania, Russia, Ukraine
Post-Communist European	Similar to former USSR countries, but considerably better levels of social well-being and egalitarianism (94)	Czech Republic, Hungary, Poland, Slovenia, Slovakia, Croatia, Bulgaria

USSR: Union of Soviet Socialist Republics

iii. Economic Cycles

One of the most remarkable events in recent human history is the dramatic improvement of macroeconomic circumstances in most of the world's population. This has been, generally speaking, accompanied by remarkable improvements in population health (109). Macroeconomic circumstances are, indeed, inseparable from social and health circumstances. Early studies on this topic showed that, in England and Wales between the 1940's and 1970's, secular trends of economic growth were strongly associated with mortality decline (110). However, this initial work was extensively criticized for methodological weaknesses (68, 109) and in an unexpected turn, analyses with different methodological choices showed the opposite result: mortality declined with economic downturns and increased with economic expansion (111-113). These findings were observed in the US for overall and many cause-specific mortality rates, but were particularly large for traffic accident deaths and

were the opposite for suicide (114). Since then, empirical analyses have both corroborated and contradicted these results, as was well evidenced in a review in 2011 that reflected these contradictions (115).

Mechanisms that explain why mortality and economic development may be procyclical (rises in economic development lead to rises in mortality and economic contractions lead to mortality falls) or counter-cyclical (rise in economic development leads to a decrease in mortality and economic contractions lead to rises in mortality) abound. Explanations are as varied as the results themselves, but most are based on the intermediary effect of employment and its impact on the stress mechanism. Counter-cyclical results are explained on the basis that falls in economic development lead to stressful job events and feelings of insecurity and anxiety about the future, thus increasing the likelihood of ill-health (68, 115). On the other hand, explanations of procyclical mortality based on stress mechanisms assume that most stress is created by work itself; thus, job loss would lead to lower stress levels and hence better health (116). Another common explanation relies on the notion that certain activities have different costs in different economic cycles. For example, health-promoting activities (such as having a healthy diet or exercising) may become too costly (in terms of time or money) in times of economic downfall, thus some people will stop investing in them, leading to a rise in ill-health (117). On the other hand, procyclical results suggest that employment may actually have negative effects on health, possibly because the worker will have less available time for health-promoting activities (68).

On a broader level, increased economic activity can also lead to unintended consequences, such as increased air pollution and increased traffic-road accidents (68). On the other hand, economic development has been associated with a greater investment in renewable energies (118), which have much lower risks for population health (119).

Analyses on the impact of economic cycles on HI are far less common. But in the face of such contradictory results on overall population health, one would expect similar heterogeneity regarding HI. Indeed, a recent review concluded that results were very variable and difficult to compare, as they differed substantially in context, time, health outcomes and methods (120). Compared to the study of economic cycles and overall population health, the analysis of HI is still very much in its infancy.

1.2.2. Which Health Outcomes?

a) Mortality

Mortality inequalities are evident regardless of what is the major cause of death. This is clear when comparing countries that are in different stages of the epidemiological transition. When communicable diseases are the main cause of death, the poor are disproportionately affected (121) and when communicable diseases give way to non-communicable diseases, mortality continues to show a gradient between poorest and richest (122).

Mortality gradients can help understand the causes of HI. Within European countries, HI have been shown for overall mortality (53, 76), infant mortality (78) and a number of cause-specific mortality rates, from cardiovascular disease (77), to respiratory disease, and injuries (50). A recent review of cause specific mortality data from various European countries showed that inequalities were generally larger for preventable causes of death (including causes amenable to behaviour change, medical intervention and injury prevention) than for non-preventable (50). This review also showed that this contrast was largest for Central and Eastern European countries, and smallest for Nordic and Southern European countries. Despite this general pattern, there were important differences among countries. By identifying which mortality cause is distributed most unequally in a society, these differences can help identify what are the major causes of HI within each country, thus helping with prioritizing interventions that seek to tackle them.

b) Morbidity

One of the most frequently used morbidity measure is SAH. SAH is measured on surveys using a question such as ‘How is your health in general?’ for which respondents usually have the options ‘very good’, ‘good’, ‘fair’, ‘bad’ and ‘very bad’. In practical terms, most statistical analyses do not analyse the complete scale of responses, and collapse them into categories, such as ‘bad health’ (including both ‘bad’ and ‘very bad’), ‘good health’ (including ‘good’ and ‘very good’) or ‘less than good health’ (including ‘fair’, ‘bad’ and ‘very bad’).

SAH has been criticized for its lack of reliability, especially among disadvantaged socioeconomic groups (123). However, extensive reviews have confirmed its strong and consistent capacity to predict mortality, even when controlling for other health

status measures and other variables that impact mortality (124). Moreover, its capacity to predict mortality has become increasingly more consistent between 1990 and 2002 in the US, possibly because of better health related information (125). On the other hand, despite its strong ability to predict mortality, this relation might vary between gender (126), age (127), and SES (128), possibly biasing results of HI analyses. However, SAH has value on top of its ability to predict mortality: it can be seen as a more comprehensive measure of health, which allows respondents to weight different aspects of their own health and value them according to their own preferences (129).

An increasingly used alternative to SAH has been to use 'health limitations' as a general measure of health. This measure is also based on a survey question that asks respondents whether they are limited in their daily activities due to a health condition. Possible answers usually include 'yes, severely limited', 'yes, somewhat limited', and 'no'. Some authors consider this a 'quasi-objective' indicator, more accurate than SAH (65), and some have used it as a proxy measure of disability (130).

HI have been observed using both SAH and limitations as an outcome measure (65). These measures rely on self-reporting, but HI have also been observed in morbidity indicators that are based on objective measurements. For example, several cancers (although not all) show a socioeconomic gradient, as does the survival rate after cancer diagnosis (78). Measures of physical ability also tend to show a socioeconomic gradient (131), as does Body Mass Index (BMI) (132) and the metabolic syndrome (133), to mention only a few examples.

c) Health Related Behaviours

According to the Global Burden of Disease Study, the three risk factors that most contribute to disease burden in western and central Europe are high blood pressure, tobacco smoking, and high BMI (134). These reflect the four major behaviours related to non-communicable diseases: eating, drinking, smoking and exercising. These four behaviours have extensively shown a social pattern, such that people from lower SES tend to show less compliance with dietary and exercise recommendations, drink more, and smoke more (135).

These health related behaviours occur within social structures and contexts that can facilitate or hinder them. For example, while ultimately smoking may be a matter of

individual choice, factors such as the economic ability to buy cigarettes, having a more or less stressful life, and living in an environment where social norms support or shame smoking behaviour, can all exert an influence on that final 'individual' decision.

Another particular form of health related behaviour is health care use. As with other behaviours, health care use and quality are also socially patterned (136). This can be related to factors like economic resources, access to information or geographical accessibility. However, at least in a European context, health care is far from being the most important cause of HI and probably contributes only slightly to these inequalities (137).

1.2.3. Which Measures?

Despite being known for centuries, HI have not always been a unanimously accepted fact. The Black Report dedicated some of its pages into showing that HI were not a product of mathematical artefact (4), but it was still criticized for the measures it used (138). In fact, the measure one chooses to analyse HI can determine the result of the analysis, possibly even leading to contradicting results (138).

One of the most commonly used methods are range measures, probably the most simple and easy to interpret. They compare the health status of two groups of the socioeconomic distribution. This is done by calculating absolute or relative differences (i.e., ratios). For example, if half (0.5) of the poorest quintile and a fifth (0.2) of the richest quintile have diabetes, the absolute difference is 30 percentage points (0.5-0.2=0.3) and the ratio is 2.5 (0.5/0.2=2.5).

While inequality is summarized in one value, range measures show an incomplete picture, as they only compare two groups (usually top and bottom). Inequality between these two groups may remain the same, while the distribution within the middle groups dramatically changes (138). Another shortcoming of these measures is that they ignore the sizes of the groups. This is important especially in comparative analyses – across time or space – as two similar results may reflect two very different distributions. This is also an issue when socioeconomic groups do not have a fixed size, such as those defined by occupation or education. A range measure of inequality may remain stable over time, but if the group with more years of education increases, while the number of less educated decrease, the distribution is clearly different.

To overcome some of these shortcomings, regression-based measures can be used. An example is the Slope Index of Inequality (SII): the regression coefficient (the slope) of a regression model of the health outcome on SES, ordered by SES. It can be interpreted as the absolute effect on the health outcome of moving from one SES category or value to the next (139). Despite its simplicity, this measure is sensitive to the population mean of the health outcome, which limits is comparability across populations and time. The Relative Index of Inequality (RII) overcomes this issue, as it is calculated by dividing the SII by the population mean of the health outcome.

Measures based on the concentration curve (CC) are also used. These measures originated in the economic analysis of income distribution, famously summarized in the Gini Coefficient – a measure of how income or wealth of a population is distributed among its elements. Equally, when a health outcome measure is used, it is possible to summarize in one number how health is distributed, reflecting not only the experience of two groups, but of the whole population. Additionally, unlike the SII and the RII, measures based on the CC do not assume a linear relationship between independent and dependent variables.

An important distinction that can be done in the methods used to calculate HI is the difference between relative and absolute measures. It has been argued that the use of only absolute or relative measures can be misleading, as it can influence the readers' perception of the magnitude, significance and even direction of HI (140, 141). In fact, methodological reviews of the reporting of HI have shown that absolute and relative measures of the same effect can yield opposite results (141). Additionally, the choice of relative or absolute measures can also reflect different equity value judgments (142). When comparing two groups that get healthier at an equiproportionate rate – i.e., in both groups' health improves at an X% rate – then a relative measure of HI will remain the same, while an absolute measure will change. On the other hand, if the groups' health improves in a uniform way – i.e., both groups see an overall improvement of X percentage points – then an absolute measure of HI will not change, while a relative measure will change (142) [1].

[1] This is better illustrated in the hypothetical example outlined in appendix 1.

1.2.4. Which Mechanisms?

a) Pathway Between Individual Socioeconomic Status and Health

The study of the pathways that link SES to health is comparatively less common than of its determinants, outcomes or measures. In 2001, Diderichsen, Evans and Whitehead outlined a framework for understanding the social origins of HI (28) that summarizes these pathways (figure 3). At that time, literature on the SDH was just escalating and starting to touch the topic of context as an important determinant of health, shying away from the traditional conceptualization of risk factors as individual attributes. Diderichsen's framework recognizes the role of context in the creation of HI, although it mostly focuses on individual pathways.

Probably the most noticeable use of Diderichsen's framework was its application by the WHO's CSDH as a basis for their own framework (figure 2) (12, 13). Diderichsen's framework has also been used as a basis for other frameworks (143); as a map to understand other social phenomena, such as intimate partner violence (144) and social consequences of disease (145); as a frame to present evidence of literature reviews on traffic injuries in youth (146), in cystic fibrosis in the UK (147) and in work-related health (148); as a basis for policy comparisons between countries (145, 149, 150); and as a map for empirical analysis of the health of lone mothers (151, 152) and smoking in adolescents (153).

Diderichsen's framework has not raised much academic discussion, and other authors who used it as a basis for their own work did not explicitly critique its applicability. Despite this, it provides a simple, yet complete summary of how SES influences health and vice-versa. The framework describes four mechanisms: (I) social stratification, (II) differential exposure, (III) differential susceptibility and (IV) differential consequences; and four entry points for policies to target those mechanisms: (A) influencing social stratification, (B) decreasing exposures, (C) decreasing vulnerability, and (D) preventing unequal consequences. With this framework, the authors aim to provide a model to understand the process of creation of HI, a systematization of what kind of policies might work in their mitigation, and a base to empirically test which HI producing mechanisms are more important in a society.

This framework provides a simple, yet exhaustive, description of how SES and health outcomes are interrelated. It can be easily applicable to any SES measure and health outcome, as the variety of analyses it has been used for clearly shows. It also clearly identifies the steps in which differential effects occur, which in turn lead to HI.

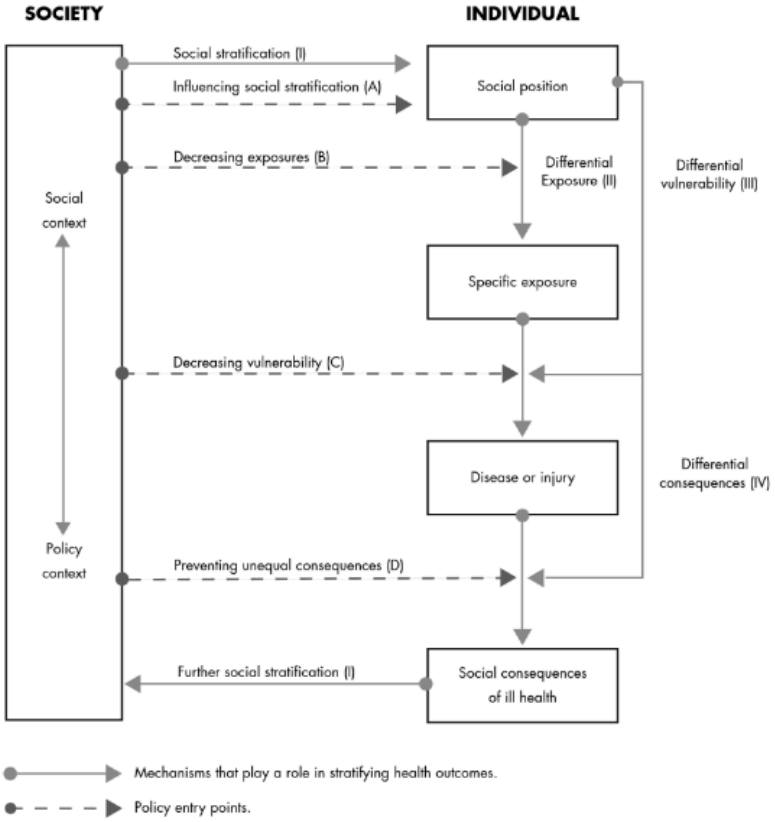

Figure 3. A framework for elucidating the pathways from the social context to health outcomes and for introducing policy interventions. Source: Diderichsen F, Evans T, Whitehead M. The social basis of disparities in health: Challenging inequities in health: from ethics to action. New York: Oxford University Press; 2001.

i. First Mechanism: Social Stratification

Social stratification is the way context determines individual social position (figure 3). 'Context' is understood by Diderichsen (28) as 'the spectrum of factors in society that cannot be directly measured at the individual level' (p. 19). As was later described by the author (154), the social stratification mechanism actually encompasses two mechanisms: 'one that generates and distributes wealth and power to different social positions in society and one that stratifies individuals into the social positions' (p. 59). Thus, the pattern of health across social positions is a result of both the characteristics of the positions and of the individuals occupying them.

Under the author's understanding, the process of social stratification occurs mostly during early childhood development (155); at this stage, a range of determinants operates to determine social position and health in adult life. For example, in a sample of the Portuguese population, height (as a proxy measure of childhood social circumstances) was strongly associated with several health outcomes, such as asthma and chronic pain, such that taller people (who tended to have had better childhood circumstances) were healthier (156). The existence of life-long determinants highlights the importance of a life-course approach to the analysis of HI.

Policies that influence social stratification usually fall out of the realm of 'health policies'. These are policies that decrease social inequalities, such as creating equal educational opportunities or redistributing wealth. Because social position is inextricably linked to health, reductions in social inequalities have the potential to also reduce HI. As poverty has also been extensively linked to health, these policies can be particularly important in protecting the most vulnerable – through, for example, illness pensions.

ii. Second Mechanism: Differential Exposure

Differential exposure refers to the unequal distribution in type, amount or duration of exposures that impact health on different social groups. Unequal exposures comprise environmental, biological or behavioural risk factors, which are commonly connected to social position. For example, an unskilled worker may have a low income that does not allow them to choose a healthy diet; a person living in an urban environment is exposed to more air pollution; and the stress of having a low income can make a person more prone to smoke. Whilst social stratification operates mainly in early life, differential exposures can occur in childhood or adult life, as a consequence of the social stratification process.

Many health policies that employ risk reduction strategies – for example, media campaigns to promote healthy eating by informing people of what constitutes a healthy diet – do not differentiate between social groups. However, health campaigns reach individuals differently, as the more educated can be more exposed. Accordingly, analyses of these strategies have shown that, despite improving some people's health, they sometimes increase HI, as they disproportionately improve the health of those that are healthier to start off with (157).

To reduce exposures, one must 'modify the effect of social position on the occurrence of the specific causes' (154: p.60). This means strategies should aim to reduce the disproportionate amount of risk factors that some people face, focusing on particular groups that face them, for example, by protecting them from occupational risks, bad housing, or inadequate nutrition. Noticeably, differential exposures tend to cluster, as people in lower social strata are more likely to be exposed to multiple adverse risk factors. This clustering of adverse exposures through life constitutes the third mechanism: differential vulnerability.

iii. Third Mechanism: Differential Vulnerability

The effect of an exposure on an individual is not exclusively a function of the exposure, but also of the individual him/herself. For Diderichsen et al. (155), the added exposures to multiple risk factors increase the vulnerability of people in lower social positions. These exposures act synergistically, making the individual more susceptible to the effect of each of them. This means that even if a given risk factor is distributed evenly across social groups, its impact may be unevenly distributed among those groups due to different underlying vulnerability (28). Thus, the third mechanism is 'mostly a question of clustering to lower socio-economic groups of causes in the same pathway' (154: p.60).

The success of policies that aim to decrease risky exposures also depends on the existence of other exposures and on the context in which the individual is in. For example, a policy might be put in place to provide housing to everyone, but a homeless individual with an incapacitating mental illness and no other form of support will not be able to navigate the administrative process to apply for the house they need. Reducing vulnerability depends on just that: tackling interacting exposures and not just focusing on a single one.

However, vulnerability is not only about the additive or interacting effect of several exposures, it is also about contextual effects. As the Diderichsen points out (158), 'children living in extreme poverty have very different mortality rates in different countries, which shows that the national policy context modifies the effect of poverty' (p. 14). For example, a society with strong social cohesion can potentially reduce the effects of poverty or unemployment in an individual's health, by reducing the stress associated with these situations.

Thus, reducing vulnerability must include comprehensive strategies that tackle multiple exposures simultaneously, and providing people with an environment that helps mitigate the effects of individual risk factors.

iv. Fourth Mechanism: Differential Consequences

Health is a fundamental good, valuable not only for its own sake, but also for how it allows individuals to fulfil their expectations about their lives. Illness can have social and economic consequences, which can feed back into the mechanism of social stratification (mechanism I in figure 3). For example, loss of a limb may lead to extensive healthcare payments and also to lost income due to inability to work; these direct and indirect costs can have tremendous consequences in a family's budget. However, this impact depends on other determinants, such as how well off the family was before the health event or the social support that is available – such as universal healthcare or disability insurance. Depending on these, the consequences can be more or less grave, changing the likelihood of 'falling behind'.

The consequences of disease can also have an effect on an aggregate level, as high rates of illness can influence a country's social and economic development. An example of this is the impact of HIV in South Africa: in 2000, the World Bank projected that Gross Domestic Product (GDP) would be 17% lower in 2010 due to the high rates of the disease (159).

Policies aimed at reducing the social consequences of disease include those related to the provision of healthcare (including primary, secondary and tertiary), and those aimed at mitigating the economic consequences of disease, such as providing work opportunities, benefits or insurance to people who are ill. These policies, by providing healthcare and promoting reintegration in the workforce after a person falls ill, have the potential to break the cycle between SES and health.

b) Pathways Between Context and Health and its Distribution

Despite extensive evidence connecting multiple contextual characteristics with individual and population health, the pathways between the two have not been particularly explored (160). Macintyre et al. (14) called this the 'black box of places' (p. 131), an unknown influence that we can see but cannot explain.

The framework of the CSDH tries to fill this gap. According to this framework, context creates social stratification and distributes individuals through strata, which

have an impact on their health (13). In this view, context is composed of governance, policy (macroeconomic, social and health), and cultural and societal norms and values (figure 2) (12). This framework took some ideas from Diderichsen's framework, whose description of the pathways between context and health was more detailed. In fact, Diderichsen's framework can be approached from a perspective of the individual or of society (150). When viewed from the perspective of society, Diderichsen's framework identifies two processes through which society impacts health and HI: social stratification and policy entry-points.

In Diderichsen's words (28), '[the process of social stratification] both allocates power and wealth to social positions and allows individuals into different positions' (p. 21). Diderichsen argues that the process of social stratification is 'central' to the issue of HI, in so much as it helps us to distinguish between 'fair' and 'unfair' inequalities (i.e., inequalities versus inequities). The author argues that, once one understands the process of social stratification, one can judge it as to whether it is 'fair' or 'unfair'. As such, if power and wealth are distributed 'fairly' among social positions of a society and if individuals are 'fairly' allocated to those positions, HI stemming from that process can also be deemed 'fair' (i.e., not inequities[2]). It remains, nonetheless, that classifying something as 'fair' or 'unfair' is a normative exercise, and thus depends on views of justice.

Context can also influence health and health distribution to the extent that it creates informal and formal rules that influence health, such as policies. For example, universal access to health care can help equalize opportunities, as it helps individuals who have fallen ill to recover, re-enter the workforce and avoid a fall in social position. Informal rules can also have a health impact, such as when expectations about a neighbourhood allow it to maintain high levels of violence. Furthermore, these rules can impact different groups differently. This influence of context is acknowledged in Diderichsen's framework to a large extent through the policy 'entry points' he identifies (decreasing exposures, decreasing vulnerability and preventing unequal consequences). By identifying these entry-points, the author describes how

[2] The distinction between health inequities and inequalities is not universally accepted, but it is generally considered to be a question of whether a moral judgement is made or not: while inequality and equality are purely descriptive – simply describe a difference between two groups – inequity and equity encompass a moral view – not only there is a difference, but it is an unjust difference.

policies, by shaping the rules within a society, influence its health and health distribution.

In summary, according to Diderichsen's framework, context influences health and health distribution through two major mechanisms: social stratification and policy entry points. Social stratification operates through the creation of hierarchies in a society, whereas policy entry points influence the pathways between social position and health. However, as Whitehead, Burström and Diderichsen (150) point out, policy is only one component of social context that 'may have an influence on the pathways between social position and health' (p. 257). A comprehensive societal perspective needs to focus on how all contextual components – not just policy – influence health and its distribution.

It remains that, despite the general agreement that context influences health and HI, lack of understanding of the mechanisms by which this happens undermines the evidence that is produced (14, 160). This is further reinforced by the observation that various public health policies seem to have failed to reduce HI, even when this was their explicit goal (25, 161). This shows a need to systematize the mechanisms by which context influences health and HI, to better understand and study them and to design policies that are appropriate for their outlined goals.

1.2.5. Summary

The choice of health outcome, SES indicator, or measure for the analysis of HI, can reflect different research questions and different normative views, and can ultimately lead to different conclusions. Despite this, HI have been shown for a variety of health outcomes – from mortality, to morbidity, and health behaviours –, of SES indicators – both individual and contextual –, and using a variety of different measures.

The mechanisms that link individual SES to health outcomes can be described in light of Diderichsen's framework, which describes a pathway that starts in social stratification – the way that context determines individual social position. Social position then goes on to determine exposure to risk factors, vulnerability to those factors, and the consequences of health back on social position. Diderichsen summarises how context influences HI in two mechanisms: social stratification and policies. However, a comprehensive perspective on context must include other

contextual determinants (not just policies) and how they influence health and health distribution.

1.3. Health Inequalities in Europe and in Portugal

European countries have gone through extraordinary changes in the last decades. From the II World War onwards, economic growth and the development of welfare states have had a tremendous impact on population health. Life expectancy at birth in the WHO European region increased from 71 years in 1970 to almost 81 years in 2013 (162). However, HI do not seem to have reduced much in this period, and in some cases have even increased. For example, Mackenbach (78) showed that mortality differences between socioeconomic groups increased in many western EU countries between the 1980's and 90's.

This increase in HI in European countries, despite the extensive economic growth, increasing support from welfare states, overall health improvement, and apparent decrease in inequality of economic circumstances, has baffled many researchers. Interestingly too, despite the fact that some welfare states are considerably more generous than others, these do not seem to have been consistently more effective in reducing HI (161). The European experience over the last decades suggests that population health improvements are not, as some might think, necessarily associated with decreasing HI.

Mackenbach (161) suggests that three circumstances may help explain this 'paradox': (i) the persistence of substantial material inequalities, (ii) an effect of health selection due to increased social mobility, and (iii) increasing benefits of immaterial resources brought about by cultural capital. Far from concluding why HI remain an issue in European countries, Mackenbach sets a stepping stone from which it is possible to explore multiple theories and mechanisms.

Europe constitutes an interesting case study for HI. It provides a variety of contexts (different countries, different welfare states, different regions), with varying contextual determinants (historical, political, cultural), and a variety of outcomes (general improvements in population health but a wide variety of results regarding HI). This variety can provide extensive opportunities to explore how HI are shaped by contextual determinants.

1.3.1. Research Findings on Health Inequalities in Portugal

Portugal is a particularly interesting case study of HI. Despite massive investments in social protection, education and healthcare in the last decades (163, 164), it remains

one of the most unequal EU countries in terms of income distribution (165). This is reflected in its health distribution: several analyses from the 1990's and the 2000's that compare HI in European countries found Portugal to be the most unequal (51, 63, 102). Additionally, Portugal has gone through a period of economic crisis and of implementation of austerity measures since 2011 that have led to a deterioration of public social services (166). Despite being one of the more unequal countries in Europe – both in income (167) and in health distribution (51) –, political interest in HI in Portugal is scarce. To the best of my knowledge, the first publications on the topic date back to the mid-1980s with cross-sectional and frequently ecological analyses of associations, odds ratios (OR) and risk ratios of health outcomes related to occupation and education (168, 169). In the 1990s and especially in the early 2000s, these analyses grew in number, in variety of health outcomes, of SES measures, and in complexity of methods.

a) Health Outcomes

A number of health outcomes have been used to measure HI in Portugal. The first analyses, in the 1980's, focused on infant (168) and overall mortality (169) and showed occupational and educational gradients. Later, Pereira (170) used ecological data to calculate the Concentration Index (CIx) and showed significant pro-poor inequality in infant mortality for poorer districts in Portugal. Kunst et al. (76) further compared occupational inequalities in overall mortality among European countries in the 1980's and showed that Portugal occupied an intermediate level both for absolute and relative inequalities.

Some cause-specific mortality rates have shown a social gradient in Portugal too. Cavelaars et al. (79) showed high rate ratios for stroke mortality between manual and non-manual occupations for men in the 1980's and an opposite trend in ischemic heart disease mortality, which was more common in non-manual workers. Gotsens et al. (171), using ecological data, showed that the relative risk of mortality in men due to transport injuries, falls, homicides and all injuries was strongly associated with the deprivation index in parishes of the Lisbon metropolitan area. However, no association was found between deprivation and suicide, drug overdoses, or female mortality rates.

SAH has probably been the most used morbidity measure in HI research in Portugal. A comparison of 22 European countries in which the author used the RII to assess inequalities in SAH in a sample of Portuguese adult population showed that, among other European countries, Portugal had the highest inequality in SAH according to educational level (51). Several other morbidity outcomes have also been used, from general measures such as chronic illness (102), to specific diseases such as bronchitis, diabetes (172), pain (172, 173), cardiovascular diseases (174) and mental issues (173, 175). An extensive exploration of different health outcomes was done by Simões et al. (172), who calculated CIx for each according to household equivalent income and found pro-poor inequality for all of them, except for allergies.

Objective measures are rare, as most analyses are based on surveys, which typically collect only self-reported data. A noticeable exception is the work by Fraga et al. (176), who showed that inflammatory markers were strongly related to education and occupation. Also, Perelman (156) showed that there was a strong association between education and height, especially among men, and that it has remained stable among birth cohorts over the last century. On the other hand, insulin resistance was higher among schoolchildren whose parents had more education, when compared to lower educational levels (177).

Finally, some authors looked at differences of health behaviours and risk factors among socioeconomic groups, such as blood pressure (172, 174, 178), physical activity (172), drinking habits (178), obesity (51, 172, 174) and smoking (51, 172, 179). Noticeably, all these showed important inequalities unfavourable towards the poor or less educated, except for smoking. Up until 2015, most analyses showed higher prevalence of smoking in Portugal among more advantaged socioeconomic groups; using data from the National Health Survey of 2005/06. Alves, Kunst and Perelman showed that this tendency has inverted for men, but remained the same for women (179). This is similar to what has happened among other countries, where smoking inequalities also shifted from being pro-rich to pro-poor (180).

b) Socioeconomic Determinants

Research in Portugal has used most SES determinants to explore HI. Education has probably been the most frequently studied determinant. One of the first analyses of the Portuguese population showed a clear gradient in child mortality between 1980

and 85 defined by maternal education (168). More recently, educational inequalities favouring the more educated have been found in morbidity (such as inflammatory markers (180), obesity and metabolic syndrome (181-183), SAH (51, 102, 184), limiting long-standing illness (102), cognitive impairment (185) and cardiovascular risk factors (186-188)), and in health behaviours (such as breastfeeding (189), physical activity (190, 191) and diet (192)). Interestingly, some health outcomes showed the opposite association with education. Examples include insulin resistance in schoolchildren, which was more common in children with more educated parents (177) and smoking, which has shown different patterns depending on gender and age group (193). Financial resources have not been so extensively studied, and have shown more contradictory results, but income has been linked to SAH (51, 194), cardiovascular disease and risk factors (188, 195) and dietary patterns (196). Occupation has also been linked to a number of health outcomes, most noticeable with mortality (197), inflammatory markers (176), cardiovascular risk factors (186) and diet (198).

A few studies explicitly sought to compare SES determinants among them, in order to establish which was more important for HI in Portugal. Simões et al. (173) used a health index that included five dimensions (mobility, self-care, usual activities, pain/discomfort and anxiety/depression) to define people as 'rich' or 'poor' in terms of health. The authors calculated the probability of being 'health poor' associated with different SES measures simultaneously. Education had the highest impact, with a decrease in 'health poverty' of around 41% for individuals with tertiary education when compared with no education. A household monthly income above 1200 €, on the other hand, was related to a decrease in health poverty of around 20% (173). Analysing determinants separately, Huisman et al. (55) also found a stronger impact of education than net household income on the likelihood of smoking among Portuguese men (OR 1.90 versus 1.33). Among women, the effect occurred in the opposite direction (more educated or richer women smoked more), and the protective effect of lower education was stronger (OR 0.37 versus 0.51) (55). On the other hand, both Veiga (194) and Van Doorslaer and Koolman (63) used the CIx and its decomposition to find that income had a significantly *higher* contribution to HI than education.

Regarding rank measures, one paper analysed the association between subjective social status and mental disorders. In a comparative analysis of 18 countries, Scott et al. (199) showed that being on the low (scores of 1 to 3 on the subjective social status scale) and medium-low (scores 4 to 5) groups of this scale significantly increased the odds of mental disorders in the last 12 months among Portuguese subjects in 2.4 and 2.1, respectively, when compared to high scoring groups (scores 8 to 10).

c) Inequality Measures

In epidemiology and public health, HI have traditionally been measured using relative risks and OR, whereas among the economic literature methods based on the CC are more common. Literature on HI in Portugal has been vastly dominated by OR, risk ratios and the CIx. An exception was the analysis of smoking inequalities between 1987 and 2006 by Alves et al. (179), who used OR, CIx, and RII. This homogeneity may be a consequence of the little amount of research done in Portugal up to date.

1.3.2. Portugal Compared to Other European Countries

In 2011, Portugal was one of the most unequal countries in the EU in terms of household income distribution, with the continent's second highest Gini coefficient (200). Not surprisingly, comparative analyses have shown that Portugal is also one of the European countries with highest HI (51). In one of these analyses, Mackenbach et al. (51) used the RII to show that the highest educational inequalities in SAH in Europe are in Portugal. Eikemo et al. (102) also showed that Portugal had the highest OR in educational related inequalities in limiting longstanding illness. Finally, Van Doorslaer and Koolman (63) found that Portugal had the highest income related inequalities in SAH.

Adding to this, in the last decade, Portugal has gone through a period of economic crisis and of implementation of austerity measures that have changed the extent of social support provided to the population. Not many analyses have been done on the effect of crises and austerity measures on HI. However, one review suggested that most research results point to a worsening of HI during these periods (120), which might mean that HI in Portugal have also increased in the past decade.

Despite faring worse than most other European countries in terms of HI, Portugal seems to lag behind in academic and political attention to the issue. Pereira and Furtado (201) notice that despite equality being one of the foundations on the

Portuguese constitution, interest in health equity has been limited. A WHO report on the Portuguese National Health Plan argued that HI were an 'important policy gap' in this plan (202). In an interesting analysis of this seeming lack of interest, Bago d'Uva argues that it is the absence of explicit and effective policies to tackle HI that allows them to remain so prevalent (203).

1.3.3. Summary

Despite considerable improvements in overall health and in social support in European countries, HI remain high, in some cases even increasing in the last years. This has been called a 'paradox', as HI remain an important public health challenge in the continent.

Portugal is a particularly interesting case study of HI, as it is one of the most unequal European countries, both in terms of income and health distribution. Current evidence suggests the existence of significant pro-poor inequality in most health outcomes and for most socioeconomic determinants, with a few noticeable exceptions, such as allergies and smoking. On top of this, Portugal has gone through important changes in the last decade, namely with the implementation of austerity measures that seem to have had an impact on the provision of social services, thus potentially increasing HI. Despite this, political attention to the issue in Portugal is still very limited, which may be exactly why HI remain so high.

1.4. Objectives

The overall aim of this dissertation is to contribute to the understanding of how characteristics of the context can have an impact on population health and health distribution, using Portugal and Europe as case studies.

To accomplish this aim, the following objectives were pursued:

- To analyse and interpret how changes in individual and contextual social capital, and the interaction between the two, were associated with changes in SAH in European countries between 2002 and 2012.
- To analyse and interpret how the relationship between social mobility and HI varied between six welfare regime types in European countries between 2002 and 2012.
- To collect, summarise, describe, and interpret available evidence about socioeconomic HI in Portugal.
- To outline how social inequalities in health limitations changed in Portugal between 2004 and 2014, considering different measures of social status, and interpret the results in the light of macroeconomic changes in the country in that period.
- Drawing on the findings from the previous analyses, to outline a theoretical framework that summarises how context influences population health and health distribution.

1.5. Methodological Approaches

This research used secondary data collected between 2002 and 2014 in European countries. According to the rules and regulations of the Ethical Council of the Institute of Hygiene and Tropical Medicine of the Nova University of Lisbon, this research did not require ethical approval from the Council (204).

1.5.1. Data Sources

This work was based on data from two main databases: the European Social Survey (ESS) and the European Union Survey on Income and Living Conditions (EU-SILC).

a) European Social Survey

The ESS is a repeated cross-sectional survey that collects data on attitudes, beliefs and behaviour patterns (205). The survey is applied every two years in more than thirty European countries since 2002. Countries are free to participate or not every year the survey is performed. The survey is jointly funded by the EU and each participating country (206). Data is made freely available online for researchers, upon a simple registration process on the website (207).

ESS aims to achieve a representative sample on each country of persons over 15 years old living in private households. Each country is given the freedom to choose their preferred sampling design, considering costs, experience and other country specific factors. However, a few requirements are applied to every country to ensure comparability of the samples, such as the use of strict random probability methods at every stage, a high response rate (minimum 70%), a full coverage of the population, and a minimum effective sample size (n=1,500 or n=800 in countries where the population is smaller than 2 million) (208).

The ESS questionnaire consists of a core section and a rotating section. The core module fulfils ESS's primary role, of monitoring change in values and attitudes in Europe through time. The rotating modules are selected based on a call for proposals made in the Official Journal of the EU. In 2014, the rotating modules were on 'Social inequalities in health and their determinants' and on 'attitudes towards immigration and their antecedents' (209). The ESS core questionnaire includes two health related questions: SAH ('How is your health in general?') and hampered in daily activities

('Are you hampered in your daily activities in any way by any longstanding illness, or disability, infirmity or mental health problem? If yes, is that a lot or to some extent?').

ESS results have been widely used in academic research and in policy documents. The ESS bibliography includes hundreds of publications that show the range of use this survey has had (210), including not only analyses of survey results, but also broad discussions on survey methodology.

b) European Union Survey on Income and Living Conditions

EU-SILC is an annual survey carried out in several European countries with a mixed longitudinal and cross-sectional design. The survey is regulated by EU law as a way of compiling comparable data on income, poverty and social exclusion within the union, using harmonized methods and definitions (211). As such, every EU country is expected to participate, by setting up its own data collection or using existing surveys that comply with EU-SILC requirements. The EU funds the first four years of data collection for each member state. Data is made available for scientific purposes given the researchers' compliance with a number of privacy requirements. To access this data, authorisation was sought from and provided by Eurostat's Microdata Access Team.

The survey's longitudinal component follows a simple rotational design: in year one, a cross-sectional sample is selected; this sample is divided in four sub-samples, each itself representative of the population. In year two, one sub-sample is dropped, the other three are followed up, and one new sub-sample is added. As such, except for the three first sub-samples, every sub-sample is requested to be part of the survey for four consecutive years. In any one particular year, the overall sample made up of four sub-samples, which make up the cross-sectional sample (212).

EU-SILC aims to interview a representative sample of people aged 16 or over living in a private household. Sample size depends on country size; for example, minimum effective sample size for the cross-sectional sample in Portugal is 10,500 and 7,500 for the longitudinal component. This adds up to a minimum sample size of 166,000 per year in the cross-sectional sample, when all countries are combined (211). Just like the ESS, sampling procedures can be defined within each country, as long as they follow certain requirements that make the samples comparable, such as the use of probability sampling and of households as the basic unit of sampling (213).

