A life course study of quality of life at older ages in a French occupational cohort

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Abstract

Background and aims. This thesis took a life course approach to examining inequalities in quality of life in early old age using the French occupational cohort GAZEL. The cohort combines company administrative records with information from annual questionnaires for 20 625 electricity and gas industry employees. The thesis aimed to examine whether current circumstances, retirement routes, mid-life working conditions or occupational grade were associated with subjective quality of life, measured with CASP-19, in retired participants.

Results. Cross-sectional and change analyses using multiple regression demonstrated that social support, financial adequacy and, above all, mental and physical health were strongly associated with quality of life.

There was a graded relationship between occupational grade in mid-life and quality of life following labour market exit, a relationship which was largely accounted for by health and financial circumstances in retirement.

After adjusting for occupational grade and social class, exposures to physical hazards and ergonomic strain were associated with lower quality of life following retirement; accumulated exposures to carcinogens were not. Pathways from working conditions to poorer quality of life via physical and mental health accounted for the associations between earlier strenuous and dangerous working conditions and quality of life following retirement.

Retiring tended to improve subjective quality of life, particularly if it was from difficult psychosocial working conditions. Retiring in ill health was associated with worse quality of life; this retirement route was more likely for individuals who had poor working conditions. Continuing professional activities after retirement was associated with better quality of life, a retirement route more likely for individuals working in higher grades.

Conclusions. The thesis demonstrated small but persistent life course influences of employment characteristics upon quality of life which appeared to be mediated via current determinants of quality of life.

Declaration of originality

The work contained in this thesis is my own, unless otherwise referenced and indicated.

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List of abbreviations

AIC. Akaike's information criterion (indicator of model fit).

BIC. Schwartz's bayesian information criterion (indicator of model fit).

CAP. *Certificat d'aptitude professionnelle.* A French vocational qualification gained from age 16 years.

CASP-12. A shortened, 12-item, version of the quality of life scale.

CASP-19. The full version of the quality of life scale with 19 items.

CI. Confidence interval.

CFI. Comparative fit index.

CSP. *Nomenclature des catégories socioprofessionnelles.* French national classification of occupations, in use up to 1982.

DAG. Directed acyclic graph.

df. Degrees of freedom.

EDF-GDF. *Électricité de France-Gaz de France* or the French public energy utility company.

ERI. Effort-reward imbalance scale.

ELSA. English Longitudinal Study of Ageing.

ESeC. European Socio-economic Classification.

FIML. Full information maximum likelihood.

GAZEL. Prospective French occupational cohort study of 20 625 gas and electricity workers.

Insee. French national statistical institute.

MAR. Missing at random.

MATEX. Job-exposure matrix indicating, for each employee, their annual exposures to harmful chemicals.

MCAR. Missing completely at random.

MNAR. Missing not at random.

NHP. Nottingham Health Profile.

NS-SEC. National Statistics Socio-economic Classification.

OR. Odds ratio.

PCS-ESE. *Nomenclature des professions et catégories socioprofessionnelles des emplois salariés d'entreprise.* French socio-economic classification for salaried posts in large organizations which has been in use since 1982.

RMSEA. Root mean square error of approximation.

SCAST. *Service central d'appui en santé au travail.* EDF-GDF occupational health department.

sd. Standard deviation.

SE. Standard error.

SEM. Structural equation modelling.

SF-36. Short-form 36, a scale measuring health functioning.

SHARE. Survey of Health and Ageing in Europe.

SMIG. *Salaire minimum industriel garanti* or the French garanteed minimum wage.

TILDA. The Irish Longitudinal Study on Ageing.

TLI. Tucker-Lewis Index.

Chapter 1

Introduction

Summary

This chapter sets out the motivation to the thesis, highlighting the interest and novelty of examining older people's quality of life from a life course perspective. The structure of the thesis will be introduced, in which participants' quality of life is examined in relation to both recent and mid-life circumstances, as well as in relation to participants' diverse transitions to retirement. In a final analytic step, participants' mid-life and more recent circumstances will be integrated into models of pathways from earlier circumstances to subsequent quality of life. The last section of this chapter will outline the scientific interest of the thesis.

1.1 Background

Questions of human well-being and fulfilment have been debated for thousands of years. In early Western philosophy, Aristotle argued in the fourth century BC that *eudaemonia*, which is often translated into English as "happiness", was the ultimate end of the human condition. A more exhaustive rendition might describe eudaemonia as "living well and doing well", in terms of achievement of the most complete life in respect of the full set of human potentialities, or, more concisely, as human flourishing (Arrington, 1998, pp. 66–7).

Describing the good life and its correlates has been of independent interest in several scientific fields for some time, including economics (Frey and Stutzer, 2002), psychology (Kahneman et al., 1999; Maslow, 1954), health research (Binder and Coad, 2013) and gerontology (Gabriel and Bowling, 2004). Much as traditional economic measurement has focused on proxies for human welfare such as GDP (Stiglitz et al., 2009), gerontological research has overwhelmingly focussed on health-related measures of quality of life (Rowe and Kahn, 1997). However, improvements in older people's health and financial security, accompanied by declines in effective retirement ages, mean that many people are active and in good health for lengthy periods during their later years. Particularly in the case of the young-old, measuring well-being solely in terms of health seems increasingly inappropriate and there is a strong case for examining broader aspects of human flourishing in old age (Bowling and Dieppe, 2005). Therefore, this thesis examines older people's well-being using a measure of quality of life which incorporates aspects of the good life in a broad sense.

This thesis is innovative in examining well-being in old age not merely in terms of current circumstances, but in relation to individuals' personal histories. While research into the determinants of wellbeing and quality of life at all ages has mainly focussed on individuals' *current* circumstances (Stutzer and Frey, 2012; Warr, 1999), the availability today of a range of large and prospective studies enables investigators to examine the processes shaping individuals' subjective evaluations of their welfare over the longer term. A particular area of interest is to understand how those current circumstances which impact on quality of life, circumstances which are well described in a large literature, might be affected by individuals' earlier choices and circumstances. Such approaches, informed by the theoretical orientation of the life course (Elder et al., 2003) and which are being independently developed in epidemiology and economics, are novel in examining pathways to later happiness or quality of life in relation to a chain of earlier circumstances (Blane et al., 2012; Layard et al., 2013). They are particularly relevant to the study of older people's quality of life, whose attitudes, habits and living conditions have been affected by decades of previous conditions and choices. Most interestingly, approaches based on the life course raise new perspectives and questions: will it be possible to find substantial long-term influences upon quality of life, or will quality of life be responsive above all to individuals' current circumstances? Can models traditionally used to describe the long-term development of diseases, such as pathway or accumulation models, be applied to a new domain of studying variations in well-being? Which pathways might link individuals' earlier circumstances to variations in quality of life in old age? Therefore, this thesis places the life course principle of life-span development at its heart (Elder et al., 2003) by studying how earlier events influence the development of individual biographies.

1.2 Approach

In examining determinants of quality of life from a life course perspective, this thesis will focus on individuals' mid-life circumstances. Specifically, it will examine how individuals' experiences during their working lives might influence their quality of life as they enter old age. Little is known about the influence of mid-life circumstances on subsequent quality of life, but it is possible to speculate that they might exert effects. A person's position in the social structure in mid-life will shape the circumstances in which they age, whether in terms of their financial constraints, levels of social support and participation, working conditions and the manner in which they retire. Disadvantaged social position in mid-life might lower older people's quality of life through its impact on their financial security in later life (Blane et al., 2012). Dangerous and strenuous working conditions are known to have long-term impacts upon health (see Bambra, 2011a, for a recent review). Since health is known to affect well-being in old age (Dolan et al., 2008), poor health might form one pathway connecting earlier physical working conditions to poor quality of life following retirement.

This thesis will concentrate on individuals' working conditions and social position in mid-life because, between them, these affect the whole workforce and are important aspects of individuals' mid-life circumstances. Analysing physical and psychosocial working conditions provides possibilities to examine a variety of life course processes, including accumulation and pathway processes. Studying social position enables exploration of the pathways which might translate differences in mid-life social position into variations in quality of life during retirement.

In addition, the effects of exposures during working life may be compounded by the ways in which people retire (Blane et al., 2007a). The timing and nature of the transition to retirement may affect a person's quality of life in a variety of ways. Individuals in poor health, perhaps resulting from poor working conditions, may leave the labour force before making their full social insurance and pension contributions, with concomitant impacts on their pension provision in retirement. Therefore, I will examine how the manner in which people retire is related to their earlier social position and working conditions as well as to their subsequent quality of life.

Specifically, this thesis tackles these questions by examining life course influences upon well-being in a prospective French cohort, focusing in particular on the pathways connecting distal and proximal influences upon quality of life. As an outcome measure of well-being, this study will use a scale of subjective quality of life called CASP-19. Based on the premise that quality of life can be defined in terms of fulfilment of universal human needs, the CASP-19 quality of life scale evaluates both hedonic and eudaemonic aspects of well-being (Higgs et al., 2003).

The GAZEL occupational cohort of employees of the Gas and Electricity Public Utilities of France is used in this thesis. The GAZEL cohort is well suited to this study, because, uniquely, it combines information about occupational conditions over the life course, which are mainly prospective and are often taken from administrative records, with the CASP-19 measure of subjective quality of life adapted to participants in early old age. In addition, the continental European location of this cohort allows previous work into life course influences upon quality of life to be extended into a new context, that of a Bismarckian welfare state.

More specifically, questionnaires have included the CASP-19 measure of quality of life on two occasions, in 2005 and 2009, and participants have also provided information on their current circumstances including their financial situation, social relationships, neighbourhood and state of health. Information about participants' mid-life characteristics are also available, including social position, retirement timing and physical and psychosocial working conditions. Using these measures, models can be built that enable examination of both distal and proximal influences upon quality of life.

1.3 The structure of the thesis

The thesis' structure is as follows: after examining the literature pertaining to the theories and measures used in the thesis, the conceptual model for the thesis will be outlined, as well as a series of research questions. Five chapters will then describe the results obtained in the course of the research.

1.3.1 Current influences upon quality of life

This chapter will examine how individuals' current circumstances might influence their quality of life in 2005. A great deal of evidence exists regarding current predictors of CASP-19 quality of life, mainly concerning cohorts from Britain and Ireland, complemented by use of one multi-country European panel. A first step, therefore, is to examine whether those factors have similar associations with quality of life in this large French cohort.

1.3.2 Predicting change in quality of life

A second results chapter studies whether changes in quality of life 2005–2009 are related to initial circumstances and changes in those circumstances. Examining change in quality of life enables stable differences between individuals to be controlled for. Therefore this analysis offers stronger evidence that individuals' current circumstances and common changes in these circumstances might be influencing their quality of life.

The next three results chapters of the thesis will take a life course approach, examining relationships between earlier circumstances and quality of life.

1.3.3 Social position and occupational conditions in mid-life

This chapter will examine associations between quality of life and the following mid-life characteristics: physical and psychosocial working conditions, employment grade and social class.

Earlier research into life course influences of social class have been carried out in British datasets (Blane et al., 2012); would similar associations with mid-life social position be found in a continental European cohort? Therefore, associations between earlier social position and quality of life following retirement were examined using two measures of social position: a lengthy hierarchical series of occupational grades and the European Socio-economic Classification (ESeC), a recent operationalization of social class specifically designed for comparative research in Europe (Rose and Harrison, 2007). Additional analyses tested for variations in quality of life in relation to intra-generational social mobility.

There is substantial evidence that working conditions affect individuals' health and well-being, yet little is known about whether earlier working conditions have lasting effects upon quality of life following retirement. Consequently, analyses are presented comparing quality of life in retired people in relation to both validated measures of psychosocial occupational exposures (effort-reward imbalance and job strain) and a range of physical working conditions (ergonomic strain, safety hazards and chemical exposures).

1.3.4 Retirement transitions and routes

The nature of retirement processes and their associations with quality of life will be considered in this chapter. It will examine whether retirement is associated with an improvement in quality of life of the type that might be expected from Third Age theories of ageing. An overall improvement in quality of life at retirement seems likely because GAZEL participants, as will emerge, retire at a relatively young age, with a good pension by French standards, and in a way that is planned and protected (Birchem et al., 2007). However, such relationships might be nuanced by the nature of the retirement route, such as participants' age at retirement, whether they continued professional activities following retirement or retired in a manner that was marked by ill health or disability. Analyses are presented comparing participants' quality of life in relation to their retirement route, as well as examining relationships between retirement routes and individuals' circumstances in mid-life.

1.3.5 Life course processes and quality of life

The influence upon quality of life of exposures occurring decades before is anticipated to occur as a result of impacts upon individuals' more recent circumstances, such as their health or finances. Therefore, it is interesting to examine possible pathways via more recent factors which might mediate between mid-life characteristics and quality of life after labour market exit. One analysis will model pathways via physical and mental health for each of the physical occupational exposures. A second analysis will model pathways from mid-life social position to quality of life via a range of current circumstances. These analyses will highlight the possible mechanisms through which working conditions and social position in mid-life may exert their influence upon quality of life following retirement.

1.4 Conclusion

In summary, this thesis will take a life course approach to determining the impact of mid-life social position and occupational exposures, retirement trajectories and current factors upon quality of life in early old age in the GAZEL cohort. It will measure the role and importance of life course accumulation of occupational exposures upon quality of life, and their interactions with current factors. In addition, the associations of retirement transitions with quality of life as well as with earlier circumstances will be examined.

The scientific interest of this thesis derives from the use of a theoretically grounded measure of quality of life as well as a unique, large and prospective dataset, containing detailed information on working conditions spanning more than four decades. It is the first time that research examining life course influences upon quality of life has been performed in a French cohort. It is one of few studies integrating both proximal and distal influences upon quality of life in combined models (Read and Grundy, 2011; Layard et al., 2013). This thesis is original in examining the pathways linking previous physical and psychosocial occupational exposures to quality of life, as well as being one of the first studies to examine how mid-life social position impacts upon quality of life following retirement (Blane et al., 2012).

Chapter 2

Background

Summary

As a first step to examining life course influences upon quality of life in early old age in a French cohort, it is vital to set the study in its theoretical and national context. To this end, in the first section of this chapter, the life course theoretical orientation is introduced. Three life course principles which lie at the heart of this thesis are described, as well as a series of life course mechanisms which link earlier conditions and subsequent outcomes. Theoretical perspectives of ageing are also presented. The positive vision of ageing emphasized in Third Age theory is contrasted with an alternative vision of structured dependency in old age. I argue for an approach which integrates these contrasting perspectives into an account that emphasizes variations and inequalities in individuals' circumstances in later life which, in turn, relate to the life course trajectories that brought them there. The final part of this chapter describes the historical context of the GAZEL cohort within a modernizing post-war French setting.

2.1 Introduction

This chapter outlines the theoretical setting for the thesis. It introduces life course theory and theories of ageing, as well as describing the French social and economic context over the course of the GAZEL cohort members' lives.

2.2 The life course theoretical orientation

Life course approaches are concerned with the dynamics of the lifelong interplay between individuals' personal behaviours and the historical social institutions, such as school, the family, or the labour market, that surround them (Heinz and Krüger, 2001). The life course approach has been described as a *theoretical orientation*, a set of principles that orient research, whether this concerns the selection of research problems, rationales for choosing variables or research design and data analytic strategies (Baltes, 1987; Elder et al., 2003). Originating from a variety of disciplines, including sociology, developmental psychology, demography, history and biology (Marshall and Mueller, 2003), the great strength of the life course tradition is its ability to integrate macro and micro-level inquiries, to incorporate, in various ways, both individual agency and social structure (George, 2003). Transitions, such as retirement, are moments in which macro-level structures and micro-level trajectories converge, as individuals attempt, in the light of their previous experiences and perceptions of future prospects, to reflectively choose when and how to leave the labour market (Heinz, 2009).

Life course research is a developing field in epidemiology (Graham, 2002), where it is predominantly used to describe the long-term effects upon chronic disease risk of exposures taking place during gestation, childhood, adolescence, adulthood and later life (Ben-Shlomo and Kuh, 2002). This approach encourages researchers to think about the temporal ordering of exposure variables and about their inter-relationships. In particular, it draws attention to how one episode of disadvantage is likely to have been preceded and to be followed by other disadvantages (Blane et al., 2007b). In this way, life course approaches challenge the prevailing concern in epidemiology with the identification of mechanisms of causation. It legitimizes an alternative approach to using longitudinal data which emphasizes rich description of processes and pathways (George, 2003) as well as engagement with the broader social and economic factors which generate social inequalities over time (Graham, 2002; Corna, 2013).

2.2.1 Three life course principles

Several life course principles have been proposed which link individual lives to changing times (Heinz and Krüger, 2001). Three of those principles are particularly relevant to this study:

1. *Life-span development.* Human development is a lifelong process. Earlier circumstances and events affect the development of biographies in part by altering the

opportunities and constraints within which individuals make choices, and in part by their incorporation into evaluative personal narratives (Marshall and Mueller, 2003). Paul Baltes (1987) emphasized the dynamism inherent in ageing, arguing that, at all stages of the human life-span, development involves processes of adaptation to changing conditions, a process which simultaneously incorporates both gains and losses.

2. *Impact of historical time and place.* Personal biographies are shaped by the historical times and places individuals experience over their lifetime (Baltes, 1987; Elder et al., 2003). However, individual differences and individuals' positions within the social structure will affect the impacts that external events and circumstances have on their biographies (Heinz, 2009).

3. *Timing.* The timing of life events matters; *cohort effects* may occur when cohorts develop distinct biographical patterns depending on their age when events occur (Elder et al., 2003). Events occurring at certain periods of development may have effects which are irreversible at a later stage (Ben-Shlomo and Kuh, 2002). This aspect is described more fully in the next section which examines life course mechanisms in epidemiology.

2.2.2 Life course mechanisms connecting exposures and outcomes

Life course theories in epidemiology link earlier exposures to their subsequent long-term effects upon health and well-being (Kuh and Shlomo, 2004). A range of models are available in social epidemiology which describe different sorts of disease generating processes and how these combine cross-sectionally and longitudinally.

One model of disease development over the life course is the *latency model*. In its strong form, the *critical period model*, it postulates that an exposure is hazardous only at a certain life stage, and that its impact is not reversed by later circumstances (Ben-Shlomo and Kuh, 2002). A contrasting model of disease development would be the *accumulation of risk model*, in which the timing of exposure is less important and which postulates that poor circumstances at one life stage can be mitigated by better circumstances later on (Graham, 2002). There are two versions of the accumulation of risk model, one in which the effect of an exposure increases as it persists over time (DiPrete and Eirich, 2006), another in which exposures merely add up over the life course to produce damage cumulatively (Kuh and Shlomo, 2004).

It is possible to conceive of the accumulation of risk model and the latency model as two opposite ends of a continuum. In between lie variations of these models, which integrate characteristics of both the risk accumulation and latency hypotheses. In the *sensitive period* variant of the latency model, an exposure has its strongest but not its only effect during the sensitive period (Ben-Shlomo and Kuh, 2002). In addition, the *critical period model with effect modifiers* includes factors that later on in life modify the risk of developing disease (Ben-Shlomo and Kuh, 2002).

Further variants to life course models of disease development concern risk clustering. In a variant of the accumulation of risk model, known as *accumulation with risk clustering*, risks are clustered *cross-sectionally* (Kuh and Shlomo, 2004) and accumulate longitudinally. It is also possible to picture risks clustering *longitudinally*, forming chains of advantage or disadvantage (Blane, 2006). Each element in the chain of exposures might increase the risk of later exposures as well as independently increasing the risk of subsequent ill health (Kuh and Shlomo, 2004). If only the final exposure in the chain causes disease, the earlier exposures are causing disease *indirectly* through mediation by the final exposure. In this pure form of the *pathway model*, an early advantage or disadvantage will set a person on a course to a later exposure which itself will affect health (Blane et al., 2007b).