Most of the EU-SILC questionnaire concerns living conditions, poverty, and income. Three health related questions are included:

- SAH: 'How is your health in general?' allowing following answers:
  - Very good / Good / Fair / Bad / Very bad / Don't know / *Refusal to answer*
- Chronic conditions: 'Do you have any long-standing illness or health problem?' allowing following answers:
  - Yes / No / Don't know / *Refusal to answer*
- Limitations by health conditions: 'For at least the past six months, to what extent have you been limited because of a health problem in activities people usually do?' allowing following answers:
  - Severely limited / Limited but not severely / Not limited at all / Don't know / *Refusal to answer*

Eurostat uses this last variable – limitations by health conditions – as a measure of disabilities (212).

EU-SILC results are a fundamental source of data for the work of the European Commission. They have been extensively used in the production of books, scientific publications, political statements, and statistical working papers, among others (214).

1.5.2. Methods

a) Systematic Review of the Literature

A systematic review (SR) can be defined as a 'review of the scientific evidence which applies strategies that limit bias in the assembly, critical appraisal, and synthesis of all relevant studies on the specific topic' (33: p.276). SR are important given the outstanding number of scientific publications and the amount of existing evidence, sometimes contradictory, on a particular topic (215). Thus, the value of SR has long been established, especially for clinical practice, as they provide quick and easy access to a summary of the available evidence to busy clinicians (216).

Public health interventions are usually more complex than the traditional randomized clinical trial. They can act on different levels simultaneously – directly with the individual or on a broader, contextual level – and through multiple mechanisms. Sometimes, randomized interventions are not feasible for practical or ethical reasons.

This means that the traditional methodological guidance for SR can be insufficient to face this complexity (215), and public health researchers have to be creative when doing a SR. This includes resorting to alternative study designs, such as qualitative or observational studies (217). This presents its own issues, as observational studies can find spurious associations, and, in this situation, the exploration of heterogeneity might yield better insights than attempts to look for an overall measure of effect (218).

To help overcome limitations associated with SR, the PRISMA guidelines systematise overarching principles that should be applied (PRISMA stands for Preferred Reporting Items for Systematic Reviews and Meta-Analyses). These guidelines (216) consist of a 27-item checklist and a flow diagram outlined by experts and, as much as possible, based on available evidence, that aim to 'improve the reporting of SR and meta-analysis' (p. 2). The proposed diagram (figure 4) suggests that all steps that lead to the inclusion of a certain number of studies should be recorded and explained in detail, including sources and reasons for exclusion. The 27-item checklist includes guidance on all elements of the SR, from the title, abstract, introduction, methods, results, discussion and funding.

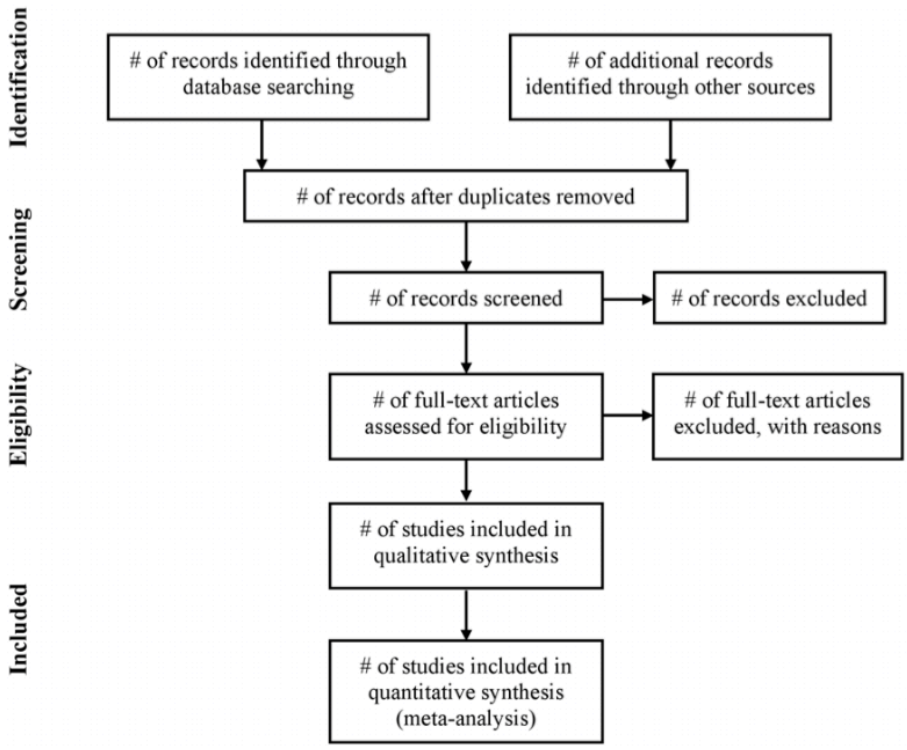

Figure 4. Flow of information through the phases of a systematic review proposed by the PRISMA statement. Source: Moher D et al. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. BMJ 2009;339(7716):332.

b) Statistical Methods

i. Logistic Regression

Regression analyses are an important part of research in HI. Binary logistic regression analyses are a particular type of regression analyses that concern themselves with binary outcomes, i.e., when the health variable only takes two distinct values. Although the general principles of the logistic regression are similar to those of the linear regression, there are differences in the form of the model and its assumptions (219). The goal of any regression analysis is to find the best fitting, most parsimonious, and interpretable model of a relationship between a set of explanatory variables and an outcome variable (219). Once fitted, the selected model yields an estimate for each coefficient for each of the independent variables included. This coefficient can be interpreted as a rate of change – of 'a function of the dependent variable per unit of change in the independent variable' (220: p.49), holding all other independent variables constant. In practice, the coefficient is the difference between the *log* of the odds for two different values of the independent variable.

In the analysis of HI, the independent variables are usually the SES variables of interest, such as income or education. Changes in the scales of the log-odds are not easy to interpret; however, logistic regression coefficients can be easily converted to OR. These, on the other hand, are easily interpreted as the ratio of the odds of the outcome variable between two groups defined by the independent variable (220). For example, if the health outcome is mortality (y=1 for death, y=0 for survival), and education is the independent variable (x=0 for less than high education, x=1 for high education), an OR=2 means that the odds of dying among the less educated are two times higher than the odds of dying among the more educated. This is also applicable for continuous independent variables, considering a 1-unit or an x-unit increase (220). Using the same example, but if instead of education we use income, an OR=2 may mean that for every increase in unit of income (1 €, 1.000 £, 100 $, depending on the scale used), the odd of death decrease by half.

ii. Multilevel Models

Ecological variables have been dismissed by epidemiology for a long time, particularly since the identification of the ecologic fallacy, which states that individual relationships cannot be inferred from ecologic relationships (15).

Conversely, in the other extreme, completely ignoring the effects of contextual characteristics can lead to the individualistic (or atomistic) fallacy – 'an erroneous inference about causal relationships in groups of people made on the basis of relationships observed in individuals' (33: p. 11). To answer this need, statistical methods must include both individual and group level characteristics, i.e., they must be multilevel. Multilevel methods are regression-based models that take into account the hierarchical structure of the data, for example, at the individual and neighbourhood level.

The concept of health determinants as both individual and contextual naturally leads to a multilevel perspective. Several other reasons also warrant the use of multilevel analyses when studying SDH. First, multilevel models allow for the simultaneous estimation of regression coefficients of variables at multiple levels. This is essential, as the result of a single level analysis might in fact be an artefact, reflecting a relationship that truly only exists at a different level (18). Second, they can disentangle complex questions of contextual and individual heterogeneity. While contexts can have an overall effect on population health, they might do so by affecting only a particular group (contextual heterogeneity); on the other hand, the variability of a health outcome within a context may be very different among different groups (individual heterogeneity). Third, multilevel models allow for the analysis of interactions between variables at different levels (individual-contextual interactions). These are important as the same context may sometimes have opposite health effects on different groups (221). Fourth, they can sequentially include multiple levels of hierarchical clustering, from individual, to households, communities, and regions, for example (222). They also allow for more complex data structures, such as cross-classified and multiple membership, which allow individuals to be assigned to multiple groups simultaneously (223). Finally, multilevel models can also take into account the time dimension, such as when observations are nested within time variables (such as year), which are then nested within region, for example (18).

iii. Concentration Index

The CIx is a measure of HI based on the CC. The CC is the result of plotting the cumulative percentage of individuals, ranked by income, with the cumulative percentage of the health variable. Figure 5 shows a hypothetical example of a CC. In plotting a CC, perfect equality is represented by a diagonal line, showing a perfectly

equal distribution of health among the sample population, regardless of income. The CIx is calculated as twice the area between the CC and the line of perfect equality. When there is no inequality, health is distributed equally within the population, the CC coincides with the diagonal and the CIx is zero. In the other extreme, if health is concentrated in one person, the CC is shaped like an inverted 'L', and the CIx is 1 (or -1).

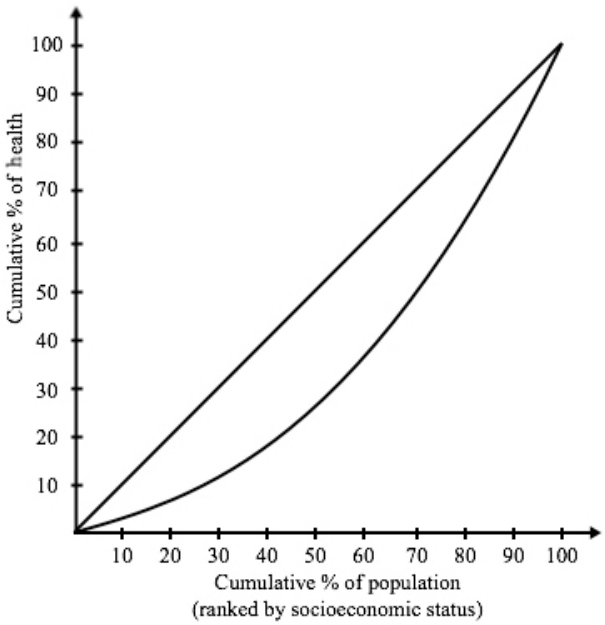

Figure 5. Hypothetical concentration curve. The x-axis represents the cumulative proportion of the population, ranked from poorest to richest. The y-axis represents the cumulative proportion of the health variable. In this example, health is disproportionately concentrated among the richest, as, for example, the poorest half of the population only have about 25% of the health variable. Source: author's own elaboration.

In the particular case of binary health outcomes, the CIx is not limited by the (-1,1) range, but depends on the mean of the outcome variable in the population. As this limits comparability between different populations (across time or between areas, for example), Wagstaff (2005) proposed a 'normalisation' of the CIx, by which it is divided by 1 minus the mean, making it comparable (224).

Wagstaff, van Doorslaer, and Watanabe (2003) have shown that the CIx can be decomposed into the contributions of individual factors to the income-related HI (225). These factors are usually demographic variables, such as age and sex, or other SES, such as education or occupation. The contribution of each factor depends on two characteristics: the elasticity of that factor with respect to the health variable, and the

degree of income-related inequality of that factor (i.e., the CIx of that factor). The contribution of each factor to the overall CIx is the product of the health elasticity and the CIx of that factor.

1.5.3. Summary

The existence of a social gradient in health shows how health is not determined only by individual SES, but depends on the context the person is in. This conceptual approach cannot be explored using only traditional statistical methods, but needs more advanced statistical models to consider the complexity and different dimensions. Multilevel analysis allows for the description of both individual and contextual characteristics and for the quantification of their impact on health. While not excluding other statistical methods, such as simple regression analyses and methods based on the CC, multilevel models can better reflect the hierarchical nature of health determinants.

The CIx, on the other hand, allows for a different analysis of HI. While not including contextual determinants, it reflects the overall experience of the population.

This research used two regression-based methods: single level and multilevel logistic regressions. It was also used measures based on the CC, namely the CIx and its decomposition. Furthermore, a SR of the literature was performed, following the PRISMA guidelines.

1.6. Introduction References

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2. Results

2.1. The 'dark side' of social capital: trust and self-rated health in European countries

Reference:

Campos-Matos I, Subramanian SV, Kawachi I. The 'dark side' of social capital: trust and self-rated health in European countries. *European Journal of Public Health*. 2016;26(1):90-95. DOI: http://dx.doi.org/10.1093/eurpub/ckv089

Online supplementary data for this publication is in Appendix 2.

The European Journal of Public Health Advance Access published May 27, 2015
European Journal of Public Health, 1–6

doi:10.1093/eurpub/ckv089

The 'dark side' of social capital: trust and self-rated health in European countries

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Background: Generalized interpersonal trust (as an indicator of social capital) has been linked to health status at both the individual and ecological level. We sought to examine how changes in contextual and individual trust are associated with changes in self-rated health in the European Social Surveys 2002–12. Methods: A multilevel analysis using a variance components model was performed on 203 452 individuals nested within 145 country cohorts covering 35 countries. Conditional on sociodemographic covariates, we sought to examine the association between self-rated health and individual trust, country average trust and a cross-level interaction between the two. Results: Although individual trust perceptions were significantly correlated with self-rated health [OR = 0.95, 95% confidence interval (0.94–0.96)], country-level trust was not associated [OR = 1.12, 95% confidence interval (0.95–1.32)]. There was, however, a strong crosslevel interaction between contextual and individual trust ($P < 0.001$), such that individuals with high interpersonal trust reported better health in contexts in which other individuals expressed high average interpersonal trust. Conversely, low trust individuals reported worse health in high trust contexts. Conclusion: Our findings suggest that contexts with increasing average trust can be harmful for low trust individuals, which might reflect the negative impact that social capital can have in certain groups. These findings suggest that contextual trust has a complex role in explaining health inequalities and individual self-rated health.

Introduction

Health status is robustly associated with individual socioeconomic status such as education, income and occupation. Beyond socioeconomic status, research has increasingly sought to demonstrate the influence of contextual influences on health and health inequalities.[1,2]

Generalized interpersonal trust as a potential determinant of health has received attention from the growing literature on social capital. 'Social capital' has been defined as resources that are accessed by individuals and groups through their social network connections.[3] Rostila,[4] building on diverse theories of social capital, defines it as 'the social resources that evolve in accessible social networks or social structures characterized by mutual trust'. These resources might include the exchange of information, instrumental assistance and affective support, and trust is a critical element that lubricates these exchanges. For example, trust facilitates the exchange of health related information, such that a trusting individual might learn about how to schedule an appointment with a doctor or where to buy the best vegetables by asking her neighbours. On a community level, interpersonal trust can facilitate collective social action, so that groups of people might unite to gather money for a charity that tackles social issues, for example.

Importantly, Rostila[4] points out that social capital can have negative consequences within closed networks. This can happen for various reasons, such as imposing pressure to engage in risky behaviour, exchanging wrong information or excluding other members, impeding them from accessing the network's social capital.

Generalized trust can thus impact health in several different ways, both at an individual and a community level. Using multilevel analysis, Snelgrove et al.[5] looked at British panel data and found that being a high trust individual lead to 20% lower odds of reporting poor self-rated health and living in a high trust area reduced these odds by almost 20%. Two other studies additionally described a cross-level interaction between contextual and individual trust, one in the United States[6] and the other from a European context.[7] In both cases, high levels of contextual trust benefited the health of individuals who had high trust scores, while not affecting or even harming those with low individual trust perceptions.

This study sought to describe how changes in trust are associated with changes in self-rated health in countries that participated in the European Social Survey (ESS) between 2002 and 2012.[8] We sought to broaden the existing European evidence, exploring how trust and health are related after controlling for unobserved confounders and secular trends, particularly on (i) the influence of individual perceptions of trust on health, taking into account individual sociodemographic characteristics; (ii) the influence of country average trust on individual health, while considering individual perceptions and (iii) the extent to which a cross-level interaction exists between individual and contextual trust.

Methods

Data sources and variables

The ESS is a survey in European Union (EU) and non-EU countries, performed in even years since 2002, which seeks to capture comparable data on attitudes, beliefs and behaviours on representative samples of participating countries. Countries are free to participate or not every year the survey is performed. The survey is funded by the EU and each participating country.[8] Data were collected from the six ESS rounds between 2002 and 2012 on all 35 participating countries.

The outcome measure, self-rated health, was assessed from the answer to the question 'How is your health in general?', which ranged from 'very good', 'good', 'fair', 'bad' to 'very bad'. This variable was dichotomized, where 1 signified 'bad' or 'very bad'.

The individual level explanatory variable, generalized trust, was measured as a continuous variable, by the response to the question

'Would you say that most people can be trusted, or that you can't be too careful in dealing with people?', in which 0 meant 'you can't be too careful' and 10 'most people can be trusted'. Contextual trust measured the average individual responses to the generalized trust question and was specific to each country in each year. This variable was also treated as continuous and centred around its grand mean.

Other individual-level covariates included age, gender, marital status, education, main activity and belonging to a minority ethnic group (according to the respondent's perception). Income level was measured by the perception of 'living comfortably', 'coping', 'finding it difficult' or 'finding it very difficult' on present household income. Disability was measured by the response to the question 'Are you hampered in your daily activities in any way by any longstanding illness, or disability, infirmity or mental health problem?'. Finally, occupation was classified into four groups based on the International Standard Classification of Occupations' major unit groups, viz. (i) managers, professionals, technicians, clerks and service workers (including military personnel); (ii) skilled agricultural, fishery, forestry and craft workers; (iii) plant and machine operators, assemblers and elementary occupations and (iv) not applicable.

All individual variables were categorical, for which a base category with contrasting indicator variables were specified, except age and trust, which were centred around their grand mean in order to have more easily interpretable coefficients.

Statistical analysis

Data were analyzed considering its structure in two levels: individual ($n = 203\,452$) and country cohort ($n = 145$); i.e. each level 2 observation was a specific country in a specific year (such as 'Portugal, 2002', 'Estonia, 2006' or 'Estonia, 2008'). Countries and years were additionally included as fixed effects. This two-level structure was chosen after considering data structure and the goals of the analysis.

Multilevel statistical techniques are unique in that they allow for the analysis of the effect of individual and contextual characteristics on an outcome and are necessary when exploring community effects. Furthermore, multilevel analysis allows the modelling of heterogeneity at each level of analysis and the exploration of cross-level interactions.[9]

In this analysis, individuals were aggregated within their country in a specific year, and countries and years were included in the model as fixed effect variables. Holding countries constant allowed the model to control for unknown time-invariant country characteristics that might affect self-rated health. This is particularly relevant given potential cultural variations in the assessment of self-rated health.[10] The contextual predictor variable (country mean trust) is time variant, therefore requiring also the inclusion of time as a level.[11] Simultaneously, adding years as a fixed effect allowed for the control of secular trends in the explanatory variables.

Given that self-rated health is a binary variable, a multilevel logistic model based on a logit-link function was used. MLwiN program version 2.28[12] was used to fit the models, using a second order predictive quasi likelihood estimation procedure.[13]

Five models were sequentially fitted. Model 1 is a two-level, variance components 'empty' model with individuals (level 1) nested within country cohort (level 2) with no predictor variables. Model 2 adds all individual-level predictor variables, except trust. Model 3 adds individual trust and model 4 adds contextual trust, allowing for the assessment of the comparative importance of individual and contextual trust on self-rated health. Finally, model 5 adds a cross-level interaction between individual and contextual trust. The median odds ratio (MOR), a measure of residual heterogeneity between country cohorts, was calculated for each model.[14]

As a sensitivity analysis, the same models were run using different estimation procedures. Different model structures were also attempted. Country-year-specific variables that might influence the relationship between trust and health {GDP per capita [retrieved from the World Bank (WB) database], Gini coefficient [Eurostat, WB and OECD], poverty rate [Eurostat], unemployment rate [International Labour Organization (ILO)] and government social spending (Eurostat and ILO)} were added to check for any possible confounding effect.

Results

Table 1 lists the descriptive statistics of the variables after excluding cases with missing data. All 35 countries participating in ESS were used, representing a total of 145 country-years. Some countries only participated 1 year, whereas others participated in all six. The number of respondents for each country-year ranged from 395 (Iceland, 2004) to 2316 (Germany, 2010), yielding a total of 203 452 individuals.

At the individual level, trust was found to have a non-linear relationship with the probability of 'bad' or 'very bad' health, such that this probability was highest for individuals with low trust perceptions, decreased steadily until 7 and then increased again. Trust was, therefore, included in the models with a quadratic term.

Table 2 presents the multilevel analytical models (country and year fixed effect parameters were excluded from this table and listed in the Supplementary Material). From model 1, we find that 5.4% of respondents reported 'bad' or 'very bad' health.

Model 2 includes all individual characteristics except trust. It shows that, as expected, age was positively associated with worse health, as was being female (OR = 1.20) or part of a minority group (OR = 1.14). The strongest effect on self-rated health was found for individuals who reported being hampered in their daily activities (OR = 22.94). Being divorced or separated increased the odds of worse health when compared with being married (OR = 1.20); being single or widowed, however, did not have an impact. People enrolled in full time education reported better self-rated health, followed by those who worked; having no activity was associated with worse health (OR = 2.39). Not having completed higher education also increased the odds of worse health (OR = 1.15). There was an association between higher skilled jobs and better health. Finally, we found a clear gradient between respondents who were 'living comfortably' versus those who found it 'very difficult' on present income (OR = 3.37).

Level 2 variance in the null model (model 1) was high ($\sigma^2_{u_0} = 0.251$) and strongly suggested differences between countries and years ($P < 0.01$). In fact, the MOR of this variance was 1.61, suggesting that, in median, an individual had a 61% increase in the odds of reporting bad or very bad health when moving to another country with higher risk. However, most of the variance was explained by compositional characteristics and by including countries and years as fixed effects, as can be seen by the drastic decrease from model 1 to model 2 ($\sigma^2_{u_0} = 0.006$). Accordingly, the MOR decreased to 1.08 and the amount of level 2 variance in model 2 is unlikely to be different from zero ($P = 0.052$).

Model 3 added individual trust with a simple and a quadratic term. This yielded a strong association, consistent with the initial analysis of the data, which showed highest probability of 'bad' or 'very bad' health for lowest individual trust scores decreasing steadily and then increasing slightly for higher trust scores. Contextual trust, added on model 4, had no effect on health ($P = 0.19$) when accounting for individual trust (which remained strongly associated to health).

Finally, model 5 included a cross-level interaction between contextual and individual trust (its main component, since the quadratic term had a very small effect), which was statistically different from zero ($P < 0.001$). Figure 1 plots the prediction lines of 3 hypothetical individuals, each with a different trust score (0, 5 and 10 for low, medium and high trust, respectively) and how their probability of 'bad' or 'very bad' self-rated health is affected by the context they live in. For high trust individuals, high average country

Table 1 Data description

Response: self-rated health		
'Bad' or 'Very Bad'	$n = 11\,559$ (5.7%)	
Level 1, individuals, $n = 203\,452$		
Age (years)	mean = 40.7, range from 15 to 64	
Gender	(ref) Male: $n = 95\,246$, 46.8%	Female: $n = 108\,206$, 53.2%
Minority	(ref) No: $n = 190\,960$, 93.9%	Yes: $n = 12\,492$, 6.1%
Hampered in daily activities	(ref) No: $n = 164\,854$, 81.0%	Yes: $n = 38\,598$, 19.0%
Marital status	(ref) Married/civil union: $n = 109\,244$, 53.7%	Single: $n = 67\,266$, 33.1% Widow: $n = 6436$, 3.2% Separated/divorced: $n = 20\,506$, 10.1%
Activity	(ref) Work: $n = 144\,981$, 71.3%	No activity: $n = 35\,195$, 17.3% Education: $n = 20\,713$, 10.2% Other: $n = 2563$, 1.3%
Education	(ref) Tertiary: $n = 58\,360$, 28.7%	Non-tertiary: $n = 145\,092$, 71.3%
Occupation	(ref) Managers, professionals and services: $n = 121\,203$, 59.6%	Agricultural and craft: $n = 27\,968$, 13.7% Plant operators and elementary occupations: $n = 33\,963$, 16.7% Not applicable: $n = 20\,318$, 10.0%
Income	(ref) Living comfortably: $n = 56\,965$, 28.0%	Coping: $n = 89\,941$, 44.2% Difficult: $n = 40\,191$, 19.8% Very difficult: $n = 16\,355$, 8.0%
Trust	Mean = 4.9, SD = 2.5	
Level 2, country cohort, $n = 145$		
Trust	Mean = 4.9, range from 2.3 to 7.0	

'ref' is reference category.

trust appears to have a slight positive impact on health. Low trust individuals, on the other hand, appear to be harmed by increasing contextual trust: the higher the average country trust, the higher their probability of rating their health as bad or very bad. Medium trust individuals appear largely unaffected by the context.

Using different estimation procedures (first and second-order marginal quasi-likelihood, first-order predictive quasi-likelihood and Markov Chain Monte Carlo) yielded similar results. Different model structures were attempted (a three-level model with countries, years and individuals in each level; two two-level models with either countries or years as level 2 and individuals as level 1 and not including countries as fixed effects) and all resulted in a model indicating a strong cross-level interaction between individual and contextual trust and no main effect of contextual trust. None of the country measures that were postulated to confound the relationship between trust and health (GDP per capita, Gini coefficient, poverty rate, unemployment rate and government social spending) had a statistically significant effect at $P < 0.01$.

Discussion

This research aimed to analyze how changes in trust and are related to changes in self-rated health in European countries. The individual-level determinants of self-rated health substantially replicated previous reports, i.e. being female, older, part of a minority, hampered in daily activities, divorced, not having an activity, lower education and lower income were each associated with worse health.

The data also showed a strong (somewhat non-linear) relationship between individual generalized trust and health. Country average trust did not exert an effect on health, conditional on individual trust scores, which supports a compositional nature of this ecological relationship, described previously.[6,7,15] However, Kim et al.[16] found that country level trust did impact self rated health, even after controlling for instrumental variables, suggesting that 'the true sizes of the effects of country-level social capital on self-rated health may be grossly underestimated using conventional methods'. Additionally, this analysis was done in a broader group of countries, which might suggest low comparability of our results with other world regions. Snelgrove et al.[5] also found that postcode area average trust in Britain was associated with individual health, which might reflect that smaller area social capital might be more important for individual health, as opposed to country level. Nonetheless, we found a strong cross-level interaction between individual and country trust, such that low trust individuals seem to be harmed by increasingly high trust contexts.

This interaction effect is consistent with what has been reported in 2002 by Subramanian et al.[6] based on an analysis of the US Social Capital Community Benchmark Survey as well as an analysis in 2006 by Poortinga[7] in European countries. Both used multilevel techniques and while Poortinga found that high trust individuals benefited more from high trust contexts, Subramanian, Kim and Kawachi also found that low trust individuals were harmed by high trust contexts. Interestingly, our data showed that the effect is much more striking for low trust individuals and subtler for high trust ones. One major difference in our analysis was the inclusion of countries and years as fixed effects. The inclusion of countries as fixed effects controlled for unobserved time invariant country characteristics, which might be confounders of the trust–health relationship, such as cultural or social factors. The inclusion of years as fixed effects furthermore removes secular trends in the explanatory variables. The removal of these confounders helps establish that the trust–health relationship is unlikely to be a product of cultural characteristics or of particular moments in time, since a relationship remained even after controlling for unobserved country and time confounders.

Our findings imply that individual disposition to share knowledge and resources or engage in collective action is only beneficial if the individual is surrounded by people who share these dispositions. As Rocco and Suhrcke[17] note in another analysis of ESS data in EU countries, 'trusting others has a positive impact on health only if trust is reciprocal'. Although one might expect low trust individuals to benefit from living in a high trust context, we found the opposite. This is consistent with Putnam's[6,7,18] suggestion that low trust individuals may feel ostracized in communities in which they do not share the same values and dispositions. This topic is further explored by Rostila,[4] who delves into the consequences of network closure. Highly closed networks can limit the access of other community members to their social capital (such as when a high socioeconomic

Table 2 Multilevel analytical models (odds ratios and 95% confidence intervals)

	Model 1	Model 2	Model 3	Model 4	Model 5
Fixed parameters					
Constant	0.054 (0.050–0.059)	0.002 (0.001–0.002)	0.002 (0.001–0.002)	0.002 (0.001–0.003)	0.002 (0.001–0.003)
Individual variables					
Age (grand mean centred)		1.021 (1.019–1.023)	1.021 (1.019–1.023)	1.021 (1.019–1.023)	1.021 (1.019–1.023)
Gender (ref: male)		1.198 (1.141–1.259)	1.191 (1.134–1.251)	1.191 (1.134–1.251)	1.192 (1.135–1.252)
Ethnic minority (ref: no)		1.139 (1.045–1.241)	1.133 (1.040–1.235)	1.133 (1.040–1.235)	1.128 (1.034–1.229)
Hampered in daily activities (ref: no)		22.943 (21.675–24.285)	22.737 (21.481–24.067)	22.737 (21.481–24.067)	22.669 (21.417–23.995)
Marital status (ref: married)					
Separated/divorced		1.201 (1.126–1.281)	1.195 (1.120–1.275)	1.195 (1.120–1.275)	1.191 (1.117–1.271)
Widow		1.112 (1.016–1.217)	1.112 (1.016–1.217)	1.112 (1.016–1.217)	1.112 (1.016–1.217)
Single		1.057 (0.988–1.129)	1.062 (0.993–1.135)	1.062 (0.993–1.135)	1.060 (0.991–1.133)
Activity (ref: work)					
Education		0.824 (0.715–0.949)	0.848 (0.736–0.976)	0.848 (0.736–0.976)	0.850 (0.739–0.979)
No activity		2.394(2.280–2.514)	2.385 (2.271–2.504)	2.385 (2.271–2.504)	2.377 (2.264–2.497)
Other		1.707 (1.429–2.041)	1.706 (1.427–2.039)	1.706 (1.427–2.039)	1.701 (1.420–2.037)
Education (ref: tertiary)		1.153 (1.083–1.227)	1.124 (1.056–1.197)	1.124 (1.056–1.197)	1.120 (1.052–1.192)
Occupation (ref: managers–prof. and services)					
Agricultural and craft		1.178 (1.100–1.262)	1.164 (1.087–1.247)	1.165 (1.089–1.248)	1.164 (1.087–1.247)
Plant operators and elementary occupations		1.326 (1.250–1.406)	1.300 (1.225–1.378)	1.300 (1.225–1.378)	1.298 (1.224–1.377)
Not applicable		1.446 (1.316–1.589)	1.438 (1.309–1.580)	1.436 (1.307–1.578)	1.431 (1.302–1.572)
Income (ref: living comfortably)					
Coping		1.335 (1.239–1.438)	1.314 (1.220–1.416)	1.314 (1.220–1.416)	1.303 (1.210–1.404)
Difficult		2.221 (2.050–2.407)	2.132 (1.967–2.310)	2.134 (1.969–2.313)	2.117 (1.954–2.294)
Very difficult		3.373 (3.083–3.692)	3.152 (2.875–3.456)	3.158 (2.880–3.463)	3.133 (2.857–3.435)
Individual trust (grand mean centred)			0.947 (0.937–0.956)	0.947 (0.937–0.956)	0.944 (0.934–0.953)
Trust 2			1.008 (1.004–1.012)	1.008 (1.004–1.012)	1.010 (1.006–1.014)
Contextual variables (grand mean centred)					
Trust				1.117 (0.948–1.317)	1.083 (0.919–1.277)
Cross level interaction					
Trust (level 2) * trust (level 1)					0.976 (0.967–0.986)
Random parameters					
Level 2 variance ($\sigma^2_{u_0}$)	0.251 (0.032)	0.006 (0.003)	0.006 (0.003)	0.005 (0.003)	0.005 (0.003)
Variance measures					
MOR	1.613	1.077	1.077	1.070	1.070

'ref' is reference category. MOR is Median Odds Ratio. For level 2, variance–standard errors are in parenthesis.

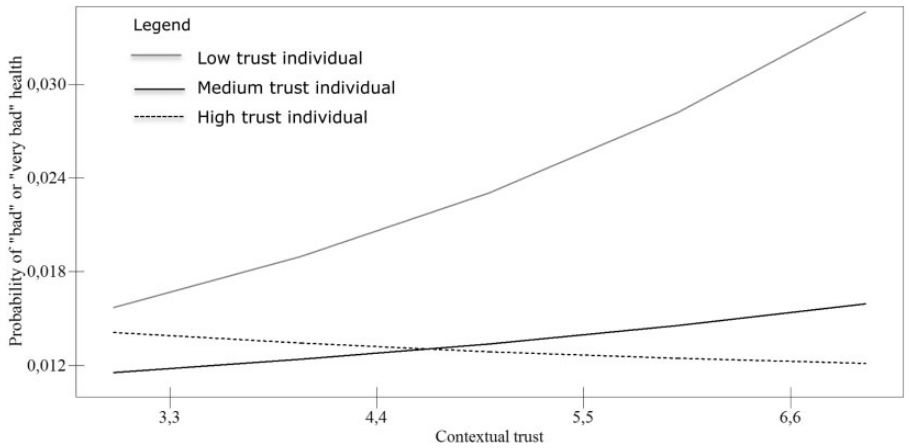

Figure 1 Predictions of the effect of country average trust on health for low, medium and high trust individuals.

group discriminates against disadvantaged people). A closed network might also harm itself by sharing 'bad social capital' (such as adverse information) or by submitting its members to negative norms. In the light of this, our findings suggest that low (high) trust people in high (low) trust contexts might create highly closed networks that harm its own members. Furthermore, high (low) trust individuals in high (low) trust contexts might also harm members of other networks by discriminating against those who do not share their values. These two possibilities help explain why low trust individuals seem to be harmed by high trust contexts and high trust individuals by low trust contexts.

Additionally, former research suggests that comprehensive welfare states tend to stimulate the creation and maintenance of social capital, given that these show higher levels of social contacts, trust and resources.[19] Under this light, our results suggest that comprehensive welfare states can positively impact general population health but simultaneously harm low trust individuals, creating important health inequalities. Understanding the mechanism by which this occurs is essential to suggest policies to mitigate these inequalities.

Some features of this study limit the interpretation of its results. Regarding the variables used, it is wise to be cautious with cross-country comparisons of subjective measures such as self-rated health and interpersonal trust, since different countries might give different meanings to each question. This issue was partially addressed by the use of countries as fixed effects, which removed from the models time-invariant unknown characteristics that contribute to this cross-country variability. Even though self-rated health has been shown to be a reliable measure of overall health,[20] it is still a subjective measure that depends on multiple individual factors. Additionally, the choice to include the category 'fair' with 'bad' and 'very bad' health has varied between authors. We have followed previous practice by excluding it,[21–23] thereby measuring 'poor health', as opposed to 'not good health'. Although this might make the results not comparable to some studies, we believe it does not preclude comparability, since it is unlikely to substantially alter the results and conclusions.

Another source of limitations is the data source. The ESS is a cross-sectional survey, which impedes the assumption of causality between trust and health. However, other studies have shown that there is strong evidence of a causal link between interpersonal trust and health.[5,24] Also, ESS nonresponse rate is often higher than its 30% target and highly variable between countries.[25] One can easily imagine that low trust individuals are more likely to be non-respondents, which introduces an important bias. It is important to note, therefore, that there might be lack of data on low trust individuals and average country trust might be overestimated.

Finally, different countries contributed differently to this analysis (some only participated in one wave while others participated in six). This might bias the data if countries that choose to participate more often are equipped with similar levels of social capital. However, as a considerable variety of different countries participated, we do not believe this will have a significant effect on the overall results and conclusions.

Overall, these results reinforce the complex relationship between individual and societal trust and health in European countries. Importantly, they illustrate that contexts influence different people in different ways and can even be harmful to low trust individuals, who might not benefit from other networks' social capital or produce 'bad' social capital themselves. A focus on disentangling this mechanism would be important to better plan effective interventions to reduce health inequalities.

Supplementary data

Supplementary data are available at *EURPUB* online.

Acknowledgements

We would like to acknowledge the helpful remarks given by Guy Harling in an initial draft of this article.

Funding

I.C.M. was supported by a Fulbright grant for Public Health research, awarded by the U.S. Department of State and the Portuguese Government and by a grant from the Portuguese Foundation of Science and Technology.

Conflicts of interest: None declared.

Key points

- Generalized interpersonal trust has a strong association with self-rated health across most European countries.
- Countries with high average trust seem to be beneficial for high trust individuals and to have an adverse effect on low trust individuals' health.
- Social capital has an important and differential impact on people's health, possibly even contributing to the increase of health inequalities.

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2.2. Social mobility and health in European countries: does welfare regime type matter?

Reference:

Campos-Matos I, Kawachi I. Social mobility and health in European countries: does welfare regime type matter? *Social Science and Medicine*. 2015;142:241-248 DOI: https://doi.org/10.1016/j.socscimed.2015.08.035

Social Science & Medicine 142 (2015) 241–248

Contents lists available at ScienceDirect

Social Science & Medicine

journal homepage: www.elsevier.com/locate/socscimed

Short communication

Social mobility and health in European countries: Does welfare regime type matter?

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ARTICLE INFO

Article history:
Received 7 October 2014
Received in revised form
10 August 2015
Accepted 19 August 2015
Available online 22 August 2015

Keywords:
Europe
Welfare regimes
Social mobility
Self-rated health

ABSTRACT

Health inequalities pose an important public health challenge in European countries, for which increased social mobility has been suggested as a cause. We sought to describe how the relationship between health inequalities and social mobility varies among welfare regime types in the European region. Data from six rounds of the European Social Survey was analyzed using multilevel statistical techniques, stratified by welfare regime type, including 237,535 individuals from 136 countries. Social mobility among individuals was defined according to the discrepancy between parental and offspring educational attainment. For each welfare regime type, the association between social mobility and self-rated health was examined using odds ratios and risk differences, controlling for parental education. Upwardly mobile individuals had between 23 and 44% lower odds of reporting bad or very bad self-rated health when compared to those who remained stable. On an absolute scale, former USSR countries showed the biggest and only significant differences for upward movement, while Scandinavian countries showed the smallest. Downward social mobility tended to be associated with worse health, but the results were less consistent. Upward social mobility is associated with worse health in all European welfare regime types. However, in Scandinavian countries the association of upward mobility was smaller, suggesting that the Nordic model is more effective in mitigating the impact of social mobility on health and/or of health on mobility.