These models are conceptual tools, and can be combined, although they can be hard to distinguish empirically (Hallqvist et al., 2004). For example, it can be difficult to determine whether an effect of parental social class during childhood which remained significant after controlling for own social class is evidence of a latent effect or an additive effect.

2.2.3 Examining quality of life using life course theory

In studying the factors that influence quality of life, the dominant approach in economics and psychology has been to examine the influence of contemporaneous or recent circumstances upon quality of life. Where panel data are used, the overwhelming concern has been to demonstrate directionality of effects upon quality of life rather than to understand how long-term processes and pathways might result in variations in quality of life (George, 2003). Even research examining the well-being of older people privileges a focus on immediate factors (George, 2010), despite the great likelihood that processes taking place over the long-term may be influencing quality of life and well-being in later life. Integration of life course principles, such as the principle of life-span development or the principle of time and place, into the examination of determinants of quality of life is a recent and innovative approach. Only recently has research begun to examine the processes through which earlier circumstances may be influencing quality of life (Blane et al., 2012; Layard et al., 2013; Niedzwiedz et al., 2012).

2.3 Perspectives of ageing

In advanced industrial economies, the twentieth century was marked by a demographic shift towards an ageing population caused by declining fertility rates and higher life expectancies. Retirement emerged as a mass phenomenon as a result of an increase in the numbers of older people and intensified displacement of the elderly from the workforce (Smith, 1984). While a range of perspectives in social gerontology has explored the implications of these developments, in this thesis, I concentrate on those perspectives which were most central to the development of the CASP-19 scale of quality of life: structured dependency theory and Third Age theory. I also describe the recent cultural turn in the sociology of ageing.[1]

2.3.1 Structured dependency theory

Structured dependency theory is an approach in social gerontology which contests the economic and social marginalization and dependency of elderly people as an inevitable outcome of their biologically generated frailty (Townsend, 1981). Instead, elderly people's dependence on the state in many industrialized countries resulted from structural factors which pushed elderly people into poverty and social isolation (Walker, 1981; Wilson, 1997). It was social policies which rendered elderly people dependent, mainly the actions of governments and employers in forcing older people to leave the labour market through retirement and by providing low levels of state retirement benefits (Townsend, 1981; Walker, 1981). In order to open up opportunities for the large baby-boomer cohorts, public policies had supported early withdrawal from the labour force through the generalization of old age pensions and policies of early retirement (Loretto, 2010; Marshall, 2011), in which retirement was actually a masked form of mass unemployment (Townsend, 1981). Consequently, until recently, the compulsory retirement age in many Western industrialized nations had been dropping, as had effective retirement ages for men, a result of employer policies and pre-retirement packages (Okba et al., 1996; Walker, 2005b).

2.3.2 The Third Age

In the 1990s, structured dependency theory was challenged by growing evidence that this picture of retirement did not relate sufficiently to many people's lived experience of early old age. Pensions for retired persons in the advanced industrialized OECD nations had been increasing (Wilson, 1997; Gilleard and Higgs, 2002); later life was no longer the principle time of poverty as it had been in previous centuries (Gilleard and Higgs, 2002). Gerontologists working in the structured dependency tradition had always recognized "two nations" of old age, a result of pre-retirement inequalities being transferred into retirement (Walker, 1981), but had emphasized the fates of those in difficulty. Gradually growing prosperity of older people and generational replacement encouraged a new form of ageing following retirement, which has been called the *Third Age* (Laslett, 1991, p. 79). Individuals leaving working life with sufficient health, economic and cultural capital were able to enjoy an "age of personal achievement and fulfilment" (Laslett, 1991, p. 4); others aspired to it (Gilleard and Higgs, 2000, p. 22). Expecting a lengthy period of healthy retirement, individuals coming to the end of working life were able to prepare for a period of active leisure, in which they could follow their own interests, before eventually succumbing to a *Fourth Age* of final dependence, decrepitude and death (Laslett, 1991, p. 4, p. 157). The Third Age is certainly a tangible phenomenon in advanced industrial economies: Gilleard and Higgs (2002) report that leisure goods and services are now the main outgoing of British pensioners.

[1] There was not space here to discuss other theoretical approaches to ageing, such as social disengagement theory (Cumming et al., 1960), continuity theory (Atchley, 1989) and successful ageing theory (Rowe and Kahn, 1997).

However, Laslett's theory of the Third Age has received robust criticism. Laslett noted himself that experiencing the Third Age is inaccessible for a large proportion of retired people who lack sufficient cultural and economic capital (Laslett, 1991, p. 25, p. 90). Women, in particular, may have difficulties in aspiring to the Third Age, and the demarcation between the Second and Third Age is often not pertinent for women, who may have spent lengthy periods in unpaid domestic labour (Bury, 1995). While women might spend longer periods in retirement than men, later life does not necessarily represent a period in which women gain personal control over their time and freedom from external demands on their labour power, since their work as a homemaker may continue or intensify (Laslett, 1991, p. 39, p. 149). For example, demands to provide informal care for others may grow, because women in particular may care, in some cases, for a *series* of frail and vulnerable relatives (Siegel, 1990). In this way, the Third Age will remain an aspiration for some, if a rather normative and elitist one, in which activities such as pursuing further education are prioritized over others such as fulfilling family obligations (Bury, 1995; Siegel, 1990).

2.3.3 A cultural turn in the sociology of ageing

While theorists in both the Third Age and structural dependency traditions have always emphasized older people's heterogeneity, the cultural turn in the sociology of ageing treats the diversity of cultures of ageing as its central focus of interest.

In industrialized societies, where individuals frequently had life-long careers if they managed to stay in employment, it has been argued that personal identities were principally shaped by individuals' relationships to the forces of production (Gilleard and Higgs, 2000, p. 28). In contrast, in current post-modern times of late or high modernity, self-identities have become an individual, active and reflexive project (Giddens, 1991, pp. 2–5).

The post-war baby-boomer cohorts represent the first cohorts that have always lived in consumer societies (Gilleard and Higgs, 2000, p. 9), and whose values decisively broke away from those of earlier generations (Becker, 1995). Consequently, they can present strikingly contrasting cultures of ageing to earlier generations (Roth et al., 2012). These are the same cohorts that Pierre Bourdieu located, using their 1970s leisure consumption and lifestyle choices, within a field generated by inequalities in economic and cultural capital (Bourdieu, 1979, pp. 140–1). As they have grown older, these cohorts are now generating diverse cultures of ageing, in which their leisure consumerism is producing new sites of distinction (Gilleard and Higgs, 2000). In addition to access to forms of physical consumption, exclusion and marginalization in late modern societies can be partly defined in terms of varying access to forms of self-actualization and empowerment (Giddens, 1991, p. 6), limiting the range of coherent narratives of the self accessible to poorer individuals.

2.4 Specificities of the French case

Following the life course principle of locating the research within a specific time and place, the historical situation of this cohort within a modernizing post-war French setting is provided in some detail. Individuals' expectations, opportunities and constraints are embedded in the structures of their societies. The GAZEL cohort was born during World War II, or in the early post-war years, and were aged in their late thirties or forties in 1989 when the study began. To understand the course of their lives as they lived them, I sketch out the particularities of the French context over this period.

2.4.1 Historical situation of the war years and early baby-boomer cohorts in France

This cohort was born from 1939 to 1954. Many in this cohort had a difficult young childhood in a context of war and want, although the youngest members of the cohort spent their young childhoods in a period of growing consumerism and economic growth (Baudelot and Establet, 2000, p. 34). Following a short and undemanding period of schooling, most directly entered the labour market (Baudelot and Establet, 2000, p. 30); only a minority attended university.

During their early working life the economic conjuncture was particularly favourable: this cohort began working at a time of full employment and when large state companies such as *Électricité de France* (EDF) and *Gaz de France* (GDF) were developing rapidly (Chauvel, 2006). Jobs in the state administration and nationalized companies were perceived as advantageous, since they provided protection from unemployment, an enduring working-class fear dating from an earlier epoch (Baudelot and Establet, 2000, p. 118). The social structure was altering, providing more middle-class jobs, and spending power was increasing (Baudelot and Establet, 2000, pp. 34–5). It was a period in which social success was not dependent on academic success and unemployment was extremely low. France still had a youth labour market at that time and even low-skilled individuals were able to rapidly integrate into the labour market (Baudelot and Establet, 2000, pp. 112–3). In addition, individuals were rapidly promoted; employees holding only the working-class CAP qualification (*Certificat d'aptitude professionnel* or certificate of vocational activity) were able to enter management in large numbers (Baudelot and Establet, 2000, p. 148).

The cohort entered the labour market at a time when differences by age in salaries were small, a result of a compromise in which each cohort was paid a higher starting salary than the previous cohort and salaries rose throughout the career (Baudelot and Establet, 2000, pp. 82–3). The model in France is one of the ascending career (Okba et al., 1996), which was adapted to the post-war boom described as the *Trente glorieuses*.[2] Oil crises in the early 1970s set France on a path of relative economic stagnation, which began when members of the GAZEL cohort were aged about 20–30 years old. It was no longer possible to increase salaries for new entrants, and these fell in real terms. Consequently, differences in salary by age in France have grown since this time, to the benefit of this same cohort of ageing workers who benefited from small inequalities in salaries in their youth. An allied problem has been the development of mass unemployment in France, particularly for young people. The opportunities provided to older baby-boomers have disappeared for

[2]The term *Trente glorieuses*, attributed to the French economist Jean Fourastié, translates most closely as a "30-year Golden Age" describing France's 30-year post-war boom 1946–1975.

their descendants (Chauvel, 2001), as this cohort has been able to monopolize positions of power and influence (Baudelot and Establet, 2000, pp. 59, 61). This has the consequence that the children of the early baby-boomers may have formidable difficulties in integrating into labour markets.

2.4.2 Two worlds of welfare: The Bismarckian model in France

The French welfare state grew out of a compromise that led to an expansion of existing insurance arrangements in a context of the strong economic growth following World War II. The welfare state was developed in a Bismarckian model, in which entitlements were related to employment and benefits to previous earnings (Palier, 2010). Declines in economic growth and increasing unemployment levels from the 1970s, particularly of young people, led to the system running into difficulties. These were spiralling costs as well as a growth in the numbers of people who were deprived of social protection because they had not built up sufficient entitlement (young people and the long-term unemployed). A division has emerged in French society between so-called *insiders*, supported by the social insurance system as a result of earlier participation in the labour market, and increasing numbers of *outsiders*, often new entrants to the labour market, who receive only minimal levels of social protection in the form of assistance benefits (Chauvel, 2003; Palier, 2010).

2.4.3 The French social policy context in relation to retirement

The rules governing access to retirement in France are complex, varying according to the worker's retirement *régime*. As such, there is no standard state retirement age. In the general regime, which contains most private-sector French workers, a 1982 reform reduced the retirement age to 60 years, as long as workers had paid contributions for at least 37.5 years (Brocas, 2013). Rather than being in the general regime, the GAZEL participants are members of a special regime for workers in the energy sector. It has less restrictive eligibility rules for retirement than the general regime, allowing retirement at younger ages (Baruch and Chastand, 2013).

As is typical in European countries, life expectancies in France have risen at the same time as individuals' effective retirement ages have fallen, leading to citizens spending more time in retirement. Employment rates of men aged 60–64 years reduced from about 65% in the late 1960s to about 20% in the 1990s (Okba et al., 1996; Brocas, 2013). These falling effective retirement ages are probably largely a result of policies expanding access to retirement payments for employees over 60 years old. Employment rates have also declined for employees in their fifties, but less precipitously. These declines have probably resulted from improved access to various forms of early retirement (*pré-retraite*) social assistance as well as growing unemployment rates (Okba et al., 1996).

Compared to other OECD nations, France, in 1993, had particularly low levels of men aged 55–64 years in work (43.5%) but more middling rates of women in this age group in work (30.4%) (Okba et al., 1996). Current French policy is to increase the French effective retirement age in line with life expectancy by increasing the number of years in work necessary to retire on a full pension. However, this will have little effect on older cohorts because most will have more than fulfilled this requirement by the age of 60 years as a result of having entered the labour market in their teens (Brocas, 2013).

Compared to other European countries, French citizens suffer little increase in the risk of poverty once they retire and have relatively low poverty rates (Walker, 2005b, p. 19). This is result of high salary replacement rates for pensions in France (at least 75%) as well as a minimum pension for low-income pensioners (Béland and Durandal, 2013). However, for citizens who have not managed to accumulate the number of years of working life necessary to receive a full entitlement to the general pension regime, the end of the career is a period of vulnerability, when risks of unemployment and financial difficulties are high, and this at a time when children in such households may be experiencing difficulties in entering the labour market (Okba et al., 1996).

The dualization of the French welfare system has implications for retired individuals too. *Insiders* holding civil servant-type posts can expect relatively early retirement accompanied by generous retirement benefits paid by those still working for the organization. This type of retirement provides a level of revenue which is comparable to the population average while retired people hold substantial wealth as a result of having lifetime employment and receiving high salaries (Chauvel, 2003). In contrast, *outsiders*, who may suffer lengthy periods of unemployment in their late fifties, will have early retirement *de facto* forced upon them if they are made redundant, because they have little prospect of being reemployed (Chauvel, 2005).

The GAZEL cohort members typify labour market insiders; their particularities compared to the French population as a whole will be explored in section 5.1 on page 98.

2.5 Conclusion

This chapter reviewed key life course principles as well as the mechanisms used in epidemiology to describe the long-term effects of earlier circumstances upon health and well-being. One important life course principle is life-span development, which relates individuals' prospects as they age to their earlier circumstances. A final section described the French context over the course of the GAZEL participants' lives, in order to embed the study in a precise temporal and spatial context.

Chapter 3

Literature review of quality of life and its influences

Summary

This chapter describes the variables which will be used in this thesis. It will firstly introduce approaches to measuring quality of life, and present the conceptual background to the CASP-19 measure of quality of life which will be used as the main outcome variable.

The main part of this chapter will review the literature to describe the relationships between quality of life and a range of factors ranging from demographic characteristics to social relationships and participation, and examining both individuals' recent circumstances and their situation in mid-life. It is possible that mid-life circumstances might influence individuals' quality of life indirectly; consequently, the evidence examining pathways from earlier circumstances to more recent or proximal determinants of quality of life will be examined.

While focussing on research reports that use the CASP measure of quality of life as an outcome, the review also integrates insights from the broader literature examining influences upon subjective well-being, largely drawn from the fields of economics and psychology.

3.1 Introduction

This chapter introduces the measure of quality of life used in the thesis as well as the potential proximal and distal determinants of quality of life. In terms of the structure of this chapter, the first section describes the approach for measuring quality of life that is taken in the thesis, taking a standpoint of measuring quality of life in terms of the fulfilment of human needs. The heart of the chapter is a review of the current evidence for influences upon quality of life of both current circumstances and individuals' mid-life conditions. Evidence will be examined for the influence upon quality of life of a range of factors: demographic characteristics, health, social relationships and participation, socio-economic position, work hazards, retirement and life events.

Initially, associations between quality of life and individuals' current circumstances will be examined. For each characteristic in turn, cross-sectional evidence will be reported, as well as more robust, longitudinal evidence when available which, in many cases, relates recent changes in individuals' circumstances to changes in their quality of life. For certain variables, such as those measured in mid-life, a life course perspective will be taken and possible pathways to quality of life via intermediary factors will be considered.

3.2 Quality of life

Quality of life is an elusive and open-ended concept. It is difficult to conceptualize, under-theorized and is consequently difficult to measure (Bowling and Stenner, 2011; Walker, 2005a; Weidekamp-Maicher and Reichert, 2005). However, its measurement is of great interest in policy and science (Layard, 2012; OECD, 2011a). This may be a result of economic and social developments which have generated a growing interest in the value of subjective experiences in late modernity (Higgs et al., 2003) but also because quality of life as subjectively experienced has tangible consequences. It has been shown to predict mortality (Netuveli et al., 2012) and subsequent health in panel studies (Steptoe et al., 2012; Steptoe and Wardle, 2012).

In this section I will outline approaches to conceptualizing quality of life before introducing the needs satisfaction perspective which is employed in this thesis.

3.2.1 Measuring quality of life

Quality of life lacks an agreed definition (Hyde et al., 2003). Consequently, there are a plethora of approaches to measuring quality of life (Bowling, 2004; Walker, 2005b):

1. *Objective indicators of quality of life.* By avoiding dependence on individuals' own evaluations, these measures avoid some of the complexities of measuring quality of life implicit in more subjective approaches. However, without any theory, it is difficult to decide how to choose appropriate indicators of quality of life in old age.

2. *Specific indicators of quality of life domains.* These indicators can be objective or subjective. For example, social networks can be measured objectively, by how

many contacts a person has, or subjectively, in terms of the satisfaction they derive from them (Weidekamp-Maicher and Reichert, 2005, p. 160). Specific indicators of quality of life domains avoid the difficulties of individual or cultural variation inherent in subjective evaluations as well as problems of hedonic adaptation and social comparison (Argyle, 1999; Frederick and Loewenstein, 1999). However, they do require an *a priori* external evaluation to be made of the importance of various elements which make up the indicator. They are also often determinants of subjective quality of life. Therefore, many of these measures have been included in the thesis as predictor variables, rather than as outcomes indicating quality of life.

3. *Subjective scales and measures of quality of life.* These capture individuals' subjective evaluations about the quality of their lives. Some scales, such as those measuring happiness, emphasize hedonic aspects of well-being; others, such as those measuring psychological well-being or flourishing, focus on measuring eudaemonic well-being (Kashdan et al., 2008). Some multi-dimensional scales may incorporate both perspectives. While these scales are becoming increasingly theoretically coherent and holistic, they are difficult to interpret (Walker, 2005b). They can behave in a complicated manner over time and space and reflect calculations individuals make between their expectations and evaluations (Oswald and Powdthavee, 2008; Oswald and Wu, 2010).

   (a) Subjective social indicators of life satisfaction and well-being. These range from single-item life satisfaction scales to multi-dimensional scales of well-being.

   (b) Satisfaction of human needs. These approaches measure the degree to which universal, human needs are fulfilled. The CASP family of quality of life scales take this approach.

4. *Hermeneutic approaches* These emphasize people's values, interpretations and perceptions, which allow those aspects of quality of life to be discussed which are most salient to people (Bowling, 2004), although these might not be the same factors which actually are affecting individuals' quality of life (Loewenstein and Schkade, 1999). These approaches tend to use qualitative methods and are suitable for small surveys or are used to create measures of quality of life that can be scaled up to larger surveys.

Generating a full picture of individuals' quality of life would require use of a wide range of subjective, economic and social indicators, because each provides a partial picture, and their strengths and weaknesses are complementary (Diener and Suh, 1999). Therefore, the approach taken in this thesis to use a single subjective indicator of quality of life carries the proviso that other equally valid approaches to measuring quality of life do exist and results from these could complement or challenge the findings presented here.

3.2.1.1 Measuring older people's quality of life

As described in section 2.3 on page 42, in advanced industrial nations older people's lives have been transformed by growing prosperity and increasing longevity in good health, while effective retirement ages have been decreasing. A new period of life has opened up for many, the Third Age, marked by possibilities for development of a fulfilling personal project at a time when individuals are freed from responsibilities to children and the labour market (Laslett, 1991).