1. Introduction

Despite sustained efforts put in effect across European countries, health inequalities persist as an important public health challenge (Mackenbach, 2012). A range of policy solutions has been tried, but so far with relatively little impact. Social mobility has been identified as an important driver of health inequalities. Social mobility can occur either between generations (parents and children) as well as within the life-course of the individual. Truncated intergenerational social mobility is of particular concern because it can result in the crystallization of wealth inequality as well as health inequalities. Ill health is a potent cause of both intra-individual and inter-generational mobility restriction. For example, childhood illness has been shown to adversely affect educational attainment (Case and Paxson, 2008), which will subsequently affect an individual's success in the labor market. Ill health in midlife can affect labor force participation (reduced working hours, job loss), resulting in downward income mobility. Restricted social mobility can be manifest in multiple dimensions – educational achievement, occupational status or earnings and income. Furthermore health selection can be both direct (e.g. depressive illness directly resulting in truncated educational achievement) as well as indirect – e.g. depressive illness resulting in reduced social mobility via intermediary factors such as stigma and discrimination (West, 1991). Accordingly, social protections such as universal access to health care or anti-discrimination legislation represent important policies to promote both intra-individual and inter-generational social mobility.

An individual's socioeconomic position is a robust determinant of his/her health, both in terms of their current (or achieved) socioeconomic position, but also their lifetime trajectory (Marmot and Macmillan, 2004; Marmot and Wilkinson, 2005). This can reflect processes of accumulation or a direct impact of social mobility (Hallqvist et al., 2004). Studies on the effect of social mobility on health have not always produced clear-cut results, with

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http://dx.doi.org/10.1016/j.socscimed.2015.08.035
0277-9536/

some seeming to indicate that upward social mobility can be just as deleterious to health as downward social mobility (Hemmingsson et al., 1999; Liberatos et al., 1988). These mixed results might, however, be a consequence of the inconsistent ways in which social mobility has been operationalized in the empirical literature (Singhammer and Mittelmark, 2010). The use of different indicators to characterize social groups can also be of consequence, since different indicators, such as education, occupation or income, as well as the intergenerational movement between them, can have different meanings (Galobardes et al., 2006).

Overall, there are both theoretical and empirical grounds to suggest that the causal relationship between health and social mobility is bidirectional: individuals have more or less opportunities for social mobility depending on their health endowment and their health achievement is affected by transitions between social strata.

The extent of social mobility varies substantially between countries (Beller and Hout, 2006). Government actions, such as expanding access to schooling or investing in the health of children (e.g. via improved nutrition or vaccination programs) have the potential capacity to break the inter-generational transmission of social disadvantage. Considering the strong relationship between social mobility and health, these governmental actions, systematized in Fig. 1, can have an important impact on health inequalities. Welfare regime types, often used to categorize European countries, share common policies such as the ones outlined in Fig. 1.

In this cross national comparative study, we sought to examine the relation between social mobility and population health among different types of welfare regimes in the European region, in order to understand how the welfare state might moderate the link between mobility and health.

2. Methods

2.1. Data sources and variables

Individual data was collected from six rounds of the European Social Survey (ESS), between 2002 and 2012, from thirty selected countries. The ESS is a repeated cross-sectional survey that collects comparable data on individual socioeconomic characteristics and health status of several European countries (ESS ERIC, 2014). Data is available online at www.europeansocialsurvey.org.

The outcome variable, self-rated health, was based on the survey participant's response to the question 'How is your health in general?', dichotomized so that 1 included 'bad' or 'very bad' (other possible answers were 'fair', 'good' or 'very good').

Social mobility was measured in relation to mother and father's achieved level of education according to the International Standard Classification of Education (ISCED) levels. Although social mobility is usually measured on the basis of the fathers' social standing, the increasing participation of women in the workforce and the importance of the mothers' characteristics on children's health behaviors (Favaro and Santonastaso, 1995) support the importance of considering mothers' status in social mobility studies; therefore, this analysis was done separately. Social mobility was classified in three possible categories: 'down', 'stable' and 'up', according to whether the respondent had reached, respectively, a lower, the same, or higher educational level than his or her parent. Our measure of mobility controlled for the parent's educational achievement when the respondent was 14 (the same variable used to assess mobility). Failing to take into account the 'social group of origin' has been a common pitfall in previous studies of intergenerational social mobility and health (Singhammer and Mittelmark, 2010). Controlling for parent's educational achievement yields mobility coefficients that can be interpreted as independent from social group of origin.

Other individual-level variables included age (restricted to 25 years and up), gender, marital status, belonging to an ethnic minority group, self-perceived income, domicile and main occupational activity. Respondents who were in full-time education were excluded, since not having completed education did not permit comparison to parents' achievement. For all these variables a base category with contrasting indicator variables was specified, except age, which was centered around it's grand mean.

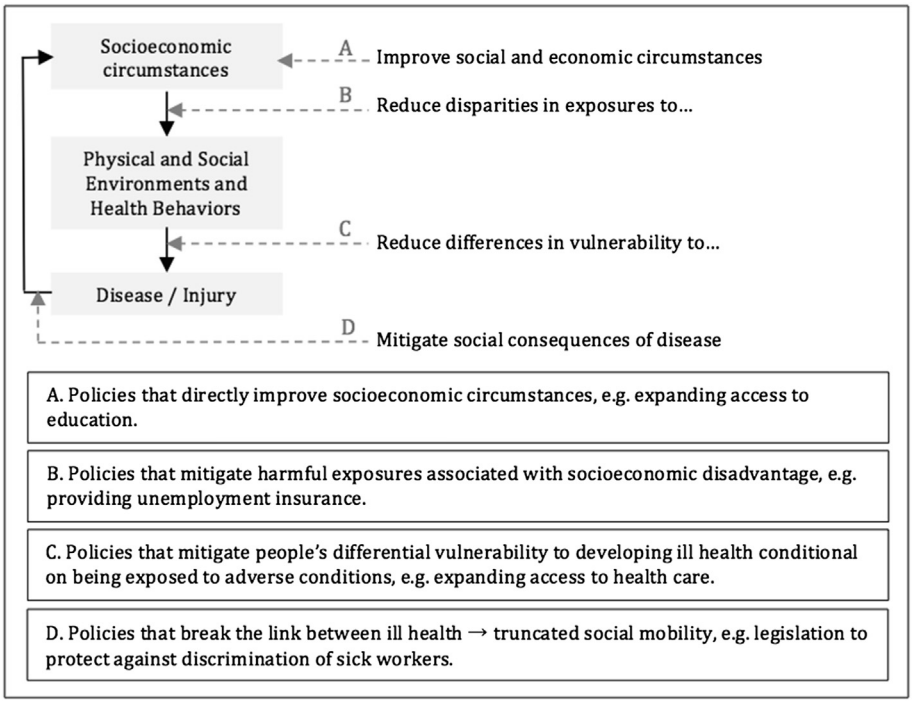

Fig. 1. Entry points for reducing and eliminating health disparities.

To reduce the possibility of confounding by economic development, Gross Domestic Product (GDP) per capita, converted to international dollars using purchasing power parity, was retrieved from the World Bank database (World Bank, 2014) and included as a country-level variable (specified per country, per year).

Additionally, the Gini coefficient, which might also confound the association between social mobility and health, was retrieved from the Eurostat database (Eurostat, 2014) and used as a level 2 variable (country-year specific). However, this was only used as a sensitivity analysis, since the Gini coefficient was missing for many countries for several years.

2.2. Welfare regimes

Countries were grouped by welfare regime type and analyzed separately. Welfare regime classification is a much-debated topic, not only with disputed typologies, but also regarding which characteristics should be used to for their classification (Bambra, 2007). Nonetheless, we started with a widely used typology that divides European countries into four regime types:

(i) Scandinavian, characterized by universal and generous benefits and a strong redistributive social security system (Eikemo et al., 2008a; Fenger, 2007);
(ii) Anglo-Saxon, with a low level of government spending on social protection, modest benefits, usually means-tested (Eikemo et al., 2008a; Fenger, 2007);
(iii) Bismarckian, with benefits tied to employment, financed mainly by employer and employee, and minimal redistribution (Eikemo et al., 2008a);
(iv) Southern, with a dualist system of welfare provision, which strongly protects part of the population while under-protecting another (19).

This classification is primarily based on Esping-Andersen's et al. (1990) groundbreaking work, which operationalized three principles: decommodification, social stratification and the public-private mix, to classify the first three typologies (Eikemo et al., 2008a; Espig Andersen et al., 1990). Ferrera (1996) later added the Southern type, basing his classification on the coverage of social protection schemes (Ferrera, 1996). This typology has been replicated in other attempts to define welfare regime types (Bambra, 2007; Bonoli, 1997) and has been used previously in the health literature (Eikemo et al., 2008a, 2008b).

The consideration of Central and Eastern European countries to the European Union adds further complexity to this classification. Historically, the trajectories of these countries' welfare transformation can be separated in two, depending on the extent to which the welfare effort collapsed in the 1990's (Cook and Press, 2010). This typology separates Central and Eastern European countries (including Poland, Hungary, Czech Republic and the Baltic states, among others) from the remaining former USSR states (such as Russia and Central Asian countries). However, using a hierarchical cluster analysis, Fenger (2007) showed that, based on similarities on government spending, social situation and political participation, these countries could be divided in the following way:

(i) Former USSR, with generally low governmental spending on social programs, mostly financed through social contributions;
(ii) Post-Communist European, very similar to the first type, but with higher levels of economic growth, inflation, social well-being and egalitarianism (Fenger, 2007).

It is important to note that these characteristics do not necessarily describe the countries in absolute; in fact, most countries have a mix of different welfare regimes, but nonetheless have predominant characteristics of one type.

2.3. Statistical analysis

Data was analyzed using multilevel logistic models based on a logit-link function with a first order quasi-likelihood estimation procedure. The models were run using MLwiN program version 2.28 (Rasbash et al., 2013). The data was analyzed considering its hierarchical structure in three levels: individuals (level 1), nested within years (level 2), nested within countries (level 3). Overall odds, odds ratios, overall probabilities and rate differences were calculated for each welfare regime. This was based in part in the methods used by Hemmingsson et al. (1999), although we applied a multilevel modeling technique.

The use of multilevel statistical techniques allows for the analysis of the effect of both individual and contextual variables on the outcome of interest. In this analysis, the contextual variable was country- and year-specific, making it mandatory to include both as levels. Additionally, these models take into account the hierarchical nesting of individual observations within a year and within a country, correcting otherwise underestimated standard errors and allow the modeling of variability at each level of analysis (Subramanian et al., 2003).

As a sensitivity analysis, the same models were run using different estimation procedures.

3. Results

Table 1 outlines the distribution of the variables among welfare regime types. Each type includes between two and seven countries, ranging in sample size from 23,310 to 62,509 individuals. Countries with a Scandinavian welfare regime had the lowest proportion of people reporting bad or very bad health (5.4%), followed by Anglo-Saxon (5.8%), Bismarckian (6.9%), Southern (11.9%), Post-Communist European (14.5%) and Former USSR (19.6%).

Most respondents had achieved a higher educational level than their parents: between 49.3 and 63.2% had improved in relation to their mother, and between 45.6 and 61.7% in relation to their father. Between one third and half of respondents remained in the same educational level as their parents and a smaller proportion 'moved down' – only 1.6% in southern countries in relation to mother's achievement, up to 12.1% in Bismarckian countries, in relation to father's.

Table 2 shows the coefficients for the mobility variable (stable, upward, downward) from the multilevel models. The full models are available in Tables 3 and 4 as an online supplement. The general pattern of association between social mobility and health was similar across all regime types, i.e. upward mobility was protective, while downward mobility was detrimental for self-rated health.

Figs. 2 and 3 show the probabilities and risk differences in the different mobility groups in each welfare regime type. As was noted in Table 1, the overall probability of bad self-rated health differs significantly between welfare regime types. The benefits of upward mobility are present in all regime types, but risk differences are particularly high for Southern, Post Communist European and Former USSR regimes and significantly different only in the latter. Scandinavian countries showed the lowest risk differences between upwardly mobile and stable individuals when considering either mothers' or fathers' education.

Downward mobility is generally detrimental. Post Communist European countries show the biggest absolute differences, with downward mobility leading to an absolute difference of 2.9 and

Table 1
Composition of each welfare type.

	Scandinavian	Anglo-Saxon	Bismarckian	Southern	Post-Communist European	Former USSR
Countries	Denmark Finland Norway Sweden Iceland	United Kingdom Ireland	Austria Belgium Switzerland Germany France Luxembourg Netherlands	Spain Greece Italy Portugal	Czech Republic Hungary Poland Slovenia Slovakia Croatia Bulgaria	Estonia Latvia Lithuania Russia Ukraine
n (level 2)	23	12	33	18	34	16
n (level 1)	37,975	23,310	62,509	31,789	51,698	30,072
Level 1 variables						
% bad or very bad health	5.4	5.8	6.9	11.9	14.5	19.6
Mobility, mother (%)						
Down	6.3	9.3	4.7	1.6	4.0	9.9
Stable	30.4	35.2	32.9	49.0	38.0	29.2
Up	63.2	55.5	62.4	49.3	58.0	60.9
Mobility, father (%)						
Down	10.1	10.2	12.1	3.4	6.8	9.4
Stable	34.6	36.7	42.3	50.9	46.1	28.9
Up	55.4	53.1	45.6	45.6	47.0	61.7
Women (%)	50.0	55.0	52.9	56.6	55.1	61.7
Mean age (years)	51.7	51.7	51.6	52.4	51.8	52.7
Urban (%)	64.3	66.0	56.9	65.0	61.3	70.2
Main activity (%)						
Paid work	63.5	49.7	53.9	48.0	48.9	50.6
No activity	31.3	35.3	32.9	35.5	42.0	42.0
Other	5.2	15.0	13.3	16.5	9.1	7.3
Feeling about income (%)						
Living comfortably	49.5	35.4	38.1	15.3	11.3	4.8
Coping	41.4	45.3	46.3	45.0	45.3	37.7
Difficult	7.0	14.3	12.3	27.7	29.0	37.0
Very difficult	2.0	5.0	3.3	12.1	14.5	20.5
Minority (%)	2.4	5.0	4.6	3.0	5.7	12.7
Marital status (%)						
Married	57.5	55.0	59.8	63.7	61.9	52.9
Separated/divorced	12.2	11.2	11.9	6.5	9.5	14.7
Widow	7.0	10.9	9.3	12.2	14.2	19.8
Single	23.3	22.9	19.1	17.6	14.3	12.7
Level 2 variables						
GDP per capita (international dollars)	39,459	36,705	37,075	26,396	19,924	16,599

Note: ISCED International Standard Classification of Education.

3.6% in the risk of bad health measured on the basis of maternal and paternal achievement, respectively. In Scandinavian, Anglo-Saxon, Bismarckian and former USSR countries, this risk difference ranges from 0.1 to 1.9%. Overall, Scandinavian countries showed the smallest absolute difference in health between stable and downward mobility when measured by the father's achievement, and former USSR countries when measured by the mother's.

As a sensitivity analysis, the same models were run using different estimation procedures (second order marginal quasi-likelihood, first and second order predictive quasi-likelihood and Markov Chain Monte Carlo). All resulted in models with the same effect of social mobility in the different welfare regimes. A model was also run with the Gini coefficient as a level 2 variable; this had very little effect in the odds ratios or risk differences and no effect in the statistical significance of the results.

4. Discussion

This study sought to describe differences in the relationship between social mobility and health within different welfare regimes to better understand the effect that different regime types might have. Different welfare regimes had a substantially different proportion of individuals with bad or very bad self-rated health, lowest in countries in the Scandinavian regime (5.4%), followed by Anglo-Saxon (5.8%), Bismarckian (6.9%), Southern (11.9%), Post-Communist European (14.5%) and finally Former USSR (19.6%).

Table 2
Mobility odds ratios and 95% confidence intervals from the multilevel models in each welfare regime type.

		Scandinavian	Anglo-Saxon	Bismarckian	Southern	Post-Communist European	Former USSR
Mother	n (level 1)	30,458	19,752	53,644	29,030	46,556	24,959
	Stable	1	1	1	1	1	1
	Down	**1.39 (1.06,1.83)**	**1.40 (1.11,1.78)**	1.09 (0.89,1.31)	0.72 (0.43,1.21)	**1.35 (1.13,1.60)**	1.01 (0.84,1.22)
	Up	**0.77 (0.68,0.86)**	**0.70 (0.60,0.81)**	**0.77 (0.71,0.84)**	**0.56 (0.49,0.62)**	**0.69 (0.65,0.75)**	**0.67 (0.61,0.74)**
Father	n (level 1)	29,837	19,184	52,326	28,417	45,500	23,036
	Stable	1	1	1	1	1	1
	Down	1.18 (0.95,1.45)	**1.51 (1.19,1.91)**	**1.20 (1.06,1.37)**	1.24 (0.92,1.68)	**1.45 (1.28,1.65)**	1.17 (0.98,1.39)
	Up	**0.76 (0.67,0.86)**	**0.68 (0.59,0.79)**	**0.76 (0.69,0.82)**	**0.57 (0.51,0.64)**	**0.73 (0.68,0.78)**	**0.68 (0.62,0.75)**

Note: bold indicates OR significant at $p < 0.05$.

Table 3
Multilevel models: mobility from mother's education.

	Scandinavian	Anglo-Saxon	Bismarckian	Southern	Post communist	Former USSR
n (level 1)	30,458	19,752	53,644	29,030	46,556	24,959
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Fixed Parameters						
Intercept	0.008 (0.005,0.012)	0.009 (0.006,0.027)	0.011 (0.007,0.018)	0.019 (0.009,0.037)	0.016 (0.011,0.022)	0.036 (0.026,0.050)
Individual Level						
Mobility (reference: stable)						
Down	1.39 (1.06,1.83)	1.40 (1.11,1.78)	1.09 (0.89,1.31)*	0.72 (0.43,1.21)*	1.35 (1.13,1.60)	1.01 (0.84,1.22)*
Up	0.77 (0.68,0.86)	0.70 (0.60,0.81)	0.77 (0.71,0.84)	0.56 (0.49,0.62)	0.69 (0.65,0.75)	0.67 (0.61,0.74)
Gender (ref: male)	1.03 (0.92,1.15)*	0.89 (0.77,1.02)*	1.07 (0.98,1.15)*	1.59 (1.45,1.75)	1.06 (0.99,1.13)*	1.21 (1.12,1.32)
Age	0.99 (0.99,1.00)*	1.00 (0.99,1.01)*	1.01 (1.01,1.01)	1.04 (1.04,1.05)	1.04 (1.04,1.04)	1.05 (1.04,1.05)
Domicile (ref: urban)	0.94 (0.84,1.05)*	0.85 (0.74,0.98)	0.88 (0.82,0.95)	1.14 (1.05,1.24)	1.11 (1.04,1.18)	0.97 (0.89,1.05)*
Main activity (ref: paid work)						
No activity	6.29 (5.39,7.35)	6.17 (5.00,7.61)	4.35 (3.90,4.84)	2.54 (2.22,2.89)	3.35 (3.06,3.67)	2.63 (2.35,2.93)
Other	2.83 (2.21,3.62)	2.55 (1.96,3.31)	1.82 (1.59,2.09)	1.91 (1.64,2.21)	1.97 (1.74,2.24)	1.56 (1.31,1.86)
Income (ref: living comfortably)						
Coping	1.40 (1.24,1.59)	1.49 (1.26,1.78)	1.52 (1.38,1.67)	1.38 (1.15,1.64)	1.55 (1.33,1.81)	1.10 (0.84,1.45)*
Difficult	2.97 (2.49,3.54)	2.61 (2.12,3.21)	3.29 (2.94,3.68)	2.28 (1.90,2.73)	3.00 (2.57,3.51)	1.76 (1.35,2.29)
Very difficult	4.57 (3.56,5.86)	4.09 (3.18,5.27)	5.21 (4.47,6.06)	3.97 (3.28,4.82)	5.37 (4.55,6.32)	2.86 (2.19,3.75)
Minority (ref: no)	1.44 (1.05,1.97)	0.86 (0.61,1.21)*	1.27 (1.08,1.49)	1.03 (0.79,1.34)*	0.97 (0.86,1.09)*	1.02 (0.91,1.15)*
Marital status (ref: married)						
Separated/divorced	1.37 (1.18,1.59)	2.02 (1.67,2.43)	1.28 (1.14,1.42)	1.23 (1.03,1.47)	1.03 (0.93,1.14)*	1.28 (1.14,1.43)
Widow	1.07 (0.89,1.27)*	1.13 (0.92,1.37)*	1.08 (0.97,1.21)*	1.06 (0.95,1.17)*	1.06 (0.98,1.14)*	1.18 (1.08,1.30)
Single	1.02 (0.87,1.19)*	1.19 (0.99,1.43)*	1.17 (1.05,1.31)	1.29 (1.12,1.51)	1.09 (0.97,1.21)*	1.31 (1.13,1.52)
Mother's education (ref: ISCED V/VI)						
ISCED I	2.39 (1.76,3.26)	1.63 (1.18,2.25)	2.14 (1.66,2.77)	1.23 (0.79,1.92)*	2.48 (1.93,3.21)	2.02 (1.68,2.43)
ISCED II	2.00 (1.49,2.71)	1.25 (0.91,1.72)*	1.72 (1.34,2.21)	0.67 (0.39,1.13)*	1.89 (1.48,2.41)	1.76 (1.45,2.12)
ISCED III	1.67 (1.25,2.23)	1.20 (0.82,1.77)*	1.34 (1.04,1.71)	1.03 (0.62,1.71)*	1.26 (0.99,1.59)*	1.25 (1.04,1.49)
ISCED IV	1.64 (1.04,2.59)	0.37 (0.17,0.79)	1.58 (1.09,2.27)	0.53 (0.15,1.88)*	1.54 (1.05,2.26)	1.12 (0.91,1.38)*
Level 2						
GDP	0.99 (0.99,1.00)*	0.99 (0.99,1.00)*	1.00 (0.99,1.00)*	0.99 (0.99,0.99)	0.99 (0.99,0.99)	0.99 (0.99,0.99)
Random Parameters						
Level 3 variance (σ_{vo})	0.08 (0.06)*	0.19 (0.19)*	0.22 (0.12)*	0.23 (0.17)*	0.07 (0.04)*	0.03 (0.02)*
Level 2 variance (σ_{uo})	0.01 (0.01)*	0 (0)	0 (0)	0.01 (0.01)*	0.03 (0.01)	0.01 (0.01)*

Notes: * not significant at $p < 0.05$. ISCED International Standard Classification of Education. OR Odds ratio. CI Confidence interval.

This difference was reproduced in the multilevel models, which controlled for several socioeconomic individual and country characteristics.

Both on a relative and on an absolute scale, upward mobility was associated with better health, regardless of welfare regime type. However, on the relative scale, these were significant for all regime types, whereas on the absolute scale there was only a true difference in countries from the Former USSR. Downward mobility was generally associated with worse health, but to differing extents and following a less clear pattern.

It has been argued before that the use of only absolute or relative measures can be misleading, and our findings reiterate this argument (King et al., 2012; Kelly et al., 2007). In fact, relative measures of health inequalities are insensitive to equiproportionate changes, while absolute measures are insensitive to uniform changes, which reflects different equity value judgments implied in the empirical analysis (Allanson and Petrie, 2013). Thus, different results between relative and absolute scales might be a consequence of different levels of overall ill-health: former USSR countries had the highest prevalence of bad or very bad self-rated health, making absolute differences more likely to emerge.

This study is sensible to a number of limitations. The outcome measure, self-rated health, is very culturally-sensitive, complicating cross-national comparisons (Jylhä et al., 1998). Nevertheless, it is an important predictor of mortality in every society where it has been examined (Idler and Benyamini, 1997), making it a much used and valued health measure. Additionally, social mobility doesn't have a unanimously accepted operationalization. Differences in educational achievement are not necessarily a reflection of different societal prestige or access to different social resources. Indeed, occupational mobility is often preferred (Beller and Hout, 2006), but the occupational measures available in the ESS were crude and difficult to compare between respondents and their parents. Also importantly, although the analyses controlled for parental education, this operationalization of social mobility might be measuring processes of accumulation. The welfare regime classification is also debatable. Although most of the regime types that were used in this study have been extensively used before, and despite both level 2 and level 3 variability being very low and non-significant (hinting to a high homogeneity between countries and country-years), they might not reflect the characteristics of welfare regimes that have an impact on the relationship between social mobility and health. Finally, it is not possible to assess causality between social mobility and health, considering that our analyses are based on cross-sectional data. Indeed, it is possible that the health of participants in our sample was already affected by mobility in the previous time period. The association between health and socioeconomic status is likely dynamic and bi-directional across the life course.

Overall, it is interesting to note that although all welfare regime types show relative differences in bad self-rated health for upwardly mobile individuals, on an absolute scale the Scandinavian regime shows the smallest differences and the former USSR group the largest. Although welfare regime type seems to account for an important part of the variation in self-perceived health among European countries (Eikemo et al., 2008b), the extent to which it impacts health inequalities has been questioned. Mackenbach et al. (2008) reported a surprisingly high degree of health inequalities in northern European countries, showing that, despite egalitarian policies, lifestyle-related risk factors remain an important cause of mortality inequalities (Mackenbach et al., 2008). Eikemo et al. (2008a) also showed a clear gradient of health inequalities

Table 4
Multilevel models: mobility from father's education.

	Scandinavian	Anglo-Saxon	Bismarckian	Southern	Post communist	Former USSR
Level 1 n	29,837	19,184	52,326	28,417	45,500	23,036
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Fixed Parameters						
Intercept	0.009 (0.007,0.014)	0.009 (0.005,0.019)	0.013 (0.009,0.018)	0.014 (0.008,0.024)	0.017 (0.013,0.023)	0.033 (0.023,0.047)
Individual Level						
Mobility (reference: stable)						
Down	1.18 (0.95,1.45)*	1.51 (1.19,1.91)	1.20 (1.06,1.37)	1.24 (0.92,1.68)*	1.45 (1.28,1.65)	1.17 (0.98,1.39)*
Up	0.76 (0.67,0.86)	0.68 (0.59,0.79)	0.76 (0.69,0.82)	0.57 (0.51,0.64)	0.73 (0.68,0.78)	0.68 (0.62,0.75)
Gender (ref: male)	1.03 (0.92,1.15)*	0.89 (0.77,1.03)*	1.05 (0.97,1.14)*	1.56 (1.42,1.72)	1.07 (1.00,1.14)	1.26 (1.15,1.37)
Age	0.99 (0.99,1.00)*	1.00 (0.99,1.01)*	1.01 (1.01,1.01)	1.04 (1.04,1.05)	1.04 (1.04,1.04)	1.05 (1.04,1.05)
Domicile (ref: urban)	0.95 (0.85,1.06)*	0.88 (0.76,1.02)*	0.88 (0.82,0.95)	1.14 (1.04,1.24)	1.11 (1.04,1.18)	0.95 (0.87,1.03)*
Main activity (ref: paid work)						
No activity	6.11 (5.23,7.14)	5.87 (4.76,7.24)	4.44 (3.97,4.95)	2.54 (2.22,2.91)	3.29 (2.99,3.60)	2.70 (2.41,3.04)
Other	2.67 (2.07,3.45)	2.47 (1.89,3.22)	1.19 (1.64,2.17)	1.94 (1.67,2.26)	1.91 (1.68,2.17)	1.58 (1.32,1.90)
Income (ref: living comfortably)						
Coping	1.41 (1.24,1.61)	1.45 (1.21,1.72)	1.50 (1.36,1.65)	1.35 (1.13,1.61)	1.55 (1.32,1.81)	1.08 (0.82,1.43)*
Difficult	2.86 (2.39,3.42)	2.54 (2.06,3.13)	3.25 (2.90,3.65)	2.24 (1.87,2.69)	2.94 (2.51,3.45)	1.71 (1.29,2.26)
Very difficult	4.66 (3.62,6.01)	3.74 (2.89,4.85)	5.05 (4.33,5.90)	3.94 (3.24,4.78)	5.31 (4.49,6.27)	2.83 (2.13,3.76)
Minority (ref: no)	1.46 (1.06,2.01)	0.97 (0.69,1.35)*	1.33 (1.13,1.57)	1.03 (0.79,1.35)*	0.97 (0.86,1.09)*	1.01 (0.89,1.15)*
Marital status (ref: married)						
Separated/divorced	1.42 (1.34,1.96)	2.06 (1.69,2.49)	1.26 (1.13,1.41)	1.23 (1.03,1.48)	1.04 (0.93,1.16)*	1.25 (1.11,1.42)
Widow	1.08 (0.84,1.34)*	1.17 (0.96,1.43)*	1.06 (0.95,1.19)*	1.06 (0.95,1.18)*	1.07 (0.99,1.16)*	1.18 (1.07,1.30)
Single	1.03 (0.88,1.22)*	1.19 (0.99,1.44)*	1.15 (1.03,1.29)	1.31 (1.13,1.53)	1.08 (0.96,1.21)*	1.15 (0.98,1.35)*
Education (ref: ISCED V/VI)						
ISCED I	2.18 (1.70,2.79)	1.59 (1.19,2.12)	1.92 (1.61,2.28)	1.70 (1.24,2.33)	2.27 (1.87,2.74)	2.12 (1.77,2.54)
ISCED II	1.67 (1.29,2.16)	1.09 (0.82,1.45)*	1.59 (1.34,1.88)	1.33 (0.94,1.89)*	1.72 (1.44,2.06)	1.79 (1.49,2.15)
ISCED III	1.42 (1.13,1.78)	1.16 (0.82,1.64)*	1.36 (1.17,1.57)	0.99 (0.68,1.47)*	1.21 (1.02,1.43)	1.39 (1.17,1.67)
ISCED IV	1.67 (1.21,2.29)	0.93 (0.54,1.62)*	1.26 (0.98,1.61)*	1.11 (0.52,2.38)*	0.83 (0.58,1.18)*	1.17 (0.94,1.45)*
Level 2						
GDP	0.99 (0.99,1.00)*	1.00 (0.99,1.00)*	1.00 (0.99,1.00)*	0.99 (0.99,0.99)	0.99 (0.99,0.99)	0.99 (0.99,0.99)
Random Parameters						
Level 3 variance (σ_{vo})	0.09 (0.07)*	0.19 (0.19)*	0.21 (0.12)*	0.24 (0.17)*	0.08 (0.05)*	0.03 (0.02)*
Level 2 variance (σ_{uo})	0.01 (0.01)*	0 (0)	0 (0)	0.003 (0.004)*	0.03 (0.01)	0.01 (0.01)*

Notes:* not significant at $p < 0.05$. ISCED International Standard Classification of Education. OR Odds ratio. CI Confidence interval.

between European welfare states, from Southern (with the highest inequalities) to Bismarckian (with the lowest) (Eikemo et al., 2008a). This 'paradox' was examined by Mackenbach (2012), who postulated that social mobility might be one of the drivers of health inequalities in Western European welfare states. Some studies have indeed shown that increased social mobility is associated with stronger health inequalities (Simons et al., 2013; Ásgeirsdóttir and Ragnarsdóttir, 2013; Elstad, 2001). However, Brekke, Grunfeld and Kverndokk (2014), showed that higher health inequalities in more egalitarian countries might be solely a consequence of a more equal health distribution, since the concentration index is more sensitive to health-contingent income transfers than to income-contingent health transfers (Brekke et al., 2012).

Our findings suggest that some welfare states are in fact more

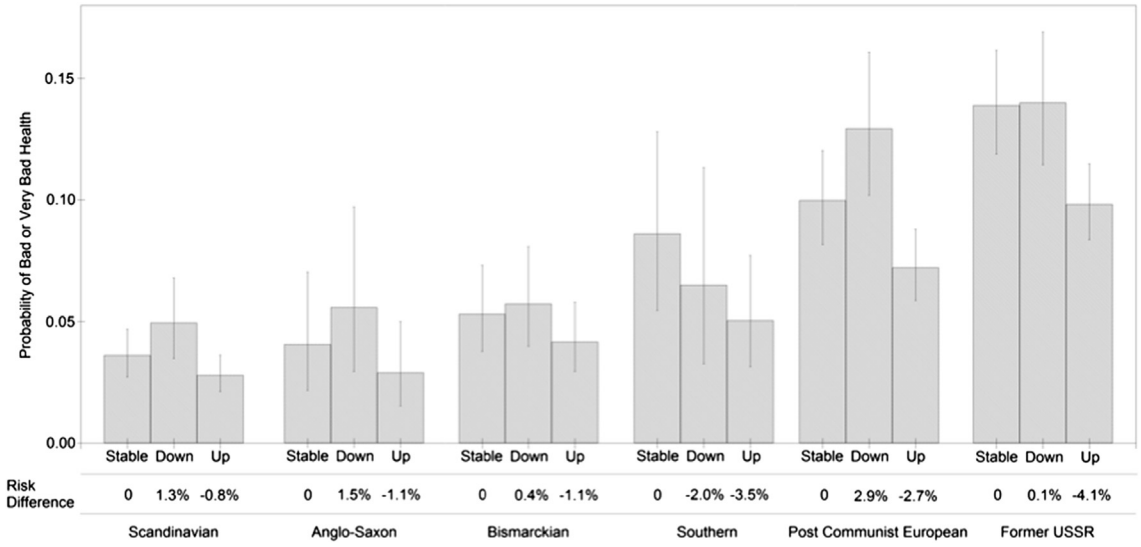

Fig. 2. Probability of 'Bad' or 'Very Bad' self-rated health per to mobility group, defined from mother's educational achievement, per welfare type (error bars are 95% confidence intervals) and risk difference.

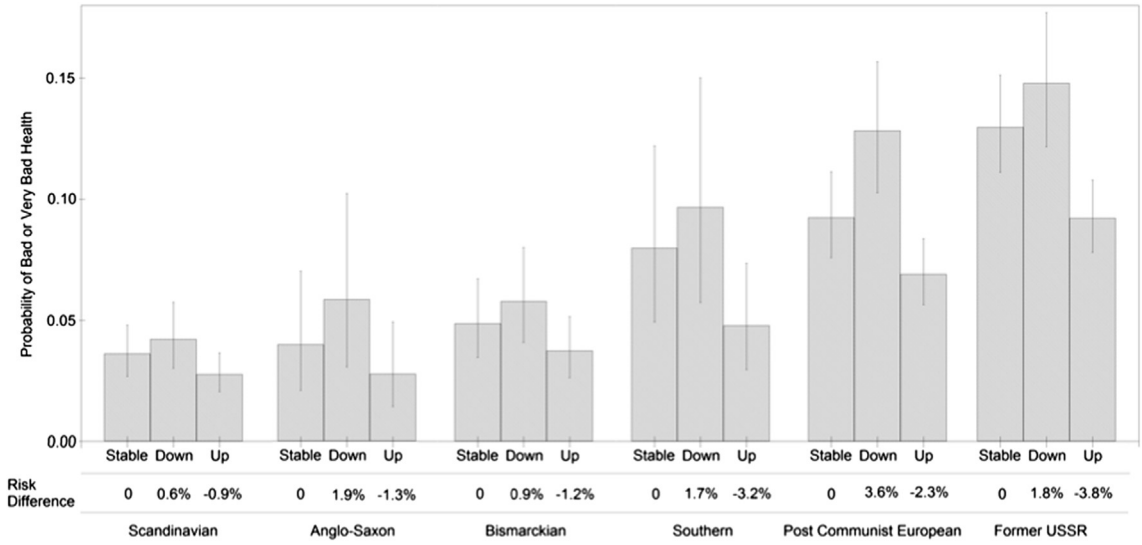

Fig. 3. Probability of 'Bad' or 'Very Bad' self-rated health per to mobility group, defined from father's educational achievement, per welfare type (error bars are 95% confidence intervals) and risk difference.

effective in separating social mobility from health, namely Scandinavian countries exhibit smaller differences while former USSR societies the largest. This is not surprising considering that, for example, comprehensive social policies seem to be associated with fewer inequalities in 'sickness' in European countries, as well as lower rates of non-employment (van der Wel et al., 2011). It is understandable then, that Scandinavian countries will manage to disassociate social mobility from health more effectively, leading to the small risk differences we found for upward mobility in these countries.

Importantly too, Central and Eastern European countries underwent considerable transitions in the last decades, with important consequences to their social structures (Saar et al., 2012). Our results for the post-Communist European and former USSR welfare regimes, which tended to show the largest absolute differences in health, might reflect, at least partially, these important structural changes and not just relative social mobility.

Our findings also reinforce the need to assess health inequalities using both relative and absolute measures, since the use of only one might be very misleading.

Interestingly too, when comparing the association of downward mobility with health as assessed in reference to paternal versus maternal achievement, the former was larger in every welfare regime except the Scandinavian region. Considering that Scandinavian countries have the best indicators of gender equality (European Institute for Gender Equality, 2013), a possible explanation for this is that in other, less gender-egalitarian countries, the father's status is more decisive in determining the family's socioeconomic status, and therefore a downward mobility from his social position has a greater impact.

To the best of our knowledge, this is the first research into the moderating effect of welfare regimes on the relationship between social mobility and health, and to measure social mobility separately based on maternal and paternal achievement. Further exploration of our findings would benefit from measuring occupational social mobility in addition to educational mobility. It would also benefit from a separate analysis for each gender, since the effect might be different for women and men and might help explain the differences in the association of downward mobility when measured on the basis of maternal and paternal achievement.

Previous studies have questioned the contribution of the welfare regime in mitigating the extent of health inequalities and identified increased social mobility as a possible cause for this (Mackenbach, 2012). However, the present results show that important systematic differences exist between regime types with regard to upward mobility and health, with a notably attenuated association on the absolute scale in Scandinavian countries and stronger association in the former USSR regimes. This suggests that social mobility is not a cause of high health inequalities found in Scandinavian countries in previous analyses.