Therefore, for this generation in particular, it is time to move beyond quality of life scales that measure older people's quality of life exclusively from the perspective of objective indicators such as their health (Walker, 2005b). Reducing the measurement of quality of life in old age to measuring health reduces human needs to a single dimension of a specific sort of "lack", in which a wide range of experiences of increasingly healthy older people are reduced to measures of health functioning and the capacities of individuals to live rich and fulfilling lives despite less-than-optimum health are ignored (Higgs et al., 2003). While good physical and mental health is an element of quality of life at any age, using such proxies excludes other important dimensions of quality of life which concern older people, such as maintaining social integration and meaningful activities (Bowling et al., 2002). The implications of the cultural turn in the sociology of ageing in particular are that quality of life at older ages cannot be limited to access to resources such as health or economic capital, but must also be considered in terms of individuals' freedom to reflexively shape their biographies in ways that are meaningful to them. Therefore, I have chosen to use a multidimensional and subjective measure of quality of life which focuses on a wider range of human needs, and one which is fit for measuring quality of life of baby-boomers in late modern society.

3.2.2 Measuring quality of life from a perspective of the fulfillment of human needs

In this thesis, I have chosen to use a theoretically founded, positive quality of life scale, CASP, which measures the fulfillment of human needs. This approach avoids conflating measuring quality of life with measuring the factors that determine it (Hyde et al., 2003), for people may manage to fulfil their needs with any of a variety of resources (Hörnquist, 1982).

While health is important for good quality of life, as a basic need, human beings have wider needs which are frequently to do with social integration and individual autonomy (Maslow, 1943; Doyal and Gough, 1991). How universal human needs are has been greatly debated, but it seems reasonable that all humans have needs that are constrained if they are unable to participate freely in society (Doyal and Gough, 1991).

The CASP scale measures four aspects of quality of life from a perspective of the fulfilment of basic needs as well as more active and reflective aspects of human nature. Specifically, the scale is made up of four domains which reflect the degree to which individuals' needs for i) autonomy, ii) control, iii) self-realization and iv) pleasure are satisfied. A single sum score for quality of life reflects the degree to which human needs in each of these domains is satisfied.

The scale distinguishes the related concepts of control and autonomy, where control reflects the need for an individual to actively intervene in their own environment, and autonomy an individual's need to feel free to behave as they wish (Patrick et al., 1993; Wiggins et al., 2008). Inclusion of the domains of self-realization and pleasure emphasizes that quality of life is not merely shaped by individuals' freedom to act or to be free of the unwanted interference of others, but the freedom to choose to carry out activities which have meaning for them and make them happy (Higgs et al., 2003; Hyde et al., 2003). In this way, the scale combines elements of both hedonic and eudaemonic well-being (Peasgood, 2008, p. 60). The CASP scale, particularly its autonomy, control and self-realization domains, taps into human agency. Consequently, this thesis is concerned, at least in part, with measuring the possibilities for human agency in later life, a central concept in life course research (Elder et al., 2003).

3.2.3 Properties of the CASP-19 measure of quality of life

The scale comes in four versions: a full scale with 19 items, scored from 0–57; a shortened 12-item scale, 0–36, used in the SHARE survey (Vanhoutte, 2012), described as CASP-12 version 1, and another 12-item scale in which the autonomy and control dimensions have been combined (Wiggins et al., 2008), often described as CASP-12 version 2. In response to concerns that the CASP-19 scale conflates subjective quality of life with influences upon quality of life, Vanhoutte (2012) developed a shortened CASP-15 scale, from which items related to specific objective circumstances (age, family, health, and money) were excluded.

Further details about the CASP scale and the manner in which it is scored is provided in section 5.2.1 on page 101, while the 19 items that make up the full scale are listed in Appendix A, section A.2.3 on page 332.

3.3 Reviewing the determinants of quality of life in early old age

The literature concerning current influences upon well-being and quality of life is vast, drawing from a variety of fields including economics, epidemiology, gerontology, sociology and psychology. Most of the evidence is from observational studies and therefore some of the relevant methodological difficulties and limitations of observational studies will be described.

In terms of empirical results, this review focusses on studies using the CASP measure of quality of life. Members of the CASP family of scales have been included in a range of British and international surveys (Netuveli et al., 2006), including the English Longitudinal Study of Ageing (ELSA), the British Household Panel Survey (BHPS), Whitehall II, The Irish Longitudinal Study on Ageing (TILDA) and the Survey of Health and Retirement in Europe (SHARE).

Compared to the wider literature examining the determinants of well-being in other disciplines, particularly in economics and psychology, presenting results merely from studies using CASP would have provided an excessively narrow focus. In addition, a substantial proportion of studies using the CASP measure of quality of life have relied on cross-sectional observational designs, which provide particularly weak evidence for causality, in part because an omitted variable such as a behavioural disposition may be confounding any association. Including potential confounding variables in models as controls can combat this problem to some degree, but controls are often imperfectly measured and residual confounding may remain (Kaplan, 2004). An alternative is to use a within-person study design with panel data, a design which controls for unobserved stable confounders (or individual heterogeneity) by examining how the outcome changes over time (Jenkins, 2011) and which avoids spuriously inflated estimates of the effect of the exposure variable on the outcome. This would allow researchers to control for time-invariant individual differences, such as personality (Dolan et al., 2008). In addition to this study design, reviews across a wider range of subjective well-being measures in economics and psychology often include articles that can more robustly demonstrate causation, such as experimental and quasi-experimental designs (Argyle, 1999). For these reasons, the results reported for the CASP family of measures are supplemented by selected articles, mainly review articles, examining the determinants of other measures of well-being, such as happiness, subjective well-being or life satisfaction, which correspond to the larger group of "subjective scales and measures of quality of life" reported on page 51.

The results reported using measures of subjective well-being or life satisfaction may vary a little from those reported using CASP-12 and CASP-19 because they may capture slightly different aspects of well-being (Frey and Stutzer, 2012). Previous research has shown that the determinants of CASP quality of life and other measures of well-being are slightly different (Peasgood, 2007). A complete review of the published literature into the determinants of subjective well-being was not performed because the literature is vast; Stutzer and Frey (2012) noted that Google Scholar contained over 20 000 papers for the year 2011 alone that contained the words happiness and economics in the text.

The current evidence for the determinants of quality of life is more limited than might initially appear. Most observational studies are mainly cross-sectional or retrospective, although some research uses prospective panels.

In the light of the difficulties in ascribing causality to associations from observational studies, it has been argued that an observational study can merely describe what is occurring, and that its role is to generate hypotheses rather than to draw causal conclusions (Oakes and Kaufman, 2006). A life course theoretical orientation allows a sympathetic perspective to be taken in which causality is a secondary issue compared to carefully describing pathways to better or poorer quality of life in old age, and observing how certain people manage to defeat the odds (George, 2003).

3.4 Determinants of quality of life

In terms of measures of subjective well-being more broadly, Binder and Coad (2013) described an individuals' well-being as depending on a complex web of factors: including socio-demographic, economic, social relations, health, personal (personality, genes) and institutional factors (such as the level of democratic participation). A broad range of factors including personality, social comparison, social participation, health and social capital was highlighted in a recent study using quality of life ratings in people aged over 65 years (Bowling et al., 2002). The research that has been carried out on quality of life, measured with the CASP-12 or CASP-19 instrument, and largely using surveys from Britain and Ireland, indicates that a similarly wide range of factors is associated with quality of life (Layte et al., 2013; Netuveli et al., 2006; Zaninotto et al., 2009).

3.4.1 Proximal determinants of quality of life

A cross-sectional study using the English Longitudinal Study of Ageing (ELSA), a nationally representative sample of community-living individuals in early old age, managed to explain almost half the variation in CASP-19 scores in terms of limiting long-standing illness and mobility difficulties, objective and subjective financial situation, social networks, neighbourhood quality, depression, and relationships and contacts with friends and family (Netuveli et al., 2006). A study using The Irish Longitudinal Study on Ageing (TILDA) explained 61% of the variation in CASP-19 quality of life with variables from sociodemographic, mental health, physical health, social participation and socioeconomic status domains (Layte et al., 2013).

When change in quality of life scores was examined using ELSA data, similar factors were highlighted, particularly depression, difficulties with activities of daily living, quality of family relationships, neighbourhood and perceived financial position (Webb et al., 2011).

There seems to be continuity in quality of life; initial CASP-19 quality of life strongly predicted quality of life at follow-up four years later (Webb et al., 2011). Similarly, in a multi-level study of five waves from the English Longitudinal Study of Ageing, 69% of the variance in CASP-19 scores was between individuals and therefore only 31% was due to variation within individuals over time (Jivraj et al., 2013).

3.4.2 Life course determinants of quality of life

A recent review highlighted the lack of studies examining life course influences upon well-being in later life (George, 2010), although some researchers have examined the associations between quality of life at older ages and individuals' earlier circumstances (see Niedzwiedz et al., 2012, for a review of life course socio-economic position and quality of life). The only study taking a life course approach in the field of economics found both childhood and adult influences upon life satisfaction in mid-life (Layard et al., 2013). Work in social epidemiology found that earlier circumstances explained little of the variability in older people's quality of life (Wiggins et al., 2007), particularly in comparison with the impact life course factors can have upon physical health (Blane et al., 2004; Wiggins et al., 2004) or in relation to the size of the associations between current factors and quality of life (Blane et al., 2012).

3.5 Demographic characteristics

A large amount of evidence exists concerning associations of gender and age with quality of life, although variations by these demographic characteristics tended to be small (Layte et al., 2013).

3.5.1 Gender

Gender is a “a person’s self-representation as male or female, or how that person is responded to by social institutions on the basis of the individual’s gender presentation” (Wizemann and Pardue, 2001, p. 1).

3.5.1.1 Gender: Evidence from cross-sectional studies

Studies comparing quality of life between the genders in older people using the CASP-19 or CASP-12 measure of quality of life have tended to find small gender differences, in which men report slightly lower quality of life than women. This is the case in the English and Irish longitudinal studies of ageing, in the continental European SHARE cohort and in the Whitehall II study of London-based civil servants (McGee et al., 2011; Netuveli et al., 2006; Siegrist and Wahrendorf, 2009; Stafford et al., 2007; Zaninotto et al., 2009). No significant gender differences were observed in the small Boyd-Orr study (Wiggins et al., 2004).

3.5.1.2 Gender: Evidence from longitudinal studies

Gender was not associated with differences in change in quality of life in an analysis of the ELSA cohort (Webb et al., 2011) while, in an analysis of SHARE participants, women were less likely to experience an improvement in quality of life than men (Wahrendorf and Siegrist, 2010).

3.5.1.3 Gender: Evidence from the broader subjective well-being literature

Analysis of a broader range of subjective well-being outcomes provides a fuller and contrasting picture of the relationship between gender and subjective well-being. A meta-analysis of 300 studies using various subjective well-being outcomes found that, in old age, women experienced lower levels of well-being than men, but that the differences were small. This difference was attributed to lower financial resources, poor health, and widowhood causing women to live alone, which are all more common among older women than older men (Pinquart and Sörensen, 2001).

A recent review of the economics literature concluded that the associations between gender and subjective well-being were inconsistent (Dolan et al., 2008). The review concluded that gender differences tended to disappear when specific subgroups were examined, such as among participants who cannot work because of health problems or who provide informal care to others, which suggests that it is correlates such as these which may account for gender differences.

3.5.2 Age

Although it is unlikely that quality of life or subjective well-being affect age, the relationship with age may not necessarily be causal, because any relationship could be due to cohort differences (Argyle, 1999). In addition, any relationship between age and well-being over the life course observed at the aggregate level might be different to the relationships observed in individual life paths that make up the aggregate statistics. Therefore, analyses examining changes in quality of life over time which trace individual developments in well-being are the most robust approaches (Baetschmann, 2013).

Another debate in the economics literature concerns whether to examine conditional or unconditional age effects. In the unconditional approach, changes in well-being as individuals age are recorded without inclusion of any covariates. In the conditional approach, the relationship between age and well-being is examined after inclusion of covariates such as income, health or marital status (Baetschmann, 2013).

3.5.2.1 Age: Evidence from cross-sectional studies

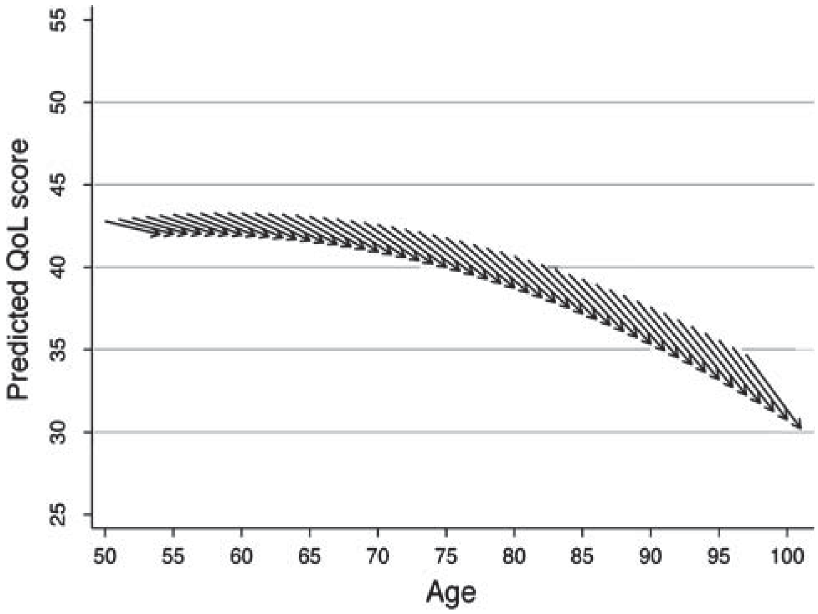
In each of the ten countries included in the continental European SHARE survey, CASP-12 quality of life was lower in those aged over 65 years than in those aged 50–64 years (von dem Knesebeck et al., 2007). In the Irish Longitudinal Study on Ageing (TILDA), a curvilinear relationship between age and quality of life was found in the unconditional model, peaking at age 67 years (Layte et al., 2013); participants aged 83 years had the same mean level of quality of life as participants aged 50 years. In ELSA, researchers took a conditional approach in which they controlled for a comprehensive range of determinants upon quality of life to find a similar curvilinear relationship which peaked at a similar age: 68 years (Netuveli et al., 2006).

3.5.2.2 Age: Evidence from longitudinal studies

A disadvantage of the results just presented are they they are from cross-sectional studies and, as such, it is not possible to distinguish whether these reflect cohort or age differences, as it may be that the results merely reflect the circumstances of more or less advantaged cohorts rather than individuals' changing circumstances over time as they age. Therefore, more sophisticated analyses, using multiple waves in order to study within-individual change have been carried out.

An analysis of three waves of ELSA using latent growth curve modelling found a curvilinear relationship between age at baseline and quality of life (Figure 3.1) (Zaninotto et al., 2009). After controlling for demographic, health, socioeconomic and pyschological determinants of quality of life, the association between age at baseline and quality of life disappeared. An analysis using multilevel linear growth curve models performed using five waves of ELSA found that the association between age at baseline and quality of life reversed after including a range of fixed and time-varying covariates, and that marital status and health variables had the greatest effect in removing the association (Jivraj et al., 2013).

Figure 3.1: Vector graph of a latent growth model of quality of life by age for participants in waves 1 to 3 of the English Longitudinal Study of Ageing



Source: Zaninotto, P., Falaschetti, E., & Sacker, A. (2009). Age trajectories of quality of life among older adults: Results from the English Longitudinal Study of Ageing. *Quality of Life Research*,18(10), 1301–1309. With kind permission of Springer Science and Business Media.

The curvilinear relationship between quality of life and age is such that older participants tend to experience greater rates of decline in quality of life. In a study using both unconditional and conditional models with data from ELSA, older individuals tended to experience more rapid declines in quality of life (Jivraj et al., 2013) (cf. Figure 3.1), a result also found in the continental European SHARE cohort (Wahrendorf and Siegrist, 2010). Using the CASP-15 scale, Jivraj et al. (2013) stated that a 60-year-old could expect their CASP-15 quality of life score to drop by nearly two points over eight years while, in contrast, an 80-year-old could expect it to drop by more than five.

While quality of life varies with age, it does not necessarily follow that older people have worse quality of life than younger people. Individuals' circumstances are more important: using ageing-vector graphs (Zaninotto et al., 2009) demonstrated that a centenarian living in good psychosocial, socio-economic conditions and in good health can have higher quality of life than a 50-year-old living in poor circumstances. Similarly, older people who considered that they were "ageing actively" reported higher quality of life scores (Bowling, 2009).

3.5.2.3 Age: Evidence from the broader subjective well-being literature

Results from the psychological literature indicate that the effects of age on happiness were small, although to the degree that any relationship at all could be discerned it indicated that quality of life tended to increase with age (Argyle, 1999). In economics, the weight of evidence suggests a U-shaped relationship between age and subjective well-being (Dolan et al., 2008; Frijters and Beatton, 2012). In this vein, a particularly comprehensive cross-sectional analysis displayed a U-shaped curve in well-being over the life course, using data from the USA, Europe and the World Values Survey, a relationship which was robust to cohort effects, and for which the lowest point corresponded to middle age (Blanchflower and Oswald, 2008). This study employed a conditional methodology, which has been criticized (Frijters and Beatton, 2012). However, an unconditional analysis using the German Socio-Economic Panel, in which individuals were followed up for up to 26 years, found a small depression in mid-life and a larger later life peak in happiness at around 70 years of age (Baetschmann, 2013).

3.6 Health

Health is a strong predictor of quality of life. It seems that causality between well-being and health runs in both directions, although a recent study concluded that the stronger relationship runs from health to happiness (Binder and Coad, 2013).

3.6.1 Physical health

3.6.1.1 Physical health: Evidence from cross-sectional studies

In terms of the relationship between current or recent circumstances and quality of life, physical health difficulties may prevent individuals from carrying out activities that allow them to remain independent, that they enjoy or that they find fulfilling. A number of studies have found cross-sectional associations between physical health and quality of life, whether physical health is operationalized as limiting long-standing illness (Blane et al., 2004, 2012; Layte et al., 2013; Netuveli et al., 2006), limitations to mobility (Layte et al., 2013; Netuveli et al., 2006), difficulties with activities of daily living (Netuveli et al., 2006; Webb et al., 2011), functional limitations (von dem Knesebeck et al., 2007; Wahrendorf and Siegrist, 2010; Zaninotto et al., 2009), frailty (Wu et al., 2013), vision or hearing problems (Breeze and Lang, 2008; Gjonça and Nazroo, 2006), sleeping problems (Kumari et al., 2010), pain (Breeze and Lang, 2008; Howel, 2012; Layte et al., 2013), frequent incontinence (Layte et al., 2013), recent falls (Wu et al., 2013), waist circumference (Zaninotto et al., 2010), self-rated health (Breeze and Lang, 2008; McGee et al., 2011) or chronic illnesses (Blane et al., 2008; Demakakos et al., 2010; Grimmett et al., 2009; Wikman et al., 2011; Wu et al., 2013). Von dem Knesebeck et al. (2005) observed consistent associations between a range of health indicators and quality of life in all nine countries included in the baseline SHARE survey.