Acknowledgments

I. Campos Matos is supported by a Fulbright grant for Public Health research, awarded by the U.S. Department of State and the Portuguese Government, and by a studentship from the Portuguese Foundation of Science and Technology.

Appendix A. Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.socscimed.2015.08.035.

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2.3. Connecting the dots on health inequalities – a systematic review on the social determinants of health in Portugal

Reference:

Campos-Matos I, Russo G, Perelman J. Connecting the dots on health inequalities – a systematic review on the social determinants of health in Portugal. *International Journal for Equity in Health*. 2016;15(1):15-26. DOI: 10.1186/s12939-016-0314-z

Online supplementary data for this publication is in Appendix 3.

Campos-Matos et al. International Journal for Equity in Health (2016) 15:26
DOI 10.1186/s12939-016-0314-z

International Journal for Equity in Health

SYSTEMATIC REVIEW Open Access

Connecting the dots on health inequalities – a systematic review on the social determinants of health in Portugal

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Abstract

Introduction: Health inequalities are recognised as a public health issue worldwide, but only a few countries have developed national strategies to monitor and reduce them. Despite its considerable health inequalities, Portugal seems to lack a systematic strategy to tackle them, possibly due to the absence of organised evidence on the issue. We performed a systematic review that aimed to describe the available evidence on social inequalities in health in Portugal, in order to contribute towards a comprehensive and focused strategy to tackle them.

Methods: We followed the PRISMA guidelines and searched Scopus, Web of Science and PubMed for studies that looked at the association between a measure of socioeconomic status and a health outcome in the Portuguese resident population since the year 2000. We excluded health behaviours and healthcare use from our search. We performed a qualitative description of the results.

Results: Seventy-one publications were selected, all reporting observational analyses, most of them using cross-sectional data. These publications showed strong evidence for health inequalities related to education and gender, chiefly for obesity, self-rated health and mental health.

Conclusions: Analysis of the eligible publications showed that current research does not seem to have consistently covered the link between health and key Portuguese social problems. A strategy focusing on the monitoring of most prevalent diseases, most determining socioeconomic factors and vulnerable populations would be crucial to guide academic research in a country in which health inequalities are so ubiquitous and deeply rooted.

Registration: This systematic review is not registered.

Keywords: Portugal, Health inequalities, Social determinants of health, Socioeconomic factors

Introduction

Several individual socioeconomic characteristics such as occupation, employment or income, have been extensively shown to be associated with health outcomes [1]. The health inequalities that this creates have not gone unnoticed to academics and policy-makers, and a number of crucial publications, from the Black report in the UK [2] to the report of the Commission on the Social Determinants of Health by the World Health Organization (WHO) [1] have helped push this issue into the political agenda of several countries. As a result, numerous European countries like the UK, the Netherlands, Ireland, Sweden and Finland, have adopted and monitored policies to reduce health inequalities [3].

Portugal seems to have lagged behind in this issue, particularly in its political agenda. Pereira and Furtado (2011) noticed that despite it being one of the foundations on the legal documents regarding the Portuguese health system, interest in health equality has been practically non-existent in the country [3]. Two WHO reports on the Portuguese National Health Plan and on the Portuguese health system argued that health inequalities were an "important policy gap" [4] and recommended the "[promotion of] health policies targeting health gains and reduced health inequalities in all areas" [5].

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There are indeed very good reasons to focus health inequalities in Portugal, as in 2011 it was one of the most unequal countries in the European Union, with the continent's second highest Gini coefficient for disposable household income [6]. Not surprisingly, comparative analyses have shown that Portugal is also one of the European countries with the highest health inequalities. Mackenbach et al. (2008), for example, showed that Portugal had Europe's highest education-related relative index of inequality in self-rated health (SRH) for both genders and in obesity for women [7].

Despite its high health inequalities and a constitutionally sanctioned commitment to health equity, Bago d'Uva argues that it is the absence of explicit and effective policies to tackle health inequalities allows them to persist so critically high [8]. Crucially, a real or perceived lack of evidence on health inequalities – its magnitude, causes, most affected areas, groups and diseases – limits the design and implementation of equity-oriented health policies.

This systematic review of the literature seeks to confront this absence, by aiming to describe the available evidence on social inequalities in health in Portugal. To the best of our knowledge, no similar review has been carried out in this context so far. This exercise has a dual purpose: to help define a research agenda on health inequalities in Portugal, by pointing out limitations in knowledge and to provide an evidence base to guide political decision-making. With this, we hope to offer a stepping-stone towards a comprehensive and adequately focused strategy to tackle health inequalities in Portugal.

Methods

Search strategy

A systematic review of published literature was conducted on health inequalities in Portugal. We followed the PRISMA statement to guide and report the review [9]. We searched for eligible articles in Portuguese and English using Scopus, Web of Science and PubMed. We focused on most recent work on the subject, limiting our search to publications after January 1st 2000. Besides these database searches, we also scoped publications of recognized specialists in this field in Portugal and selected those that were relevant and met the outlined eligibility criteria. The detailed search strategy is outlined in the online Additional file 1.

Study selection

We looked for studies that (i) analysed resident Portuguese population, (ii) looked for the association between a measure of socioeconomic status (SES) and health status, (iii) aimed to quantify the impact of SES on the outcome and (iv) in this quantification, controlled at least for age and gender as potential confounders. We followed the PROGRESS framework– standing for Place of residence, Race/ethnicity/culture/language, Occupation, Gender/sex, Religion, Education, Socioeconomic status and Social capital – to identify socioeconomic determinants of interest [10]. Both individual and contextual socioeconomic determinants were considered. Health outcomes were restricted to three types of indicators, following Blaxter's classification [11]: medical, functional and subjective health. This excluded commonly mentioned mediators of the socioeconomic-health relationship, namely health related behaviours and healthcare use or access. We also excluded qualitative studies. Studies that analysed Portugal among other countries were not excluded, as long as a result for Portugal was presented. We included only studies that used data from the year 2000 onwards as to focus our study on contemporary issues.

The search and initial title screen were performed by one author, who identified relevant publications. The selected publications were independently analysed by two authors for compliance with inclusion and exclusion criteria. Any discrepancy was resolved in a panel discussion between the three authors.

Data extraction

One author performed data extraction; uncertainties were resolved by a second author extracting the data independently. The following information was extracted from each publication: sample characteristics (sample size, geographic area and demographic characteristics), data source (for analyses based on previous surveys), exposure(s), outcome(s), study design (including sampling procedures), methods used in analysis, variables controlled for and main findings. Each publication was also assessed for strengths and limitations, considering the following items: sample size, sampling methods, control for confounders, appropriate measurement of variables, appropriate statistical analysis and possible sources of bias.

Data presentation

The extracted data is summarized in the online Additional file 2. Data was first summarized through a table with a brief description of results according to combinations of SES and health variables. Subsequently, a diagram was drawn, where SES determinants were represented by circles proportional to the number of publications in which they were used. In this diagram, health outcomes were written in a font size also proportional to the number of publications in which each was used. Arrows connecting the two denote the strength of the associations found. Details on how this diagram was built are outlined in the online Additional file 3.

Results

Study selection

Figure 1 shows the number of publications identified, screened, assessed for eligibility and included, with reasons for exclusion at each stage. Five thousand nine hundred and two publications were initially identified. After removing duplicates and the initial title screening, the most common reasons for exclusion were that no data for Portugal was presented (mostly international analyses that did not show country-specific results); SES differences were not quantified (the analysis did not compare SES groups); data was previous to the year 2000 or the analysis did not control for age and/or gender. In the end of this process, 71 publications were considered eligible. The complete extracted information from these 71 publications is in the online Additional file 2 and the list of references is in the online Additional file 4.

Study characteristics

All eligible publications described observational data. The vast majority of these were cross-sectional and individual-level (five used ecological data). Five studies had a longitudinal design, three of which used data from the same cohort (the EpiPorto cohort, a cohort of community dwelling adults from Porto [12]). Other sources of data included the national health survey (a repeated cross-sectional nation-wide survey [13] (3 publications)), the Generation XXI cohort (a cohort of newborns and their mothers recruited in Porto between 2005 and 2006 [14] (3 publications)) and the EpiTeen cohort (a cohort of adolescents born in 1990 from Porto [15] (3 publications)). Sixteen publications used school-based samples, fifteen healthcare-based and twelve community-based.

Sample sizes ranged from 18 (municipalities in the Lisbon Metropolitan Area [16]) to over 800,000 (all national births over several years [17]), with an overall median of 1,234. The vast majority used regression analyses – linear and logistic – to quantify inequalities. Adults were the most commonly studied group (forty publications), followed by adolescents (twelve), children (seven) and newborns (four). Five analysed only women or girls and two had samples exclusively constituted my migrants.

Eligible studies focused on subjective health assessment, functional indicators and medical health. The majority (fifty-eight) used medical health outcomes, among which obesity and mental health were the most common, used in fifteen and fourteen publications, respectively. Subjective health assessments were used in twelve publications, mostly measured by self-

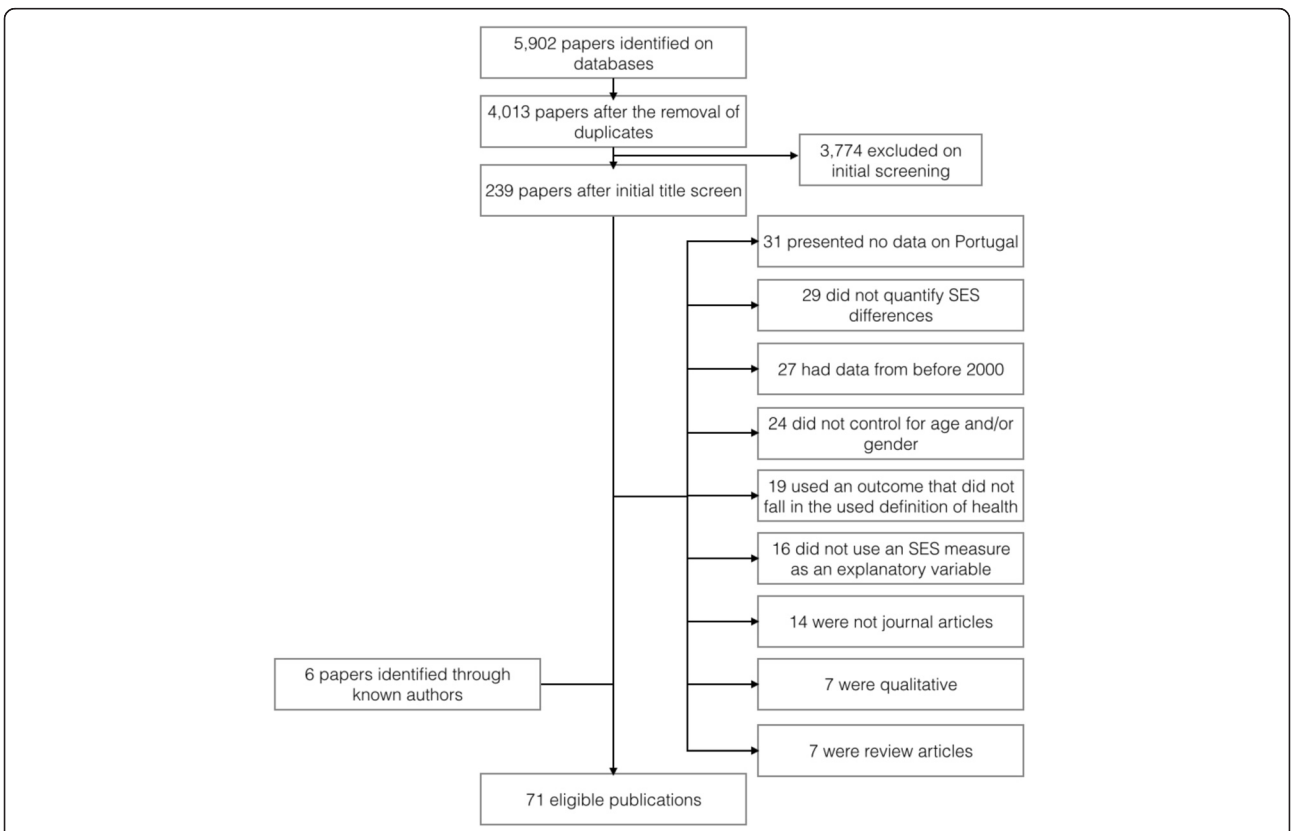

Fig. 1 Process of study selection

assessed health. Finally, functional indicators were used in only ten publications, including measures of physical ability, cognitive ability, sickness absence and pain.

The most commonly used SES measure was education, used in thirty-three publications, followed closely by gender, used in twenty-eight. All other SES indicators were each used in less than twelve publications and were mostly measured at an individual level, except in the five ecological analyses and one multilevel analysis [18].

Table 1 summarizes the main results by health outcome and SES indicator. Publications looking at the association between place of residence showed that urban environment and deprivation were associated with worse health (see, for example, references [19] and [20]). For inequalities related to migration, mortality was consistently worse in migrants [21, 22] but migrant adolescents had better health [23–25]. Being employed or having a more differentiated occupation was either strongly or not associated with better health, never the opposite [21, 26–31]. Only two publications showed (some) worse health indicators for men as compared to women [32, 33]; otherwise, women consistently showed worse results for a variety of health outcomes [32, 34]. Only one study found an association between religion and life satisfaction [19]. Education was used in thirty-three publications, of which only three found an association between more education and worse health [19, 35, 36]; all others found strong associations between ill-health and lower education [20, 26, 31, 37–40]. Most publications that looked at health inequalities according to marital status found no association (see, for example, references [19, 31, 41]). Only six publications looked at income-related health inequalities and pro-poor inequalities were found in half of these [19, 28, 31]. Social capital was analysed using individual measures of social support and social activities, which were found to be associated with better health [28, 42].

Synthesis of results

Figure 2 summarizes the associations found between SES indicators and health outcomes among the most commonly used variables. It stands out that obesity, mental health and subjective health were the most commonly employed health outcomes, and education and gender the most common SES variables. It is also clear that the strongest evidence for health inequalities exists between lower education and obesity and subjective ill-health, and between female gender and mental health symptoms and subjective ill-health.

Obesity and education were strongly linked in six publications, both for adults [31, 33, 43, 44] and for children and their parents' education [45, 46]. The two of these studies that stratified the analyses by gender showed an effect only in women [43, 44]. One of these [43] had a longitudinal design and measured incidence rates of central and overall obesity in both women and men, showing a much lower rate in educated women (the adjusted risk ratio (RR) of women with over 11 years of education was 0.43 of that of those with less than 5 years, 95 % Confidence Interval (CI) = 0.22–0.84).

Education was also strongly linked to worse self-rated health in five publications, all using cross-sectional data. One showed no effect on men [39], but others showed an effect on both genders [47–49]. Schutte et al. (2013), for example, calculated that controlling for age, marital status and urbanization level, women in the lowest educational group were almost six times more likely to report poor health (Relative Index of Inequality (RII) = 5.9; 95 % Confidence Interval (CI) = 2.6–13.4) and men1.4 times (RII = 1.4; 95 % CI = 0.6–3.3) [39].

Strong evidence of gender health inequalities was also found. Of the six studies looking at gender and subjective health measures, only one - using a non-random sampling procedure - showed no association [19]. All others showed a strong association favouring men [28, 32, 47, 50, 51]. Perelman (2012), for example, used a community sample of over 30,000 randomly selected adults (from the National Health Survey) and after adjusting for other SES indicators such as income, marital status, occupation, employment, among others, showed that women still had between 1.4 and 2.3 higher odds of reporting bad SRH [32].

Female gender was also strongly linked to mental health symptoms. Of the nine studies looking at this link, two found no association, one of which used a non-random procedure and the other had no information on the sampling procedure [24, 52]. The other seven publications analysed children [53, 54], adolescents [23, 55] and adults [32, 34, 56], looking at a range of mental health outcomes, from depressive symptoms [55] to insomnia [53]. Santos (2014a), for example, used a random sample of adults over 50 registered in primary care from two health registries and showed that, after controlling for multiple medical conditions and health behaviours, women scored significantly higher on the Geriatric Depression Scale [56].

Discussion

Summary of evidence

This review identified the most studied health inequalities that have been evidenced in the literature for the Portuguese population since the year 2000. We selected 71 publications that explored a wide range of SES indicators and health outcomes, but strong evidence was found on health inequalities related to education and gender, mostly for obesity, SRH and mental health symptoms. In most cases, a large, significant and negative relationship was observed between SES and health outcomes.

Table 1 Description of main results of eligible publications, according to SES variable and health outcome used

		Health outcome		
		Medical indicators	Functional indicators	Subjective health
Socioeconomic determinants	Place of residence	Physical health tended to be better among rural adolescents (Machado-Rodrigues, 2012, Machado-Rodrigues, 2011) and less deprived neighborhoods (Bastos, 2013). Parental perceptions of better neighborhood environments also tended to show an association with better physical (Nogueira, 2013a, Machado-Rodrigues, 2014) but worse mental health (Carvalho, 2014) among children.	The only study (Nunes, 2010) showed no association between place of residence and cognitive ability.	One study (Humboldt, 2014) showed that life satisfaction was better in rural areas.
	Race/ethnicity/ culture/language	Migrants showed higher mortality (Harding, 2008, Williamson, 2009), worse oral health (Pereira, 2013) and a higher percentage of small preterm births (Harding, 2006b). On the other hand, migrant adolescents had less mental health problems (Neto, 2009 and Neto, 2010) and better cardiorespiratory fitness (Santos, 2011).		There were differences in SRH among nationalities in one study (Dias, 2013), but all other studies showed no association between migration, ethnicity or nationality and subjective health (Malmusi, 2014 and Humboldt, 2014).
	Occupation	Most studies showed a strong association between unemployment or less differentiated occupations and worse health (see, for example, Fraga, 2014 or Santos, 2008), although some found no association (for example Alves, 2012 or Bastos, 2013). None found an opposite result.	One study (Azevedo, 2012) found people who were unemployed or retired were more likely to suffer from chronic pain.	Silva (2014) showed strong associations between employment and more differentiated occupations with SRH. On the other hand, Humboldt (2014) found no association between employment and life satisfaction.
	Gender/sex	Almost all studies showed an association between being female and worse health (see, for example, Santos, 2011 or Bulhões, 2013). Some studies found no gender differences (see, for example, Bastos, 2013 or Neto, 2010) and two found the opposite association (Perelman, 2012 and Stewart-Knox, 2012).	Women were more likely to take sickness absence (Masterkaasa, 2014 and Perelman, 2012) and report chronic pain (Azevedo, 2012 and Perelman, 2012), and one study showed men reported more bed days (Perelman, 2012). Cognitive abilities differed between genders, depending on the test used (Martins, 2012, Santos, 2014a).	Almost every study showed women had worse subjective health outcomes (see, for example, Bambra, 2009, Dias, 2013 or Pereira, 2011).
	Religion	One study showed no association between religion or spirituality and the onset of major depression (Leurent, 2013).		One study showed religious people showed higher life satisfaction (Humboldt, 2014), and another showed no association between religion or spirituality and quality of life or well-being (Vilhena, 2014).
	Education	Lower education tended to show a strong association with worse health in almost all studies (see, for example, Bastos, 2013 or Santos, 2010). There were two exceptions: Lawlor, 2005, who showed that insulin resistance was more common in children of more educated parents and Costa, 2008, who showed girls whose parents were more	Education was strongly associated with cognitive ability (Martins, 2012, Nunes, 2010 and Santos, 2014a), chronic pain (Azevedo, 2012) and functional limitations (Eikemo, 2008, Knesebeck, 2006).	Better SRH was associated with higher education in all studies (see, for example, Knesebeck, 2006 or Silva, 2014) except one, that showed the opposite (Humboldt, 2014).

Table 1 Description of main results of eligible publications, according to SES variable and health outcome used *(Continued)*

	educated had more eating disorder symptomatology.		
Socioeconomic status	Married individuals tended to show better health outcomes (see, for example, Harding, 2008 or Williamson, 2009), but had higher odds of being obese (Alves, 2012 and Goulão, 2015). Income, deprivation and financial difficulties showed conflicting results: while most studies tended to show worse health outcomes for more deprived people (see, for example, Pereira, 2013 or Alves, 2012) or no association at all (see, for example, Correia, 2014 or Pimenta, 2011), there were some exceptions that showed, for example, lower prevalence of obesity among homeless people (Oliveira, 2012) or more insulin resistance among children with richer parents (Lawlor, 2005).	One study (Azevedo, 2012) found no association between marital status and chronic pain. Early life SES, as measured by height, was strongly associated with chronic pain in women (Perelman, 2014).	Objective income (Humboldt, 2014, Silva, 2014) and perceived income (Dias, 2013) were found to be associated with subjective health, but not marital status (Humboldt, 2014) or height, as a measure of early life SES (Perelman, 2014).
Social capital	One study (Ferreira-Valente, 2014) showed that social support was associated with better psychological functioning.	One study (Ferreira-Valente, 2014) showed that social support had a strong association with physical functioning, but not pain intensity.	Number of activities outside the home was the only social capital indicator that showed an association with SRH (Silva, 2014). Other analyses showed no association (Vilhena, 2014, Silva, 2014).

Note: no eligible publication explored the relationship between 'race/ethnicity/culture/language' or 'religion' and functional indicators
Legend: SRH Self Rated Health. SES Socioeconomic Status

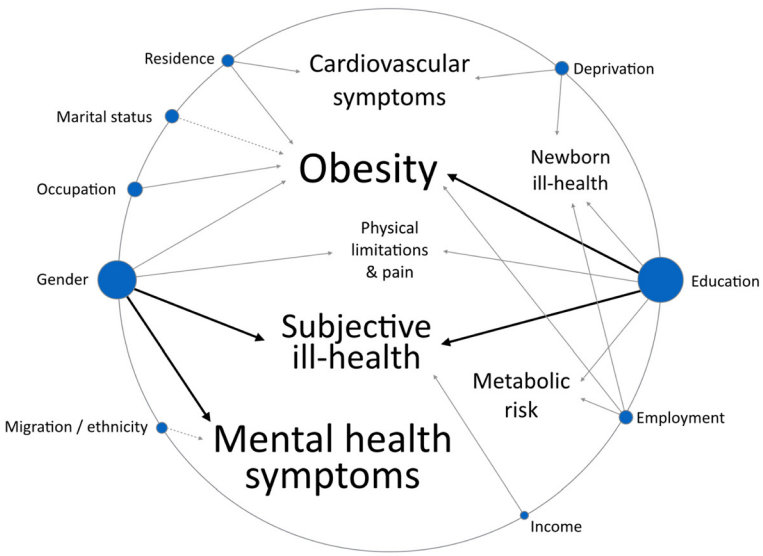

Fig. 2 Diagram representing main results of the associations found in the eligible publications. The visual aspect of the diagram, but not the rules for its construction, was based on the diagram built by Ashley EA et al., "Clinical assessment incorporating a personal genome" The Lancet 375(2010): 1525-35. Note: Font size of health outcomes and circle size of socioeconomic determinants are proportional to the number of eligible publications in which they featured. Black arrows represent strong evidence of an association between socioeconomic indicator and health outcome; grey arrows represent weak evidence and dashed arrows represent evidence of the "negative" associations. In the results obtained, "negative" includes migrant populations having better mental health and married individuals having higher prevalence of obesity. Evidence of all other associations had a "positive" direction, i.e., ill health was associated with lower education, lower income, female gender, unemployment, deprivation, having less differentiated occupations and living in an unfavourable or urban area. Details on how this diagram was constructed are in the online Additional file 3

Education was the most frequently studied determinant of health and for which most evidence exists of health inequalities. Evidence of educational inequalities in obesity was particularly common, especially for women, as the two studies that stratified the analysis by gender found only women showed significant inequalities [43, 44]. This suggests educational inequalities in overweight/obesity are found mostly or exclusively in women. This is not unique for Portugal: Roskam et al. (2010) found that other southern European countries also show high education inequalities in overweight and obesity only for women [57]. In this analysis, Portugal had the highest educational inequalities in overweight and obesity among women in all the countries analysed. This can be a consequence of various factors, such as inequalities in physical activity, dietary patterns or parity. However, both men and women seem to show the same extent of educational inequalities in physical activity and diet in Portugal [58, 59], which makes them unlikely factors in explaining inequalities in obesity seen mostly in women. On the other hand, women with lower education in Portugal have a higher fertility index [60], and since higher parity is strongly associated with obesity [61], this might be the most suitable explanation for the high educational inequalities in overweight and obesity seen for women in Portugal.

Education was also strongly associated with SRH [28, 39, 47–49], which is consistent with other international analyses [49, 62]. Interestingly a European comparison among 22 countries found that Portuguese men showed the highest education inequalities in SRH when compared to other countries [49]. However, educational inequalities in SRH should be interpreted with caution. As Huisman, Lenthe and Mackenbach (2007) pointed out, the predictive ability of SRH for mortality varies significantly among educational groups for men [63]. This probably reflects educational differences in men's health perception, biasing the answers to questions on subjective health.

Our review also suggested strong gender inequalities in both SRH and mental health symptoms. Gender-related health inequalities is a broad and complex topic. Despite the prevailing notion that men have higher mortality and women higher morbidity [64], this has been challenged in the literature, and contradictory patterns continue to appear [65, 66]. Additionally, gender inequalities in health are probably a result of multiple factors, including biological and social [67], which raises questions of whether they should be considered as unfair or as unavoidable. Despite this, almost every publication that explored gender differences in our review showed strongly favourable results for men, particularly for mental health symptoms and SRH [32]. Noticeably, no publication explored gender differences in mortality.

Academic attention to health inequalities in Portugal has tended to focus on specific topics. Gender and education are by far the most commonly used SES indicators, possibly because they are the most easily measurable, commonly used in surveys with high response rates and high validity of answers and are less affected by reverse causation. Twelve publications also looked at health inequalities between migrants and Portuguese natives; this is surprising considering Portugal is one of the European countries with the lowest proportion of migrant population among its residents [68]. This could be imputed to both the ease of measurement of this variable and the presence of research groups in the country investigating this subject.

Other SES indicators appear to have been overlooked. For example, despite the growing literature on the effect of place in health, only a few publications explored this topic, most of which focused on rural/urban differences. There was also a notable deficiency of studies of social capital and poverty, despite Portugal's high income inequality [6] and considerable risk of poverty and social exclusion [69]. Additionally, despite the growing recognition of the time dimension in the building of health inequalities [70], no publication took a life course approach to how SES indicators might affect health. This, coupled with the scarcity of longitudinal studies, substantially precludes the possibility of assessing causal relationships. This also speaks to a very scarce focus on the elderly - of the 71 eligible publications, only 7 focused on older people, which is surprising in a country where the old-age dependency ratio was the fifth highest in Europe in 2014 [71].

In 2013, the major causes of death in Portugal were diseases of the circulatory system (30), malignant tumours (24), diseases of the respiratory system (12), and endocrine, nutritional and metabolic diseases (5 %) [72]. In this sense, despite malignant tumours being the second most common cause of death, after circulatory diseases, there are strikingly few publications focusing on this health issue (four, of which two are ecological). This might again reflect the absence of a nationally oriented research policy, in part attributable to absence of political attention to this issue [3, 4, 8]. This is also the case for respiratory diseases, which are also almost absent from our analysis. In a recent report of a consortium published by the European Commission on Health Inequalities, Portugal was described as having "[clear] difficulties in measuring and analysing health inequalities" [73] (page 129). Interestingly, the current Portuguese National Health Plan identifies the reduction of child obesity as one of its four goals for 2020, but with no focus on its unequal distribution among socioeconomic groups [74]. This plan does mention the importance of the social determinants of health, but focuses almost exclusively on the access to health care services as a remedy for health inequalities [74].

The limited attention given to health inequalities in Portugal can only be explained with an extensive

exploration of multiple factors, but one of these factors is probably the engrained belief that the National Health Service, as a universal and (relatively) inexpensive service at point of care, is enough to face these inequalities. However, this is apparently not true, as this review has shown there are still important health inequalities in Portugal. Tackling these inequalities will demand an important effort to build an organized research and policy strategy that will have to go beyond the National Health Service. It is important to notice that Portugal is amongst the most unequal countries in Europe, so that it could benefit from a more progressive taxation scheme and higher social protection to the poorest, which are major evidence-based and consensual measures to fight inequalities in health [75].

Limitations

This review tried to bring together analyses not always comparable among them. In fact, many of these publications focused on specific populations – migrants, children or certain regions in Portugal – that might have particular patterns of health inequalities. This might have hidden inequalities that are not apparent when all groups are pooled together. Our search strategy might have also excluded important publications, namely international comparisons that included a Portuguese sample not specifically mentioned. However, we tried to overcome this by searching for publications by researchers known for having published in this area. The quality of the analyses in the reviewed publications was found to be heterogeneous, with some presenting highly reliable analyses and others relying on 'convenience samples', or on small sample sizes. Following the PRISMA guidelines, we chose not to score nor select the publications based on 'quality', but to carry out a brief assessment of strengths and limitations on each (table in Additional file 2). Also, we focused our review on papers published in indexed peer-reviewed journals according to good practices of scientific research, but this may have excluded important publications, in particular from the grey literature.

Finally, we restricted our analysis to health outcomes, and did not consider mediating factors such as lifestyle and healthcare use. Also, we did not consider studies on interventions to decrease inequalities in health. We adopted this strategy to avoid a too large scope for the review, which would have complicated the identification of general trends and interpretations. Further research should focus on these connected issues.

Along this paper, we referred to "inequalities" in health instead of other possible terms such as "inequity" or "differences". In particular, inequity refers to differences that are unjust, unfair and avoidable [76]. This option was made because the concept of inequality is more neutral in terms of interpretations and value judgements, whereas the term "inequity" implies strong assumptions about the causes of differences, which none of the reviewed papers could confirm. Additionally, most reviewed papers referred to inequalities in health, so we opted to be faithful to authors' interpretations.

Conclusions

We have shown that there is strong evidence of socioeconomic health inequalities in Portugal and comparative analyses show that these are possibly one of the highest among European countries. We identified education and gender as the main determinants of health inequalities, affecting mostly the distribution of obesity, self-rated health and mental health symptoms. The publications we identified also reflect the absence of a nationally oriented research strategy on health inequalities focusing on the most prevalent diseases (such as malignant tumours and respiratory diseases), determining factors of inequalities (living contexts, poverty or social capital) and vulnerable populations (such as the elderly). We hope this review will help guide decision-making to tackle these issues, as has long been recommended.

Additional files

Additional file 1: Detailed search strategy. (PDF 79 kb)

Additional file 2: Table of extracted data from the 71 eligible publications. (PDF 196 kb)

Additional file 3: Description of rules adopted to build diagram in Fig. 2 of the main text. (DOCX 16 kb)

Additional file 4: Complete list of the seventy one eligible publications identified by the systematic review, by alphabetical order. (PDF 70 kb)

Competing interests

The authors have no competing interests to declare.

Authors' contributions

ICM contributed to study conceptualisation and design, data acquisition, selection and analysis, and drafted the manuscript. GR contributed to study conceptualisation and design, data selection and manuscript revision. JP contributed to study conceptualisation and design, data selection and extraction and manuscript revision. All authors approved the final manuscript.

Acknowledgements

The authors wish to thank the contribution of the researchers from the Nova Healthcare Initiative, who provided comments on a late draft of this paper. The final paper is the responsibility of the authors.
This project has been financed by the Fundação para Ciência e Tecnologia (Grant VIH/SAL/0065/2011).

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Received: 23 November 2015 Accepted: 1 February 2016
Published online: 16 February 2016

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2.4. Shifting determinants of health inequalities in unstable times: Portugal as a case study

Reference:

Campos-Matos I, Russo G, Gonçalves L. Shifting determinants of health inequalities in unstable times: Portugal as a case study. Accepted for publication in the *European Journal of Public Health* in May 2017. DOI: https://dx.doi.org/10.1093/eurpub/ckx080

Online supplementary data for this publication is in Appendix 4.

European Journal of Public Health, 1–6

doi:10.1093/eurpub/ckx080

Shifting determinants of health inequalities in unstable times: Portugal as a case study

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Background: We explore how health inequalities (HI) changed in Portugal over the last decade, considering it is one of the most unequal European countries and has gone through major economic changes. We describe how inequalities in limitations changed considering different socioeconomic determinants, in order to understand what drove changes in HI. **Methods:** We used cross-sectional waves from the European Survey on Income and Living Conditions database to determine how inequalities in health limitations changed between 2004 and 2014 in Portugal in residents aged 16 years and over. We calculated prevalence estimates of limitations and differences between income terciles, the concentration index for each year and its decomposition and multiple logistic regressions to estimate the association between socioeconomic determinants and limitations. **Results:** The prevalence of health limitations increased in Portugal since 2004, especially after 2010, from 35 to 47%. But the difference between top and bottom income terciles decreased from 23 to 10 percentage points, as richer people experienced a steeper increase. This was driven by an increase in prevalence among economically active people, who, from 2011 onwards, had more limitations (OR and 95% CI were 2.42 [2.13–2.75] in 2004 and 0.71 [0.65–0.78] in 2014). **Conclusion:** These results suggest worsening health in Portugal in the last decade, possibly connected to periods of economic instability. However, absolute HI decreased considerably in the same period. We discuss the possible role of diverse adaptation capacity of socioeconomic groups, and of high emigration rates of young, healthier people, reflecting another side of the 'migrant health effect'.

Introduction

Socioeconomic health inequalities (HI) are ubiquitous. They have been observed worldwide as long as data have been available. It appears that, regardless of place and time, health tends to follow the patterning of socioeconomic differences (1).

Various socioeconomic indicators—education, financial resources, employment or occupation—determine HI, operating through different pathways. Education leads to better information, cognitive abilities and determines preferences (2); financial resources, such as income or wealth, allow individuals to access health-producing resources, such as healthcare or housing. Employment not only provides income, but also a sense of control over one's life, lack of which is strongly associated with important stress reactions, which can deteriorate health (3). People with higher occupational grades also tend to have a stronger sense of control over their health, their jobs and their lives (4), but occupation can also reflect an individual's place in society, showing the effect of rank and subjective feelings towards one's position in society (2). The simultaneous analysis of various socioeconomic determinants of HI can provide clues as to which processes are more important in the creation of HI (5). A better understanding of which processes shape HI will help to build a base to design policies that tackle them effectively.

Portugal is a particularly interesting case study for HI. The country has had low economic growth (6), and despite substantial investments in social protection, education and healthcare (7, 8), remains one of the most unequal European Union countries in income distribution (9). This is reflected in health distribution: several analyses found Portugal to have some of the highest HI among European countries (10–12). Additionally, Portugal has gone through a period of economic crisis and implementation of austerity measures in the last years, that have led to a spike in emigration (13) and a deterioration of public social services (14). A recent review of the impact of economic crises found that they tended to aggravate HI in a variety of countries (15). However, the review noted that results were variable, perhaps due to differing welfare policies, or the diversity of health and socioeconomic variables. Poor understanding of how economic crises shape HI hinders the interpretation of these results.

This work aims to support policy choices that attempt to mitigate the effect of economic crises or other contextual changes on HI. To do this, we describe how HI changed in Portugal over the last decade, in light of the important social and macroeconomic changes that the country has been through, and how the socioeconomic determinants of these inequalities changed. We used data from the cross-sectional waves of the European Survey on Income and Living Conditions (EU-SILC), from 2004 to 2014. Portugal is used as a case study, but this analysis is applicable to other countries as it describes how determinants of HI can be shaped by contextual transformations. This is particularly useful considering that many countries have recently gone through similar macroeconomic changes as Portugal.

Methods

This analysis was performed using data from the Portuguese cross-sectional waves of EU-SILC between 2004 and 2014 (provided by Eurostat in December 2015). EU-SILC is an annual survey carried out in several European countries with a mixed longitudinal and cross-sectional design. Despite this mixed design, cross-sectional samples are representative of the target population when appropriate weights are used (16). Portugal participates since 2004 using a stratified, multi-stage, household-based sample. The survey collects data on living conditions and includes three health related questions:

limitations in daily activities due to health problems, self-reported health (SRH) and chronic conditions.

We used 'limitations' as our health outcome. Individuals were asked if they were limited in activities they usually did because of health problems. Possible answers included 'Yes, strongly limited', 'Yes, limited' or 'No'. The first two options were collapsed, creating a binary variable (1 = 'with limitations', 0 = 'without limitations'). This health outcome was chosen as it provides an objective measure than SRH and should capture health status more accurately (17). The initial descriptive analysis was also done for the other two health variables: SRH and chronic conditions. SRH is a widely used survey measure in which respondents rate their overall health; we used SRH as a binary variable in which 'bad' and 'very bar' health were the outcome. 'Chronic conditions' is a self-assessed question in which respondents are asked whether they have a chronic condition; this was also used as a binary variable, in which having a chronic condition was the outcome.

The following variables were included in the analysis:

- Age at interview (in years).
- Sex (male or female).
- Income: yearly household equivalised disposable income, in euros, deflated using the harmonised index of consumer prices (18).
- Education: defined by highest International Standard Classification of Education (ISCED) level attained (19), categorised into 'primary or less' or 'more than primary'.
- Occupation: based on the International Standard Classification of Occupations (ISCO) used in EU-SILC, occupations were categorised in white or blue collar, following previous work (ISCO codes 1–5 were white collar, 6–9 blue collar and armed forces were excluded) (20).
- Activity: based on the EU-SILC variable 'self-defined current economic status', people were categorised as 'active' if they defined themselves as being employed (part or full time), in training or studying, or fulfilling domestic tasks; and 'inactive' if they were unemployed, retired, unfit to work or in the 'other inactive' category.
- Savings: EU-SILC further asks households about their capacity to face unexpected financial expenses and to afford one-week annual holiday away from home. These two variables were merged and transformed into a binary variable so that the value '0' was attributed to households who could afford both and '1' to the remaining households.