It seems that illness affects quality of life as a result of its effect upon daily life: having a limiting illness was associated with a reduction in quality of life that was almost four times larger than merely having a long-standing illness (Netuveli et al., 2006). Another study using ELSA data found that the mean quality of life for participants reporting two or more difficulties with activities of daily living was 10.7 points lower on the CASP-19 scale than for participants without any such difficulties (Demakakos et al., 2010). Similarly, in the British Boyd-Orr cohort, having a long-standing illness was associated with a smaller difference in quality of life than having an illness that was classified as serious by the Royal College of General Practitioners, which required treatment with medication or which was limiting (Blane et al., 2004; Netuveli et al., 2005). In a cross-sectional survey of the ELSA sample, better lung function was associated with modestly higher CASP-19 quality of life scores in both genders, an association which seemed to be mediated via functional limitation and, to a less extent, depression (Blane et al., 2008). While associations with being obese were also found, which were mediated via functional limitation, blood pressure was not associated with CASP-19 quality of life. An explanation for these findings is would be that lung function and obesity may impact on physical and social functioning, while high blood pressure is often asymptomatic (Blane et al., 2008).

3.6.1.2 Physical health: Evidence from longitudinal studies

Studies following up participants from the ELSA study which controlled for baseline quality of life found that declines in quality of life were greater for participants who, a baseline, had limiting longstanding illness, had difficulties with at least one activity of daily living, or were obese or had large waist circumferences (Zaninotto et al., 2008, 2010).

A change analysis found that worsening of difficulties with activities of daily living, instrumental activities of daily living and mobility were associated with a decline in CASP-19 quality of life, while a lessening of difficulties with activities of daily living and mobility were associated with an increase in quality of life (Emmerson and Muriel, 2008). A similar prospective analysis of change in quality of life using continental European SHARE data found that the emergence or persistence of functional limitations was associated with a greater likelihood of decline in quality of life (Wahrendorf and Siegrist, 2010).

3.6.1.3 Physical health: Evidence from the broader subjective well-being literature

A review of the gerontological, psychological and sociological literature concluded that health is the strongest predictor of subjective well-being in later life (George, 2010). Although the direction of causation may be bi-directional (Dolan et al., 2008; Stutzer and Frey, 2012), adverse health developments reduce subjective well-being, and the worse the size of the decline in health, the greater the reduction in well-being (Easterlin, 2003). For example, disablement was associated with declines in quality of life and adaptation to it was only partial (Oswald and Powdthavee, 2008). Cancer, stroke and visual impairments also had relatively large influences upon change in life satisfaction (Binder and Coad, 2013).

3.6.2 Mental health

3.6.2.1 Mental health: Evidence from cross-sectional studies

There is a very close relationship between mental health and quality of life: a recent Irish study found that mental health accounted for the largest proportion of explained variance in CASP-19 quality of life (Layte et al., 2013). Studies have found associations between quality of life and depression (Blane et al., 2012; Howel, 2012; Layte et al., 2013; Netuveli et al., 2006; Webb et al., 2011; Wu et al., 2013; Zaninotto et al., 2009); anxiety, worry and stress (Layte et al., 2013); and psychological and emotional wellbeing (Bowling and Stenner, 2011).

3.6.2.2 Mental health: Evidence from longitudinal studies

In terms of mental health, a prospective study using English data which included baseline CASP-19 quality of life scores found that developing depression was strongly predictive of a decrease in quality of life, although both of these measures were self-reported (Webb et al., 2011).

3.6.2.3 Mental health: Evidence from the broader subjective well-being literature

A recent review concluded that mental health was more closely correlated with subjective well-being than physical health (Dolan et al., 2008). A recent study examined change in life satisfaction over time in relation to a range of specific illnesses, finding that mental illness, particularly drug abuse, anxiety and depression, had the greatest impact upon life satisfaction (Binder and Coad, 2013). After recovering from health problems, the degree to which individuals' life satisfaction improved varied; average improvements were larger for mental health conditions (Binder and Coad, 2013).

3.7 Social relationships and participation

In this section, family characteristics, social relationships, social exclusion, caring, social participation and neighbourhood characteristics are discussed in turn.

3.7.1 Family characteristics

Marital status has frequently found to be associated with quality of life and well-being; but it is difficult to attribute causality. It is possible that a third variable, such as a less agreeable personality, confounds the relationship; sophisticated analyses have been performed in psychology and economics to examine this possibility.

3.7.1.1 Family characteristics: Evidence from cross-sectional studies

Studies have found an association between marital status and quality of life (Netuveli et al., 2006; von dem Knesebeck et al., 2007; Ejechi, 2012). In the Irish Longitudinal

Study on Ageing, living with a spouse was associated with better CASP-19 quality of life compared to living alone or living with others (McGee et al., 2011). In a community dwelling sample from Taiwan, participants living alone had lower average quality of life scores than other participants (Wu et al., 2013). In ELSA, living with a partner was positively associated with quality of life for men but not for women (Zaninotto et al., 2009). Interestingly, an analysis of data from ELSA found that married people had substantially higher CASP-19 scores (around five points higher) than individuals with other marital statuses only when they reported receiving high levels of support from their spouse (Demakakos et al., 2010). Adjusting for aspects of social participation and social relationships also removed associations in studies using TILDA and ELSA data (Layte et al., 2013; Netuveli et al., 2006).

3.7.1.2 Family characteristics: Evidence from longitudinal studies

In a study of change in quality of life over four years using ELSA data, becoming widowed was associated with improved quality of life. This may be due to recovery from difficult circumstances preceding the bereavement but might also be due to controlling for a range of other covariates such as changes in depression (Webb et al., 2011). A prospective analysis with continental European SHARE data found that participants who entered a partnership were were less likely than those who left a partnership to experience a decline in CASP-12 quality of life (Wahrendorf and Siegrist, 2010). A prospective analysis of data from ELSA found that neither losing a partner (through death, separation or divorce) nor gaining a partner was associated with any change to CASP-19 quality of life (Emmerson and Muriel, 2008). An analysis using three waves of ELSA found that recent widowhood was associated with lower average quality of life only among the group of individuals who displayed symptoms of depression (defined as non-resilient), a result which highlights variations in individual responses to widowhood (Demakakos et al., 2008). Studies with a sub-sample of the Boyd-Orr cohort suggested that individuals who maintained quality of life following such adversities had managed to draw upon resources such as close ongoing relationships or maintaining previous enjoyable social roles that provided continuity in the face of life changing events (Hildon et al., 2008).

3.7.1.3 Family characteristics: Evidence from life course studies

Family conflict or family fracture by the age of seven years was associated with lower CASP-12 (v2) quality of life in participants aged 50 years from the British National Child Development Study, as was divorce, separation or death of a spouse by age 33 years (Blane et al., 2012). In path analyses, much of the impact upon quality of life at age 50 years of family fracture or family conflict by age of seven seemed to be mediated by current depression.

In a small retrospective study using the British Boyd-Orr cohort, variations in quality of life by different life course relationship statuses were suggestive but not significant. This study examined differences by gender, finding that men who experienced relationship break-up or early widowhood had lower quality of life than those who were continuously married (Wiggins et al., 2007). In contrast, it was continuously married women who were at a disadvantage compared to other groups of women. However, these differences, particularly for men, are mostly likely due to the lasting effects of the relationship trajectory on current circumstances, in this case current marital status.

In a large prospective study using the British Household Panel Survey, having had children at younger ages was related to lower quality of life among participants aged over 51 years, a relationship which was largely accounted for by pathways through current socio-economic and health disadvantages (Read and Grundy, 2011).

3.7.1.4 Family characteristics: Evidence from the broader subjective well-being literature

Marital status has been found to be one of the strongest correlates of happiness and well-being (Argyle, 1999). Research into changes in marital status have found that divorce or separation can have greater effects than widowhood (Argyle, 1999). It appears that the association between marriage and subjective well-being is causal. This is because, if the association between marriage and well-being were due to happier people marrying sooner, then, as people age, the average happiness of both marrying and never-married people should decline. However, this is not what happens (Myers, 1999). A recent review in economics concluded that stable and secure intimate relationships (whether marriage or cohabitation) are beneficial for subjective well-being and the dissolution of relationships tends to harm well-being (Dolan et al., 2008). Bringing up children has been found to be associated with improved life satisfaction but not with happiness (Dolan et al., 2008).

3.7.2 Social relationships

George (2010), in a recent review, states that the dimension of social relationships most strongly associated with subjective well-being in older people is perceived social support. She defines this as the “perception that high-quality emotional support and instrumental assistance are available if needed” (George, 2010). The nature of the support provided by social relationships can be sub-divided into two types: 1) functional measures of social support such as provision of confiding/emotional support, practical support or negative aspects of close relationships and 2) structural measures such as frequency of contacts, size of a person’s social network or marital status (Stringhini et al., 2012).

3.7.2.1 Social relationships: Evidence from cross-sectional studies

Studies have found that social relationships are important for quality of life, whether this is measured by relationships and contacts with family and friends (Hildon et al., 2010; Howel, 2012; Layte et al., 2013; Netuveli et al., 2006; Webb et al., 2011), loneliness (Layte et al., 2013), network size (Demakakos et al., 2010; Litwin and Stoeckel, 2013a; Wiggins et al., 2004; Zaninotto et al., 2009) or network quality (Litwin and Stoeckel, 2013a; Wiggins et al., 2004). Individuals who felt that they were not receiving positive support from their spouse, children, family, or friends reported lower quality of life (Zaninotto et al., 2009), although this result could be vulnerable to individual differences affecting evaluations of both social support and quality of life.

Individuals who experienced social detachment (an index made up of people with at least three of: no (i) civic, (ii) social/recreational or (iii) cultural participation; (iv) no emotional support; (v) little contact with others, (vi) no holiday or day trip taken over last year) had lower CASP-19 quality of life scores in ELSA (Tomaszewski and Barnes, 2008).

3.7.2.2 Social relationships: Evidence from longitudinal studies

Improvements in the quality of relationships with family and friends were associated with an improvement in CASP-19 quality of life scores in a prospective study, although, as both measures are self-reported, it is not possible to be sure that a factor such as improved mood is contributing to evaluations of both (Webb et al., 2011). Increased contact with friends was associated with an improvement in quality of life, but increased contact with family was associated with a deterioration in quality of life, perhaps because an increase in contact with family was a result of an increased need to receive or provide emotional or practical support.

3.7.2.3 Social relationships: Evidence from life course studies

Individuals who had experienced longer durations of social detachment (defined in section 3.7.2.1, above) reported lower quality of life, suggesting either a cumulative effect of social exclusion over time upon quality of life if the relationship with quality of life was causal, or that lengthier periods of social detachment signal individuals who are in greater difficulty (Tomaszewski and Barnes, 2008).

3.7.2.4 Social relationships: Evidence from the broader subjective well-being literature

Myers (1999) reports robust evidence for associations between social support and well-being, including results from quasi-experimental studies which suggest that higher levels of social support promote well-being. There is also evidence that changes in the quality of people's relationships drive changes in their well-being (Stutzer and Frey, 2012). Socializing with friends and family has been found to be associated with higher well-being, including in later life, although this is not the case when the contact involves provision of care from others (Dolan et al., 2008).

3.7.3 Caring

In France, most care to ill or disabled adults is provided within their household by family members (CNSA, 2011, p. 22). Carers are a heterogeneous group, with a minority of carers providing most of the care (Hirst, 2003, 2005). Many carers do not self-identify as such, instead regarding caring as a normal part of their obligations to other family members (Department of Health, 1999, p. 11); therefore questions inquiring about caring need to be carefully phrased. Trends over the last 30 years point to an intensification of care, in which more adults are providing longer episodes of more intensive care (Hirst, 2003; Marks et al., 2002).

3.7.3.1 Caring: Evidence from cross-sectional studies

Certain sorts of social relationships can negatively influence quality of life; in cross-sectional analyses in ELSA, participants coming up to the state pension age with caring responsibilities reported lower quality of life (Zaninotto et al., 2013), although no relationship was found for people over the state retirement age (McMunn et al., 2009). In cross-sectional analyses of SHARE data from continental Europe, caring for a person was associated with lower quality of life (Litwin and Stoeckel, 2013b; Wahrendorf et al., 2008), a relationship that was weakened but did not entirely disappear when the participant felt that their activity was appreciated (Wahrendorf et al., 2006).

Greater burden of care is associated with lower quality of life; there was little difference between the health of non-carers and carers providing under 20 hours a week of care in a survey of English data (Ross et al., 2008, p. 44). Providing help was associated with lower average CASP-19 quality of life scores in ELSA when participants were caring for a partner or spouse, a difference which was accounted for not by lack of satisfaction or appreciation, but rather by the burden of care, expressed in the number of hours of care provided and the sense of obligation carers had (Breeze and Stafford, 2010). Quality of life was similar for both carers and non-carers of a parent or parent-in-law, while participants who reported caring for a grandchild reported higher-than-average quality of life, particularly those who did not spend long hours caring and who did not feel obliged to care (Breeze and Stafford, 2010).

Characteristics of the individual being cared for were also associated with quality of life of the carer. Carers had lower quality of life when the recipients of care had problems with memory, but not when they had pain, difficulties with instrumental activities of daily living or more general cognitive abilities (Ross et al., 2008).

3.7.3.2 Caring: Evidence from longitudinal studies

In a prospective analysis of the second wave of SHARE data, caring for a person was not associated with quality of life in wave two (Siegrist and Wahrendorf, 2009). Beginning or stopping providing care for an adult was not associated with quality of life in a multivariate change analysis of two waves of the SHARE data (Wahrendorf and Siegrist, 2010), although this study included as carers individuals declaring that they provided any care to a sick or disabled adult during the last four weeks, meaning that individuals providing low levels of care were included.

3.7.3.3 Caring: Evidence from the broader subjective well-being literature

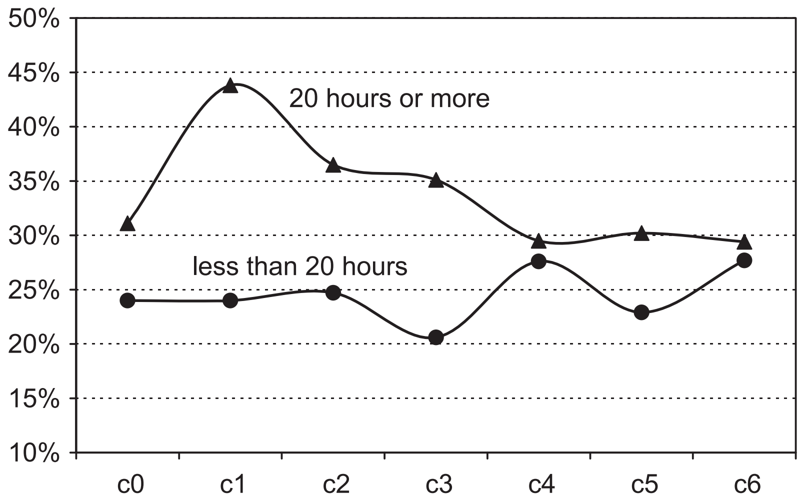
A substantial literature, briefly reviewed by Hirst (2005), demonstrates the negative impact of providing informal care on mental and physical health, and that transitions into and out of care have been associated with changes in carer distress. While the act of helping others might have potentially beneficial impacts (Department of Health, 1999; Marks et al., 2002), the studies that exist indicate that informal caring tends to be associated with poorer well-being, particularly when more intensive care is provided and when the recipient of care is close family (Dolan et al., 2008; Hirst, 2003; OECD, 2011b).

Transitions into caring have been associated with declines in a range of well-being measures (Hirst, 2005; Marks et al., 2002; Pinquart and Sörensen, 2003). Figure 3.2 shows that the decline in mental health associated with gaining informal caring responsibilities is visible only in women who were providing 20 hours or more care per week (similar but less pronounced trends were reported for men) (Hirst, 2005). This result highlights the importance of differentiating the care population, in this case by gender and the intensity of caring; other studies have demonstrated the importance of differentiating carers by factors such as the type of chronic illness and the carer's relationship to the recipient of care (Marks et al., 2002; Pinquart and Sörensen, 2003; Schoenmakers et al., 2010; van Groenou et al., 2013).

Figure 3.2 also displays higher distress among women who will subsequently provide high levels of care in the year before they actually begin caring. Several explanations are possible, but one is that individuals are already providing some level of emotional or other support to somebody showing early signs of frailty or impairment (Hirst, 2005).

Transitions out of caring have also been associated with poorer well-being, perhaps because this corresponds to the life event of a close family member entering an institution or passing away (Dolan et al., 2008; Hirst, 2005).

Figure 3.2: Prevalence of psychological distress before (c0) and during care episodes (c1–c6) by hours caring per week in the British Household Panel Survey



Women only. The vertical axis is the proportion of women reporting high distress scores. The horizontal axis indicates the years of caregiving provided (e.g., c2 means the second successive year of caring).
Source: Hirst, M. (2005) Carer distress: A prospective, population-based study. *Social Science & Medicine*, 61(3), 697–708. With kind permission of Elsevier.

3.7.4 Social participation

A number of studies have examined the relationship between social participation, commonly participation in religious, community activities or in volunteering, and quality of life. However, a particular difficulty with studies examining the associations between social participation and subjective well-being is that it is extremely difficult to assign causality, even in longitudinal studies. It is most likely that any relationships are bi-directional, as people with poorer quality of life for other reasons, such as health difficulties or caring responsibilities, may choose to reduce their levels of participation and that participation in pleasant and sociable activities may contribute to well-being.

3.7.4.1 Social participation: Evidence from cross-sectional studies

A recent Irish study found that social participation is an important factor explaining variation in CASP-19 quality of life (Layte et al., 2013). Cross-sectional associations have been repeatedly found between social participation and quality of life, whether this concerns leisure and social activities (von dem Knesebeck et al., 2007; Wahrendorf and Siegrist, 2010), current or past membership of civil society organizations (Timonen et al., 2011; Blane et al., 2012), religious activities (Levin, 2013) or volunteering (Timonen et al., 2011; Wahrendorf and Siegrist, 2010).

3.7.4.2 Social participation: Evidence from longitudinal studies

It is likely that people with a positive outlook on life will tend to report both higher quality of life and more reciprocal interactions with others. Controlling for baseline quality of life in a prospective change analysis will deal with this confounder, if it is a permanent characteristic of individuals. In such prospective studies using the SHARE or ELSA surveys, and which controlled for baseline quality of life, volunteering was associated with higher quality of life, but only among those who reported reciprocity in the interaction (Siegrist and Wahrendorf, 2009; Nazroo and Matthews, 2012) or only among those who were retired (Potočnik and Sonnentag, 2013). Nazroo and Matthews (2012) additionally found that higher frequencies of volunteering and participation in a wider range of activities were associated with higher quality of life. People volunteering in three or more activities reported four-point higher CASP-19 quality of life scores than non-volunteers.

A prospective study with ELSA found that dropping organizational membership was associated with a two-point reduction in CASP-19 scores (Gjonça et al., 2010). Similarly, a prospective survey using the SHARE study found that older people who took up or maintained voluntary activities had a lower chance of experiencing a decline in CASP-12 quality of life (Wahrendorf and Siegrist, 2010). These results were robust for controlling for functional limitation, socio-economic position and living with a partner, all factors which might affect both quality of life and volunteering.

3.7.4.3 Social participation: Evidence from the broader subjective well-being literature

A recent review of the literature in psychology, sociology and gerontology concluded that both religious participation and volunteering seemed to promote subjective well-being (George, 2010) although another review voiced caution concerning the evidence for volunteering (Dolan et al., 2008). It is likely that one of ways in which participating in religious and voluntary activities increases happiness is through the social support and socializing that occurs (Argyle, 1999; Stutzer and Frey, 2012). However, there is evidence that performing volunteering work is rewarding in itself (Stutzer and Frey, 2012).