We used the complete sample of residents aged 16 and over. The proportion of individuals who had limitations was calculated for each year in the overall sample, within each income tercile, and stratified by age groups. Income terciles were calculated according to the distribution of income for each year.

The concentration index (CIx) for income-related inequalities in limitations was calculated for each year. The CIx is a measure of inequalities based on the health concentration curve. This curve is the result of plotting of the cumulative percentage of individuals, ranked by income, with the cumulative percentage of limitations. In this plot, perfect equality is represented by a diagonal line, showing an equal distribution of limitations among the population, regardless of income. The CIx is calculated as twice the area between the concentration curve and the line of perfect equality. When there is perfect equality, the CIx is zero. By convention, if all limitations are concentrated in the richest (poorest) person, the CIx is 1 (-1). However, with dichotomous outcome variables, the CIx is not within the [-1,1] range and between-year comparability may be limited; following Wagstaff (21), to minimise this limitation, we normalised the CIx by dividing it by 1 minus the proportion of respondents reporting limitations in each year.

Wagstaff et al. (22) showed that the CIx can be decomposed into contributions of individual factors to the income-related HI. This analysis allows for the quantification of how each factor (i.e. each socioeconomic variable) contributes to the overall distribution of the health outcome among income ranks. The contribution of each factor is the product of the elasticity of that factor with respect to the health variable (i.e. the proportional change of a specific factor in relation to a proportional change in the health variable) and the CIx of that factor (i.e. the degree of income-related inequality of that factor).

Finally, we performed a multiple logistic regression for each year, using the dichotomous health variable (limitations) as an outcome. We included all the demographic and socioeconomic variables listed above as explanatory variables: age, sex, income, education, occupation, activity and savings. These were all added to the model simultaneously.

Analyses were weighed by a personal cross-sectional weight provided by the EU-SILC database, which controls for geographical, household size, gender, and age group distribution, and non-response within each household. Analyses were done on SPSS Statistics v21 and in ADePT Software v6.0 using a non-linear model for the CIx.

Results

Table 1 summarises the sample characteristics. Yearly sample size ranged from 9947 individuals in 2007 to 14 650 in 2014. Average age increased from 46.3 to 49.0-years-old from 2004 to 2014. The proportion of individuals with limitations also increased from 35.2 to 47.3%. Median income increased between 2004 and 2012, from 5869 to 8366 euros per year, and dropped to 8265 euros in 2014. There was also an increase in the proportion of people with secondary and tertiary education and in white-collar occupations, both representing approximately half the sample in 2014. The proportion of active people decreased from 70% in 2004 to 58.5% in 2014.

Figure 1 shows the proportion of individuals with limitations by year. This proportion was stable at around 30% until 2011, when it increased to 43%, and then increased again in 2014 to 47%. These changes occurred in all income terciles, but a few differences were noticeable: (i) in almost every year, the proportion of people with limitations was higher in the first tercile (the lowest-income population group), followed by the second, and lowest in the third; (ii) this difference was stable until 2011, when the proportion of limitations increased in all terciles, most markedly in the second and third; (iii) this led to a decrease in the absolute difference in limitations inequalities between the first and third income terciles. Figure 1 points out the absolute differences between the first and third income terciles in four years (23% age points in 2004 and 2010, 16 in 2011, and 10 in 2014). When stratified by age groups, the analysis presented in figure 1 shows that inequalities in limitations were highest in the older age groups, the increase in limitations in 2011 occurred in younger age groups, and the oldest age groups showed a decrease in limitations in 2012 (Supplementary figure S1A).

The CIx was negative every year, as the prevalence of limitations was higher in poorer people (figure 2). The CIx ranged between 0.15 and 0.18 (in absolute values) until 2010 and dropped in 2011 to 0.09 and to 0.05 in 2014. Until 2010, every socioeconomic variable had a negative contribution to the CIx, meaning that they all contributed to pro-poor inequality in the distribution of limitations. However, after 2010 there were a few noticeable changes.

First, activity now gave a positive contribution to the CIx. Detailed analysis of the contribution of each variable (Supplementary table S1A) showed that the elasticity of limitations with respect to activity changed in 2011, from positive to a negative contribution; the CIx of activity, on the other hand, remained stable. This means that, in all years, inactive people had lower incomes when compared with active people. However, while limitations were more prevalent in inactive people until 2010, they were more prevalent in active people after this year.

Table 1 Sample characteristics per year

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Sample size	11 690	10 706	10 148	9947	10 101	11 101	11 380	12 489	13 584	14 009	14 650
Age (mean)	46.3	46.6	46.8	47.0	47.2	47.4	47.7	47.9	48.8	48.7	49.0
Gender (women, %)	52.2	52.2	52.2	52.2	52.2	52.2	52.2	52.2	52.9	53.0	53.1
Limitations (%)	35.2	29.3	28.7	30.1	30.0	31.9	31.3	43.3	38.5	38.8	47.3
Income (€, median)	5869.50	6242.08	6512.14	6924.29	7672.91	7735.13	8198.83	8271.50	8366.97	8285.95	8265.94
Income (€, lowest tercile cut-off—P33)	4530.13	4841.51	5160.42	5465.58	6011.53	6163.88	6377.49	6537.98	6599.24	6592.84	6414.43
Income (€, highest tercile cut-off—P66)	7583.07	7956.39	8280.41	9215.01	9716.13	9821.59	10 372.96	10 581.76	10 571.86	10 606.75	10 411.02
Education (more than primary, %)	45.9	46.0	45.5	47.5	48.6	50.9	51.5	54.4	52.8	55.7	52.9
Occupation (white collar, %)	44.6	43.4	42.4	43.0	43.8	44.1	44.1	45.0	48.8	49.9	51.3
Activity (active, %)	70.2	69.8	69.4	68.8	68.6	64.0	62.8	62.3	58.8	57.6	58.5
Savings (can afford unexpected expenses and annual holiday, %)	38.3	39.6	39.1	37.8	34.6	35.5	34.4	40.0	37.7	34.1	37.1

Notes: Sample includes all individuals in the survey (16 years and older). Income refers to yearly household equivalised income, in euros, deflated using the harmonised index of consumer prices, base year 2015. 'Active' people include individuals who defined themselves as being employed, in training or studying, or fulfilling domestic tasks. 'Savings' is a variable build from two variables (capacity to face unexpected financial expenses and capacity to afford a one-week holiday per year). All values (except sample size) are calculated using sample weights for geographical, household size, gender and age group distribution, and non-response within each household. P33 and P66 are percentile 33 and 66, respectively.

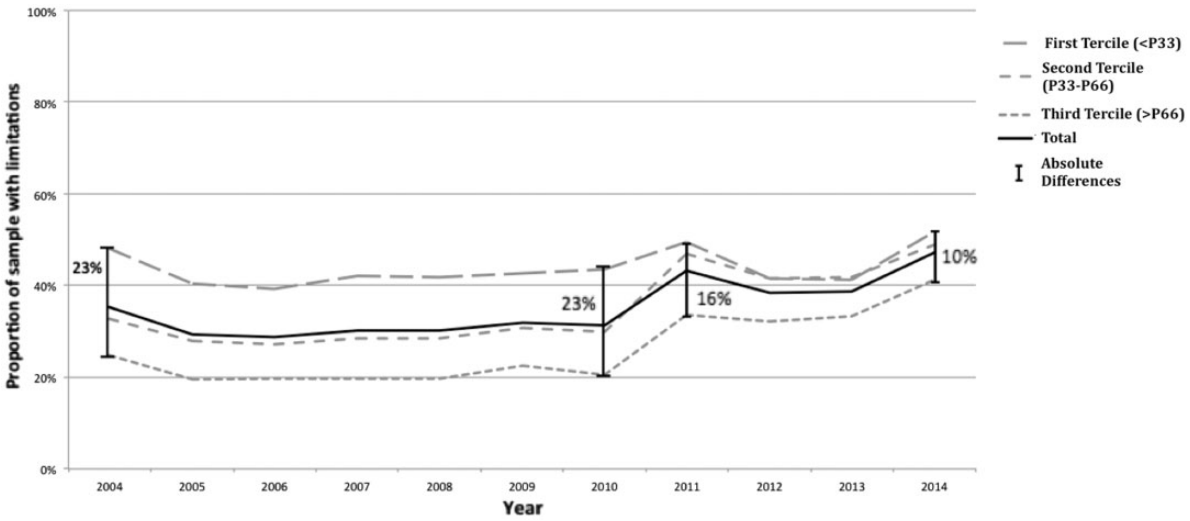

Figure 1 Proportion of the sample with limitations per income tercile and in total. Notes: Income terciles are defined for the income distribution within that year. Values are weighed so as to reflect the geographical, gender, age group, household size distribution and the non-response rate within each household, but do not control for compositional differences between income tercile groups. Absolute differences between the first and third terciles are presented for clarity for 2004, 2010, 2011 and 2014

Second, the contribution of education was considerably reduced from around 0.03 until 2010 to less than half from 2011. The CIx of education remained approximately the same through the years, but its elasticity changed, indicating differences in limitations between educational groups decreased over the years.

Third, occupation, which had a small contribution up until 2010, became the most important component of the CIx from 2011 onwards. This was due to an increase in the elasticity of the occupation component, meaning that inequalities in limitations between occupational groups increased.

These findings are further explored by yearly logistic regression analyses. Figure 3 shows the odds ratios (OR) for occupation, education and activity for multiple logistic regressions for each year, which controlled for socioeconomic and demographic variables. These show that, controlling for other variables, the odds of limitations were always higher in blue collar workers when compared with white collar, but especially so from 2011 onwards. People with primary education or less had higher odds of limitations when compared with people with more than primary education, although this decreased significantly from 2010 onwards. Finally, when compared with active people, inactive people showed significantly higher odds of limitations up until 2010, and from 2011 onwards this was inverted, as the OR was below 1.

Analysis of the other two health outcomes provided by EU-SILC—SRH and chronic conditions—did not show such marked changes in the overall sample or in each income tercile over the years (Supplementary figures S1B and C).

Discussion

This analysis showed that health limitations increased in Portugal over the last decade, especially after 2010. This occurred in a time of socioeconomic instability, after the first announcement of austerity measures in 2010, followed by resignation of the ruling government and the beginning of external financial intervention (23). Immediate health impacts of recessions and economic crises were also reported in other European countries such as Spain (24) and Greece (25).

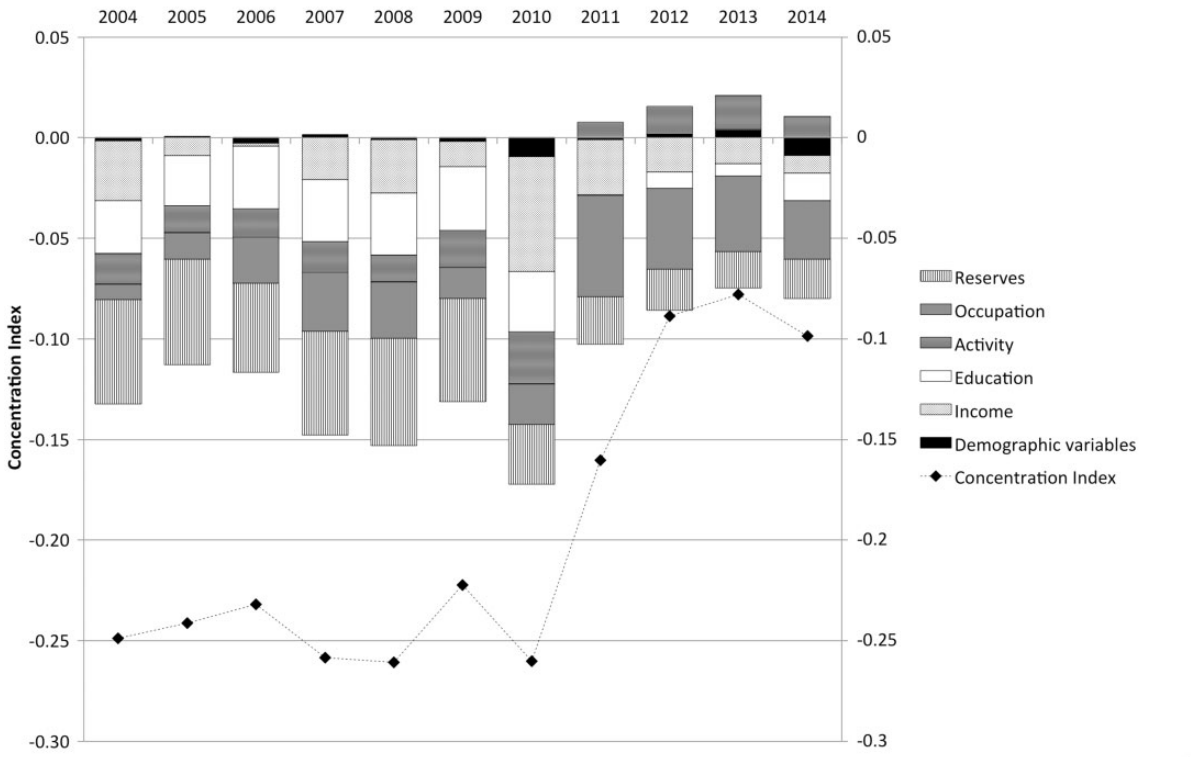

Figure 2 Concentration index and decomposition of its components for income-related inequalities in limitations per year. Notes: For visual simplicity, residuals were excluded from the bar charts (but are included in the total concentration index). The analyses are weighed so as to reflect the geographical, gender, age group, household size distribution and the non-response rate within each household

A second finding was that the increase in prevalence of limitations was particularly marked in the richest terciles of the population, leading to a decrease in income-related inequalities. Between 2010 and 2011, the difference in the prevalence of limitations between the richest and the poorest income terciles decreased from 23 to 16 percentage points. Decomposition of the CIx and logistic regression analyses showed that the decrease in HI was driven by two important changes: (i) an inversion in the distribution of limitations among active and inactive people in 2011, whereby active people had more limitations than inactive people after 2010 and (ii) a decrease in the difference in prevalence of limitations among educational groups, such that people with less education always had higher prevalence of limitations, but less so after 2010.

These findings are somewhat surprising, considering the deterioration of public social services in Portugal in the last years (14), negative growth rate of household disposable income in 2011 (26), and literature showing increases in HI after periods of economic crises and austerity measures (15, 27, 28). However, this literature is not consistent (15). In the case of Portugal, the decrease in HI may be a reflection of different adaptation capacities among socioeconomic groups. Research has shown that declining economies can lead to a deterioration of population health, which may be a consequence of economic circumstances forcing individuals to adapt to unexpected, health damaging events (29). In our analysis, richer individuals showed a steeper increase in limitations, which may reflect more difficulties in adapting to new economic circumstances than poorer people, possibly for inexperience in dealing with a less affluent lifestyle.

The decrease in HI might also be understood in light of a process of selective migration. Emigration in Portugal increased markedly after 2009 (13), making it the 12th country with the highest emigration rate in 2010, most of which affecting the working age population, who also have the highest educational level (30). Migration is a selective process, as healthier people tend to migrate more easily (31); if healthier people migrated at a higher rate than their unhealthy counterparts, this might have led the richer tercile to become unhealthier, contributing to the decrease in HI after 2010. This explanation is compatible with the differences seen among age groups in our EU-SILC Portuguese sample, as the increasing HI were especially marked among the working age population. This would also explain the 'inversion' in the prevalence estimate of limitations between active and inactive people, as emigration would have happened pre-dominantly in people who were active and healthy, thus leaving behind an unhealthier group of active people. This would constitute the other side of the coin of the 'healthy migrant effect'—a finding from multiple epidemiological studies that has shown that migrants are almost always healthier than the population they leave behind (31).

Our results should be interpreted under some limitations. Firstly, data collection for the EU-SILC database might have excluded marginalised groups, as household survey non-respondents tend to have lower socioeconomic status and worse health (32). However, overall household response rates for the Portuguese cross-sectional sample have been around 90% every year (33), a measure that would be considered excellent by many researchers (34), and this analysis used weights that made the sample representative of the target population (35), making this a less likely explanation. Nevertheless, EU-SILC excludes institutionalised and homeless people, who may in the future be warranted as a research focus.

A second limitation is that our selected health variable might be an inadequate measure of respondents' health. Self-reported limitations have been used before as an objective measure of functional limitations (36, 37) and Eurostat uses it as an aspect of disability (38), making it the most objective measure available in EU-SILC. However, it is surprising that the other health variables show considerably less marked changed. On the other hand, studies have also shown that the association between functional limitations and

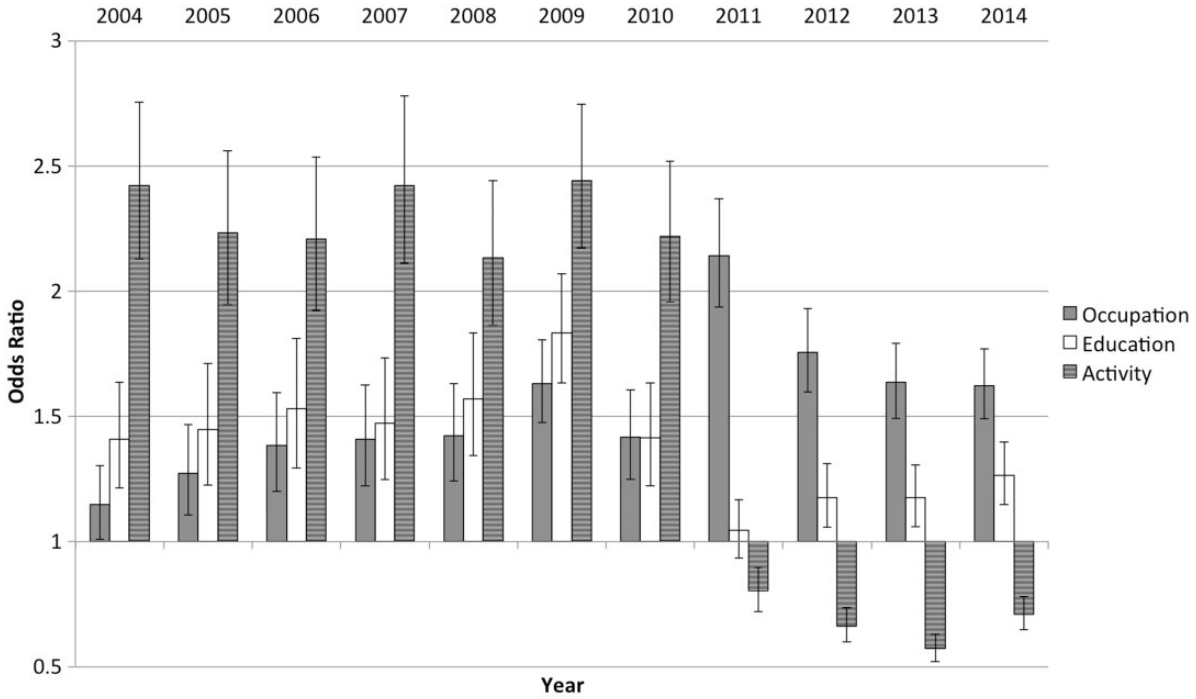

Figure 3 Odds ratios (and 95% confidence intervals) of limitations according to occupation, education and activity per year. Notes: Odds ratios (OR) are calculated from logistic regressions for each year, which controlled for sex, age, income and savings. OR of occupation are blue collar in relation to white collar; OR of education are primary or less in relation to more than primary; OR of activity are inactive in relation to active

SRH can be moderated by demographic and socioeconomic factors such as race (39), gender (40) or education (36). This may mean that, despite showing an increase in prevalence of limitations, richer people in this sample did not necessarily have worsening health status, but may have less capacity to deal with these limitations.

Finally, it is important to note that we interpreted these results through time, but the analysis was based on cross-sectional samples. As such, despite the use of weights that made samples representative of the target population, there might be changes in the composition of the yearly samples populations that could impact the results.

Our findings show that changes in HI may result from profound, sometimes counter-intuitive, changes in the determinants of health. Looking at how the determinants change can help in understanding the underlying mechanisms at work. In the case of Portugal, these might be explained by socioeconomic groups' different ability to changing economic circumstances, or by a process of selective migration, although our analysis alone cannot confirm either. Further analyses should focus on a more detailed exploration of these changes in the determinants of health, perhaps using longitudinal data, in order to capture trajectories rather than compositional changes within socioeconomic groups.

Key points

- Portugal is a good case study for shifting health inequalities (HI), being one of Europe's most unequal countries and having gone through substantial instability in the last decade.
- Prevalence of health limitations increased substantially in Portugal in conjunction with the start of socio-political instability.
- However, HI seem to have decreased over the same period, driven by an increase in limitations in active people.
- The impact of major economic changes in HI may occur through multiple mechanisms, such as migration trends and socio-economic groups' different ability to adapt to changing circumstances.

Supplementary data

Supplementary data are available at *EURPUB* online.

Acknowledgements

I.C.M. is supported by a PhD grant from the Portuguese Foundation of Science and Technology and L.G. is supported by project UID/MAT/00006/2013 from the Centre of Statistics and its Applications from the University of Lisbon.

Conflict of interest: None declared.

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3. Discussion and Conclusions

3.1. Summary of Results

3.1.1. Social Capital and Health in European Countries

Social capital – a resource that can be accessed by individuals from their social interactions – has been extensively associated with better health outcomes (1). Many possible explanations have been put forward: on an individual level, social capital can provide access to information, emotional support, or instrumental assistance; it can also be seen as a group-level construct, to the extent that it can facilitate collective social action, informal social control, or social contagion (2, 3). These multiple theories have raised questions as to whether social capital should be operationalized as an individual or group characteristic (4). Although most authors would agree that it works on both levels, how each level works and how they interact remains contentious. In this analysis, we aimed to clarify these effects and their interaction by describing how changes in individual and contextual social capital influenced individual changes in SAH in European countries between 2002 and 2012.

The first publication of this dissertation used data from the ESS and included 35 European countries in the period between 2002 and 2012. The analysis was done using multilevel models with two levels – country-year[1] and individual. Conditional on sociodemographic variables, we measured how individual social capital, contextual social capital, and an interaction between the two, had an impact on health. Social capital was operationalized as 'general interpersonal trust', a measure that reflects a cohesion-based perspective of social capital (as opposed to a network-based perspective) (2).

This publication showed that individual trust was highly correlated with SAH (such that highest values of trust were generally associated with better health). On the other hand, an association between contextual trust and SAH was not found. However, a strong cross-level interaction showed that individuals with low levels of trust fared worse when in high trust contexts compared to low trust individuals in low trust contexts and to high trust individuals in high trust contexts.

[1] 'Country-year' refers to a country in a particular year; for example Portugal in 2006, Portugal in 2008, or France in 2006, which made up the level 2 observations.

These findings show that context, in particular contextual levels of social capital, has a complex association with health, affecting different groups of people differently, thus potentially changing health distribution. Although similar results had been shown for European countries (4) and US states (5), this analysis was the first to show a particularly strong effect on individuals with low social capital, and the particularly strong negative effect a context with high social capital can have.

Considering the use of a cohesion-based perspective of social capital, this strong negative effect can be interpreted under different lights. It may be that individuals with low social capital are discriminated against in these contexts by a high trusting majority who does not share their values. Discrimination can have an important impact on health (6), which could lead low trust individuals to show poorer SAH. An alternative explanation may be that low trust individuals create closed networks that share harmful social capital amongst them, such as health harming behaviour. The complexity of this relationship – between contextual and individual social capital – challenges the common notion that social capital always has a positive influence on health (7-9), and highlights its potential to shape HI.

3.1.2. Social Mobility and Health in European Welfare Regimes

Social mobility can have an important impact on health distribution within a population. In fact, it has been put forward as the explanation for the persisting high levels of HI in northern European countries with strong welfare states (10). This hypothesis argues that, as these countries have high levels of social mobility, this may facilitate processes of health selection, by which individuals fall (rise) in the social ladder because of their bad (good) health status. As time moves on, social groups become more homogenous, as people who have better health tend to rise to the top and people with worse health tend to fall to the bottom, thus increasing HI. However, despite strong empirical evidence of the existence of a process of health selection, it is not clear whether it plays a role in the creation of HI (11, 12).

The second publication of this dissertation aimed to analyse the relationship between social mobility and HI in six different European welfare regime types. By looking at this relationship and how it differed between regimes, we hoped to understand whether processes of social mobility could explain differences in HI between welfare regimes.

We used data from six rounds of the ESS, between 2002 and 2012, which included 36 countries and 237,535 individuals. Data was organized in three levels – individuals, years and countries – and analysed using multilevel statistical techniques. Countries were grouped according to their welfare regime type and analyses were done separately for each group. Each individual was attributed one of three social mobility paths: upward, stable, or downward, according to the differences between their own and their mother and father's educational achievement (analyses were done separately for mother and father). Health was operationalized as a binary variable: 1 for 'bad' or 'very bad' SAH and 0 for 'fair', 'good', and 'very good'. In order to ensure that the social movement itself was analysed and the effects of childhood circumstances were excluded, analyses were controlled for parental education. We calculated relative (OR) and absolute (risk difference) measures of the association between social mobility and SAH for each welfare regime type.

Results showed that upward mobility (when compared to being socially 'stable') was positively associated with better health in all welfare regime types, measured both from mother and father's achievement, using absolute and relative measures. On a relative scale, these results were statistically significant for $p<0.05$. On an absolute scale, former USSR countries showed the biggest and only significant difference for upward movement (4.1 and 3.8% difference, when social mobility was measured from the mother's or the father's achievement, respectively). Scandinavian countries showed the smallest and not significant differences: 0.8 and 0.9% difference, from mother or father's, respectively.

Overall, this analysis showed that social mobility was associated with differences in health in all welfare regime types, but Scandinavian countries showed the smallest association. Despite having high levels of social mobility, these countries seemed to efficiently separate it from health, more so than countries from other welfare regime types. These results suggest that the 'paradox' of high HI in northern European countries is unlikely to be due to social mobility differences among welfare regime types. This analysis did not test other hypotheses on why HI remain high in northern European countries, but showed that welfare regimes play a role in determining both levels of population health and health distribution in European countries.

3.1.3. Social Determinants of Health in Portugal

As one of the most unequal countries in Europe, both in terms of income distribution (13) and health distribution (14), Portugal presents an interesting case study for understanding HI. Despite the high levels of inequality, WHO identified HI as an 'important policy gap' in the Portuguese National Health Plan (15), which reflects the low political interest in the subject and the absence of a national strategy in place to tackle these inequalities. It was thus important to systematize current knowledge on socioeconomic HI in Portugal, to set a stepping-stone towards a possible strategy to tackle HI in the country. For this, we carried out a SR of the literature that gathered the existing evidence about socioeconomic HI in Portugal.

The PRISMA statement was used to guide and report the review (16). The review began by defining what measures of SES would be included. For this, the PROGRESS[2] framework was followed, standing for Place of residence, Race / ethnicity / culture / language, Occupation, Gender/sex, Religion, Education, Socioeconomic status and Social capital (17). Both individual and contextual determinants were included. Healthcare utilization or access, and health related behaviours were excluded from the analysis, as we were interested solely on inequalities in health outcomes. We included every study that quantified an association between the socioeconomic and health variables, and controlled for, at least, gender and age. Studies that used data from 2000 onwards and from the Portuguese resident population (regardless of nationality) were included. We excluded qualitative studies. Articles written in Portuguese and English were included. We searched Scopus, Web of Science and Pubmed for papers that met the eligibility criteria. Additionally, we scoped publications of researchers in Portugal who regularly publish research in this area for publications that met the eligibility criteria, to complement our online search. Data was extracted from the selected articles and a brief quality evaluation was performed. Results were presented using a narrative description and a diagram that summarized the findings.

The final selection included seventy-one papers, all of which reported observational studies, and most of which used cross-sectional data. Most publications reported

[2] The PROGRESS framework was created as an aide-memoir to help researchers apply an equity lens to their research, and public health professionals to consider all potentially inequitable circumstances in public health interventions.

significant HI that favoured individuals or groups with better social standing. Some associations were particularly common and showed strong evidence of HI: lower education with obesity and with subjective ill health; and female gender with mental health symptoms and subjective ill health.

Of the seventy-one selected papers in the SR, seventeen analysed, in one way or another, the effect of a contextual variable. Seven of these studies had an ecological design (18-24). Four investigated how an individual's perceptions of their neighbourhood were associated to their health (25-28). Four other studies explored the difference between residents of urban and rural settings (29-32). The two remaining studies looked at differences between deprived and affluent neighbourhoods (33) and municipalities (34). Overall, these were very heterogeneous studies, looking at different topics, different populations, and with differing degrees of quality.

This review offered a systematization of current evidence on HI in Portugal, which had not been done before. Its results show that, while there are a considerable number of publications touching on the subject, they tend to focus on specific topics, reproducing similar results; they do not necessarily focus on what are the most prevalent health and social issues in Portugal; and they tend to use similar methodologies. This analysis was also able to identify what are the most important HI in Portugal for which evidence is available – education and gender inequalities in obesity, SAH and mental health – and the major gaps in the research literature regarding this topic – analyses focused on the most prevalent health issues, the most important SES factors, and the most vulnerable populations. It is clear from these results that, at the present moment, there is no nationally oriented research strategy which would be crucial to guide research in a country where HI remain particularly high.

3.1.4. Shifting Determinants of Health Inequalities in Portugal

Many individual socioeconomic variables can determine HI. Education, one of the most commonly used indicators, can determine better cognitive abilities and better knowledge, that allow individuals to prevent illness, have better health, and better manage disease (35). Financial resources can allow individuals to acquire health-producing resources (36). Employment provides income, but also a sense of purpose,

a structure to the day, and social connections, which are all associated with better health (37). Occupation, on the other hand, is a reflection of social rank, and has also been strongly connected to multiple health outcomes; famously, the Whitehall studies showed that these differences were a consequence of feelings of control over one's life, which are stronger among people in higher occupational ranks (38). This variety of SES indicators is a reflection of the multitude of pathways that lead to HI. Observing which indicators are more important, and how these change over time, can give important clues to which processes are the most relevant in creating HI. Portugal has been through important changes over the last decade, with periods of political instability and implementation of austerity measures (39). These transformations provide a unique opportunity to observe how contextual changes can lead to changes in overall health, health distribution, and to the determinants of HI. With the fourth publication, we aimed to describe how the determinants of HI changed in Portugal over the last decade, in order to understand what processes created HI and how these changed over time. This understanding can hopefully lead to informed policies that can successfully tackle HI.

The fourth and last publication of this dissertation used data from the cross-sectional waves of the Portuguese sample of EU-SILC from 2004 to 2014 was used, with limitations in daily activities as the outcome variable. We calculated the prevalence of limitations in each income tercile in each year and absolute differences between first and third terciles for selected years. We then calculated the CIx for each year and its decomposition in various SES indicators: occupation, employment, education, income, savings, age, and sex. Finally, we ran a multiple logistic regression analysis for each year, to determine the OR for each of these indicators.

The prevalence of limitations was found to have increased in Portugal in the last decade, especially after 2010. However, this increase was steeper in richer terciles, which led to a decrease in both absolute and relative inequalities in limitations. Analysis of the CIx decomposition and of the OR showed that professional activity was the main determinant of the decrease in inequality – active people had fewer

limitations than inactive people before 2011, but this pattern reversed from this year, as active people had more limitations[3].

This analysis was the first that looked at the change of HI in Portugal over time. Despite focusing on one country alone, several lessons can be applied to other contexts for research and policy purposes. Firstly, HI changed considerably in Portugal over the last decade, possibly related to changes in the country's social and economic circumstances. In 2011 Portugal went through a period of considerable uncertainty with the request of a €78 billion bailout from the EU and the International Monetary Fund, resignation of the ruling government and snap elections, and constant talks of austerity measures that would force the Portuguese to 'tighten their belt' in the near future (40). This might have influenced overall health and changes in its distribution, which highlights the importance of contextual determinants on HI and adds knowledge to the growing body of evidence of the impact of economic crises on HI (41). Secondly, it shows that HI, even within one country, are neither static nor determined by the same factors over time. On the contrary, contextual socioeconomic changes can have substantial impacts on HI and on what drives them. Finally, this understanding of the drivers of HI can be extremely useful to outline policies to tackle them. In our analysis, the main driver of decreasing HI was an inversion in the prevalence of limitations among active and inactive people. We hypothesized this may be a consequence of high emigration rates in the country (which led to an exit of healthier, richer people) or of different adaptation capacity among socioeconomic groups (as groups of higher social standing may be less capable of adapting to worse socioeconomic circumstances).

3.1.5. Summary

These four publications paint a picture of how contextual determinants interact with individual characteristics to influence the distribution of health in Portugal and in its wider European context. The analyses and their results are summarized in table 2.

Contextual social capital was found to have no impact on population health in European countries, but had an effect for a particular group of people – those with low individual levels of interpersonal trust. Welfare regime types were also associated

[3] People were considered 'active' if they were employed (part or full time), in training or studying, or fulfilling domestic tasks; 'inactive' people were unemployed, retired, unfit to work or in the 'other inactive' category.

with the magnitude of the health impact of social mobility, with Scandinavian countries showing the smallest absolute differences. Finally, important contextual changes in Portugal over the last decade seem to have influenced health and its distribution in the country.

From a different perspective, the SR sought to summarize the knowledge on HI in Portugal up to date. This analysis showed that the study of contextual determinants of HI is still uncommon in Portugal and focused on a limited number of determinants. Results of this paper must be interpreted with caution as they aggregate all the data on HI in Portugal over the last decade; as the fourth publication showed, this was a time of intense changes in the distribution of health in Portugal, so aggregating the results over this period of time may have hidden important information.

Table 2. Summary of dissertation publications, determinants tested, geographic context, time period, and main findings.

Publication	Social Capital and Health in European Countries	Social Mobility and Health in European Welfare Regimes	Social Determinants of Health in Portugal	Shifting Determinants of Health Inequalities in Portugal
Contextual determinant	Social capital	Welfare regime	n/a	Macroeconomic context
Individual determinant	Social capital	Social mobility	n/a	Socioeconomic determinants (a)
Context	Europe	Europe	Portugal	Portugal
Time period	2002-2012	2002-2012	2000-2014	2004-2014
Main findings	Important cross-sectional interaction – low trust individuals have worse health in high trust contexts	Scandinavian countries had the smallest association between social mobility and health	Few studies on contextual determinants of health.	HI decreased in Portugal after 2010, mostly due to worse health among professionally active people

(a) Five individual determinants were tested: occupation, activity, income, education, and savings.
HI: Health Inequalities

3.2. Limitations

The publications included in this analysis are subject to a number of limitations. Limitations that are specific to each publication have been spelled out in the results section. Some limitations are common to two or more publications.

The first is that the data that that was used was cross-sectional. EU-SILC has a longitudinal component that could have been used, but panels only last four years, and this was not considered a sufficient amount of time to assess changes in health outcomes. As such, it was decided to use only cross-sectional data. This decision limited the study's ability to determine whether health is an outcome of the determinant under study, or the other way around. However, it was tried, when appropriate, to consider both directions of the association. For example, by acknowledging both processes of health selection and of the impact of social mobility in health in the second publication.

Another possible source of limitations is from the used health variables. The use of SAH and of health limitations is open to criticism, but it must also be considered that these have important value, and there is a reason why most population surveys ask these questions specifically. SAH has been shown to be a reliable measure of overall health (42), and even a good predictor of mortality (43). Arguably, SAH is a better measure of health than an 'objective' one, such as a diagnosed illness, as it incorporates the individual's perception of their own health (42). Self-reported limitations in daily activities are also a reflection of the individual's perceptions, but provide a more objective measure than SAH. This outcome has been used by other authors as an objective measure of functional limitations (44, 45) and Eurostat uses it as measure of disability (46).

The two first publications must also be interpreted with caution as they consist of cross-country comparisons of subjective measures, which may be interpreted differently in each country. This is particularly important for the first publication, as interpersonal trust showed considerable variation between countries. We tried to address this issue by using countries as fixed effects, thus removing from the model time-invariant country characteristics.

As a whole, the four publications may also occasionally seem to bear only a loose connection, as they focus on different geographical areas, on different determinants of

health, and are sometimes framed in ways that do not seem to be connected. Indeed, the SR of the literature was slightly different in its goals, but was considered a necessary first step, in order to aggregate all available knowledge about HI in Portugal before carrying on further research. Excluding the SR, all the publications look at contextual characteristics – be it welfare regime, social capital, or an economic crisis – and how these have an impact on the distribution of health within particular population groups.

3.3. The Effect of Context on Health and on Health Distribution

As was outlined in the introduction, the study of context and how it influences health and HI has been undermined by a lack of a theoretical basis on how contextual determinants work. Both the CSDH and Diderichsen have recognised the role of context in creating HI, but only insofar as it is responsible for social stratification and for the production of policies (47, 48). While helpful for policy formulation, this is an incomplete view of how context can influence health and HI.

The framework proposed here seeks to fill this gap by outlining the mechanisms by which context influences health and health distribution. It does this by describing two mechanisms: (i) changes in overall heath and (ii) changes in health distribution. This distinction is important because, just as is argued for the CSDH's framework (48), policies aimed at improving population health do not always have a positive impact on its distribution. Hence, when seeking to influence HI, it is not enough to implement a policy to improve overall health. Rather, it is important to consider how that policy can change health distribution also. It is hoped that the framework proposed here contributes to the absence of this theoretical foundation, by outlining the mechanisms by which context influences health and health distribution, providing a basis for policy choices and empirical analyses.

This framework was substantially inspired by Diderichsen's framework, drawing on the individual pathways that the author outlines to form a basis of how context can influence those pathways. Unlike that framework, however, this one focuses on the role of context, and highlights its impact on population health, on the one hand, and on health distribution, on the other. These impacts are not mutually exclusive, as any one change in context or contextual characteristic can influence health and health distribution through multiple pathways; however, it is hoped this distinction supports a reflection on how context operates and helps fill the 'black box' of contextual effects on health (49).