3.7.5 Neighbourhood

3.7.5.1 Neighbourhood: Evidence from cross-sectional studies

Cross-sectional associations have been found between quality of life and neighbourhood quality (Netuveli et al., 2006; Wiggins et al., 2004). In a cross-sectional study of ELSA participants, higher CASP-19 quality of life was associated with higher quality of the neighbourhood measured with a nine-item scale including elements such as presence of vandalism, a sense of belonging, and participants' perceptions of trust and support (Netuveli et al., 2006). Again, in the ELSA survey, difficulty in accessing services and amenities such as a bank, local shops or opticians was associated with lower quality of life (Ross et al., 2008, p. 46); quality of life was even lower if individuals struggled to access multiple services (Demakakos et al., 2010). Higher quality of life was associated with greater attachment to the local area and lower area deprivation measured with the index of multiple deprivation (Gilleard et al., 2007). Having high compared to low fear of crime was associated with CASP-19 quality of life scores that were lower by two points (Stafford et al., 2007) in a study using data from the occupational Whitehall II cohort.

3.7.5.2 Neighbourhood: Evidence from longitudinal studies

In a prospective analysis with English data, higher initial neighbourhood quality and improvements in the perceived quality of the neighbourhood were associated with improved quality of life (Webb et al., 2011). An intervention study of individuals aged over 65 years living in British urban neighbourhoods found cross-sectional associations between quality of life and neighbourhood characteristics such as: barriers and nuisance in local open space and neighbourhood; ease of getting out and about; and good paths and cycleways (Thompson et al., 2012). Residential street improvements were not associated with improved quality of life at the standard 95% level of statistical significance, but this may be a consequence of the small sample size (36 people) limiting power. A cross-sectional study of extra care housing schemes for older people found associations between quality of life and elements of the building design such as security and accessibility (Orrell et al., 2013).

3.7.5.3 Neighbourhood: Evidence from the broader subjective well-being literature

Studies have indicated that living in a deprived or unsafe area may worsen life satisfaction, but these studies may have been vulnerable to confounding by socio-economic position (Dolan et al., 2008). A recent study which controlled for a range of socio-demographic characteristics reported the importance of neighbourhood belonging for greater sense of mastery, an aspect of mental well-being (Nyqvist et al., 2013). Quality of life ratings in older people in a British survey were associated with characteristics of the neighbourhood such as: quality of local facilities, perceived safety of area and degree of neighbourliness of the area (Bowling et al., 2002).

3.8 Socio-economic position

A person's socio-economic position describes their location within the economic and social structure of their society. Social stratification is multi-dimensional and in sociological research, following Max Weber, individuals' positions can be described in relation to one of two forms of social stratification: class and status. Class is generated by the social relations of economic life, which relate to possession of goods and opportunities for income within the commodity or labour markets, which in turn affects individuals' life chances (Weber, 1922). Status, in contrast, concerns notions of honour and esteem, and is founded on lifestyles, education, hereditary prestige and occupational prestige (Weber, 1922). Distinguishing these two aspects of the social structure is important because they are not so highly correlated with each other and are likely to be related to health and well-being outcomes by highly diverse pathways (Goldthorpe, 2009). For example, different dimensions of social stratification have been shown to have differing relationships with mortality and may consequently influence quality of life via different pathways (Torssander and Erikson, 2010). These two forms of stratification are related to commonly used measures of socio-economic position more or less closely. The associations of income and wealth with social class are stronger than with social status (Goldthorpe, 2009). In contrast, parental and own education are likely to more closely relate to social status.

The next sections consider social position, social mobility and economic circumstances in turn.

3.8.1 Social position

In this section, I examine the relationships between social class, occupational grade and subjective social status with quality of life. In many cases, social position is assigned based on individuals' occupations. This is a complex task, in part, because occupation may affect a broad range of aspects of individuals' circumstances, including material resources, social standing, physical and psychosocial working conditions, social networks and cultural capital (Galobardes et al., 2006b).

3.8.1.1 Social position: Evidence from cross-sectional studies

Associations have also been found between quality of life and social class (Blane et al., 2007a; Netuveli et al., 2006). Lower current or most recent civil service grade was associated with lower quality of life, in a graded relationship (Stafford et al., 2007). There was a 1.5-point difference between the high and low employment grades. Subjective social status was also associated with quality of life, independently of individuals' social class, employment status and depressive symptoms (Netuveli and Bartley, 2012).

3.8.1.2 Social position: Evidence from life course studies

Life course studies have examined relationships between quality of life and various measures of lifetime social position. A retrospective study of the British Boyd-Orr cohort did not find associations between manual or non-manual social class based on the last period of employment and CASP-19 quality of life (Blane et al., 2004). However, a cross-sectional study of ELSA data showed a graded relationship between quality of life and previous social class, with a stronger gradient among individuals aged 50–74 years if they were retired than if they were still employed (Blane et al., 2007a). This result might have been affected by selection bias as those still in employment at relatively old ages, particularly participants working past standard retirement ages, were likely to be a highly selected group.

A recent large study using the 1958 British birth cohort study found associations between social class at age 33 years and quality of life at age 50, which was accounted for to some degree by current physical functioning and perceived state of finances (Blane et al., 2012). A study using path analysis and ELSA data found that the relationship between CASP-19 quality of life and social class (measured with NS-SEC) was accounted for by subjective social status independently of depressive illness and activity (Netuveli and Bartley, 2012).

3.8.1.3 Social position: Evidence from the broader subjective well-being literature

Argyle (1999) reports robust associations between various measures of socio-economic position, including social class, and quality of life from a range of countries worldwide. Reverse causation is a possibility, in which happier individuals are more likely to achieve upward social mobility, but the explanation is more likely to lie in the wider friendship networks, greater participation in leisure activities, higher social status and happier and longer-lasting marriages for individuals in advantaged social groups.

3.8.1.4 Social position: Possible influences upon the proximal determinants of quality of life

Since this study will examine pathway models linking mid-life social position to quality of life in early old age, it is essential, in addition to examining the literature for relationships linking quality of life on to social position, to examine associations between social position and proximal determinants of quality of life. In most cases, there is a great deal of robust evidence in the literature. Therefore, this section examines how the proximal determinants of quality of life are affected by earlier social position.

Health. In terms of the relationship between social position and current or recent circumstances, there is persuasive evidence for associations between social position and physical and mental health. Associations between occupational grade and a range of subsequent mental and physical health outcomes have been observed in the British Whitehall studies (Breeze et al., 2001), including depression (Stansfeld et al., 1998), chronic conditions (Marmot et al., 2001) and mortality following retirement (Marmot and Shipley, 1996). Similar associations have been observed in a range of French surveys (Chevalier et al., 1987; Niedhammer and Leclerc, 2004).

Social support. The degree of social support an individual receives might be affected by their position in the social structure (Taylor and Seeman, 1999; Turner and Marino, 1994), but the evidence is thin and mixed (House et al., 1988; Stringhini et al., 2012), sometimes indicating that social support is an independent factor which can buffer the effects of socio-economic position (Gorman and Sivaganesan, 2007). Some researchers found differences in social support by social class (Turner and Marino, 1994), and contrasting associations by gender (Stringhini et al., 2012).

Financial circumstances. In contrast, the relationship between social position and wealth is likely to be unproblematic, since income is strongly related to occupation and wealth results from capital accumulation over the life course (Galobardes et al., 2006b).

3.8.2 Social mobility

Social position can change over the course of people's lives, a process which may have consequences for individuals' well-being in later life. However, it can be difficult to disentangle the effects of social mobility from the effects of a person's current social class because individuals who are upwardly mobile by definition have higher current social class than others (Hallqvist et al., 2004; Houle, 2011). Considering life course processes from an accumulation perspective, it can be argued that people might have lower quality of life in old age if they have spent lengthy periods of time exposed to low salaried, low status and low responsibility occupations that may have been monotonous and even harmful to physical health (Bartley and Plewis, 2002). Therefore, individuals who were promoted may have a level of quality of life which is intermediate between their original and final position. However, if upward socially mobile individuals have quality of life as high as their peers in their new social position, it is difficult to conclude whether this is due to their new social position or was an effect of their upward mobility.

An additional problem is causality. It may be that individuals who are promoted into high-level occupations had pre-existing characteristics which helped them achieve higher mobility than their peers. These characteristics might include better health or the ability to form strong social relationships. Such a direct social selection hypothesis would indicate that it was these pre-existing characteristics which determined higher quality of life in the socially mobile, rather than upward mobility itself (Blane et al., 1993) or the benefits of having an advantageous social position in later life. Therefore, controlling thoroughly for these factors is necessary before conclusions can be made that suggest an intrinsic impact of social mobility upon quality of life (Houle, 2011).

The single study which has examined associations between CASP-19 quality of life and social mobility found no support in the British Boyd-Orr cohort for any relation between CASP-19 quality of life and inter-generational mobility between manual and non-manual jobs (father's occupation compared to the respondent's longest held occupation) (Blane et al., 2004). Similarly, no relationship was found between quality of life and intra-generational mobility between manual and non-manual occupations at the age of 25 and 50 years (Blane et al., 2004).

Examining subjective well-being more broadly, a prospective study of almost 5000 men in the Wisconsin Longitudinal Study, using the self-acceptance sub-scale of Ryff's psychological well-being scale, examined the influence of intra-generational mobility between the ages of 36 and 52 years upon self-acceptance (Houle, 2011). Care was taken to include possible confounders which were associated with both mobility and psychological distress. Mobile individuals most closely resembled others in their current social class, particularly if they had been in the current social class for some time. This result also suggests that self-acceptance, an aspect of wellbeing, is influenced by current circumstances rather than previous histories.

3.8.3 Economic circumstances

A wide variety of approaches to measuring individuals' economic circumstances are available. Often income measures are used but, particularly at older ages, wealth, a measure which combines total assets and income, can be a better measure of an individuals' economic circumstances (Galobardes et al., 2006a). Another approach is to use subjective indicators of individuals' financial situations, such as perceived financial situation. Individual aspects of household assets have also been used to measure material circumstances, such as housing tenure or car ownership (Galobardes et al., 2006b).

3.8.3.1 Economic circumstances: Evidence from cross-sectional studies

Associations between quality of life and financial circumstances have frequently been reported in cross-sectional analyses: whether financial circumstances are operationalized as welfare benefit receipt (Blane et al., 2004), perceived financial situation (Blane et al., 2012; Netuveli et al., 2006; Webb et al., 2011), housing problems (Ross et al., 2008, p. 47), technology use (Matlabi et al., 2011), perceived adequacy of pension arrangements (Wiggins et al., 2004), income (Netuveli et al., 2006; von dem Knesebeck et al., 2007), wealth (Demakakos et al., 2010; Layte et al., 2013; McGee et al., 2011; Zaninotto et al., 2009; von dem Knesebeck et al., 2007), or receipt of additional non-pension income (Blane et al., 2004). Housing tenure was related to quality of life in the Boyd-Orr cohort, with a difference of almost four CASP-19 points between owner-occupiers and the rest (Blane et al., 2004), in ELSA (Ross et al., 2008, p. 47), but not in another British sample (Bowling and Stenner, 2011). Home ownership was inconsistently related to CASP-12 quality of life in an analysis of the continental European SHARE survey, while car ownership was consistently associated with higher quality of life (von dem Knesebeck et al., 2007).

3.8.3.2 Economic circumstances: Evidence from longitudinal studies

A more robust prospective analysis of quality of life over two years in an English sample showed that greater wealth at baseline was associated in both genders with a small and significant increase in quality of life after controlling for baseline quality of life (Zaninotto et al., 2010). Webb et al. (2011) found that greater income and improved financial position were associated with improving quality of life over a four-year period. A similar analysis with continental European SHARE data found that higher income at baseline was associated with better quality of life, after controlling for initial quality of life (Siegrist and Wahrendorf, 2009). Similarly, improvements in income as well as in perceived financial position were associated with improvements in quality of life in an English sample (Webb et al., 2011).

3.8.3.3 Economic circumstances: Evidence from life course studies

Quality of life at age 50 years, measured using the CASP-12 (v2) measure, was associated in the larger 1958 British birth cohort in a graded manner with deprivation during childhood, a measure which summed exposure to the following four factors: i) father's social class at birth, ii) receipt of free school meals at age 11, and iii) the family experiencing financial difficulties when the participant was aged seven, or iv) when they were aged 16 (Blane et al., 2012). A similar graded relationship existed with a six-level scale of deprivation, measured as living in crowded accommodation, rented accommodation or receiving benefits at the ages of 23 or 33 years. Deprivation at birth was associated with deprivation at age 33 years. Whether participants had limiting illness and their financial circumstances at age 50 accounted to some degree for the associations between deprivation at earlier stages in the life course and quality of life at age 50 years (Blane et al., 2012).

Years of accumulated exposure to retrospectively reported environmental hazards (air pollution, residential damp and inadequate nutrition) were associated with lower CASP-19 quality of life scores in men, but not in women, in the small British Boyd-Orr cohort (Blane et al., 2004). Similarly, longer periods of time on benefits were associated with lower CASP-19 quality of life scores in men, but not in women. In terms of both environmental hazards and time on benefits, these differences disappeared when current housing tenure and limiting long-standing illness were included in the model, suggesting that these factors might be on pathways from accumulated disadvantage to poor quality of life.

Further analyses of the same cohort showed that men and women who had always been suburban owner-occupiers and who had bought their council home had significantly higher quality of life than those who had always lived in urban rented housing (Wiggins et al., 2007). Most importantly, the effect sizes were large: a difference of about 3.5 CASP-19 points between those in the advantaged and disadvantaged housing categories. However, it is not sure how much of this effect is due to the life course; the association with quality of life might merely result from current circumstances, particularly as those who became owner-occupiers late had similar quality of life to the lifelong owner-occupiers. In addition, perhaps their housing *per se* is not at cause, instead owner-occupiers might be economically secure or live in safer and more pleasing neighbourhoods.

3.8.3.4 Economic circumstances: Evidence from the broader subjective well-being literature

Associations between income and happiness have been found, but it seems that income is affected by relative comparison (Dolan et al., 2008). It is perhaps the gap between individuals' aspirations and their actual circumstances which is associated with well-being (Stutzer and Frey, 2012). In this way, it is unfavourable comparisons of subjective evaluations of wealth which are associated with well-being rather than absolute incomes *per se* (Argyle, 1999).

3.9 Work

Whether individuals are economically active and the sort of work they do are factors that may have long-term effects upon their quality of life. People may work for decades in jobs that are stressful, hazardous and physically strenuous; such exposures are a potential mechanism through which social class influences subsequent quality of life (Hoven and Siegrist, 2013; Kaikkonen et al., 2009).

However, little research using the CASP measure has examined the relationships between working conditions and quality of life. This is also the case for research into the impact of the type of work on well-being (Dolan et al., 2008).

3.9.1 Activity

3.9.1.1 Activity: Evidence from cross-sectional studies

Being out of the labour market through unemployment and looking after the home and family was associated with lower quality of life while being retired was associated with higher quality of life in an English and Irish cohort (Layte et al., 2013; Netuveli et al., 2006). Being unemployed, a homemaker or on sick leave were associated with lower CASP-12 quality of life in Spain (SHARE data) compared to retired people, while being employed was advantageous (Ateca-Amestoy and Ugidos, 2013). These associations should not be interpreted as evidence of a causal relationship, because the studies will be confounded by selection of individuals into and out of paid employment.

3.9.1.2 Activity: Evidence from the broader subjective well-being literature

In the Third European Quality of Life Survey, unemployed participants reported lower average life satisfaction and hedonic well-being, particularly if they had been unemployed for at least one year (Eurofound, 2013). In the same vein, Argyle (1999) reported consistent associations of unemployment with poorer well-being in the psychological literature, associations which diminish but do not disappear after controlling for income. Large negative effects of individual unemployment on subjective well-being have also quite consistently been found in the economics literature (Dolan et al., 2008). For example, individuals who reported gaining a job reported higher than average levels of the related measure of subjective happiness, while the inverse was found for individuals who reported losing a job (Ballas and Dorling, 2007). Results from factory closure studies indicated that unemployment causes lower well-being (Stutzer and Frey, 2012), although there may be some reverse causation from well-being to unemployment too (Argyle, 1999).

3.9.2 Physical working conditions

While it might have been hoped that technical progress, increases in education level and the development of the service sector would have led to improvements in quality of life at work, strenuous and dangerous physical working conditions have remained ever present (Bahu et al., 2013). The rapid pace of improvements in physical working conditions that took place in France between the generation born in 1938 and the generation born in 1953 has slowed, in part as a result of intensification of working rhythms (Lasfargues, 2005). Reported levels of exposures to physical risks at work have reduced little since the first European Working Conditions Survey in 1991 (Eurofound, 2012, p. 45). For example, nearly half of participants in the 2010 survey reported having to hold tiring or painful positions in the course of their work, and over one third of workers reported having to handle heavy loads (Eurofound, 2012, p. 45). Levels of physical occupational exposures tended to be higher for male workers. These proportions rose when employees were asked if they had ever been exposed during the course of their work, even if they were not currently exposed (Bahu et al., 2013). In a recent French survey of workers aged 50–59 years old who had reported having had to perform strenuous tasks at some point in their careers, the median duration of exposure was 18 years (Bahu et al., 2013). Compared to other countries in the European Union, French workers reported over-average levels of physical risks and British workers below-average levels (Eurofound, 2012, p. 47).

To my knowledge, studies using the CASP-19 or CASP-12 measures of quality of life have not examined the relationship between physical occupational exposures and quality of life in a cross-sectional or change analysis design. However, a wide range of studies have examined the relationship between physical occupational exposures and subsequent well-being and health outcomes.

3.9.2.1 Physical working conditions: Evidence from cross-sectional studies

One report of a cross-sectional analysis of SHARE data found that individuals from each country had higher CASP-12 quality of life scores if they reported better conditions on a measure of working conditions which combined physical exposures, psychosocial strain and support from co-workers (Ogg and Renaut, 2013), although it is not possible to know how much of the effect was due to the physical working conditions alone.

3.9.2.2 Physical working conditions: Evidence from life course studies

One study using the Boyd-Orr cohort found an inverse association between CASP-19 quality of life and accumulated years of exposure to a variety of occupational hazards (occupational fumes and dusts, physically arduous work, low job control), incorporated into a single measure with smoking and household hazards, in men, but not in women (Blane et al., 2004). However, it is not possible to determine how much of the association was due to occupational hazards and how much was due to the other factors that were included in the single measure.

3.9.2.3 Physical working conditions: Evidence from the broader subjective well-being literature

A small retrospective survey in the British county of Northamptonshire indicated that aspects of previous employment might influence retirees' quality of life via their effects on the quality of retirement (Lowis et al., 2010).

3.9.2.4 Physical working conditions: Possible influences upon the proximal determinants of quality of life

While there is little evidence to date demonstrating impact of poor physical working conditions upon quality of life, substantial evidence exists for their long-term impacts on health, which is an important determinant of subsequent quality of life. In this section, I will briefly describe how different sorts of working conditions have had demonstrable effects upon individuals' mental and physical health. Because different types of physical occupational exposures may affect health through different mechanisms, I subdivide the physical exposures into those that affect individuals' safety, concerning the risk of accidents, and those that affect individuals' health, which includes chemical hazards and biomechanical hazards (Levy et al., 2011).

Safety hazards. Common safety hazards include: contact with moving objects and equipment; bodily reaction and exertion; slips and trips; falls from a height; and injuries from carrying or lifting heavy loads; (Bambra, 2011b; Castillo et al., 2011). In the US, the most common diagnoses in emergency departments of workers treated for occupational injuries were: sprains and strains (28%); lacerations, punctures, amputations and avulsions (25%); haemotomas and abrasions (17%); and dislocations and fractures (7%) (Castillo et al., 2011).

Occupational accidents may have long-term implications for individuals' health in later life, as well as their financial circumstances, if a work injury prevents promotion or causes early retirement. Aside from the risk of accidents, safety hazards can generate musculoskeletal disorders and sickness absenteeism (Chevalier et al., 1994; Melchior et al., 2005). It is likely that there are selection effects into hazardous posts, as workers in hazardous professions tend to have lower rates of depression and anxiety disorders (Chevalier et al., 1994, 1996).

Safety hazards can interact with psychosocial working conditions to worsen risks of injury. Workers on precarious contracts tend to receive less health and safety training and carry out the most hazardous jobs (European Agency for Safety and Health at Work, 2007). Similarly, high workloads can affect health and safety (European Agency for Safety and Health at Work, 2007). Older workers are at particular risk of accidents in part because they may be deprived of opportunities to participate in training (European Agency for Safety and Health at Work, 2007).

Chemical hazards. These concern exposures to a wide range of chemicals known to be harmful to human health (Levy et al., 2011). Low levels of work-related exposures to toxic substances can cause illnesses that have long latency periods such as cancer or chronic obstructive pulmonary disease (Bahu et al., 2013). A study of the French SIP survey (*Santé et itinéraire professionnel* = Health and professional mobility) found substantially higher frequency of limitations to daily activities and declarations of poor health among participants, aged 50–59 years, who reported ever having been in contact with dangerous chemicals in the course of their work (Bahu et al., 2013).

Chemical hazards and lung cancer. Lung cancer accounts for half of all occupational cancers worldwide and it is exposure to asbestos which is the most important occupational exposure (Ward, 2011). Studies using the GAZEL cohort and its job-exposure matrix have linked asbestosis and cancers of the pleura, lung and larynx to exposures to asbestos fibres measured with a job-exposures matrix (Imbernon et al., 1996), and a dose-response relationship between exposure to crystalline silica and creosotes to lung cancer (Martin et al., 2000).

A classification of chemicals implicated in causing cancer is provided by the International Agency for Research on Cancer (IARC, 2013). Many substances that are or were widely used in workplaces are on the list, such as asbestos, benzene, crystalline silica and creosotes. The IARC classifies chemicals for which there is sufficient evidence of carcinogenicity in humans in Group 1; and chemicals which are probably or possibly carcinogenic in humans in Groups 2A or 2B (IARC, 2013). Workers are generally not exposed to any single chemical in isolation; many exposures are mixtures, occupations often involve exposure to a changing and diverse array of substances, and individuals may be employed in several occupations over the course of their career (Ward, 2011). The situation in advanced industrial economies is improving; generally, exposure levels are much lower now than in the past (Ward, 2011).

Chemical hazards and chronic obstructive pulmonary diseases. About one fifth of chronic obstructive pulmonary diseases cases have been attributed to exposures to fumes and gases at the workplace (Ahasic and Christiani, 2011). There can be a long latency between workplace exposures and symptoms, but unless these diseases are diagnosed very early in their course, they are generally not curable and become disabling (Ahasic and Christiani, 2011).

Biomechanical hazards. Exposures to ergonomic strain are diverse in nature and can include postural constraints such as working with the arms in an elevated position or kneeling/squatting, lengthy driving, handling heavy material, using vibrating tools or bending/twisting (Melchior et al., 2005; Plouvier et al., 2009). Ergonomic strain at work is thought to cause or worsen a range of medical conditions, including musculoskeletal disorders, vibration syndromes and cardiovascular disease.

Biomechanical hazards and musculoskeletal disorders. Silverstein and Evanoff (2011) defined work-related musculoskeletal disorders as “soft-tissue disorders of nontraumatic origin that are caused or exacerbated by interaction with the work environment”. Reversible inflammation of tendons and tendon sheaths caused by too many forceful contractions of muscles can progress to more serious and potentially irreversible nerve compression, tendon rupture, calcium deposits, or the formation of fibrous nodules (Bahu et al., 2013; Silverstein and Evanoff, 2011). The most frequently affected body areas are the neck, arms and lower back, although evidence is growing that some common hip and knee disorders are work-related (Descatha et al., 2011; Silverstein and Evanoff, 2011).

Musculoskeletal disorders are the among the most common cause of disability pensions in France and are becoming more common (Lasfargues, 2005). They occur from a relatively young age: the average age for attribution of a disability pension is only about 50 years while the most common cause of disability pension in workers younger than 45 years is back problems (Lasfargues, 2005) .

Particular risk factors for the development of work-related musculoskeletal disorders are tasks that require workers to perform forceful motions, repetitive or prolonged motions, work in static or awkward postures, or endure hand-arm vibration or mechanical stresses (Silverstein and Evanoff, 2011). Tasks that combine more than one risk factor place workers at greater risk of developing musculoskeletal injury.

Biomechanical hazards and cardiovascular disease. A proportion of cardiovascular incidents have also been attributed to occupational factors (Nurminen and Karjalainen, 2001). It is thought that one mechanism relating physical activity at work to cardiovascular disease may be prolonged intravascular turbulence and wall shear stress upon arterial vessels. This is thought to induce inflammatory processes which may lead to atherosclerosis (Holtermann et al., 2012).

Biomechanical hazards and vibration syndromes. Using vibrating tools or experiencing whole body vibration (such as through operating vehicles over uneven surfaces) are known to cause vibration syndromes as well as musculoskeletal disease (Bambra, 2011b). According to the British Health and Safety Executive, (reported in Bambra, 2011b, p. 59), two million workers in the UK are at risk of hand-arm vibration syndrome. This condition can permanently affect the nerves and blood vessels in the hands and arms, causing numbness and pain, and loss of abilities to perform fine movements (Bambra, 2011b, p. 59). Whole body vibration is associated with lower back pain, sciatica and degenerative changes to the spine (Bambra, 2011b, p. 60).

Biomechanical hazards, hospital use and limiting illness. In a recent register-linked study, ergonomic strain at work (measured prospectively by questions about cardiorespiratory and muscular stain) was associated with greater hospital care use after age 65 years (von Bonsdorff et al., 2014). Higher frequency of limitations to daily activities and declarations of poor health were observed among 50–59-year-old participants who reported ever having been employed in posts requiring strenuous labour in the French SIP (*Santé et itinéraire professionnel* = Health and professional mobility) survey (Bahu et al., 2013). Results from the survey suggest that vulnerable workers are selected out of employment in high physical strain jobs; workers reporting many years of exposure tended to have less limiting illness than workers exposed to several years only of exposure (Bahu et al., 2013).

3.9.3 Psychosocial working conditions

The European Agency for Safety and Health at Work defines psychosocial risks as risks "linked to the way work is designed, organised and managed, as well as to the economic and social context of work" (European Agency for Safety and Health at Work, 2007). It has been demonstrated that work-related psychosocial factors are related to mental illness, increased risk of musculoskeletal disease and cardiovascular disease (Lasfargues, 2005).

3.9.3.1 Conceptualizations of psychosocial working conditions

Three influential conceptualizations of psychosocial risks are the demand-control model of job strain, the effort-reward imbalance model and the concept of organizational justice. The job-strain (or demand-control) model as originally developed postulates that the interaction between psychological job demands[1] and low decision latitude (or control) can result in mental strain or stress at work (Karasek, 1979). A worker's degree of decision latitude depends on their levels of decision authority and skills discretion. The Job Content Questionnaire is used to measure job demands and decision latitude (Karasek et al., 1985, 1998). "High strain" jobs are those in which the psychological demands of the job are high and the worker's decision latitude is low, causing the worker to experience unresolved strain (Karasek, 1979). A social support aspect was subsequently added to the model, in which support from co-workers and supervisors helped workers manage the demands. This

[1] Although five items in the questionnaire refer to the physical content of the job, this is in a general manner (Karasek et al., 1985).

variant of the model is called the “demand-control-support” or “iso-strain” model (Karasek et al., 1985).

In the effort-reward imbalance model (ERI), as part of reciprocal social exchange, workers invest effort in return for rewards which could be financial, esteem or security/career opportunities (Siegrist, 1996). An imbalance occurs when a high level of intrinsic (e.g., personal coping pattern, measured by overcommitment) or extrinsic (e.g., time pressure, obligations) effort at work combined with a low level of rewards generates psychological distress (Siegrist, 1996). The model has been extended beyond the workplace, to homemakers as well as to voluntary activities (Sperlich et al., 2013; Siegrist and Wahrendorf, 2009).

Organizational justice approaches encapsulate the idea that people are not only affected by workplace rewards themselves, but also by the nature of the procedures that determine how they are distributed (Elovainio et al., 2002). Organizational justice can be divided into two components: 1) procedural justice, describing whether decision-making procedures are ethical, accurate, correctable, consistently applied, suppress bias and include input from affected parties and 2) relational justice, describing whether supervisors treat workers in a fair, truthful and considerate manner (Elovainio et al., 2002; Nieuwenhuijsen et al., 2010).

3.9.3.2 Psychosocial working conditions: Cross-sectional analyses

In results from the first wave of the SHARE study, the prevalences of both low control at work and effort-reward imbalance were higher for people who reported quality of life scores corresponding to the lowest tertile of the CASP-12 measure (Siegrist et al., 2007). Similarly, individuals tended to have higher CASP-12 quality of life scores if they reported better conditions in terms of a single measure combining greater support from co-workers, lower psychosocial strain and lower physical exposures (Ogg and Renaut, 2013). Unfortunately, it was not possible to discern from the analysis what the specific role of psychosocial working conditions was.

3.9.3.3 Psychosocial working conditions: Evidence from the broader subjective well-being literature

From the large literature examining associations between psychosocial working conditions and well-being in its broadest sense (including aspects such as mental health, job satisfaction, fatigue, and psychosomatic symptoms), relatively few studies have examined associations with subjective well-being in the sense in which I use the term in this thesis, avoiding conflating the concept with health (Danna and Griffin, 1999).[2]

Emotional well-being tends to be associated with psychosocial working conditions: Stansfeld et al. (2013) found associations between subjective well-being (measured using the Affect Balance Scale) and subjective assessments of both high control and low levels of job strain at work in a study that adjusted for well-being at baseline. Similarly, using a single-item measure of emotional problems such as anxiety or irritability, Vanroelen et al. (2009)

[2] Associations with a range of mental health outcomes are described in section 3.9.3.4.

reported cross-sectional associations with iso-strain, job strain and control. Small associations were reported in both men and women, which were statistically significant to at least the 95% level, between higher life satisfaction and higher autonomy, lower stress, higher skill and higher security (Suppa, 2012). A recent review reported evidence that casual work was detrimental to subjective well-being and that belonging to a union was beneficial to life satisfaction (Dolan et al., 2008). Individuals who reported a positive change in their job, such as promotion, reported higher than average levels of subjective happiness (Ballas and Dorling, 2007).

3.9.3.4 Psychosocial working conditions: Possible influences upon the proximal determinants of quality of life

While there is little evidence to date examining direct influences of earlier psychosocial working conditions upon quality of life following retirement, associations are well documented between psychosocial strain and subsequent health (LaMontagne, 2012), which is an important influence on quality of life in old age. The sections below describe associations between the three measures of psychosocial strain and a range of health outcomes, although the job strain measure has been the most widely used.

Job strain, measured with the demand-control model, has been associated with greater subsequent use of hospital care (von Bonsdorff et al., 2014), inconsistently with diabetes (Heraclides et al., 2009; Kroenke et al., 2007) and, rather equivocally, with mortality (von Bonsdorff et al., 2012). In prospective studies using the GAZEL cohort, job strain was predictive of worse self-reported health, greater sickness absence, and more depressive symptoms (Fuhrer et al., 2002; Melchior et al., 2003, 2005; Niedhammer et al., 1998; Niedhammer and Chea, 2003; Paterniti et al., 2002). Effort-reward imbalance has been associated prospectively with self-reported health (Niedhammer et al., 2004) as well as with mental and physical health functioning following labour market exit (Wahrendorf et al., 2012). A great deal of research has examined psychosocial working conditions as risk factors for psychiatric illness and cardiovascular disease, and this research will be discussed in more detail in the sections that follow.

Psychosocial strain and psychiatric illness. In France, psychiatric illness is one of the leading causes of disability pension and rates are increasing (Lasfargues, 2005). It is thought psychosocial strain is an important risk factor for psychiatric illness, and job strain has been estimated to account for 6.5% of common mental health disorders and 15% of depression prevalence (LaMontagne et al., 2008; Sultan-Taïeb et al., 2011).

A recent review of prospective studies found that high job demands, low job control, high effort-reward imbalance, low co-worker and supervisory support, and low procedural and relational justice predicted the incidence of stress-related disorders (Nieuwenhuijsen et al., 2010). Similarly, associations were found in a review of studies examining perceptions of adverse psychosocial working conditions and subsequent depressive symptoms or a major depressive episode (Bonde, 2008). A third review found relationships between common mental disorders and psychosocial occupational exposures, particularly job strain and effort-reward imbalance (Stansfeld and Candy, 2006). In addition, organizational justice was associated with mental health in a review of prospective studies independently of the demand-control and effort-reward imbalance models (Ndjaboué et al., 2012).

A great weakness with most observational studies, including most of the studies included in these reviews, is that it remains a matter of conjecture whether the relationship between psychosocial exposures and the psychiatric illness outcome is merely due to confounding or response bias. Almost all studies use self-reports of both working conditions and the health outcome, measures which are vulnerable to common method variance (Bonde et al., 2009). It is possible that pre-existing personality traits might influence the reporting of both mental health and working conditions (Stansfeld and Candy, 2006). This is a concern even in prospective studies, and it is a problem that precludes causal inference (Bonde, 2008). Another possibility is that the direction of causation might be reversed if poor mental health is influencing the reporting of work characteristics (Stansfeld and Candy, 2006).

Various approaches to this problem have been used. An analysis of changes over time in both the predictor and outcome provides stronger evidence of causality than studies in which the predictor and outcome are each measured at one time point. In this way, a paper using the Whitehall II study found that changes in organizational justice were associated with changes in risk of psychiatric morbidity (Ferrie et al., 2006).

Another approach is to base exposure assessments on the averaged perceived job strain at the work unit level (Bonde et al., 2009; Kolstad et al., 2011); no statistically significant associations were found between any of the job strain measures and depression, whether measured by prescription of antidepressants or depressive symptoms. However, these negative results need to be interpreted cautiously because of the misclassification of exposures that will have been introduced by not using individual exposure assessments (Bonde et al., 2009).

An alternative approach is to use assessments of psychosocial working conditions provided by external observers, although this approach is prone to misclassification if we consider that it is the perception of the stress which is the relevant exposure under study (Kasl, 1998). One study comparing this approach with subjective measures found large inconsistencies between results obtained using equivalent subjective and objective measures (Stansfeld et al., 2013).

Other approaches have found relationships between mental health outcomes and externally assessed proxies of psychosocial strain, whether overtime work (Virtanen et al., 2012), long working hours (Virtanen et al., 2011). Associations were also found in a quasi-experiment of nurses' psychiatric sickness absence in relation to externally assessed hospital ward overcrowding, used as an instrument for job demands (Kivimäki et al., 2010).

To conclude, while associations between psychosocial strain and subsequent mental health have frequently been found, studies using more robust designs which would provide stronger evidence of causality have generated inconsistent results. Therefore, the question of whether this association is causal remains unresolved.

Psychosocial strain and cardiovascular disease. A recent meta-analysis managed to estimate the proportion of cardiovascular disease morbidity and mortality which is attributable to job strain: 6.5%–25.2%, with the caveats that it is not known whether the relationship is causal nor what the mechanisms might be that relate psychosocial strain to cardiovascular disease (Sultan-Taïeb et al., 2011). This estimate might have been larger had other aspects of individuals' psychosocial working conditions, such as job insecurity or organizational injustice been included.

Recent systematic reviews found mixed but promising evidence for associations between psychosocial strain and increased risk of cardiovascular disease (Backé et al., 2012; Eller et al., 2009; Hemingway and Marmot, 1999; van Vegchel et al., 2005). In the case of the demand-control model, it is a matter of debate whether its job strain component is a risk factor or whether the association with disease risk is entirely explicable merely by the model's job demand component (Eller et al., 2009).

A collaborative meta-analysis of 197 473 men and women without pre-existing coronary heart disease from 13 European cohort studies which included both published and unpublished data found a small increased risk of coronary heart disease for participants exposed to job strain (Kivimäki et al., 2012). Only the combination of high demands and low control was significantly associated with coronary heart disease, not high demands or low control in isolation (Kivimäki et al., 2012). However, the effect size for job strain upon coronary heart disease risk is small, at only about one-seventh of that for lifestyle risk factors such as obesity or smoking (Kivimäki and Kawachi, 2013).

A range of biological mechanisms could plausibly link psychosocial stress to coronary heart disease. Stressful working conditions may foster adverse health behaviours as mechanisms for coping with distress, such as dietary perturbations (Lasfargues, 2005), and reduce the odds of succeeding in initiating and maintaining positive health behaviours such as physical activity (Fransson et al., 2012), low body mass (Nyberg et al., 2012), or avoiding smoking (Heikkilä et al., 2012), which can influence cardiovascular risk factors such as high blood pressure, diabetes and metabolic syndrome. Neuroendocrine disruptions are another range of candidate mechanisms (Yudkin et al., 2000). A recent review concluded that there was evidence, although not clear-cut, that psychosocial strain alters the functioning of the sympathetic nervous system (leading to increased levels of catecholamines, such as adrenaline) and the hypothalamic-pituitary-adrenal axis (causing a greater cortisol awakening response) (Chandola et al., 2010). Evidence was stronger that participants reporting greater psychosocial strain had lower heart rate variability (Chandola et al., 2010).

Psychosocial strain and musculoskeletal disease. Physical and psychosocial occupational exposures can interact. A recent review found that a range of workplace psychosocial factors, such as high job demands, highly monotonous work or insufficient social support at work can increase the risk of experiencing work-related musculoskeletal disorders (Lang et al., 2012).

3.9.4 Interactions between physical and psychosocial working conditions

Although this thesis distinguishes between physical and psychosocial exposures, understanding how they interact is important for understanding the paradox in modern industrialized economies of increasing rates of work injuries in the face of technological improvements. Recent technological and organizational changes at work have generated new psychosocial risks which threaten workers' health and safety (European Agency for Safety and Health at Work, 2007; Lasfargues, 2005). These include new forms of employment contracts and greater job insecurity, work intensification, high emotional demands at work, and an ageing workforce. These tendencies exacerbate the risk for workers of strenuous and hazardous physical working conditions. Psychosocial factors, such as high workload, may exacerbate risks of ergonomic strain, perhaps by altering muscle tension, decreasing micropauses in muscle activity and influencing pain perception (Silverstein and Evanoff, 2011). Employees who are working under time pressure, who receive low levels of social support at work, or who are on precarious contracts may work for longer hours to finish tasks, take fewer breaks, and perform tasks in more hazardous ways (European Agency for Safety and Health at Work, 2007; Silverstein and Evanoff, 2011). For example, in an emergency, a nurse may manually lift a patient rather than use equipment designed to assist them (Eurofound, 2012, p. 71).