3.3.1. First Mechanism: Changes in Overall Health

The first mechanism leads to changes in the overall health of a population. Using the individual pathway of Diderichsen's framework as a base, this mechanism can operate by changing SES, exposure to risk factors, or health status of individuals. Figure 6 shows these three effects. The core of the framework starts from social

position, which determines differential exposures; exposures lead to differential vulnerability; and finally disease or illness lead to differential consequences, which can have an impact back on social position.

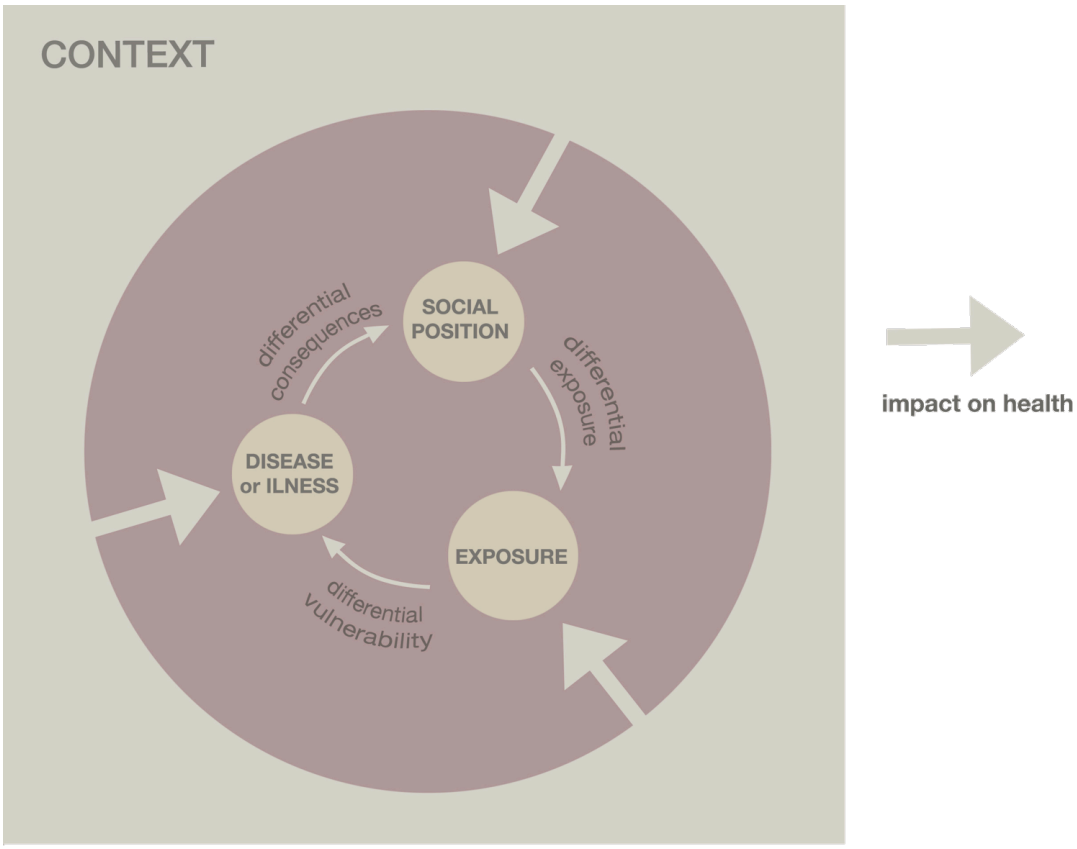

Figure 6. First mechanism: changes in overall health.

The first effect refers to how individuals' social position can be altered by context. For example, when a country's finances improve, poverty tends to decline, and individual economic status of its citizens tends to improve, leading to overall improvements in health. The second effect reflects changes in the exposure to risk factors; examples of this are water fluoridation or reductions in air pollution, which can reduce the exposure to risk factors in an entire population, thus improving its overall health. The third effect refers to events that change health status, such as when an innovative treatment to a prevalent disease is discovered and made available. All these effects have the potential to improve overall population health, either directly, by affecting individuals' health or indirectly, by affecting social position or exposure

to risk factors. However, they may have no effect on the distribution of health within that population, as they may impact everyone equally[4].

3.3.2. Second Mechanism: Changes in Health Distribution

Unlike overall population health, health distribution is influenced by another mechanism. To change the *distribution* of health, context must act on the *links* between social position, exposure to risk factors, and illness. Once again building on Diderichsen's framework, these links are differential exposure, differential vulnerability and differential consequences. Contextual effects that modify these links can potentially change HI within a population, as they weaken (or strengthen) the connections between social position, exposures, and health.

In addition to this, and despite falling off the realm of health, the process of social stratification is also included. This is because processes of social stratification – how social strata are created in a society – are key in creating HI (50). This was also acknowledged by the CSDH and Diderichsen in their own frameworks, where social stratification played a major role (51, 52).

Figure 7 outlines the four effects that constitute the second mechanism. The first effect refers to any contextual characteristic that can potentially change the distribution of social positions within a society (i.e., social stratification); for example, changes in taxation policy, from proportional to progressive, can lead to more equality in terms of income distribution. The second effect occurs as a result of contextual characteristics that influence differential exposure. For example, healthy diets are enjoyed disproportionately by individuals in better social positions, one possible reason being a prohibitive cost of fresh produce; changes in the market price of these products may impact HI by making a healthy diet more accessible to poorer people, thus reducing their exposure to unhealthy diets. The third effect refers to contextual changes that modify differential vulnerability; i.e., the clustering of risky exposures in lower socioeconomic groups. The exemption of co-payments for healthcare services for poorer people, for example, can have such an effect, as it targets a vulnerable group with the aim to encourage a health-producing behaviour (healthcare use). Finally, context can also have an impact on differential

[4] This is an oversimplified description to help illustrate and facilitate understanding of the framework; as has been mentioned before and is illustrated in appendix 1, a contextual determinant that affects everyone 'equally' will depend on how we define 'equal' and how this is measured.

consequences; an example of this is how higher levels of social support within a community may help its members recover from ill health or even providing them with work opportunities that otherwise would not be accessible to them.

While the first mechanism led to changes in *overall* population health, the second mechanism leads to changes in health *distribution*. It is important to note that these are not mutually exclusive mechanisms, as a change in a contextual determinant (such as implementation of a health policy or change in air quality) may have more than one effect, thus influencing both overall population health *and* health distribution. For example, the introduction on a vaccination program may seek to improve overall population health and will probably do so; however, if access to the vaccine is better for higher status individuals, the policy may create a previously inexistent inequality, thus having an effect on health distribution. On the other hand, improvement of air quality in a deprived area will impact poorer people more, thus having an impact on health distribution; however, by improving the health of the worse-off, overall population health will also improve.

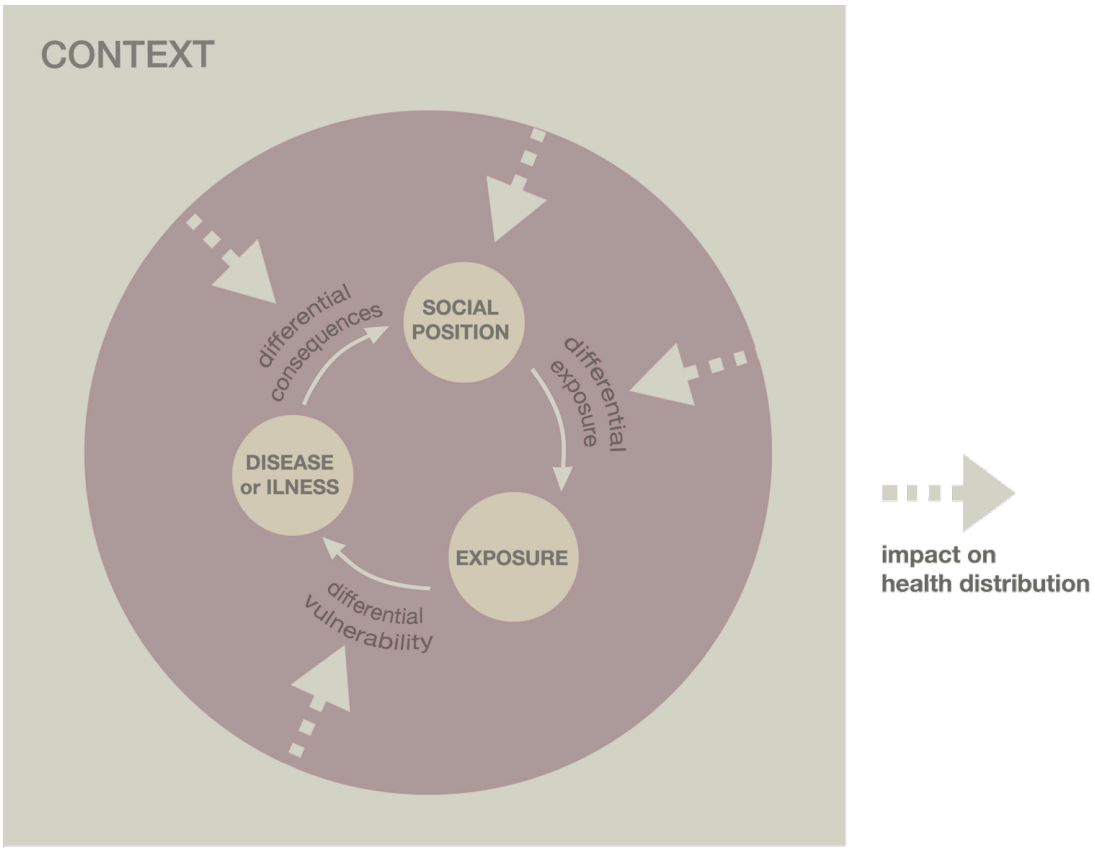

Figure 7. Second mechanism: changes in health distribution.

3.3.3. Conceptual Framework

Figure 8 summarizes the two mechanisms that make up the conceptual framework. This framework is shaped by the pathways that link social position to differential exposure, exposure, differential vulnerability, disease or illness, and differential consequences, back to social position. Contextual determinants are represented around this central pathway, and the effects of context on each step of the pathway are represented by arrows: full lines for effects that change overall health (first mechanism), and dashed lines for effects that change health distribution (second mechanism). The following section further describes and gives examples of how each of these effects work.

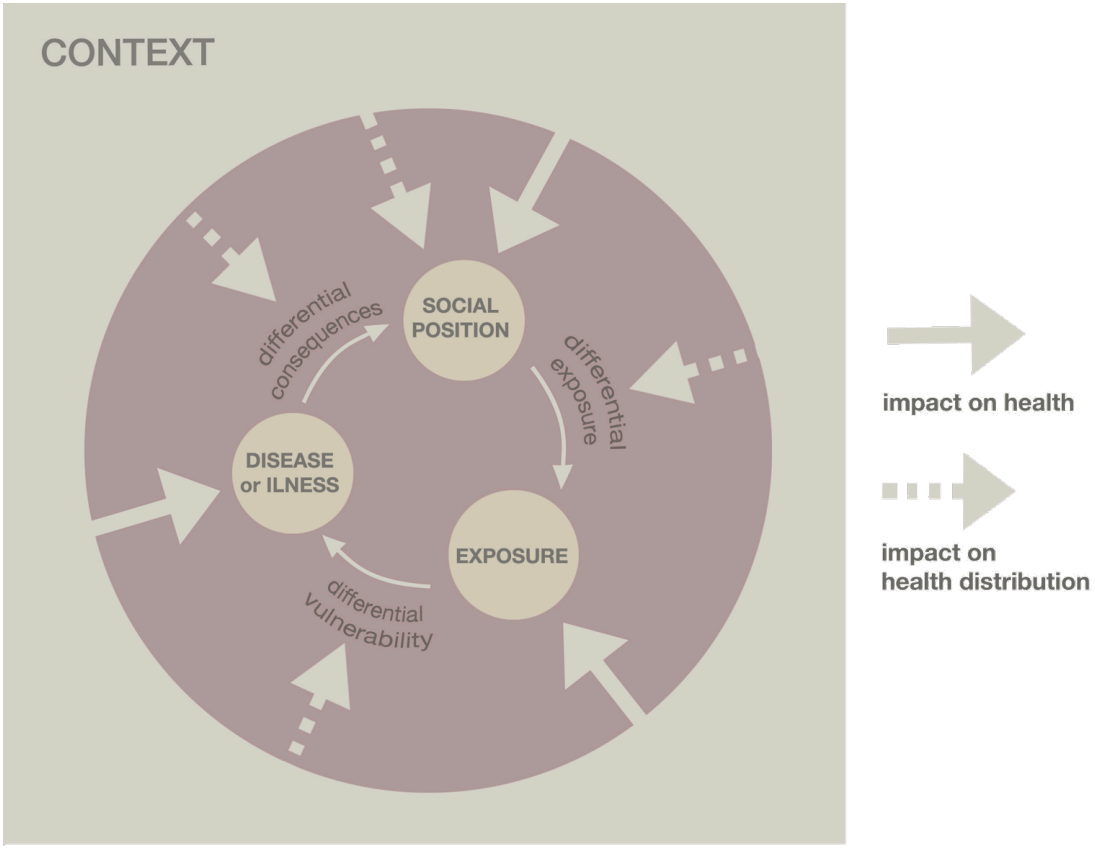

Figure 8. The impact of context on health and health distribution: conceptual framework. Source: author's own elaboration.

a) First Mechanism: Changes in Overall Health

i. Impact on social position

This refers to contextual characteristics that lead to changes in the SES of individuals. For example, using longitudinal data and multilevel models on European countries, an

analysis by Eurostat showed that higher regional GDP per capita (contextual characteristic) decreased the risk of poverty (individual SES) (53). This suggests that improvements in GDP per capita – either if an individual moves from a country to another or if a country's finances improve – will lead to a decrease in poverty risk. This may seem an obvious connection, but it is not always the case. According to the UK's Department for International Development (DFID), the extent to which economic growth reduces poverty differs from country to country, as it depends on the degree to which the poor participate on the growth process (54). Nonetheless, in European countries, increases in GDP per capita tend to improve individual social position, thus leading to overall improvements to population health.

ii. Impact on exposure to risk factors

This effect relates to how contextual characteristics can influence individual exposures to risk factors. An example of this is how weather (contextual characteristic) strongly impacts air quality (individual exposure); in particular, how climate change is expected to worsen air quality (55). This will lead to an increase in the exposure to a risk factor across the population, regardless of SES, and consequently potentially worsen overall population health.

iii. Impact on disease or illness

Evidence suggests that investment in primary care leads to improvements in overall population health (56). For example, one review showed that, in numerous contexts, higher primary health care performance was associated with lower rates of avoidable hospitalisation (57); another review found that primary care physician supply was inversely associated with a number of health outcomes, such as cancer, stroke, and infant mortality in the US (58). Although these analyses can be strongly limited by the effect of the inverse care law – the observation that 'the availability of good medical care tends to vary inversely with the need for it in the population served' (59; p. 405) – these reviews include longitudinal analyses that overcome this limitation. This thus exemplifies how a contextual determinant – primary care policy – can lead to improvements in overall population health.

b) Second Mechanism: Changes in Health Distribution

i. Impact on social position

Contextual characteristics can also impact the distribution of health. This effect 'starts' with their influence on social stratification in a society. For example, in an analysis of the US in the 20th century, Treiman describes how the process of industrialization (contextual characteristic) led to substantial changes in the structure of the labour force (60). This is not surprising, as industrialization intuitively leads to a decrease in the number of certain occupations, such as those related to agricultural work, for example. As occupation is strongly connected to health outcomes (61), this change can influence the health distribution within the society, by changing the size and distribution of its occupational groups.

ii. Impact on differential exposure

Differential exposure occurs when the social position of an individual determines his or her likelihood of being exposed to a certain risk factor (52). Context can modify how different social groups are exposed to a risk factor. An example can be given with dietary behaviour. Taxation of food products (contextual characteristic) has been advocated and used as a policy to tackle the 'obesity epidemic'. However, rather than having an equal impact on overall population health, this policy has a stronger effect on poorer people, as this group is more sensitive to price changes (62). Because this effect is stronger in a particular social group, the connection between social position and exposure is modified, and, consequently, the contextual variable (in this case, a policy to tax certain food products) has an impact on HI[5].

iii. Impact on differential vulnerability

Differential vulnerability refers to the clustering of risky exposures in certain socioeconomic groups (52). Multiple exposures can substantially increase an individual's risk of ill health. This was well shown in an analysis in the city of Rome, between 1998 and 2001, in which Forastiere et al. (64) showed that, surprisingly, people with higher SES were exposed to poorer air quality, as they lived in the areas of the city with more intense road traffic. Air pollution (contextual characteristic) is

[5] This description reflects a small, limited view over food taxation policies, focusing on only one of its possible outcomes for exemplification purposes. In reality, these policies can have extensive (unintended) consequences, such as substitution for alternative products.

strongly associated with daily mortality, but even though people with low SES were exposed to better air quality, the effect of air pollution on mortality was much stronger in this group in the city of Rome. The authors add that people with lower SES had a higher prevalence of chronic conditions, and suggest that it is this vulnerability that explains the higher susceptibility to poor air quality. This analysis showed the importance of understanding differential vulnerability when considering public health interventions. In particular, it suggests that an intervention to improve air quality in the most polluted areas of Rome might improve overall population health (as it would reduce the exposure to a risk factor), but could potentially increase HI, as it would have an impact mainly on the health of the more wealthy and less vulnerable.

iv. Impact on differential consequences

Illness is an important risk factor for downward social mobility (65). The ability to return to work after a period of illness, for example, is related both to individual social position and to contextual characteristics. A study of Brazilian children with cerebral palsy further illustrates this effect. In this study, children from high SES families tended to use a wheelchair at home more often than their low SES counterparts (66), suggesting higher mobility capacity. This difference is not surprising, and constitutes what Diderichsen called 'differential consequences' (52), to the extent that SES influences the impact that disease has on a person's life. As the authors pointed out, differences in usage of wheelchairs at home among SES groups is likely to be a consequence of the ability to modify their environment – while richer families can adapt the architectural characteristics of their home, poorer families are less likely to be able to do so (66). This suggests that policies that support these types of interventions in the homes of families with a child with cerebral palsy have the potential to decrease the inequalities that are seen among different SES families.

Another example of how context can modify consequences can be seen in screening programs for cancer. Women of lower SES are less likely to attend breast screening in north America (67). This might be because their doctor is less likely to refer them, because they have less available time, or poorer knowledge about the importance of screening, among other possible reasons. This leads to substantially different consequences of disease, as late diagnoses have a lower survival rate (68). Screening

programs (contextual characteristic) have the potential to reduce this inequality, as they provide easier access to screening to people who otherwise might not use it (69).

3.3.4 Summary

The framework proposed here outlines how context influences health and health distribution. It is proposed that context operates through two mechanisms, one that changes overall population health (though effects on social position, exposure to risk factors, and disease or illness) and another that changes health distribution (through effects on social stratification, differential exposure, differential vulnerability, and differential consequences).

This framework seeks to fill a gap in the research literature, by which the pathways between the context and health and HI have not been outlined before. It takes a step forward from other conceptual frameworks, as it acknowledge the role of context on several different steps between social position and health outcomes. In this framework, context does more than just stratify individuals to their social position.

The framework will hopefully be used as a basis for future policy and empirical analyses, helping clarify the mechanisms by which context influences health and its distribution.

3.4. Application of the Conceptual Framework

The framework described in the previous section (figure 8) outlines the mechanisms by which contextual determinants can influence health and health distribution. This framework seeks to summarize how this influence operates, and can potentially be used as a basis for policy and empirical analyses. In this chapter, the framework is applied to three research papers from this dissertation, in order to illustrate how it can be used in the interpretation of evidence. It is not applied to one publication – the SR – as this did not look at how one contextual determinant interacts with individual characteristics but rather set out the background for the last piece of investigation on Portugal (see table 2).

3.4.1. Social Capital and Health in European Countries

This analysis showed a complex effect of national-level social capital on individual health, making it an interesting case study for the application of the framework. The framework focuses on how the contextual determinant (contextual social capital) can have an impact on population health and health distribution, operating through an individual characteristic (individual social capital). The key results were:

- Contextual social capital was not associated with individual health, and
- High contextual social capital was associated with worse health in low trust individuals and better health in high trust individuals.

These results show that contextual social capital had no impact on overall population health. Within the conceptual framework (figure 8), this means that social capital will not operate through the full arrows (the first mechanism – changes in overall population health).

On the other hand, contextual social capital had a differential effect on different social groups, leading to changes in health distribution (dashed arrows, second mechanism – changes in health distribution). This is probably a reflection of how contextual social capital is not a resource enjoyed equally by all individuals – when high trust individuals are the majority, the social capital they produce between them is not shared with the minority, low trust individuals. Moreover, not only is this resource out of their reach, but discrimination from the majority and dissemination of ‘bad social capital’ (such as reinforcing social norms that are harmful to health) might further damage a group that is already vulnerable. This differential effect can thus be a

consequence of processes of network closure, discrimination, and dissemination of 'bad social capital'. All these processes in essence reflect a differential exposure to social capital: high trust individuals have access to contextual social capital, while low trust individuals do not; furthermore, low trust individuals may also be exposed to 'bad' social capital, further damaging their health.

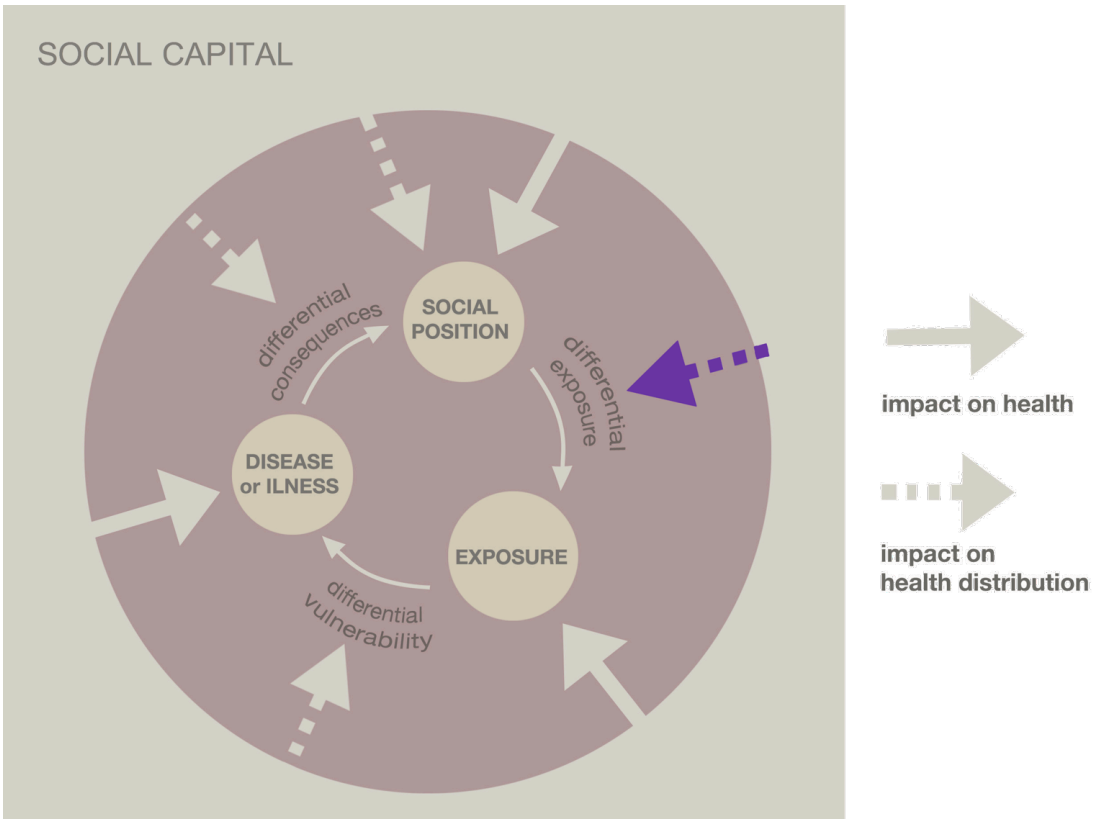

Figure 9. Effect of contextual social capital on health distribution: results of the first publication (Campos-Matos I, Subramanian SV, Kawachi I. The 'dark side' of social capital: trust and self-rated health in European countries. European Journal of Public Health. 2016;26(1):90-95).

It is important to note that applying the framework to only one analysis does not exhaust all possible mechanisms by which one contextual determinant operates. Contextual social capital can impact HI, as people are not equally exposed to its effects, and it can also impact overall population health – as some authors argue and indeed have shown (4, 70). This framework is helpful to clearly identify the mechanisms under study in an empirical analysis, and further suggests other mechanisms that may also exist and not have been detected in that particular analysis.

3.4.2. Social Mobility and Health in European Welfare Regimes

This analysis focused on how the association between social mobility and health can differ between European welfare regimes. Importantly, it provided some evidence that

health selection does not seem to be an important determinant of HI in countries with high levels of social mobility. To apply the framework to this analysis, the focus will be on how the contextual determinant (welfare regime) can have an impact on health and health distribution through the individual determinant (social mobility). The key messages regarding the impact of welfare regime through social mobility were:

- There were significant differences in overall health between different welfare regime types – Scandinavian countries showed the best and former USSR countries the worse results; and
- Individuals who were upwardly mobile showed better health than those who were socially stable, but upward mobility had a small impact in Scandinavian countries, compared to a large impact in former USSR countries.

First, it is clear that welfare regime is associated with differences in overall population health. There are many ways in which certain welfare regimes can have an impact on health – it can be related to economic development, health services provision, and cultural aspects, among others. One possible way is through social mobility. Political choices, such as how to provide education or how to redistribute wealth, have the potential to break the inter-generational transmission of social disadvantage and improve the social position of many, regardless of their parents' social standing. Thus, the extent of social mobility varies substantially between welfare regimes (71) and can potentially lead to better socioeconomic circumstances across the population. This is evident by the observation that countries where social mobility is highest also tend to have higher overall educational levels (72). It is by this effect on social mobility that welfare regimes, through improvements in people's social position, can lead to a better (or worse) level of overall population health (figure 10).

Second, upward mobility was associated with better health in all countries, but the difference was considerably bigger in former USSR countries and smallest in Scandinavian countries. This suggests that Scandinavian countries are more effective at separating social mobility from health. This means that when individuals climb up (down) the social ladder, they are more likely to have better (worse) health, especially if they live in former USSR countries. This can reflect a mechanism of social stratification, as welfare regimes determine how individuals are placed in a society and, consequently, their health. From a health selection perspective, it may also mean

that individuals who are ill (healthy) are much more likely to fall (climb) in the social ladder in former USSR countries, when compared to Scandinavian countries. This second possibility can reflect a mechanism of differential consequences, as a person's health leads to changes in their social position.

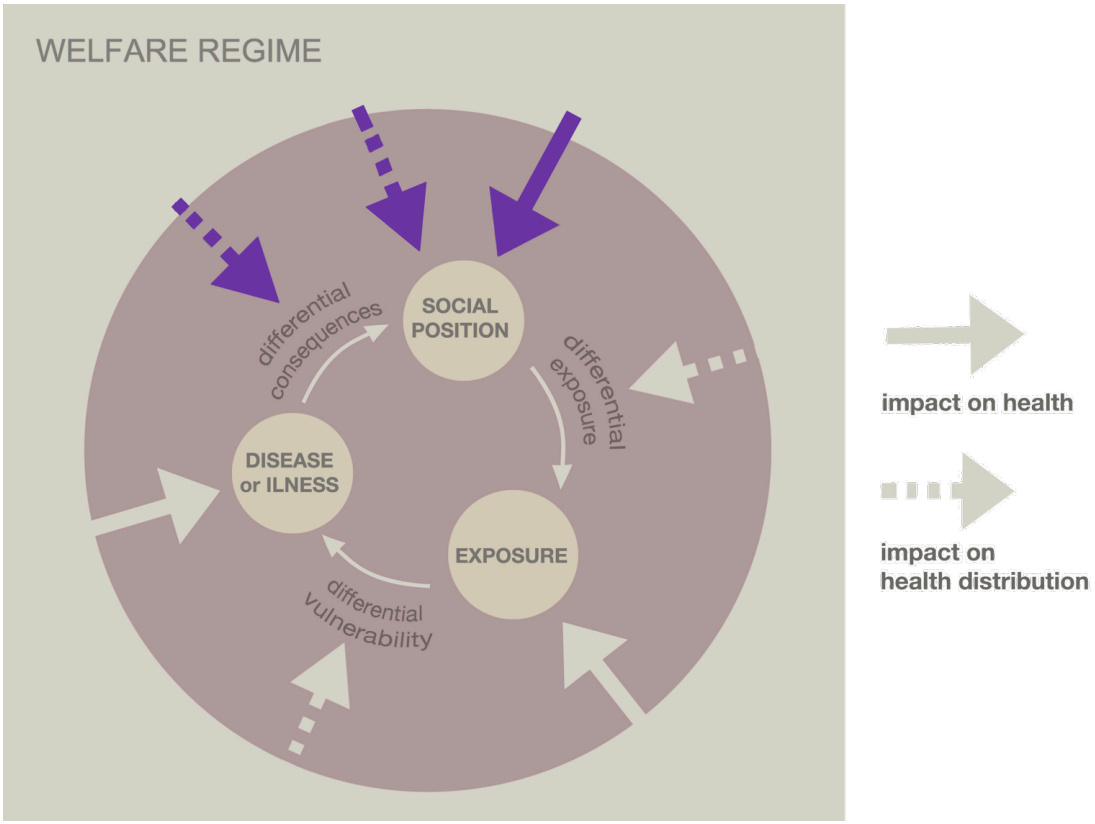

Figure 10. Effects of welfare regimes and social mobility on health and health distribution: results of the second publication (Campos-Matos I, Kawachi I. Social mobility and health in European countries: does welfare regime type matter? Social Science and Medicine. 2015;142:241-248).

The results of this analysis reflect social mobility's effects on health and HI, since more generous welfare regimes not only show better overall health, but also fewer inequalities between social mobility groups. Thus, welfare regime, through its effects on social mobility, can impact both the health and the health distribution of a population (figure 10). This analysis, of course, does not include other effects that welfare regimes can have both on health and HI, as it focuses exclusively on the effects that are mediated by social mobility.

3.4.3. Shifting Determinants of Health Inequalities in Portugal

The focus of this analysis was on how HI have changed in Portugal over the last decade. Although we did not test the effect of any contextual determinant, we interpreted the results considering the substantial economic changes that were

happening in the country at the time. For the application of the framework, the following key points summarize the most relevant results of this analysis:

- Overall population health deteriorated in Portugal between 2010 and 2011;
- This deterioration was steeper in the richest tercile, thus decreasing inequalities between income terciles; and
- The main driver of this decrease was the change between active and inactive groups: while limitations were more prevalent in inactive people until 2010, they became more prevalent in active people after this year.

The overall deterioration in population health in Portugal between 2010 and 2011 is likely to be related to overall economic changes happening at the time. These events, such as implementation of highly publicized austerity measures, can operate through a stress-determined pathway, as a climate of uncertainty can lead to stress and, consequently, poorer health, leading to worse health outcomes across the population. In the framework, this can be interpreted as an effect on exposure to a risk factor: economic changes are the contextual determinant that lead to an increase in the exposure to a risk factor – stress – thus having an effect on the whole population's health (figure 11). However, not everyone reacted the same way to this uncertainty. In fact, richer people (the richest tercile) seemed to suffer the greatest hit. This was greatly mediated by the fact that active people – who also tended to be richer – had a higher prevalence of limitations after 2010 than inactive people. Despite not having formally tested this, we hypothesized that two mechanisms might be behind this change. First, people from higher socioeconomic classes (who tend to have higher incomes) may not be as used to dealing with uncertainty as people from lower socioeconomic classes are. To them, the prospect of uncertain times ahead could have led to more intense stress reactions and to an inability to deal with practical day-to-day problems on a more restricted budget. This first mechanism can be identified in the framework as differential vulnerability, as all groups were exposed to uncertainty and stress, but – perhaps counter intuitively – high SES people were more vulnerable, at least during a certain period of the time. Second, considering the high emigration rates Portugal was going through at the time (73), the group of active people who was 'left behind' might have had disproportionately high rates of limitations, as migration is known to be a selective process by which healthier people tend to migrate more (74). This second mechanism is a consequence of changes in the composition of the

population. This can be seen as a change in social stratification, as changes in the economic context led to changes in how wealth and power were distributed to different social positions.

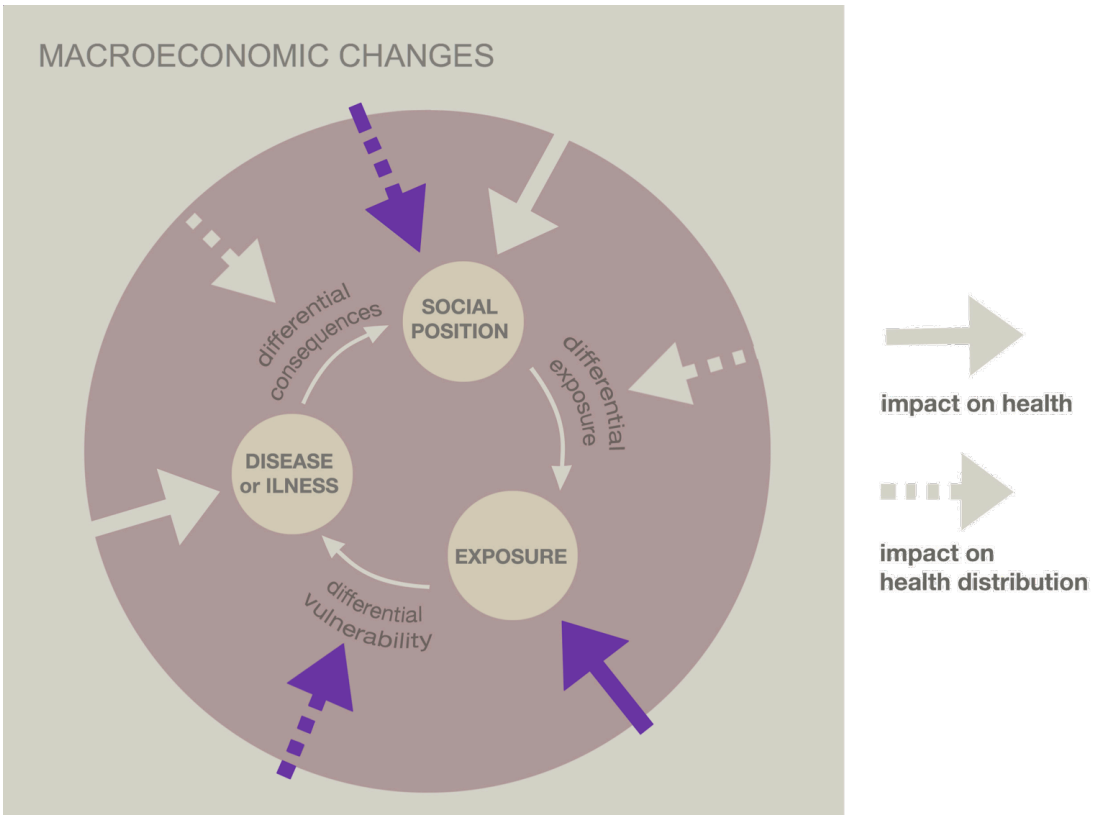

Figure 11. Effects of macroeconomic changes on health and health distribution: results of the fourth publication (Campos-Matos I, Russo G, Gonçalves L. (accepted for publication). Shifting determinants of health inequalities in unstable times: Portugal as a case study. Accepted for publication in the European Journal of Public Health in May 2017. DOI: https://dx.doi.org/10.1093/eurpub/ckx080).

Overall, this analysis suggests that economic and social changes in a country can lead to changes in health and health distribution through three mechanisms: social stratification, exposure to risk factors, and differential vulnerability to those risk factors (figure 11). Once again, this does not provide an exhaustive description of how economic crises impact health and health distribution, but suggests some of the mechanisms that may operate and frames the findings in a larger context.

3.4.4. Summary

The framework proposed here aims to outline the mechanisms that connect contextual characteristics to population health and health distribution. It was applied to the analysis of three contextual determinants: social capital, welfare regime, and macroeconomic changes. Each of these determinants influenced health outcomes and their distribution through various mechanisms: differential exposure (social capital);

social stratification, social position, and differential consequences (welfare regimes); and social stratification, exposure, and differential vulnerability (economic crisis).

The framework proved a useful tool to frame these publications, in which contextual determinants were explored. In particular, it acknowledged the importance of context in several steps in order to influence both health and HI. In future research, it can provide a structure to facilitate a reflection about the theoretical basis that underscores analyses, thus strengthening them and the arguments they propose.

3.5. Contribution to Policy and Research

3.5.1. Regarding Health Inequalities

This research has presented a new framework on how context can shape health and health distribution. This framework is built on a framework proposed by Diderichsen et al. (figure 3) (52), and incorporates a few important differences from the original framework. Firstly, it explicitly focuses on context. For Diderichsen, context was responsible for social stratification and policies. In the framework put forward here, it is proposed that context is seen is a broader perspective, encompassing also physical and other social elements (besides policies). It is also proposed that context not only contributes by creating a system of social stratification and policies, but also by influencing all the other steps of the pathway between social position and health outcomes. Furthermore, this framework highlights that context can influence health and health distribution, and it does so by different mechanisms.

Another important distinction from Diderichsen's work is that in the former framework differential vulnerability is the accumulation of harmful risk factors in a particular population group. In applying the new framework to the analyses, it was found that differential vulnerability does not necessarily mean that the same individuals are always vulnerable. Similarly, differential exposures and consequences do not necessarily mean that the poorest or least educated will always be more exposed to risk factors or suffer greatly the consequences of ill-health. In our work, it is proposed to redefine the term 'differential' to mean only that effects are different in different socioeconomic groups, without suggesting a direction of the effect.

Hopefully, this framework can be used in future research projects to collect evidence of the effect of a contextual determinant. For example, to perform a review of how economic growth can impact on health and health distribution, the collected evidence can be organized using this framework. This framework could also help researchers outline a clear theoretical basis for their work, thus building a stronger evidence base around the topic of their research. This is particularly important considering the lack of a clear theory about the mechanisms by which context operates has been one of the factors hampering the study of contextual influences on health (75).

Regarding its contribution to policy making, as it builds on and further the current theories on contextual effects on health, the framework may also help policy makers

understand the options available to tackle specific aspects of HI. Particularly, it could prove a useful instrument for equality impact assessments – the analysis of policies that tries to ensure they do not discriminate against any vulnerable group (76).

Besides being a practical instrument for researchers and policy makers, the framework will hopefully contribute to the rising trend of a different thinking about HI. Namely, it emphasizes how HI are not a product of individual characteristics alone, but a consequence of the interaction between context and individuals. This can have important implications on how HI are tackled – from a focus on individual behaviour change, policy makers should also think about enabling and disabling characteristics that contexts can provide to influence those behaviour changes.

Another contribution of the present research is the concurrent analysis of several individual SES characteristics as an opportunity to explore the mechanisms behind HI. This type of analysis is not common, but proved very productive. In this analysis, this allowed for the exploration of what might have been behind the decrease in HI in Portugal after 2010, thus laying groundwork for further research on the topic. This method provided interesting levels of analysis, and could be reproduced in future analyses in other contexts.

3.5.2. Regarding Europe

This research also provided some contribution to the understanding of HI in European countries. The persistence of HI in Europe has been called a ‘paradox’ and social mobility has been put forward as one of a few possible explanations (10). The present findings on social mobility in different welfare regimes in Europe show that this is highly unlikely, or countries with high social mobility would show at least as high inequalities in health between mobility groups as countries with low mobility, which was not the case. This can help move forward the exploration of the ‘paradox’, as other explanations are now more likely and should be further investigated. In terms of policy-making, these findings suggest that it is possible to mitigate the association between social mobility and health. Although all welfare regimes showed some kind of association between social mobility and SAH, some were significantly smaller, suggesting that it is possible to separate the two more efficiently, and that the answer lies in the differences between the welfare regimes.

Social capital is another important contextual characteristic in European countries, traditionally seen as a 'positive' determinant, with exclusively positive effects on individual health (7, 77). The findings from this research suggest that there is in fact a complex relationship between contextual social capital and different social groups, which are important in shaping HI. Previous research had already suggested that such a relationship existed (4, 5, 70), but our findings indicate that high levels of social capital can have particularly important negative effects in some groups. These findings will hopefully help challenge the view that high contextual social capital is an unquestionably good thing, to a view that not all people benefit equally – and some might even be damaged by – what initially may appear as a 'positive' contextual determinant. This can have important implications for future research, as the study of social capital should take into account population groups, and not just population as a whole.

The concept of social capital has been criticized for its political connections and implications. Navarro (77), for example, condemns how social capital is analysed without any attention to power and class relations, and is in fact associated (at least in the US) with a call for less state intervention and more 'communitarism' as an alternative to this intervention. This traditional view of social capital suggests, at least implicitly, that communities are responsible for their own health and wellbeing, as this will depend on how much social capital they are able to accumulate through their actions. The present research challenges this traditional view to the extent that it shows that high communal social capital does not necessarily mean positive outcomes are accessible to all its individuals. As such, it has the potential to call into question the thinking about making communities responsible for their own welfare, and highlight the importance and necessity of other interventions that ensure more equality in access and outcomes.

3.5.3. Regarding Portugal

This research aimed to contribute in particular to knowledge on HI in Portugal, given that political and academic attention to this issue has been low. The most important policy documents around planning for health and healthcare have either ignored HI or interpreted them solely as a matter of inequalities in access to healthcare (15, 78). Some research has been done on the subject, but the third paper showed that there is no consistent strategy nor has it focused on the important social and health issues in

Portugal. Hopefully, this research will provide a stepping-stone for a more goal-oriented research strategy and a more appropriate political focus on HI in Portugal.

The analysis on how the determinants of HI in Portugal have changed over the last decade provided a particularly important contribution. It was the first of its type in Portugal and it showed surprising results. It showed that HI had decreased since the beginning of big economic changes in the country, an important finding both for the country and for wider research on the topic. In fact, the impact of economic crises on population health and HI is still widely debated, and research shows contradictory results (41). This paper will contribute to this knowledge base and to policy making not only for describing an increase in HI after an economic crisis, but also for exploring the mechanisms behind that increase.

3.5.4. Summary

Overall, this work tried to contribute to both to research and policy making. In terms of research, it aimed to contribute to how contextual determinants of health and HI are conceptualized, to provide a framework to help organize the evidence around contextual determinants, and to contribute to a shift in thinking about the determination of health and HI. It also aimed to contribute specifically to knowledge about HI in Europe and Portugal, namely by exploring the 'paradox' of HI in the continent, to shaping how social capital is perceived, summarizing all available evidence on HI in Portugal, and identifying the main determinants of HI in the country.

Despite its academic nature, this body of work sought to provide an evidence base to policymaking regarding HI. As such, it provides a framework that might prove useful to think about policy options when tackling HI, provides clues to how welfare states may operate in separating social mobility from health, challenges the idea that communities should be left to themselves to produce their own well-being, and identifies opportunities in Portuguese policies to tackle HI.

3.6. Conclusions

As we enter the fifth decade of research and political attention to HI, a lot has changed since the Whitehall studies and the Black report. More and more, characteristics of context are acknowledged as important determinants of health, replacing the focus on individual characteristics and behaviours that has dominated the literature so far (79-81). However, the individualistic perspective still dominates research on HI. This is surprising, as HI, more so than health itself, are inseparable from context – we are only unequally healthy in relation to someone else, within a context, whereas we can be healthy on our own.

This analysis has hopefully helped clear the way towards the integration of context in the study of HI. It showed, through multiple examples, that context does interact with individual characteristics to change health distribution in a population. This was exemplified by showing that contextual social capital and individual social capital interact with each other and lead to different health outcomes in European countries. It was also demonstrated that welfare states and individual social mobility trajectories interact to create different degrees of HI. Focusing only on Portugal, we also presented evidence that suggested that economic crises can interact with individual socioeconomic characteristics – such as employment – to produce different levels of HI. Hopefully this contribution can lead other people to consider the interaction between context and individual characteristics, and how it can be responsible for the distribution of health in a population. If there was only one goal to this dissertation, it would be to draw attention to this topic.

In the way, knowledge was also hopefully added to existing evidence, particularly for the Portuguese context, where knowledge about HI is sparse and attention is little. The SR of the literature showed which were the most significant HI in Portugal, and suggested a way forward regarding research and policy strategies. This will hopefully be a contribution to future actions that will help decrease HI in the country.

HI can be a good measure of the sense of justice of a community. People may not be impressed or shocked by inequalities in education, income, or wealth – in fact, they are sometimes called for, as they can act as a stimulus to work harder. However, systematic differences in health between socioeconomic groups have a different implication – they provide proof that people of lower social standing do not have the

same opportunity to health as people of higher social status. The focus on individual characteristics and behaviours as determinants of health and HI has proven fruitless to address this issue. HI remain as high or continue to grow, even in the most comprehensive welfare states. It is my belief that context holds the key to this issue, if only we start by acknowledging it.

3.7. Discussion and Conclusion References

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4. Appendices

4.1. Appendix 1: Illustration of how changes in health inequalities affect absolute and relative measures – a hypothetical example

Start by considering a population with two groups: white collar workers and blue collar workers. In year 1, the prevalence of diabetes was 10% in white collar workers and 20% in blue collar workers (table 1). Inequality between the two groups can be expressed using an absolute measure or a relative measure. In absolute terms, the difference in diabetes prevalence between the two groups is 10%; in relative terms, the odds of diabetes in the blue collar workers are two times higher than in white collar workers (table 1).

Table 1.

Population group	Diabetes prevalence	Absolute measure: difference	Relative measure: odds
White collar	10%	20% - 10% = 10%	20 % / 10% = 2
Blue collar	20%		

In Y2 the prevalence of diabetes halved in both groups. This was an **equiproportionate rate of improvement**, because both groups improved at the same rate. Now, the white collar workers have a prevalence of 5% and the blue collar workers of 10%. The absolute difference is now only 5%, half of that in Y1. But the relative measure – odds – remained the same (table 2).

Table 2.

Population group	Diabetes prevalence	Absolute measure: difference	Relative measure: odds
White collar	5%	10 - 5 = 5%	10 / 5 = **2**
Blue collar	10%		

In an alternative future, the prevalence of diabetes decreased by 5% in both groups in Y2. This is a **uniform improvement**, because in both groups the improvement was the same. In this future, white collar workers have a prevalence of 5% and blue collar workers of 15%. The absolute difference between the two groups remains the same as in Y1 – 10%; but the relative measure of inequality has changed, as the odds are now 3 to 1.

Table 3.

Population group	Diabetes prevalence	Absolute measure: difference	Relative measure: odds
White collar	5%	15 - 5 = **10%**	15 % / 5% = 3
Blue collar	15%		

This hypothetical and simple example serves to show that the same change in disease occurrence can lead to changes in health inequality measures or to no change at all, depending on the nature of the measures used. As different changes – equiproportionate or uniform – may reflect different ethical preferences, the measures used and how they are interpreted will also reflect these preferences.

4.2. Appendix 2: Online supplementary data from the first publication

Reference:

Campos-Matos I, Subramanian SV, Kawachi I. The 'dark side' of social capital: trust and self-rated health in European countries. *European Journal of Public Health*. 2016;26(1):90-95. DOI: http://dx.doi.org/10.1093/eurpub/ckv089

Online Supplement

Table 3. Year and country parameters for multilevel models on table 2 (Odds Ratios and 95% Confidence Intervals).

	Model 2	Model 3	Model 4	Model 5
Year (ref: 2002)				
2004	0.915 (0.831, 1.007)	0.917 (0.833, 1.009)	0.909 (0.825, 1.000)	0.908 (0.824, 0.999)
2006	0.828 (0.751, 0.913)	0.831 (0.754, 0.917)	0.817 (0.739, 0.903)	0.819 (0.741, 0.905)
2008	0.813 (0.739, 0.895)	0.816 (0.742, 0.899)	0.805 (0.730, 0.888)	0.808 (0.734, 0.890)
2010	0.812 (0.738, 0.894)	0.822 (0.747, 0.905)	0.805 (0.728, 0.890)	0.808 (0.731, 0.893)
2012	0.795 (0.729, 0.879)	0.800 (0.725, 0.885)	0.786 (0.708, 0.872)	0.789 (0.713, 0.874)
Country (ref: Greece)				
Austria	1.031 (0.777, 1.367)	1.099 (0.825, 1.463)	0.958 (0.676, 1.358)	0.955 (0.674, 1.354)
Belgium	1.372 (1.078, 1.746)	1.458 (1.143, 1.859)	1.292 (0.955, 1.747)	1.287 (0.953, 1.737)

Bulgaria	3.284 (2.580, 4.179)	3.241 (2.542, 4.133)	3.435 (2.662, 4.432)	3.449 (2.673, 4.450)
Check Republic	1.943 (1.545, 2.443)	2.038 (1.617, 2.568)	1.925 (1.507, 2.460)	1.910 (1.498, 2.435)
Croatia	2.965 (2.189, 4.018)	3.071 (2.262, 4.169)	2.915 (2.131, 3.989)	2.878 (2.107, 3.930)
Cyprus	1.278 (0.926, 1.762)	1.269 (0.918, 1.753)	1.255 (0.910, 1.731)	1.247 (0.904, 1.720)
Denmark	2.104 (1.650, 2.683)	2.425 (1.895, 3.105)	1.733 (0.993, 3.024)	1.956 (1.123, 3.407)
Estonia	2.413 (1.889, 3.083)	2.702 (2.107, 3.466)	2.286 (1.613, 3.241)	2.323 (1.642, 3.287)
Finland	0.862 (0.670, 1.107)	1.003 (0.779, 1.292)	0.748 (0.453, 1.236)	0.814 (0.493, 1.344)
France	2.829 (2.184, 3.665)	2.924 (2.253, 3.795)	2.773 (2.116, 3.635)	2.740 (2.095, 3.845)
Germany	3.297 (2.652, 4.098)	3.473 (2.788, 4.326)	3.158 (2.438, 4.091)	3.133 (2.424, 4.050)
Great Britain	2.477 (1.977, 3.103)	2.702 (2.153, 3.392)	2.316 (1.680, 3.195)	2.333 (1.695, 3.211)
Hungary	3.622 (2.885, 4.546)	3.755 (2.985, 4.722)	3.622 (2.868, 4.573)	3.586 (2.840, 4.528)
Iceland	1.883 (1.195, 2.968)	2.138 (1.354, 3.376)	1.665 (0.925, 2.998)	1.758 (0.978, 3.158)

Ireland	1.195 (0.933, 1.530)	1.298 (1.012, 1.665)	1.103 (0.781, 1.557)	1.112 (0.789, 1.567)
Israel	2.635 (2.063, 3.367)	2.829 (2.210, 3.622)	2.470 (1.801, 3.386)	2.465 (1.798, 3.379)
Italy	2.173 (1.331, 3.547)	2.282 (1.393, 3.739)	2.094 (1.263, 3.472)	2.075 (1.252, 3.441)
Kosovo	2.881 (1.946, 4.263)	2.942 (1.984, 4.362)	3.040 (2.050, 4.509)	3.007 (2.032, 4.450)
Latvia	1.732 (1.246, 2.407)	1.797 (1.288, 2.507)	1.754 (1.260, 2.443)	1.728 (1.246, 2.397)
Lithuania	1.709 (1.194, 2.447)	1.840 (1.281, 2.645)	1.679 (1.143, 2.465)	1.669 (1.139, 2.445)
Luxembourg	4.702 (3.498, 6.322)	5.053 (3.751, 6.807)	4.375 (3.039, 6.300)	4.384 (3.051, 6.300)
Netherlands	1.454 (1.151, 1.835)	1.624 (1.281, 2.059)	1.307 (0.878, 1.946)	1.349 (0.908, 2.004)
Norway	2.349 (1.857, 2.972)	2.732 (2.151, 3.479)	2.006 (1.196, 3.365)	2.226 (1.329, 3.727)
Poland	2.300 (1.836, 2.882)	2.328 (1.855, 2.922)	2.300 (1.836, 2.882)	2.286 (1.829, 2.859)
Portugal	4.096 (3.269, 5.132)	4.175 (3.326, 5.240)	4.212 (3.356, 5.288)	4.183 (3.339, 5.240)
Romania	6.062 (4.327, 8.492)	6.135 (4.371, 8.611)	6.209 (4.441, 8.681)	6.141 (4.401, 8.569)

Russian Federation	2.625 (2.083, 3.308)	2.673 (2.117, 3.375)	2.630 (2.087, 3.314)	2.588 (2.054, 3.262)
Slovakia	1.992 (1.568, 2.530)	2.046 (1.608, 2.604)	2.016 (1.587, 2.560)	1.996 (1.571, 2.535)
Slovenia	2.477 (1.954, 3.140)	2.457 (1.935, 3.121)	2.389 (1.878, 3.041)	2.370 (1.866, 3.011)
Spain	5.124 (4.074, 6.445)	5.590 (4.436, 7.045)	4.938 (3.680, 6.626)	4.938 (3.680, 6.626)
Sweden	1.670 (1.315, 2.122)	1.891 (1.486, 2.406)	1.467 (0.938, 2.293)	1.550 (0.993, 2.418)
Switzerland	1.369 (1.061, 1.767)	1.519 (1.175, 1.964)	1.244 (0.840, 1.840)	1.271 (0.861, 1.878)
Turkey	3.117 (2.369, 4.102)	2.866 (2.174, 3.779)	3.294 (2.337, 4.641)	3.452 (2.455, 4.855)
Ukraine	2.519 (1.999, 3.175)	2.588 (2.050, 3.268)	2.527 (2.001, 3.191)	2.492 (1.977, 3.140)

Note: ‘ref’ is reference category.

4.3. Appendix 3: Online supplementary data from the third publication

Reference:

Campos-Matos I, Russo G, Perelman J. Connecting the dots on health inequalities – a systematic review on the social determinants of health in Portugal. *International Journal for Equity in Health*. 2016;15(1):15-26. DOI: 10.1186/s12939-016-0314-z

Additional File 1: Search Strategy

The PROGRESS framework was used as an initial framework to ensure the main determinants of socioeconomic health inequalities were covered in the search strategy. From each term of this framework (first column of table 1), the closest MeSH terms were identified (second column of table 1 and corresponding entry terms in the third column). The MeSH terms in Table 1 were all included in the search as a Major Topic and connected by an “OR” Boolean operator. This search was performed with the term “Portug*”, connected by an “AND” operator.
To make sure articles not focusing exclusively on Portugal were included, a second search was performed by looking for the term “Portug*” in all fields and adding other terms referring to international comparisons. The following chart schematizes these two searches:

Search 1
Table 1, (A)
AND
Portug*[MeSH]

Search 2
Table 1, (A)
AND
Portug*[All Fields]
AND
(international[All Fields] AND comparison$[All Fields]) OR (european[All Fields] AND comparison$[All Fields]) OR (european[All Fields] AND countries[All Fields])

Both searches were restricted to articles published after January 1st 2000 in English or Portuguese.
Using the MeSH terms (and corresponding entry terms) as a starting point, the most appropriate terms for Web of Science and Scopus were then selected (fourth and fifth columns of table 1). This selection excluded terms that did not apply to the Portuguese context (such as “Minority Health and Health Disparities Research and Education Act of 2000”) and terms that were felt would amplify the search too much to little or no gain (such as “domicile”).
In both Web of Science and Scopus, these terms were searched for in the title, abstract or keywords of the publications. They were all included and connected by the “OR” operator. All databases in both aggregators were used and were limited to publications written in English or Portuguese published after January 1st 2000.
In Web of Science it is not possible to search for a term in all fields of a publication. Therefore, a search for publications on country comparisons retrieved an high amount of papers, many of which did not include Portugal. Thus, only two searches were performed in this aggregator, on articles focusing on Portugal:

Search 1
Table 1, (B)
AND
Portug*
AND
health*

Search 2
Table 1, (C)
AND
Portug*
AND
"saúde" OR "saud*"

Finally four searches were performed on Scopus:

Search 1
Table 1, (B)
AND
Portug*
AND
health*

Search 2
Table 1, (B)
AND
"international comparison$" OR "european comparison$" OR "european countries"
AND
health*
AND
Portug*

Search 3
Table 1, (C)
AND
Portug*
AND
"saúde" OR "saud*"

Search 4
Table 1, (C)
AND
"comparaç* internaciona*" OR "comparaç* europeia$" OR "países europeus"
AND
"saúde" OR "saud*"
AND
Portug*

PROGRESS Framework		MESH terms (A)	MESH Entry terms	Web of Science / Scopus (English) (B)	Web of Science / Scopus (Portuguese) (C)
P	Place of residence	Residence Characteristics	Domicile Residential selection Neighborhood Place of birth / Birth place Community Living arrangements	"Poverty area$" "Slum$" "Ghetto$" "Rural health" "Urban health" "Suburban health" “Context*” “Place of birth” “Birthplace”	“Desigualdade$ geográfica$” “Disparidade$ geográfica$” “Gueto$” “Saúde rural” “Saúde urbana” “Saúde suburbana” “Context*”
		Poverty areas	Slum Ghetto		
		Rural population	Rural Spatial Distribution Rural Community		
		Rural health			
		Urban population	Urban Spatial Distribution		
		Urban health			
		Suburban population	Nonmetropolitan Population Suburbanization		
		Suburban health			
R	Race / ethnicity / culture / language	Continental Population Groups	Racial Stock Race	"Race$" "Ethnic group$" "Nationalit*" "Migrant$" "Emigrant$" "Immigrant$" "Minority group$" "Minority health"	“Raça$” “Etnia$” “Nacionalidade$” “Migrante$” “Emigrante$” “Imigrante$” “Minoria$”
		Ethnic groups	Nationality		
		Culture	Custom Belief Cultural background		
		Language			
		Transients and Migrants	Migrant Workers Nonmigrant Squatter Illegal migrant Nomad		
		Emigrants and Immigrants	Foreigner Alien		
		Minority groups			
		Minority health	Minority Health and Health Disparities Research and Education Act of 2000		
O	Occupation	Occupations	Vocation	"Occupation$" "Employment" "Underemployment" "Unemployment"	“Ocupaç*” “Profiss*” “Desemprego” “Emprego”
		Employment	Occupational status Employment termination Informal sector Underemployment Employment status Child labor Labor force		
		Unemployment			
G	Gender / sex	Gender Identities	Sex role Gender role Man’s role Woman’s role	"Gender inequalit*" “Gender disparit*” "Sex inequalit*" “Sex disparit*”	“Desigualdade$ de género” “Disparidade$ de género”
		Sex	Phenotypic Sex Genotypic Sex		
R	Religion	Religion	Religious Beliefs Religious Ethics Prayer	"Religio* discrimination"	“Discriminação relig*”

E	Education	Education	Workshop Training Programs Educational Activities Literacy Programs	"Education* disparit*" "Education* inequalit*" "Illiteracy" “Schooling” “Grad*”	“Disparidade$ educa*” “Desigualdade$ educa*” “Iliteracia” “Escolaridade” “Nota$”
		Educational Status	Educational Achievement Illiteracy Maternal Educational Status		
S	Socioeconomic status	Social Class	Socioeconomic Status Middle Class Population Caste	"Social Class" "Socioeconomic Status" "Socioeconomic Factor$" "Standard$ of Living" "Living Standard$" "Inequalit*" "Disparit*" "Poverty" "Income$" "Remuneration" "Salaries" "Salary" "Social mobility" "Social determinant$ of health" "Deprivation" "Marital status" “Affluen*” “Consumption” “Asset$”	“Classe$ socia*” “Estatuto socio$económico” “Fa$tor* socioeconómico$” “Níve* de vida” “Desigualdade*” “Disparidade*” “Pobreza” “Rendimento$” “Remuneraç*” “Salário$” “Mobilidade social” “Determinantes sociais da saúde” “Deprivação” “Estado civil” “Afluência” “Afluente$” “Consumo” “Bens”
		Socioeconomic Factors	Standard of Living Living Standard Land Tenure High-Income Population Inequality		
		Health Status Disparities			
		Poverty	Indigent / Indigency Low-Income Population		
		Income	Income Generation Programs Savings Income Distribution		
		Remuneration			
		Salaries and Fringe Benefits	Wage Salary Paternity Benefits Pay Equity Fringe Benefits		
		Social mobility			
		Social Hierarchy			
		Social determinants of health			
		Psychosocial deprivation			
		Social stigma			
		Marital status			
S	Social capital	Social capital		"Social capital" "Social condition$" "Living conditions" "Social environment" "Social support" "Social network$" "Social isolation" “Social exclusion”	“Capital social” “Condiç* social*” “Condiç* de vida” “Ambiente social” “Apoio social” “Rede$ socia*” “Isolamento social” “Exclusão social”
		Social conditions	Living conditions		
		Social environment	Social ecology		
		Community Networks	Community Care Networks Community Health Networks		
		Social support	Social Network Psychosocial Support Systems		
		Social isolation			
		Loneliness			
		Social alienation	Social Breakdown Syndrome		
		Social marginalization			

Additional File 2: Extracted data from eligible publications

Reference	Population	Variables	Methods	Results	Strengths	Limitations
Alves et al, 2012	Consecutive sample of 7,381 puerperae from public maternities, Porto (Generation XXI)	Exposures: marital status, income, occupation, education and working conditions. Outcomes: overweight/obesity, hypertension, dyslipidemia and diabetes mellitus. Control: age.	Logistic regression	Being obese/overweight was strongly associated with being married, lower education, less differentiated occupations, being unemployed or a "housewife" and having a lower income. Hypertension was less likely in highly educated women and more likely in "housewives" relative to "employed". Diabetes was inversely associated with income. Dyslipidemia was not related to any SES indicator.	Probability sampling, large sample size.	Most outcomes were self-reported, cross-sectional data.
Amaral et al, 2013	School-based sample of 6,899 adolescents, aged 12-18, Viseu	Exposure: gender. Outcome: insomnia. Control: age.	Logistic regression	Female gender was associated with insomnia symptoms in adolescents (OR=1.82; 95% CI=1.56–2.13).	Large sample size.	Use of a “convenience sample”, cross-sectional data.
Azevedo et al, 2012	Random stratified sample of 5,094 adults, over 18	Exposures: gender, marital status, occupation and education. Outcome: chronic pain. Control: age.	Logistic regression	Women were more likely to have chronic pain than men (OR=2.37, 95% CI=2.03–2.77). Unemployed (OR=1.64, 95% CI=1.14–2.38) and retired people (OR=1.67, 95% CI=1.28–2.17) were more likely to have chronic pain when compared to full time employees. Low educational level was associated with increased probability of chronic pain. Marital status was not associated with chronic pain.	Large sample size, probability sampling.	Cross-sectional data.
Bambra et al, 2009	No mention of sample size for Portugal, adults over 16 (EUROTHINE/NHS)	Exposure: gender. Outcome: SRH. Control: age.	Logistic regression	Women had higher odds of reporting bad or very bad SRH (OR= 2.01, 95% CI=1.87-2.15).	Probabilistic sampling procedure.	Cross-sectional data.
Bastos et al, 2013	Random sample of 2067 adults, over 18, Porto (EPIPorto cohort)	Exposures: education, neighborhood deprivation, occupation and gender. Outcome: H. pylori infection. Control: age and gender.	Poisson regression	Living in a deprived neighborhood was associated with a higher prevalence of infection. The incidence rate of infection was lower among the more educated (≥10 vs ≤9: risk ratio = 0.25, 95%CI: 0.06–0.96). No evidence of gender or occupational differences.	Probability sampling, considerable sample size, longitudinal data.	Possibility of selection bias on follow-up.
Bettencourt et al, 2013	Sample of 600 consecutive hospital admissions due to acute heart failure, 6 month follow-up	Exposure: socioeconomic deprivation index (income, educational level and living alone). Outcome: mortality. Control: age, gender and admission brain natriuretic peptide.	Cox regression analysis	Deprivation was not strongly associated with mortality (the hazard ratio of all-cause death was 1.48, 95% CI=0.77–2.82).	Longitudinal data, adequate control for confounders.	Used an uncommon SES measure, small sample size.

Bingham et al, 2013	Stratified random sample of 17,136 children, aged 3–10, mainland Portugal	Exposures: gender and parental education. Outcome: overweight/obesity. Control: age.	Logistic regression	Low paternal education was strongly related to the odds of being overweight or obese, while low maternal education was only related to the odds of being obese. Girls had higher odds of both obesity and overweight.	Trained technicians obtained anthropometric measures, probability sampling, large sample size.	Cross-sectional data, low response rate (57%).
Borrell et al, 2014	207 small areas from the Lisbon metropolitan area.	Exposure: social deprivation (unemployment, manual workers, population aged 25–64 with primary education or lower, population aged 25–34 with a university degree and foreigners from low income countries). Outcome: overall mortality. Control: age.	Relative risks of smoothed standardized mortality ratios.	In women, mortality was higher in neighborhoods with higher deprivation index, proportion of unemployed people and proportion of adults with primary education. In men, this association was only seen for unemployment.	Objective health outcome.	Ecologial design, low number of deaths can lead to low statistical power.
Bulhões et al, 2013	School based sample of 1,988 13 year-olds, Porto	Exposures: gender and parental education. Outcome: depressive symptoms. Control: gender, parents' depression and education.	Logistic regression	The prevalence of depressive symptoms was 18.8% in girls and 7.6% in boys ($p < 0.001$). Parental education was not a determinant of depressive symptoms in either boys or girls.	Outcome was assessed with a validated instrument.	Cross-sectional data.
Camões et al, 2010	Random sample of 1,621 adults, 18 and over, Porto (EPIPorto cohort)	Exposures: gender and education. Outcomes: overall and central obesity. Control: age, energy intake and leisure time physical activity.	Poisson regression	The incidence rate of central obesity was significantly higher in women (5.97, 95% CI: 5.09–7.03) when compared to men (2.38, 95% CI: 1.81–3.20). There was a significant inverse association between obesity and education in women.	Longitudinal design, probability sampling, outcomes assessed by trained researchers.	High loss to follow-up (66% were followed).
Campos-Matos et al, 2014	Sample of 712 health care workers from primary care centers	Exposure: occupation. Outcome: overweight/obesity. Control: age and gender.	ANCOVA	Health service personnel had more than 3 kg/m^2 higher BMI when compared to superior technicians. Nurses and doctors were not significantly different.	Outcome assessed by researchers.	Non-probabilistic sampling, cross-sectional data, low response rate.
Carvalho et al, 2010	Sample of 442 adults, 18 and over	Exposure: gender. Outcome: sexual desire. Control: age and education.	MANCOVA	Women reported significantly lower levels of sexual desire when compared to men.	Use of validated instruments to measure health outcomes.	Non-probabilistic sampling, cross-sectional data.
Carvalho et al, 2014	Stratified school-based random sample of 17,911 adolescents, 10-17 years	Exposures: gender and perceptions of neighborhood safety. Outcome: emotional symptoms. Control: school commitment, communication with family and school grades	Linear regression	Female gender ($\beta=0.16$, $p=0.0001$) and higher perception of a safe neighborhood ($\beta=0.03$, $p=0.024$) were associated with more emotional symptoms.	Large sample size, probability sampling.	Not validated health measure, cross-sectional data.
Correia et al, 2014	Consecutive sample of 7,472 puerperae from public maternities, over 18, Porto (Generation XXI)	Exposures: maternal education, occupation and income. Outcome: impaired female fertility. Control: previous pregnancy experience, age, pregnancy planning and behavioral characteristics	Logistic regression	Lower education was associated with higher infertility among primigravidae but not in multigravidae. Occupation and income were not related to infertility.	Probability sampling, large sample size.	Excludes women who could not get pregnant, possibility of misclassification.

Correia et al, 2015	Sample of 6,893 adult mothers of singletons, Porto (Generation XXI)	Exposures: grandparents' education and social class, maternal education and marital status. Outcome: small for gestational age. Control: maternal age and gravidity.	Logistic regression	Being small for gestational age was less likely in more educated (OR= 0.77, 95% CI=0.65–0.90) and in married women (OR=0.64, 95% CI = 0.47–0.86). No association was found between grandparents' education and social class and being small for gestational age.	Large sample size, high response rate.	Possibility of recall bias, cross-sectional data.
Costa et al, 2008	Random sample of 2,036 13 year olds, Porto (EPITeen)	Exposure: parental education. Outcome: eating disorders symptomatology. Control: type of school, grade at school, age at menarche, BMI and depressive symptoms.	Linear regression	Parental education had a significant positive effect on girls' drive for thinness and body dissatisfaction scores and a significant negative effect in boys' bulimia and body dissatisfaction scores.	Probability sampling, extensive control for confounders.	Possibility of selection biases (among schools and students).
Dias et al, 2013	Snowball sample of 1,375 adult immigrants, over 18, Lisbon	Exposures: gender, nationality, education and perceived income. Outcome: SRH. Control: age, reported chronic disease, experienced mental illness, physical exercise and concern about eating habits.	Logistic regression	Good SRH was reported by 66.7% of men and 56.6% of women ($p < 0.001$). Good SRH was associated with African and Brazilian origin (compared to Eastern European) and secondary/higher education. Among women, good health was also associated with perceived sufficient income.	Extensive control for confounders.	Cross-sectional data.
Eikemo et al, 2008	Random sample of 3,410 adults, 18 and over (ESS)	Exposure: education. Outcomes: SRH and limiting longstanding illness. Control: age.	Rate differences	All rate differences, for women, men, in SRH or limitations, were statistically significant, such that people with less education had worse health.	Large sample size, probability sampling.	Cross-sectional data.
Falcão et al, 2008	Random sample of 1,911 13-year-old urban adolescents (EPITeen).	Exposure: gender and maternal education. Outcomes: asthma and rhinitis. Control: age.	Chi-square test	Boys were more likely to have had a rhinitis diagnose (prevalence was 0.120 versus 0.092, p=0.014). There was no difference in asthma prevalence. There were no differences in asthma or rhinitis diagnosis regarding maternal education.	Probabilistic sampling procedure and objective measurement of outcome.	Possibility of selection bias (some schools refused to participate, some significant differences between students who participated and students with missing data).
Ferrão et al, 2013	Sample of 2,690 children, aged 3-10, Porto	Exposure: parental perceptions of residential neighborhood environments. Outcome: obesity. Control: age, gender, maternal education and school cluster.	Logistic regression	The odds of obesity were lower in neighborhoods that were perceived as safe, pleasant and with well-maintained sidewalks.	Researchers took anthropometric measures, large sample size.	No information on sampling procedures, cross-sectional data.
Ferreira-Pinto et al, 2012	Aggregated statistics on 278 counties based on approx. 200,000 hospital admissions	Exposure: counties' economic development. Outcome: mortality rates. Control: age, gender and health care resources.	Linear regression	Counties with higher economical development had significantly higher mortality rates (coefficient = 1.696, $p<0.001$).	Objective health outcome, considerable sample size.	Ecological design, cross-sectional data.

Ferreira-Valente et al, 2014	Sample of 324 patients with chronic musculoskeletal pain from health institutions, 18 or over	Exposure: social support. Outcomes: pain intensity, physical functioning and psychological functioning. Control: age and gender	Linear regression	Social support was associated with physical functioning and psychological functioning but not pain intensity.	Use of validated instruments to measure the exposure and outcome.	Non-probabilistic sampling, small sample size, cross-sectional data.
Fraga et al, 2015	Random sample of 1205 adults aged 35-75, Porto (EPIPorto cohort)	Exposures: education and occupation. Outcome: inflammatory markers. Control: age, gender, marital status, current smoking, heavy drinking, inactivity, BMI, chronic disease and anti-inflammatory medication	Logistic regression	Both low education and undifferentiated occupation were associated with increased inflammatory markers.	Large sample size, objective outcome measure, extensive control for confounders, data collection by trained interviewers, probability sampling.	Self-reported health behaviors, cutoffs used for health outcome were dependent on the distribution in the population, cross-sectional data.
Gotsens et al, 2013	207 small areas from the Lisbon metropolitan area.	Exposure: social deprivation (unemployment, manual workers, population aged 25–64 with primary education or lower, population aged 25–34 with a university degree and foreigners from low income countries). Outcome: injury mortality. Control: age.	Relative risks of smoothed standardized mortality ratios.	There were higher mortality rates due to transport injuries, falls, homicides and all injuries in neighborhoods with lower socioeconomic index for men. For women, suicide mortality was lower in neighborhoods with higher social deprivation. There were no other important associations.	Objective health outcome.	Ecologial design, low number of deaths can lead to low statistical power.
Goulão et al, 2015	Spatial random sample of 1,736 migrants, Lisbon and Setúbal	Exposures: nationality, gender, time in Portugal and marital status. Outcome: BMI. Control: gender, age, education, marital status and birthplace.	Linear regression	Being married was associated with higher BMI, when compared to being single (β=0.55, p=0.019). Immigrants from São Tomé e Príncipe had higher BMI when compared to Brazilians (β=1.21, p=0.004). Living in Portugal for 10-14 years (β=1.15, p=0,004) or over 15 years (β=1.48, p<0,001) was associated with higher BMI when compared to less than 5. Gender was not associated with BMI.	High response rate (97,9%).	Weight and height were self-reported, cross sectional data.
Harding et al, 2006a	All births in a year in a hospital, 4,227 newborns, Amadora-Sintra	Exposures: maternal migrant status, education and occupation. Outcome: birth weight. Control: maternal age, education, mode of delivery, smoking, parity, gestational age and child gender.	Linear regression	Among babies of Portuguese white mothers, manual occupations were associated with lower birth weight. Maternal education was not associated with birthweight in any group. There were no significant differences in birthweights between different ethnic groups.	Large sample size, controlled for most important possible confounders.	Use of hospital records, with considerable missing information.
Harding et al, 2006b	All births registered in Portugal (1995 – 2002), 872,058 newborns	Exposure: migration status. Outcome: birth weight. Control: year of birth, gender, maternal age, gestational age, and parity	Polytomous logistic regression	There was no difference in overall mean birth weights between Portuguese and African babies, but the percentage of small preterm births was higher among African (4.7%) than among Portuguese (2.9%) births.	Large sample size, analyses the whole population, not a sample.	Exposure is nationality, not migration status.