3.9.5 Retirement

Retirement is a formal exit from the labour market as a result of old age. It is a life course transition embedded in the individual's previous occupational trajectory as well as within their current structural and situational exigencies and opportunities (Moen, 1996). While an objective transition, it is also a process of subjective transformation, in which individuals respond to and actively shape their external circumstances (Moen, 1996).

The retirement process can be viewed as a series of losses, of social relationships from the work environment, social role, social status, income and a habitual daily routine, in the face of which individuals employ their compensatory capacities (Baltes, 1987). For example, individuals usually manage to replace their social relations from work with new social contacts following retirement (Weidekamp-Maicher and Reichert, 2005). However, the way in which individuals manage to cope with the transition to retirement is circumscribed by their earlier physical and psychosocial development as well as the nature of their current circumstances (Salokangas and Joukamaa, 1991). How older individuals' circumstances in retirement are circumscribed by earlier periods in the life course, or how they might manage to overcome earlier difficulties during the passage to retirement, are questions that are highly relevant to the sociological and epidemiological literatures of ageing (George, 2003).

The boundaries between work and retirement are ill-defined and unstable; retirement is a process that can play out over time (Kim and Moen, 2001). Employees can redefine their work roles to make them more of a vocation, develop their job into self-employment, reduce their hours in the lead-up to retirement and continue professional activities following retirement from their career job (Mein et al., 2000; Moen, 1996).

As described more fully in the previous chapter, sociological theories of ageing have suggested how retirement can potentially lead to economic and social marginalization or can launch people into a new phase of life in which they find time to devote themselves to their own interests. The sort of retirement transition a person experiences is likely to be greatly influenced by the sort of work they were doing before (Moen, 1996). For example, individuals exposed to dangerous, strenuous or stressful working conditions are more likely to be retire early, whether as a result of personal preferences (Siegrist et al., 2007) or occupation-induced illness (Polvinen et al., 2013).

In addition, the institutional and occupational context is likely to influence the type of retirement process a person undergoes. Retirement rules differ by position, occupation, sector and country, and individuals are often engaged in negotiations with their organization in order to retire earlier or later. In the case of the Whitehall II cohort of civil servants working in London, over two-thirds of the cohort managed to retire early in one form or another (Hyde et al., 2004). Therefore, individuals who retire can be strongly selected, as those who most strongly wish to stop working may manage to retire sooner than others, a factor which makes it difficult to compare quality of life of retired and non-retired individuals of similar ages (Charles, 2002).

Taking these factors into consideration, five sorts of transitions from full-time work to retirement can broadly be outlined:

1. *Exit at the standard retirement age.* The age at which individuals can retire on a full pension in France is based on the legal retirement age as well as whether individuals worked for the minimum number of years necessary to receive full benefits when they retire (Mette, 2013). These, in turn, depend on the pension regime that individuals are a part of, whether it is the general retirement regime (or *régime général*) which concerns around 80% of French workers, or one of the specific regimes (*régimes spéciaux*) which concerns employees in specific sectors such as energy and gas as well as civil servants (Birchem et al., 2007). Fulfilling the requirements of age or minimum number of years was the most frequent retirement route in France for the generation born in 1944 and concerned about half of male and two-thirds of female workers on the general retirement regime (Mette, 2013).

2. *Negotiated early retirement.* In many cases, individuals are able to negotiate early retirement through redundancy or disability. This concerned around 27% of male and 22% of female workers in the general regime in France who were born in 1944 (Mette, 2013). In the case of redundancy, they may expect slightly reduced levels of retirement benefits, while in the case of disability, payments may be increased (Jokela et al., 2010; Mette, 2013).

3. *A generally early exit accompanied by the development of a second career.* Workers may formally retire from their main job, but maintain ties to the labour market by recommencing work or by maintaining certain professional activities in a limited

capacity. Typically, they enjoyed their work and held positions amenable to conversion into "consultancy" roles. Although individuals might be forced to maintain professional activities following formal retirement as a result of financial constraints, it seems most likely that this is a free choice and a strategy aimed at combining early retirement with new employment that is more flexible and independent (Polverini and Lamura, 2005).

4. *Exit via unemployment.* Older persons leaving the labour market in this manner are typically in a vulnerable position, living on low incomes and having a low likelihood of finding a job because labour markets for older people are generally very small. If unable to find other work, they will bridge the period between leaving the labour market and formally retiring with social security benefits (such as unemployment benefits or disability pensions) (Hyde et al., 2004). The GAZEL cohort participants were not exposed to this retirement route because employees working for the state company EDF-GDF had a high level of job security like French civil servants.

5. *Exit later than the standard retirement age.* A small minority of employees choose to retire after the standard retirement age. In France, for the generation of 1944, these were typically individuals who began their working careers late or who had lengthy non-working periods (Mette, 2013).

The following sections review the evidence for the potential impacts of retirement upon quality of life and well-being.

3.9.5.1 Retirement: Evidence from cross-sectional studies

In a cross-sectional analysis using the Boyd-Orr cohort, individuals who reported that their retirement transition was voluntary rather than forced reported higher quality of life, as did those who continued working beyond the state retirement age (Blane et al., 2002). Similarly, quality of life was associated with participation in paid work for ELSA participants above the state pension age, particularly if individuals felt that they were adequately rewarded for their activities (McMunn et al., 2009).

A study by Topa et al. (2013) provides evidence, despite relying on self-reports, that good quality bridge employment, where individuals continue working in another form after retiring from their main occupation, is one way in which individuals who had good quality of life before retirement maintained it. The benefits of high quality bridge employment are likely to include maintaining social contacts and providing a structure to the day as well as opportunities to perform rewarding activities.

Retrospective research suggests that individuals' previous position in the social structure affects the benefits they may acquire from retiring. In the Boyd-Orr cohort, there was evidence that early retirement among the socio-economically disadvantaged was associated with lower quality of life (Higgs et al., 2005). In addition, years since labour market exit were inversely related to CASP-19 quality of life among the relatively deprived (non-owner occupiers) but not among those who owned their homes (Blane et al., 2004). The authors concluded that this suggested a “structured dependency” route out of paid employment for those living in material disadvantage. This effect was not completely accounted for by either current deprivation or illness.

3.9.5.2 Retirement: Evidence from longitudinal studies

It seems that the transition to retirement itself may be beneficial for quality of life, at least in the short term. In an analysis of change using European SHARE data, individuals who had recently retired between the two survey waves were more likely than the others to experience an increase in CASP-12 quality of life over that time, and were less likely to experience a decrease in quality of life (Wahrendorf and Siegrist, 2010). Similarly, individuals retiring between two waves of the English Longitudinal Study of Ageing tended to experience an increase in quality of life measured with the CASP-19 scale (Emmerson and Muriel, 2008).

3.9.5.3 Retirement: Evidence from the broader literature examining health and subjective well-being

Retirement, as the social transition from regular employment to leaving the labour market, may have important consequences for health and wellbeing. Reviewing the psychological literature, Argyle (1999) reported that retired people were happier than people who were still at work; another review found inconsistent relationships in the literature between retirement and psychological well-being (Kim and Moen, 2001).

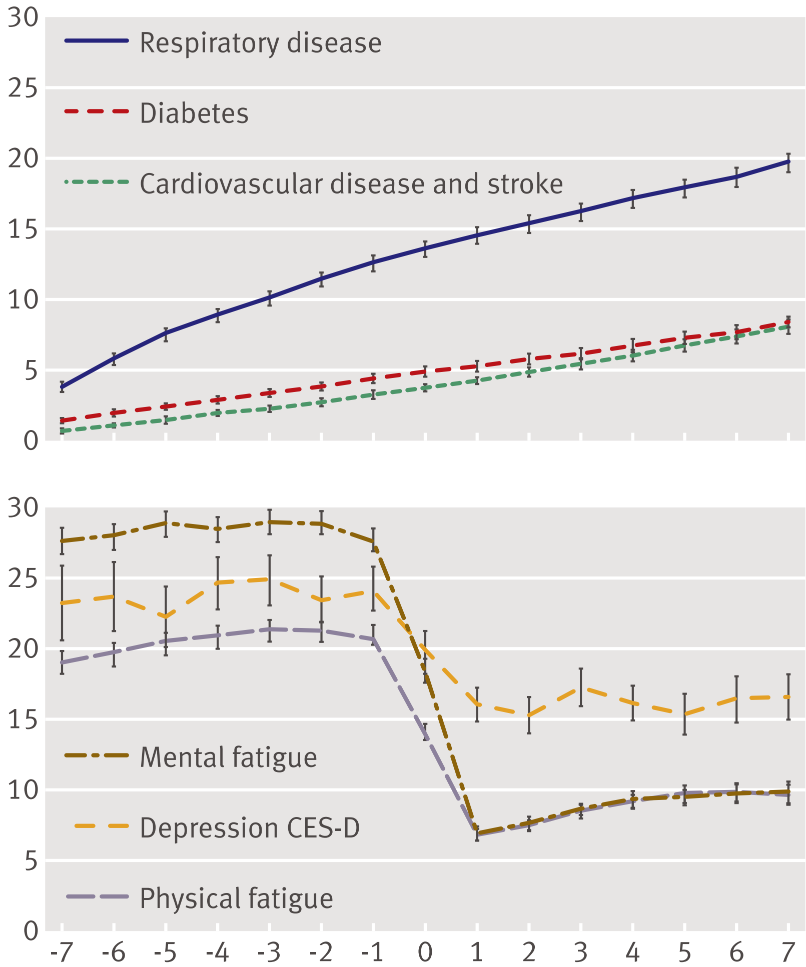
It is difficult to interpret such findings. Any seeming impact of retirement might not necessarily be causal, for the decision to retire is one taken as an outcome of a negotiation between employee and employer, within the context of the individual’s, family’s, organization’s and national circumstances. Consequently, the possibility of selection effects is very strong, since employees in poor health may succeed in retiring early and subsequent health declines may have more to do with their pre-existing health conditions than any changes taking place since retirement (Jokela et al., 2010; Mein et al., 2000). Similarly, retirement regimes in large industrial organizations in France tend to award earlier retirement to individuals who had the hardest physical working conditions (Birchem et al., 2007).[3] In addition, it is necessary to design studies carefully to distinguish retirement and ageing effects.

In well-designed prospective studies, the degree to which retirement appears to impact health and well-being seems to depend on the outcome measure chosen. In studies examining physical health or physical functioning, the impact of retirement is frequently indiscernible (Jokela et al., 2010; Mein et al., 2003; Salokangas and Joukamaa, 1991; Westerlund et al., 2010) (except in the case of migraine and headache, Sjösten et al. 2011, or mortality, Bloemen et al. 2013), the time trends for physical health seeming to reflect the effects of ageing alone (see Figure 3.3, upper panel, for a typical example).

In contrast, the impact of retirement on mental health, measures of perceived health,

[3]French retirement rules are described in more detail in section 2.4.3 on page 46.

Figure 3.3: Trajectories in health in relation to retirement in the French GAZEL cohort



On the horizontal axis, 0 marks the point at which retirement takes place. In the upper panel, illnesses were self-reported by the GAZEL participants: respiratory disease (defined as self-reported chronic bronchitis or asthma); diabetes; cardiovascular disease and stroke (presence of self-reported angina, myocardial infarction, or stroke). In the lower panel, depression was measured with CES-D while physical and mental fatigue were each measured with a single question asking about levels of physical or mental fatigue on an eight-point visual analogue scale.

Reproduced from: Westerlund, H., Vahtera, J., Ferrie, J. E., Singh-Manoux, A., Pentti, J., Melchior, M., Leineweber, C., Jokela, M., Siegrist, J., Goldberg, M., Zins, M. & Kivimäki, M. (2010). Effect of retirement on major chronic conditions and fatigue: The French GAZEL occupational cohort study. *British Medical Journal*, 341, c6149, with permission from BMJ Publishing Group Ltd.

long-standing illness with reduced working capacity, and psychological well-being are larger and positive (Kim and Moen, 2002; Vahtera et al., 2009; Vogel, 2002; Westerlund et al., 2009, 2010) (see Figure 3.3, lower panel). This was also the case in a study examining changes in laws affecting mandatory retirement and social security in the US (Charles, 2002). This relationship may take the form of a U-shaped curve reflecting a temporary improvement around the time of retirement (Andersson, 2005; Westerlund et al., 2009). The size of the improvement has been described as equivalent to a gain of about 8–10 years (Vahtera et al., 2009; Vogel, 2002; Westerlund et al., 2009).

Overall, individuals' health and well-being tend to improve following retirement, but this is not always the case (Sahlgren, 2013). In qualitative and quantitative studies examining a range of health and well-being outcomes, the nature of the retirement process itself as well as individual's circumstances before retirement seemed to affect post-retirement outcomes. These are summarized in Table 3.1. In short, individuals were more likely to experience a downward trajectory of health and well-being following retirement if their retirement transition was rapid, sudden, forced, premature, for health reasons and if it led to greater financial pressure. They were more likely to experience an upward trajectory following retirement if they retired from poor physical and psychosocial working conditions, they were not depressed, were in good health, and retired in a manner that was gradual, planned, voluntary and which was not premature.

Table 3.1: Factors affecting post-retirement trajectories

Downward trajectory in health or well-being if retirement was:	Upward trajectory in health or well-being if retirement was:	Source
Rapid	Gradual	(Hildon et al., 2008)
Unexpected	Planned	(Hildon et al., 2008; Peeters et al., 2005)
Forced	Voluntary	(Hildon et al., 2008; Peeters et al., 2005)
Premature	Not premature	(Hildon et al., 2008)
	From poor physical and psychosocial working conditions*	(Vahtera et al., 2009; Westerlund et al., 2009)
For health reasons*	In good health	(Jokela et al., 2010; Vahtera et al., 2009)
Accompanied by depression	Unaccompanied by depression	(Westerlund et al., 2009)
Led to more financial pressure	Led to less financial pressure	(Hyde et al., 2004)

* Results which are inconsistent.

However, these differences in post-retirement circumstances which seem to vary by retirement route may in fact be an outcome of pre-retirement circumstances. For example, one British study examining pre-retirement factors and retirement routes in the Whitehall II cohort found that pre-retirement circumstances had a greater influence on later life than the retirement route (Hyde et al., 2004). In addition, the impact of retirement may differ according to the circumstances within which individuals retired, such as whether it occurred in the context of a health crisis, or as a result of a requirement to provide personal care to a close relative (Kim and Moen, 2001).

The life event of retirement may also impact on social inequalities. Longitudinal studies examining time trends in inequalities before and after retirement have tended to find evidence for one or more of three trajectories (Andersson, 2005):

1. *Catch-up.* The health of the disadvantaged improves more than the health of the advantaged, reducing inequalities. This might result from levelling of some social inequalities following retirement (such as the loss of strenuous working conditions or pensions being more redistributive than salaries which may improve the lot of the disadvantaged). It can be difficult to spot these trends because the nature of inequalities may change. For example, individuals may no longer own a car, a typical measure of material advantage, for health rather than financial reasons. Similarly, grade of employment may predict variations in quality of life and well-being more poorly following retirement (Marmot and Shipley, 1996).

   In a prospective study of the French GAZEL cohort, participants who reported particularly difficult working conditions, sickness absence, musculoskeletal symptoms or physical illnesses before retirement were on a trajectory of a steeper decline in self-assessed health in the years leading up to retirement than the rest. However, they experienced greater retirement-related improvement in self-assessed health following retirement. In contrast, employees who had particularly favourable working conditions such as a high occupational grade, low job demands and high satisfaction at work showed little if any improvement in self-reported health at retirement (Westerlund et al., 2009).

2. *Business-as-usual.* The differences between the groups remain the same following retirement. This is a trend which might be expected where retirement is just one of many life events that have buffeted people during their long lives (Salokangas and Joukamaa, 1991), and in particular where individuals experience a transition to retirement that is in continuity with their circumstances over the rest of their lives. This may be the case for certain outcomes, such as chronic physical diseases (Westerlund et al., 2010).

3. *Dispersion.* Differences between the groups might emerge or widen after retirement if individuals continue to be exposed to cumulative hazards. GAZEL cohort participants with depression (measured with CES-D) had worse health before retirement as well as a lower rate of improvement following retirement (Westerlund et al., 2009). Similarly, individuals who retired on health grounds experienced an increase rather than a decrease in sleep disturbances following retirement (Vahtera et al., 2009).

3.10 Conclusion

This literature review has explored existing research into life course influences upon quality of life in early old age, as well as reflecting on the measurement of quality of life itself. A wide range of current factors have been associated with quality of life in early old age, including socio-demographic circumstances, social relationships and health. In some cases, accumulation processes have been demonstrated, in which quality of life is associated in a graded manner with increasing degrees of exposure to disadvantage. Some observational studies with stronger study designs, such as those including a range of domains in a change analysis, suggest that a range of aspects of older individuals' common circumstances can influence quality of life. The geographical range of most studies examining influences upon quality of life is small. Although some investigators have used European SHARE data, all single-country research with large samples has used British or Irish cohorts. In addition, relatively few studies have examined life course influences upon quality of life, in particular concerning employment characteristics in mid-life, such as working conditions or occupation-based measures of social position. Where such studies have been performed, they have shown small associations of quality of life with life course circumstances; which seem to have a role limited to shaping individuals' current situations in a manner that corresponds to pathway models of the life course. Similarly, very little research has examined the associations between quality of life and retirement, although the evidence that there is suggests that retirement improves quality of life. Therefore this thesis, taking a life course perspective on variation in quality of life in early old age in a large, prospective, continental European cohort, will contribute to the state-of-the-art as it currently stands.

Chapter 4

Aims, conceptual model and hypotheses

Summary

This chapter introduces the overall aim of the thesis: to describe the relationships between mid-life employment characteristics and quality of life in early old age. It will describe the conceptual model, in which mid-life employment characteristics are related to quality of life via individuals' more recent circumstances as well as retirement processes. Lastly, the chapter will outline the thesis' research questions.

4.1 Introduction

In this chapter, the thesis' aims and hypotheses will be introduced, as well as the conceptual model for the thesis.

4.2 Objective of the thesis

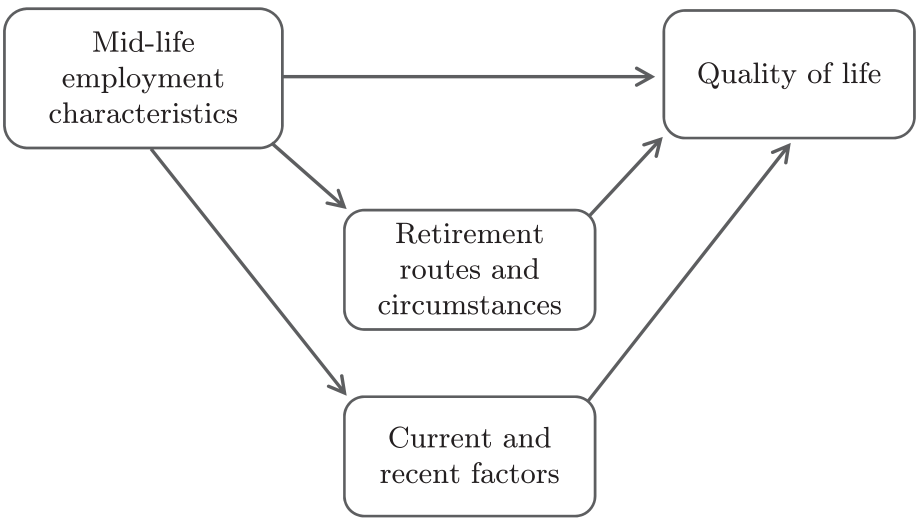
The overall objective of this thesis is to describe the relationships between mid-life employment characteristics and quality of life in early old age. In particular, it will examine the associations of occupational position and physical and psychosocial working conditions with later quality of life in the GAZEL cohort. Any long-term influences of mid-life circumstances upon quality of life in early old age may result from their role in shaping individuals' present circumstances. Therefore, it is necessary to examine which recent or current factors are associated with quality of life. The thesis will then test whether these factors might be on pathways linking earlier circumstances to later quality of life.