Harding et al, 2008	Data from death registrations, 1998–2002, over 15,000 deaths.	Exposures: migration, marital status and occupational class (for men). Outcome: cardiovascular mortality. Control: age.	Death rates	African migrants had higher mortality for all causes, circulatory disease, coronary heart disease and stroke. There was considerable heterogeneity among Africans with Cape Verdeans having higher mortality than Angolans or Mozambicans. Occupation was associated with heart disease mortality rate for African but not for Portuguese men. Married individuals had lower mortality.	Analysis of all deaths in the time period, large sample size.	Change in ICD codes in the middle of the period analyzed.
Hoffman et al, 2014	207 small areas from the Lisbon metropolitan area.	Exposure: social deprivation (unemployment, manual workers, population aged 25–64 with primary education or lower, population aged 25–34 with a university degree and foreigners from low income countries). Outcome: avoidable mortality. Control: age.	Relative risks of smoothed standardized mortality ratios.	Deaths due to AIDS, cervical or uterine cancer, cerebro-vascular diseases and congenital heart diseases were higher in more deprived neighborhoods. Mortality due to malignant colon illness was higher in less deprived neighborhoods. There was no association between social deprivation and malignant diseases of the rectum, anal area or testes, or hodgkin's disease, rheumatic heart disease, hypertension, heart failure, peptic ulcer, renal failure or conditions from the perinatal period.	Objective health outcome.	Ecologial design, low number of deaths can lead to low statistical power.
Humboldt et al, 2014	Sample of 1,234 adults from life-long learning centers, over 75, Lisbon and the Algarve	Exposures: gender, education, marital and professional status, income, urban-rural residence, religion and nationality. Outcome: life satisfaction. Control: age, recent disease, physical activity, medication.	Structural equation modeling	Having a religion (β=0.725; $p<0.001$), higher income (β=0.551; $p<0.001$), lower education (β=−0.403; $p<0.001$) and living in a rural area (β=−0.292; $p<0.001$) were associated with higher life satisfaction. Other SES variables were not significantly related to life satisfaction.	Adequate control for confounders.	Non-probabilistic sampling, cross-sectional data.
Knesebeck et al, 2006	Random sample of 1,312 adults, 25 or over (ESS)	Exposure: education. Outcomes: SRH and functional limitations. Control: age.	Logistic regression	Lower education was strongly associated with worse SRH and more functional limitations, both in women and in men.	Probability sampling.	Cross-sectional data.
Lawlor et al, 2005	School-based random sample of 1,153 children, aged 9 and 15, Madeira	Exposures: family income and parental education. Outcome: insulin resistance. Control: age, sex, parental BMI, birth weight, breast-feeding, height, pubertal stage, BMI and waist circumference.	Linear regression	Lower income and lower parental education were associated with lower insulin resistance.	Probability sampling, extensive control for confounders.	Income was not equivalised for family size, cross-sectional data.
Leurent et al, 2013	Consecutive sample of 1,005 adults, aged 18–75, from primary care, 6-12 months follow-up, Lisbon	Exposures: spiritual and religious beliefs. Outcome: major depression. Control: age, sex, education, employment, social support and past history of depression.	Logistic regression	There were no significant differences in onset of major depression between religious (OR=1.78, 95% CI=0.39–8.08) or spiritual people (OR=1.52, 95% CI=0.27–8.48) when compared to neither religious nor spiritual.	Longitudinal data.	Unclear sampling methods and on response rates.
Machado-Rodrigues et al, 2011	Sample of 362 adolescents, 13–16 years of age, midlands (MALS)	Exposures: urban-rural residence and parental education. Outcome: CRF. Control: age, weight status and physical activity.	Logistic regression	Adolescents of both sexes from rural settings were 76% more likely to be classified as aerobically fit compared to those from urban areas. Higher maternal education was also a predictor of better CRF in girls.	Researchers assessed CRF, adequate control for confounders.	Cross-sectional data, small sample size.

Machado-Rodrigues et al, 2012	School-based stratified random sample of 362 adolescents, aged 13-16, midlands	Exposure: urban-rural residence. Outcomes: CRF and BMI. Control: Age	ANCOVA	CRF was better in both rural boys and girls. There were no statistically significant differences in BMI according to place of residence.	Researchers objectively assessed CRF and BMI.	Cross-sectional data, small sample size.
Machado-Rodrigues et al, 2014	Stratified random sample of 1,886 girls aged 7–9 years.	Exposure: parental perceptions of neighborhood environments. Outcome: obesity and overweight. Control: age, time spent in organized sports and parental education.	Linear regression	Neighborhoods with interesting things to look at while walking were significantly associated with higher BMI (Beta =0.057, p=0.02), and neighborhoods with many stores within easy walking distance were significantly associated with lower BMI (beta=-0.065, p=0.01).	Weight and height were collected by trained researchers.	Cross-sectional data.
Malmusi, 2014	Stratified random sample of approximately 12,000 adults (EU-SILC)	Exposure: migrant status. Outcome: SRH. Control: age.	Poisson regression	There were no differences in age-adjusted prevalence of poor health between migrants and natives, neither in women nor in men.	Large sample size, probability sampling.	Cross-sectional data, little control for other possible confounders.
Marí-Dell'Olmo et al, 2015	207 small areas from the Lisbon metropolitan area.	Exposure: social deprivation (unemployment, manual workers, population aged 25–64 with primary education or lower, population aged 25–34 with a university degree and foreigners from low income countries). Outcome: mortality. Control: age.	Relative risks of smoothed standardized mortality ratios.	In men, higher mortality in more deprived areas was found for respiratory diseases, chronic liver diseases, cerebrovascular diseases, influenza and pneumonia and diabetes. In women, the same relationship was found for ischemic heart disease, chronic liver disease, cerebrovascular disease and diabetes. An opposite association was found for lung cancer and breast cancer in women. No associations were found for ischemic heart disease, lung cancer or prostatic cancer in men and for respiratory diseases and influenza and pneumonia in women.	Objective health outcome.	Ecologial design, low number of deaths can lead to low statistical power.
Martins et al, 2012	Sample of 479 adults attending primary care in two metropolitan areas, over 50	Exposures: gender and education. Outcome: executive function. Control: age.	Linear regression	Lower educational levels were significantly associated with worse executive function. Gender was associated with some, but not all tests, and the direction of this association depended on the test.	Assessment of outcome by trained researchers.	Possibility of selection bias, cross-sectional design.
Mastekaasa, 2014	Random sample of adults, aged 20-59 (EULFS)	Exposure: gender. Outcome: sickness absence. Control: age, living with partner, children, level of education, working hours, occupation and industry.	Poisson regression	There were statistically significant gender gaps in sickness absence in Portugal, with OR that ranged from 1.27 to 2.22 in all the years analyzed (women had higher odds).	Very high response rate (91%) for Portugal.	No information on sample size for Portugal, cross-sectional data.
Mello et al, 2008	School-based sample of 700 13 year olds, Porto.	Exposures: type of school, maternal education and gender. Outcome: dental caries. Control: soft drinks consumption.	Logistic regression	Attending a public school, being female and having parents with low educational attainment were identified as risk factors both for having dental caries and for having a high level of dental caries.	Caries registered by one trained dentist.	Cross-sectional data, non-probabilistic sampling.
Miranda et al, 2014	18 municipalities, Lisbon metropolitan area	Exposures: illiteracy rate, deprivation, unemployment rate and proportion of precarious households. Outcome: pre-term births. Control: maternal age.	Relative risk & Moran's I	There was a global significant association between the relative risk of preterm births and illiteracy rate (Moran's I=0.44), deprivation (Moran's I=0.32) and the unemployment rate (Moran's I=0.26). There was no association with precarious households.	Adequate methods.	Ecological design, cross-sectional data.

Neto, 2009	Sample of 1,055 adolescents (partially from ICSEY), Lisbon	Exposures: migration status and gender. Outcome: mental health problems. Control: age and SES.	ANCOVA	Adolescents from immigrant families reported fewer mental health problems than their native Portuguese counterparts, and girls reported more mental health problems than boys.	Large array of instruments to measure mental health problems.	Cross-sectional data, non-probabilistic sampling.
Neto, 2010	Sample of 322 adolescents, aged 13-19, north of Portugal	Exposures: migration status and gender. Outcomes: depression, anxiety and psychosomatic symptoms. Control: age.	ANCOVA	Adolescents from immigrant families reported fewer mental health problems than Portuguese adolescents who have never migrated. There were no gender differences.	Use of a control group.	Non-probabilistic sampling, small sample size, cross-sectional data.
Nogueira et al, 2013a	School-based sample of 1,885 children, 3–10 years, Coimbra	Exposure: parents' perceptions of social and built residential environment. Outcome: obesity. Control: age and parental education.	Logistic regression	Girls living in neighborhoods perceived as having poorly built environmental conditions and as being unsafe had increased odds of being obese (OR=1.47 and 1.34, respectively, $p<0.005$). These relationships were not evident for boys.	Researchers measured weight and height.	Recruitment and sampling procedures are not described, cross-sectional data.
Nogueira et al, 2013b	Sample of 1,885 Portuguese children, aged 3–10, Coimbra	Exposure: parental education. Outcome: obesity. Control: gender, age and clustering of children in schools.	Logistic regression	Children whose parents had low (OR = 51.76, 95% CI=1.25–1.99) and medium (OR=1.57, 95% CI=1.34–2.33) education were more likely to be obese than their high-education peers.	Large sample size.	No information on selection or sampling procedures, cross-sectional data.
Nunes et al, 2010	Random sample of approximately 1,000 adults, aged 55-79, primary care registries, Northen Portugal	Exposures: urban-rural residence and education. Outcomes: cognitive impairment and dementia. Control: age, gender, vascular risk factors, cardiovascular disease, depression and other diseases.	Logistic regression	Lower education was associated with cognitive impairment (OR = 1.54, 95% CI=1.02-2.33), whereas residence was not. There were no significant associations with dementia.	Probabilistic sampling.	Cross-sectional data, high non-response rate (40-48%).
Oliveira et al, 2012	Sample of 146 homeless adults, over 18, and matched controls (on sex, age and education) from the general population, Porto	Exposure: homelessness. Outcomes: overweight/obesity, abdominal obesity, hypertension, dyslipidemia and diabetes. Control: age and education.	Poisson and linear regression	Overweight/obesity (prevalence ratio=0.66, 95% CI=0.45-0.95) and self-reported dyslipidemia (prevalence ratio=0.21, 95% CI=0.10-0.43) were less common among homeless participants than in non-homeless. There were no differences in the other health outcomes.	Some anthropometric measures taken by researchers, use of matched control group.	Most outcomes are self-reported, cross-sectional data.
Oliveira et al, 2015	Sample of 96,905 hospital patients with hip fracture, 50 and over, within 278 municipalities of continental Portugal	Exposure: municipal deprivation. Outcome: hip fracture. Control: age and gender.	Hierarchical regression model	In women, there was a lower risk associated with more affluent municipalities: relative risk=0.83 (95%CrI 0.65–1.00). In older ages (≥75 years) affluent municipalities had higher risk of hip fracture.	Large sample size, use of multilevel data and methods.	Cross-sectional data.

Pereira et al, 2011	Sample of 1,191 HIV-positive adults, over 18.	Exposure: gender. Outcome: quality of life. Control: time since diagnosis, CD4 counts and HIV stage.	MANCOVA and linear regression	There was a significant effect of gender on quality of life, as women tended to report lower scores.	Adequate control for potential confounders.	Non-probabilistic sampling, cross-sectional data.
Pereira et al, 2013	Sample of 146 homeless adults, over 18, Porto	Exposures: gender, education, nationality and duration of homelessness. Outcome: oral caries. Control: age.	Linear regression	Having decayed teeth was significantly associated with nationality ('other' vs. 'Portuguese', β = 2.7, 95% CI=0.4-5.2) and years of homelessness ('>=6' vs '<=1 month', β=2.8, 95% CI=0.4,5.2) but not associated with gender or education. Having missing teeth was not associated with any of these variables.	A single dentist assessed outcome.	Cross-sectional data, not a probabilistic selection procedure.
Perelman et al, 2012	Random sample of 33,662 adults, over 18 (NHS)	Exposure: gender. Outcomes: SRH, restricted-activity days, bed days and chronic diseases. Control: age, education, employment status, income, insurance status, marital status, occupation.	Logistic regression	Women were more likely to have poor SRH, more days lost to disability, and 6 out of 8 chronic diseases. Men experienced more bed days.	Probability sampling, large and representative sample.	Cross-sectional data and self-reported information on height and health conditions.
Perelman, 2014	Random sample of 28,433 adults, aged 25-79 (NHS)	Exposure: height (as an indicator of early-life SES). Outcomes: SRH and chronic diseases. Control: age, gender, obesity, smoking, employment and education.	Logistic regression	Height was associated with the risk of several chronic diseases (asthma, chronic pain, cardiovascular disease, mental disease), but this association is largely mediated by education among men.	Probability sampling, large and representative sample.	Cross-sectional data and self-reported information on height and health conditions.
Pimenta et al, 2011	Sample of 243 women with vasomotor symptoms, aged 42-60, Lisbon	Exposures: marital status, professional status, income and education. Outcomes: Hot flashes and night sweats. Control: perceived control, age, parity, menopause, health care use, therapy for menopausal symptoms, psychological problems, alcohol and coffee intake, smoking, physical exercise and BMI.	Structural equation modeling	No SES variable showed any association with the health outcomes.	Extensive control for potential confounders.	Recruitment and sampling procedures are not described, cross-sectional data, small sample size.
Ramos et al, 2007	Random sample of 2,161 13-year-old urban adolescents (EPITeen).	Exposure: parental education. Outcome: overweight. Control: parental smoking and BMI, gender, family structure, school characteristics, birth weight, breastfeeding practice, age at menarche, sleep duration and leisure time activities.	Logistic regression	There was no statistical association between overweight children and parental education.	Weight and height were collected by trained researchers.	Cross-sectional data.
Ribeiro et al, 2014	Sample of 97 centenarians, Porto and Beira Interior	Exposure: gender. Outcome: anxiety symptoms.	Logistic regression	There was no difference in anxiety symptoms between men and women (OR=4.29, 95%CI=0.88–21.05)	Use of validated instruments to measure outcome.	No information on selection or sampling procedures, cross-sectional, small sample size.

Rodrigues et al, 2008	Sample of 1,822 consecutive births from public maternities.	Exposure: maternal employment. Outcome: pre-term delivery. Control: maternal age, marital status, education and obstetric characteristics.	Logistic regression	Women entering pregnancy while unemployed presented a significantly increased risk of spontaneous preterm delivery (OR=1.5, 95% CI=1.18–1.88).	Use of control group, controlled for most important confounders.	Possibility of bias due to health selection, non-probabilistic sampling.
Ruiz et al, 2015	Consecutive sample of 8,330 births from public maternities, Porto (Generation XXI)	Exposure: maternal education. Outcomes: pre-term birth and small for gestational age. Control: child sex, maternal age and ethnicity.	Relative index of inequality and slope index of inequality	There was no association between maternal education and pre-term birth. There was a significant association between maternal education and being small for gestational age (RII=1.29, 95% CI = 1.01;1.58 and SII=2.90, 95% CI = 0.20;5.60).	Probability sampling and large sample size.	Missing data was more common among mothers with low education – possibility of bias.
Santana et al, 2014	All diabetes deaths per municipality in Portugal, covering 278 municipalities.	Exposure: index of sociomaterial deprivation (illiteracy, unemployment and housing without toilets). Outcome: diabetes mortality. Control: age and gender.	Bayesian hierarchical model	After the year 2000, the relative risk of death by Diabetes Mellitus according to vulnerability associated to social and economic conditions in the area of residence was not significant (relative risk: 1.00; IC95%: 0.98-1.02).	Observes all population (all deaths), objective outcome.	Ecological design, cross-sectional data.
Santos et al, 2003	Random sample of 1,436 adults, aged 18–90, Porto	Exposures: education, occupation and marital status. Outcome: obesity. Control: age, smoking status, physical activity and energy intake	Logistic regression	The prevalence of obesity was significantly higher in women (26.1%) than in men (13.9%). In women, the odds of obesity were higher in the less educated. In men, there was no association between obesity and any of the SES variables.	Outcome was measured by researchers, probability sampling.	Cross-sectional data.
Santos et al, 2008	Random sample of 1,962 adults over 40 years, Porto.	Exposures: marital status, education, occupation and social class. Outcome: metabolic syndrome. Control: age, BMI, blood pressure, physical activity, alcohol consumption and smoking.	Logistic regression	Among women, lower education, more differentiated occupation and lower social class, but not marital status, were associated with higher odds of metabolic syndrome. There were no significant associations among men.	Antrhopometric measures were taken by trained researchers, probability sampling and large sample size.	Cross-sectional data.
Santos et al, 2010	Random sample of 1,093 adults, over 18, Porto (EPIPorto cohort).	Exposures: gender and education. Outcome: metabolic syndrome. Control: age, blood pressure, waist circumference, cholesterol, glucose and triglycerides.	Poisson regression	Low education was associated with 1.53 higher odds of developing metabolic syndrome ($p<0.05$). There were no gender differences.	Longitudinal data, extensive control for confounders, probability sampling.	High loss to follow-up (23%).
Santos et al, 2011	School based sample of 266 adolescents, aged 12-18, Lisbon.	Exposures: gender and ethnicity. Outcome: CRF. Control: age and percentage body fat.	Linear regression	Interactions between age and ethnicity and between age and gender showed negative associations with CRF, such that Caucasian adolescents and girls had lower cardiorespiratory fitness.	Researchers objectively assessed CRF.	Non-probabilistic sampling, cross-sectional data, small sample size.
Santos et al, 2014a	Random sample of 1,051 adults, 50 and over, from health registries, Guimarães and Vizela.	Exposures: education and gender. Outcomes: cognitive abilities and mood. Control: age, physical activity, alcohol consumption, chronic diseases and BMI.	Linear regression and structural equation modeling	Gender showed different associations with cognitive ability, depending on the test used. Women tended to show more depressive mood. Education was positively associated with cognitive ability.	Probability sampling, measures are confirmed by medical records.	Cross-sectional data.

Santos et al, 2014b	School-based sample of 517 adolescents, aged 15–18, Azores	Exposure: parental education. Outcomes: body fat, systolic blood pressure, triglycerides, cholesterol, insulin resistance and metabolic risk score. Control: age and gender.	Z-scores	Systolic blood pressure and metabolic risk score were higher in adolescents whose parents had lower education. The other outcomes were not associated with parental education.	Outcomes were objectively tested.	Cross-sectional data.
Schutte et al, 2013	Stratified random sample of approximately 1,000 adults (EQLS)	Exposure: education. Outcome: SRH. Control: age, marital status and urbanization.	RII	Only women showed significant education-related inequality in SRH (RII for men = 1.4 (0.3, 3.3) and women = 5.9 (2.6, 13.4)).	Adequate methods.	Cross-sectional data.
Silva, 2014	Randomized stratified sample of 1,000 adults over 50, continental Portugal	Exposures: gender, occupation, employment, income, education, individual social capital indicators (characterization of social network, characterization of social activities). Outcome: SRH. Control: age.	Linear regression	Being male, with more education, more differentiated occupation, employed, with higher income and higher number of activities outside the home were all associated with better SRH. Other social capital indicators had no association with SRH.	Probability sampling, extensive control for potential confounders.	SRH was analyzed as a continuous measure, cross-sectional data.
Sousa-Ribeiro et al, 2014	Sample of 300 adults aged between 40 and 65, Porto.	Exposure: employment. Outcome: psychological well-being. Control: gender, parental status, civil status and education.	MANOVA	The employed reported better well-being than the other groups, and the unemployed in training showed lower distress than those who were not.	Used validated instruments to measure the health outcome.	Use of a “convenience sample”.
Stewart-Knox et al, 2012	Stratified cluster sample of 540 adults, aged 43-93	Exposures: employment, gender and education. Outcomes: waist circumference and BMI. Control: dietary habits, physical activity, resilience, mood, hopelessness, perceived stress and life events.	Linear regression	BMI was not predicted by any SES variable. Being male, not working and having lower education were associated with higher waist circumference.	Researchers took anthropometric measures, probability sampling.	Cross sectional data.
Vilhena et al, 2014	Sample of 774 chronic disease patients, over 17, from hospitals	Exposures: spirituality and social support. Outcomes: quality of life and subjective well-being. Control: gender, education, age, time since diagnosis and severity of disease perception	MANCOVA	Spirituality and social support were significant predictors of quality of life and subjective well-being.	Used validated instruments to measure health outcome, extensive control for potential confounders.	Unclear sampling procedures, cross-sectional data.
Williamson et al, 2009	All death registrations, 1998–2002, over 5,000 deaths.	Exposures: migration status, gender, marital status and occupational class (for men). Outcome: infectious disease mortality. Control: age.	Death rates	Compared with people born in Portugal, African migrants had higher mortality for infectious diseases including AIDS. Death rates were higher among unmarried people and men from manual occupational classes.	Objective health outcome, analysis of all deaths in the time period.	Change in ICD codes in the middle of the period.

Legend:

AMI Acute Myocardial Infarction. ANCOVA Analysis of Covariance. CI Confidence Interval. COPD Chronic Obstructive Pulmonary Disease. CRF Cardiorespiratory Fitness.BMI Body Mass Index. CrI Credible Interval. EPITeen Epidemiological Health Investigation of Teenagers in Porto.EQLS European Quality of Life Survey. ESS European Social Survey.EU-SILC European Union Survey on Income and Living Conditions. EULFS European Union Labour Force Survey. EUROTHINE Health Inequalities in Europe. ICD International Classification of Diseases. ICSEY International Comparative Study of Ethnocultural Youth. MALS Midlands Adolescent Lifestyle Study.MANCOVA Multivariate Analysis of Covariance. NHS National Health Survey. RII Relative Index of Inequality. SES Socioeconomic Status. SRH Self Rated Health.

Additional file 3: Rules for building diagram in figure 2.

The diagram presented on figure 2 was built according to the following rules:

- Health outcomes are presented inside the circle. Only health outcomes that were used in six or more eligible publications are used. The font size is proportional to the number of publications in which that outcome is used.
- SES variables are represented by circles in the circumference perimeter. Only SES variables that were used in six or more eligible publications are presented. The size of the circles is proportional to the number of publications in which the SES variable is used.
- Main findings from eligible publications were broken down to identify every combination of SES variable – health outcome analyzed. Each association was categorized as "positive", "negative" or "null".
    - Associations were considered "positive" if ill-health was associated with lower education, lower income, female gender, unemployment, deprivation, being a migrant or belonging to an ethnic group other than Caucasian, not being married, having a less differentiated occupation and living in an unfavorable or urban area.
    - Associations were considered "negative" if there was a significant association in the opposite direction.
    - Associations were considered "null" if they were not significant.
- Arrows in the diagram represent these associations. These were constructed based on the following rules:
    - *Grey* arrows indicate *weak* evidence. Evidence was considered weak when the difference between the number of "positive" and "negative" associations found was two or three. For example, obesity was found to be associated with female gender in three analyses and with male gender in one; this was considered to be weak evidence that female gender was associated with obesity.
    - *Black* arrows indicate *strong* evidence. Evidence was considered strong when the difference between the number of "positive" and "negative" associations was more than three. For example, worse subjective health was associated with lower levels of education in five analyses, and the opposite in one. This was considered strong evidence that higher education is associated with better self-rated health.
    - When there was only a difference of one analysis on a particular pair of SES variable and health outcome, it was considered insufficient evidence and excluded from the diagram.
    - When there were equal number of "positive" and "negative" associations, the result was considered contradictory and was not included in the diagram.
    - Non-significant results and associations in which "null" results were as common as either "positive" or "negative" were also excluded from the diagram.
- The visual aspect of the diagram, but not the rules for its construction, was based on the diagram built by Ashley EA et al., "Clinical assessment incorporating a personal genome" *The Lancet* 375(2010): 1525-35.

Additional file 4: References of eligible publications.

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4.4. Appendix 4: Online supplementary data from the fourth publication

Reference:

Campos-Matos I, Russo G, Gonçalves L. (accepted for publication). Shifting determinants of health inequalities in unstable times: Portugal as a case study. Accepted for publication in the *European Journal of Public Health* in May 2017. DOI: https://dx.doi.org/10.1093/eurpub/ckx080

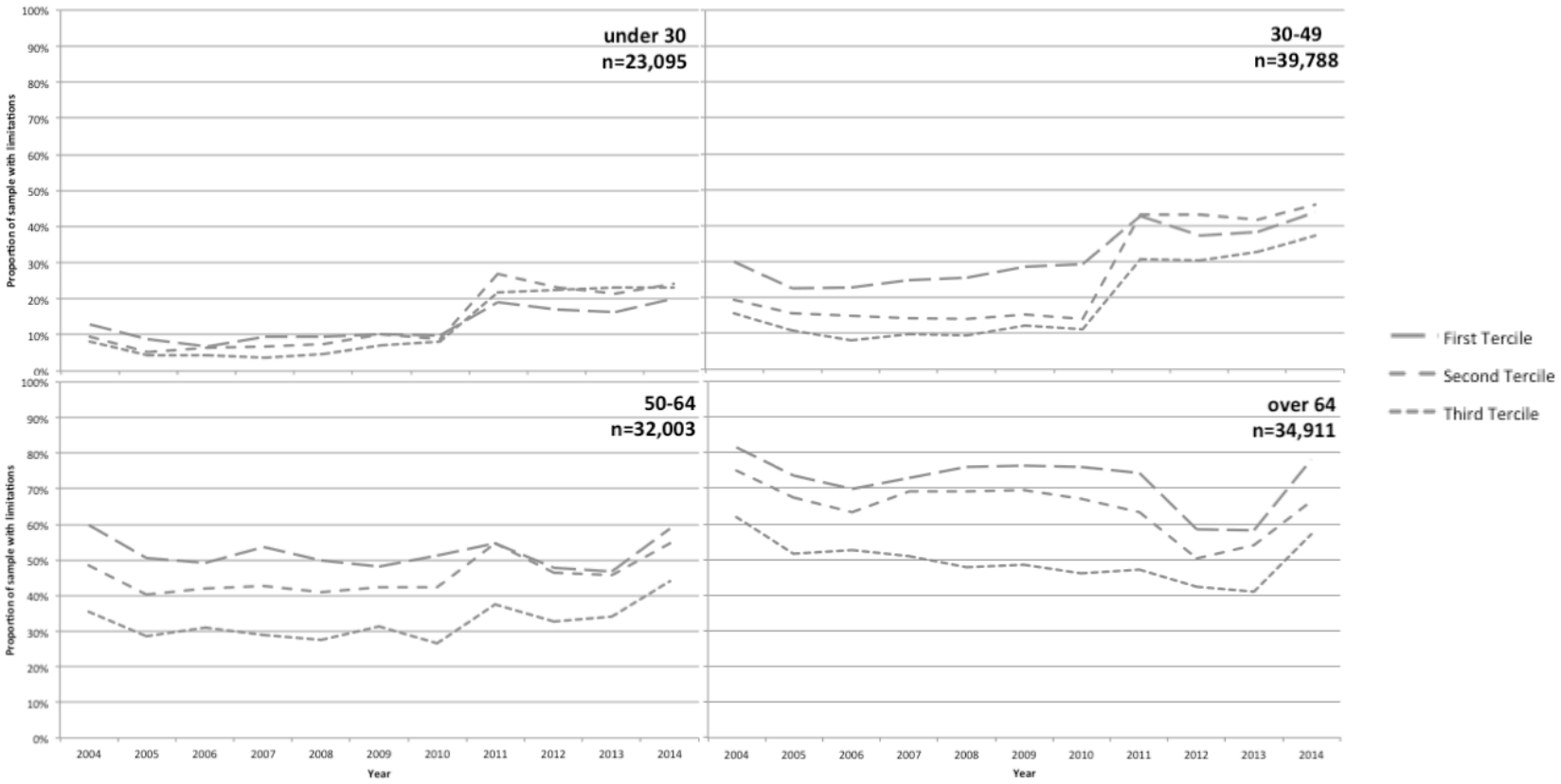
Table 1.A. Concentration indexes, elasticities, and total contribution of each variable in each year for the overall concentration index.

		Demographic variables		Socioeconomic variables						
		Age	Sex	Income	Education	Activity	Occupation	Reserves	Residuals	Total
2004	Elasticity	1,430	0,150	-0,080	-0,096	0,152	0,034	0,228		
	CI	-0,002	0,011	0,368	0,273	-0,100	-0,223	-0,227		
	Total	-0,003	0,002	-0,030	-0,026	-0,015	-0,008	-0,052	-0,029	0,162
2005	Elasticity	1,646	0,132	-0,024	-0,092	0,149	0,060	0,215		
	CI	-0,001	0,017	0,372	0,274	-0,090	-0,219	-0,244		
	Total	-0,002	0,002	-0,009	-0,025	-0,013	-0,013	-0,052	-0,059	-0,171
2006	Elasticity	1,594	0,176	-0,004	-0,110	0,149	0,107	0,190		
	CI	-0,003	0,013	0,368	0,282	-0,093	-0,216	-0,232		
	Total	-0,005	0,002	-0,002	-0,031	-0,014	-0,023	-0,044	-0,048	0,165
2007	Elasticity	1,611	0,129	-0,058	-0,113	0,169	0,134	0,211		
	CI	0,000	0,009	0,362	0,271	-0,089	-0,219	-0,244		
	Total	0,000	0,001	-0,021	-0,031	-0,015	-0,029	-0,052	-0,035	0,181
2008	Elasticity	1,500	0,141	-0,075	-0,126	0,156	0,134	0,239		
	CI	0,000	-0,003	0,352	0,245	-0,085	-0,209	-0,222		
	Total	0,000	0,000	-0,027	-0,031	-0,013	-0,028	-0,053	-0,030	0,182
2009	Elasticity	1,338	0,156	-0,036	-0,138	0,176	0,072	0,221		
	CI	-0,002	0,002	0,349	0,230	-0,105	-0,214	-0,232		
	Total	-0,002	0,000	-0,012	-0,032	-0,018	-0,016	-0,051	-0,020	0,151

2010	Elasticity	1,317	0,176	-0,171	-0,127	0,205	0,097	0,138		
	CI	-0,007	-0,004	0,332	0,235	-0,126	-0,208	-0,215		
	Total	-0,009	-0,001	-0,057	-0,030	-0,026	-0,020	-0,030	-0,007	0,179
2011	Elasticity	0,694	0,098	-0,081	-0,001	-0,072	0,245	0,094		
	CI	-0,002	-0,001	0,339	0,203	-0,109	-0,205	-0,252		
	Total	-0,001	0,000	-0,027	0,000	0,008	-0,050	-0,024	0,004	0,091
2012	Elasticity	0,575	0,085	-0,050	-0,042	-0,149	0,181	0,091		
	CI	0,003	-0,002	0,343	0,193	-0,092	-0,223	-0,223		
	Total	0,002	0,000	-0,017	-0,008	0,014	-0,040	-0,020	0,015	-0,055
2013	Elasticity	0,675	0,080	-0,039	-0,032	-0,171	0,161	0,087		
	CI	0,005	0,003	0,340	0,188	-0,101	-0,232	-0,206		
	Total	0,004	0,000	-0,013	-0,006	0,017	-0,038	-0,018	0,006	-0,047
2014	Elasticity	0,781	0,075	-0,025	-0,064	-0,096	0,132	0,087		
	CI	-0,010	-0,011	0,340	0,214	-0,111	-0,222	-0,220		
	Total	-0,008	-0,001	-0,009	-0,014	0,011	-0,029	-0,019	0,017	-0,052

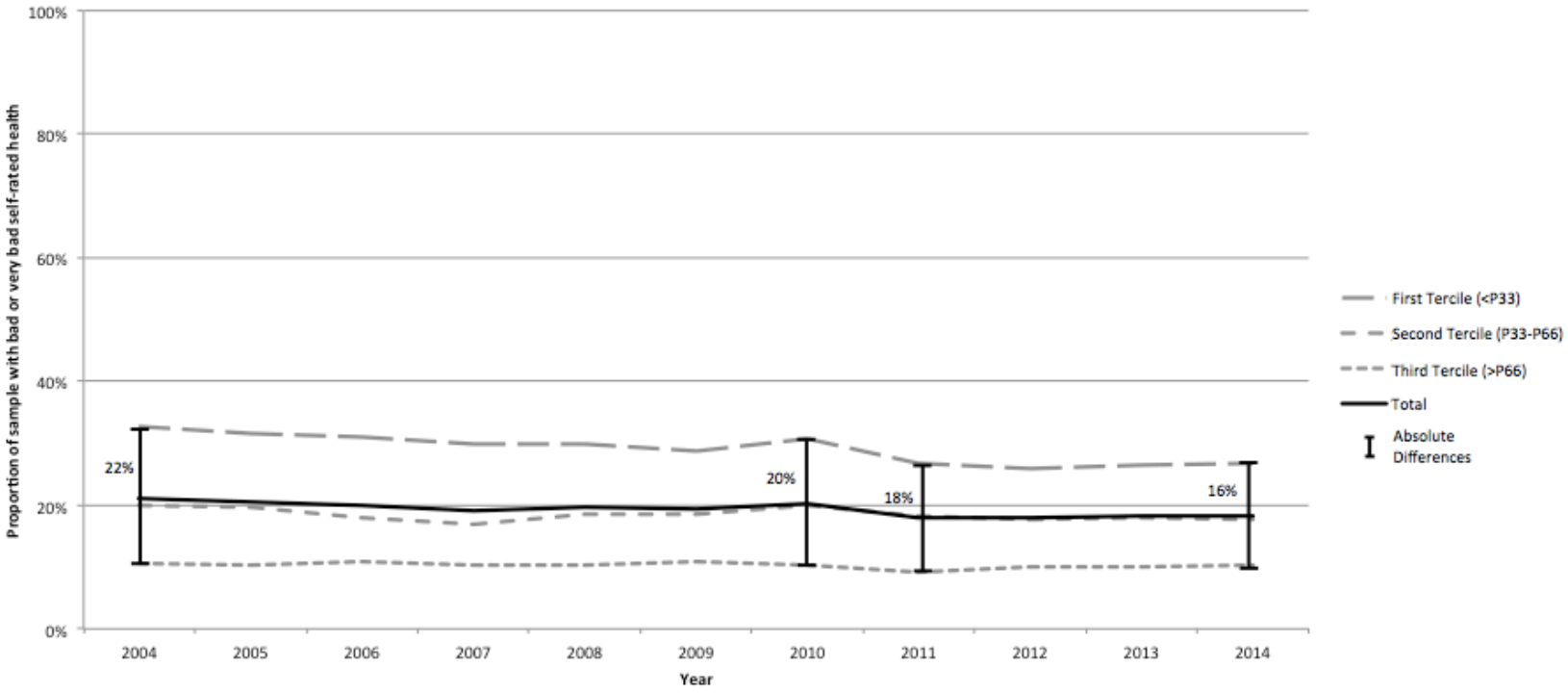
Notes: CI – concentration index.

Figure 1A. Proportion of the sample with limitations per income tercile per age group (n=129,764).



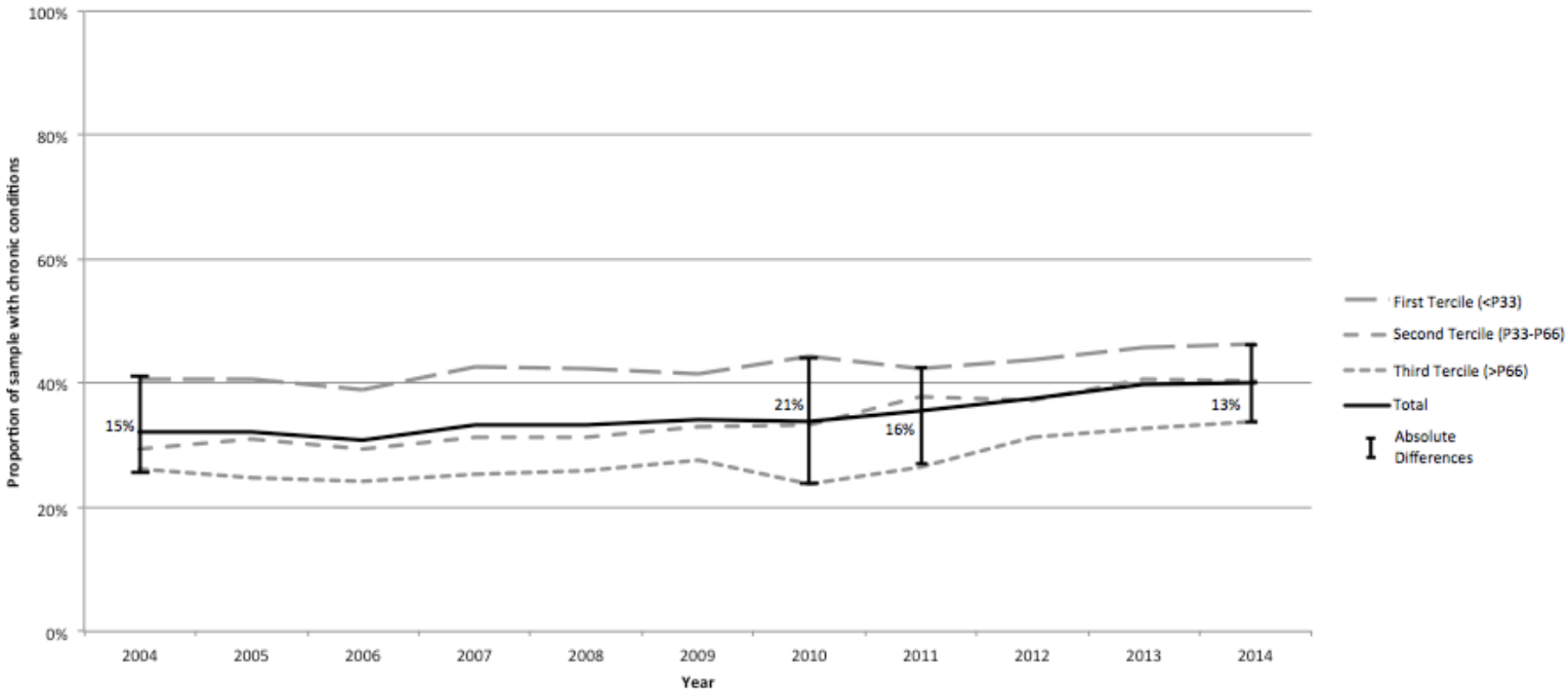
Notes: Income terciles are defined for the income distribution within that year. Values are weighed so as to reflect the geographical, gender, age group, household size distribution and the non-response rate within each household, but do not control for compositional differences between income tercile groups

Figure 1.B. Proportion of the sample with bad or very bad self-rated health per income tercile.



Notes: Income terciles are defined for the income distribution within that year. Values are weighed so as to reflect the geographical, gender, age group, household size distribution and the non-response rate within each household, but do not control for compositional differences between income tercile groups

Figure 1.C. Proportion of the sample with a chronic condition per income tercile.



Notes: Income terciles are defined for the income distribution within that year. Values are weighed so as to reflect the geographical, gender, age group, household size distribution and the non-response rate within each household, but do not control for compositional differences between income tercile groups