Since study onset, most of the GAZEL participants have retired. The thesis will examine whether retiring is associated with changes in quality of life as well as if this depends on the type of retirement route taken. In addition, it will examine whether mid-life characteristics are associated with the type of retirement route participants undergo.

4.2.1 The conceptual model

A conceptual model for the thesis has been developed which relates current and earlier circumstances to quality of life.

Figure 4.1: Conceptual model for the thesis



Mid-life employment characteristics may influence quality of life directly, or indirectly, via their influences upon the retirement route and/or upon their influences upon more recent circumstances. These recent circumstances might include health status, and social and financial characteristics.

The thesis will examine the evidence for each of these pathways, both singly and in combination, in order to understand how variations between individuals in quality of life might develop over adulthood.

Although this approach models pathway mechanisms to later quality of life, it is able to incorporate accumulation mechanisms too. Where the data allow, the accumulation of physical occupational exposures over time will be considered.

4.2.2 Aims of the thesis

Examining life course influences upon quality of life taking place over a period of several decades is a complex task. Consequently, the analyses in the thesis are organized initially by time period: mid-life, retirement, post-retirement, followed by the presentation of integrated analyses. Four aims describe the analyses, each aim being sub-divided into a series of research questions:

Aim 1. *Establish which current or recent factors are associated with quality of life.*
I will examine whether factors that have been shown in the research literature to be associated with quality of life in other cohorts are related to quality of life in the GAZEL cohort. Associations will be examined cross-sectionally, as well as in a change analysis of associations between individuals' recent circumstances and changes in their quality of life scores. This latter approach deals with the problem of individual heterogeneity, making a stronger case that these factors truly determine quality of life.

1.1. Which current or recent factors predict quality of life?

1.2. Which current or recent factors predict change in quality of life?

Aim 2. *Examine whether mid-life employment characteristics are associated with subsequent quality of life.*
Firstly, I will test whether social position in mid-life is related to quality of life following retirement. Relationships between individuals' social mobility during their career and quality of life will also be analysed. Secondly, I will examine whether a range of physical and psychosocial working conditions are associated with quality of life following labour market exit. In some cases it will be possible to examine whether the accumulation of these exposures over the life course is associated with worse quality of life.

2.1. Is previous social position related to quality of life?

2.2. Are trajectories in social position related to quality of life?

2.3. Are physical and psychosocial working conditions during working life related to subsequent quality of life?

Aim 3. *Examine whether retirement circumstances and routes are associated with subsequent quality of life.*

Initially, I will examine whether there are associations between retiring and quality of life, before analysing variations in quality of life by retirement route. It is possible that the sort of work a person was doing before has an influence on the type of retirement route they take, and this will be examined.

3.1. Is retirement beneficial for quality of life?

3.2. How does quality of life following retirement relate to the type of retirement transition participants experienced?

3.3. How do people's mid-life circumstances influence their chances of experiencing these different types of retirement?

Aim 4. *Model the pathways linking earlier events in the life course to subsequent quality of life.*

This section will test pathway models of the life course in order to establish whether the associations between earlier circumstances and later quality of life are mediated by more recent influences upon quality of life.

4.1. Is the association between earlier physical occupational exposures and quality of life mediated via physical and mental health?

4.2. Is the association between social position and quality of life mediated by more recent factors?

The next chapter will describe the GAZEL cohort, the measures available, and how the analyses will be performed.

Chapter 5

Methods

Summary

This chapter outlines the data, variables and analysis strategies which were used in this thesis. In the first part of the chapter, the GAZEL dataset of employees of the French national gas and electricity company will be introduced. The features and peculiarities of the cohort will be described, including a description of the specific working and retirement circumstances of the GAZEL employees compared to other French citizens. Details of participant recruitment and retention are also provided.

The next section describes the variables that were used in the analyses. These include the outcome measure of quality of life, CASP-19 and a range of measures of individuals' characteristics encompassing both their working careers and their circumstances in later life. The final section describes the analyses which were performed as well as the make-up of the samples for each analysis.

5.1 Data

This thesis uses data from the the GAZEL occupational cohort of persons employed by the French national gas and electricity company (EDF-GDF). The GAZEL cohort combines retrospective, prospective and administrative data. Since its inception in January 1989, participants have filled in annual postal self-completion questionnaires. These data are complemented by personnel, medical and work exposure records provided by the company.

5.1.1 Working life for GAZEL participants

EDF-GDF employees held a wide variety of jobs in electricity production (coal, oil, nuclear fuel and hydroelectric) as well as gas and electricity transmission, distribution and research (Imbernon et al., 1995; Martin et al., 2000). The GAZEL cohort contains many participants who had manual occupations and have been exposed to strenuous and hazardous working conditions. However, unlike many holding blue-collar jobs in the French population, the GAZEL participants benefited from secure posts and good standards of employment. The security of employment led to them having more comfortable pensions than other French workers, including participants who worked in low-skilled occupations (Baruch and Chastand, 2013).

GAZEL participants tended to be hired in their twenties and work for the company until they retired at ages 50–60 years. Intragenerational occupational social mobility in this cohort has been substantial. Around 80% of employees entered the workforce as low-level workers and were subsequently promoted during the course of their career. Most retired having reached mid-level positions although around 25% of the men reached high-level posts (Marshall et al., 1999).

5.1.2 Particularities of the GAZEL cohort

Since the work on the influence of the life course upon quality of life in this thesis uses an occupational cohort, those people who followed an 'outsider' life course are absent from the GAZEL study population. This means that the great difficulties that some French people may experience throughout their lives and upon retiring, such as having to live on minimum welfare payments because long periods of unemployment prevented them from making enough insurance payments to qualify for full pensions (Palier, 2010), are not observed here.

Although working conditions in the state company are likely to be better than those in the private sector, it is possible that members of the cohort may have accepted poorer working conditions in exchange for job security and rewards post-retirement. Similarly, employees may have accepted the lower rates of promotion in the public sector against the non-existent risks of demotion and unemployment (Goux and Maurin, 2012).

The GAZEL participants are likely to have a particularly positive level of quality of life during retirement, particularly as this high level of social protection may accompany the termination of some difficult and stressful working conditions such as shift or night work, or working in conditions or with materials known to damage health.

5.1.3 Retirement practices in the GAZEL cohort

As workers in the nationalized energy sector, the specific, *spécial*, pension regime in place for the GAZEL participants has always been more favourable than the general pension regime in France (Brocas, 2013). Although the EDF-GDF retirement rules are complex, they presented four substantial advantages over the private sector. Firstly, the superior level of pensions compared well to those in the general (state) regime. Secondly, since the GAZEL participants tended to be hired in their twenties and work for the company until retirement at around 55 years old (Melchior et al., 2005), they were able to make payments into the retirement scheme without any breaks due to unemployment. Thirdly, during the 1990s and the early 2000s several programmes enabled employees to retire three to five years earlier in return for slightly smaller pensions (Westerlund et al., 2010). Fourthly, the number of years employees needed to work before retiring on a full pension was low compared to the private sector. Men could retire in 2005 after working for an average of 28 years and 5 months at the company and women after 31 years, compared to around 37 years for private sector workers (Birchem et al., 2007).

The reason men tended to retire sooner than women was because men often held posts categorized as requiring physical work (in French: *actif*) rather than desk-based (*sédentaire*) posts (CFDT, 2013a; Plouvier et al., 2009) and the rules governing retirement at EDF-GDF depend on the number of years employees had worked in manual occupations. Employees who had worked for most or all of their careers in blue-collar occupations are able to retire at up to five years younger (at age 55 years) on a full pension than those who exclusively held white-collar occupations who retired at 60 years. Many employees had mixed careers, and therefore an intermediate date of retirement is calculated for them by the company.

Partial retirement was rare (Westerlund et al., 2009). Women's retirement ages also depended on the number of children they have. Women who had at least three children and who had completed 15 years of service could retire before 55 years of age. Retirement on health grounds was possible "in the event of long-standing illness or disability" and a supplement to the standard pension was provided. Generally, employees would have their last working day some time (perhaps several months) before their retirement date in order to use up substantial holiday which was typically accrued (Westerlund et al., 2009). To summarize, GAZEL participants retired at a relatively young age, with a high pension by French standards (Baruch and Chastand, 2013), and in a way that was planned, protected and clear-cut.

5.1.4 Recruitment of the participants

At study onset, in January 1989, 15 011 male employees aged 40–50 years and 5614 female employees aged 35–50 years old were recruited into the cohort, making 20 625 participants in all (Goldberg et al., 2007). The age range for women was larger than for men in order to have sufficient numbers of female cohort participants, since the employees of EDF-GDF were predominantly male. Although the GAZEL cohort represents a specific employment sector with favourable employment conditions, the study population was recruited from urban and rural areas throughout France, represents a wide range of occupations and has a socio-economic structure that compares well to the French population (Goldberg et al., 2007).

A great deal is known about those who originally declined to take part in the study, and about those who have withdrawn subsequently. The overall participation rate at inception of the cohort was 44.7% (Goldberg et al., 2006). Lower initial participation was associated with being male, married and a manager, but the most important factor was living in particular regions (Goldberg et al., 2001).[1]

Attrition rates are very low, with about 0.5% of the employees lost to follow-up over almost 20 years of the study to the end of 2008 (Zins et al., 2009). While data provided by the company suffers little from any bias caused by attrition, the effects on questionnaire data are likely to be more profound. About three-quarters of the cohort respond to the annual questionnaires (Zins et al., 2009). Therefore there has been a substantial rate of permanent or temporary voluntary withdrawal concerning the annual questionnaires (Zins et al., 2009). Using administrative data on medical absenteeism and deaths, as well as a cancer registry, each containing disease codes according to the International Classification of Diseases (ICD-9), it has been possible to follow up the health of fully participating cohort members, participants who stopped returning questionnaires and eligible non-participants. When the health status of participants and non-participants was followed up over a six-year period, non-participation was associated with higher rates of sick leave, incidence of several groups of diseases, and mortality. Among men, diseases related to alcohol, smoking or accidents were the main reason for health differences between participants and non-participants, leading the investigators to conclude that cultural and lifestyle factors were the most important determinants of participation (Goldberg et al., 2001). Most of the factors associated with initial recruitment to the GAZEL study were also associated with continued participation in the study (Goldberg et al., 2006).

Data provided from administrative sources are generally complete; a small amount of data that is missing is most likely to be unrelated to the characteristics of the individuals pertinent for this thesis.

5.2 Measures

As outlined in section 4.2.1 on page 94, this thesis takes a life course approach to the determinants of quality of life, examining working life in particular. In this section, the measures used in the thesis will be presented. Each of these variables is presented in its original form and in English translation in Appendix A, *Original questions from the GAZEL questionnaires with English translations*.[2]

Initially, the outcome variable: CASP-19 quality of life, will be presented. Then

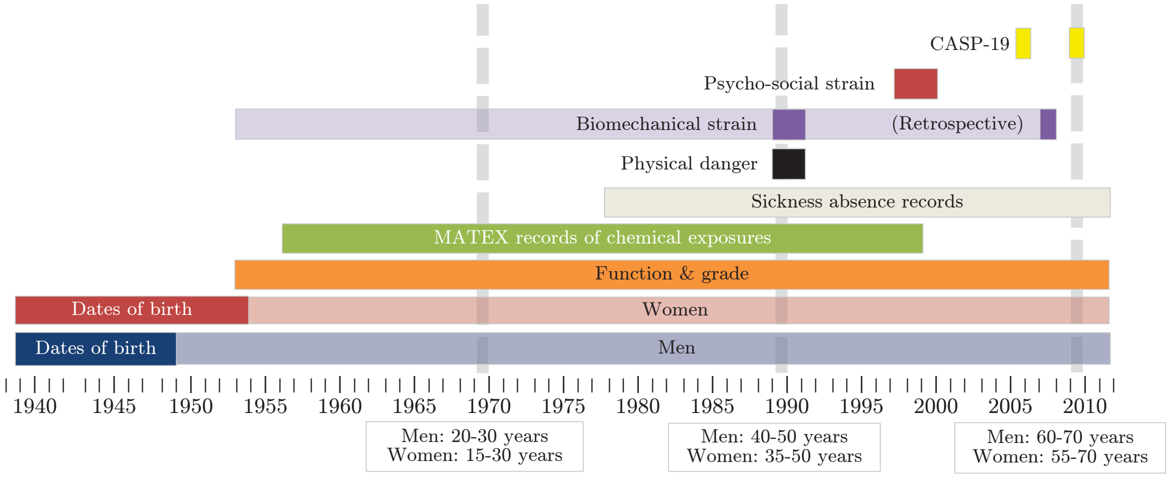
[1] The analysis divided France up into 23 regions. No clear geographic tendency was visible in the large variations in participation by region.

[2] The variables have been translated from French by the author of this thesis. Where standardized measures are available in English, they have been provided.

variables describing individuals' current or recent characteristics will be described: firstly, demographic variables, then variables describing the participants' family situation, education level, finances, neighbourhood, social relationships and social participation, life events and health. Turning to the life course, measures of physical and psychosocial occupational exposures will be introduced, as well as measures of social position in mid-life. In the last part, the variables available to record the timing and nature of retirement transitions will be presented.

Figure 5.1 displays the timing of measurements for a wide range of life course variables used in this study.

Figure 5.1: Timing of the life course measures in the GAZEL dataset



The participants' ranges of ages in 1969, 1989 and 2009 (years indicated by the dashed vertical lines) are indicated at the bottom of the figure.

5.2.1 CASP-19 quality of life scale

In this study, the CASP-19 measure of quality of life is used. The background to the development of the scale has been described fully in the literature review, in section 3.2.2 on page 52, but is presented briefly here. CASP-19 is specifically designed to measure quality of life in early old age, and, as such, is adapted to the demographic profile of the GAZEL cohort. This multi-dimensional measure of quality of life has been developed by drawing on the literature of ageing and the Third Age (Gilleard, 1996; Laslett, 1991), identifying human needs (Doyal and Gough, 1991) particularly relevant in early old age (control, autonomy, self-realization, and pleasure (Hyde et al., 2003; Wiggins et al., 2004). Widely used in international ageing surveys (Hyde et al., 2003; Netuveli et al., 2006), the CASP-19 measure is intended to be distinct of individual or contextual factors that influence quality of life, such as health or material circumstances.

Each of the 19 four-point Likert-scaled items in the CASP-19 measure draws from one of four domains: control (C), autonomy (A), self-realization (S), and pleasure (P). The full questionnaire is given in Appendix A: Table A.6. Following the established procedure for calculating CASP-19 quality of life, each item is scored on a four-point adverbial scale from 0–3 (*often, sometimes, rarely, never*); six items are reverse-coded (Netuveli et al., 2006; Wiggins et al., 2008). The total sum score ranges from 0 to 57, with higher scores indicating a higher overall quality of life.

To establish its face validity, the 19-item Likert-scaled CASP measure was validated with an expert panel and by focus groups of people in early old age from London, Cumbria and Fife (Blane et al., 2004). Early work to develop CASP-19 in the Boyd-Orr cohort found satisfactory internal reliability for each of the four domains (Cronbach's alphas ranging from 0.59–0.77) (Blane et al., 2004). Concurrent validity was assessed as satisfactory through the CASP-19 measure's strong correlation with previously validated measures of life satisfaction/well-being: the Life Satisfaction Index - Wellbeing (LSI-W), in a British population of a similar age (Wiggins et al., 2007), and the Satisfaction With Life Scale (SWLS) (Sim et al., 2011). A recent paper, using the English Longitudinal Study of Ageing, found that CASP-19 was responsive to changes in anchor variables related to health, social and economic circumstances, which means that the measure is suitable for this purpose (Howel, 2012).

Subsequent work examining the internal reliability of the four domains included in CASP-19 has had varying results, depending on the cohort used. Psychometric validation on the Boyd-Orr cohort, the British Household Panel Survey (BHPS) and ELSA suggested that CASP-19 could be used as a single summary index of quality of life (Blane et al., 2004; Wiggins et al., 2008). Confirmatory factor analysis of the scale's measurement properties in the same three British datasets led to the construction of a shortened 12-item scale which combined the domains "control" and "autonomy" (Wiggins et al., 2008). Other investigators have proposed an additional dimension (CASPP-19) (Wu et al., 2013); combined the control and autonomy domains in other ways (CASP-15) (Vanhoutte, 2012), or have challenged the empirical distinguishability of its dimensions (Oluboyede and Smith, 2013; Sexton et al., 2013). For these reasons, CASP-19 is used in this thesis in its form as a single summary index of quality of life.

In the GAZEL cohort, CASP-19 quality of life was assessed in the self-completion questionnaires in 2005 and in 2009. It was translated into French by the GAZEL cohort team (Marcel Goldberg 2013, pers. comm.).

5.2.2 Demographics

Each individual's *date of birth*, *date of death*, *date of retirement* and *gender* were obtained from company administrative records. Previous work has demonstrated a non-linear relationship between age and quality of life (Netuveli et al., 2006; Zaninotto et al., 2009), therefore age was centred and subsequently squared in order to create two variables: age and age-squared (age^2).

The company records also indicate whether individuals requested to leave the study or left the company.

5.2.3 Family situation

Three variables were used to describe participants' family situation: their marital status, household size and whether they had children.

Marital status. Individuals indicated their *marital status* in the 2005 self-completion questionnaire from the following six categories: single, married, cohabiting, separated, divorced, widowed. Both the cohabiting and separated categories were small, with, in 2005, only 3.7% of the sample cohabiting and 1.4% of the sample being separated. Therefore, these were combined with the married and divorced categories, respectively. A small number of participants had selected more than one category and were reclassified into the most appropriate category by the GAZEL cohort team. Marital status was treated as a categorical variable with four categories: 1) single, 2) married/cohabiting, 3) separated/divorced, and 4) widowed.

Changes to marital status. Marital status was additionally recorded in the 2009 self-completion questionnaire with the same six categories as in 2005. Change in marital status between 2005 and 2009 was recorded as:

- Widowed: transition from married or cohabiting in 2005 to widowed in 2009. The variable was coded as 1 if the transition occurred, otherwise 0.
- Separated or divorced: transition from married or cohabiting in 2005 to separated, divorced or single in 2009. The variable was coded as 1 if the transition occurred, otherwise 0.
- Married or cohabiting: transition from separated, divorced, single or widowed in 2005 to married or cohabiting in 2009. The variable was coded as 1 if the transition occurred, otherwise 0.

Household size. In the 2005 self-completion questionnaire, participants indicated their household size. A three-category variable of household size was created: living alone, two people and three or more people.

Children. In the 1989, 2002 and 2005 self-completion questionnaires participants indicated whether any children were living at home. This information was used to create a variable indicating whether children had ever been recorded at home, categorized as 1 if a child had ever been present and 0 otherwise.

5.2.4 Education level

Individuals indicated their level of education in the baseline 1989 self-completion questionnaire. They selected from eight categories (listed in Appendix A: Table A.3), which were recoded into four categories: any university-level education, school leaving certificate at age 18 years, lower level qualification, other. In the GAZEL cohort, individuals' levels of education are often very low despite their subsequent occupational success; consequently, education is not an appropriate measure of mid-life social position in this cohort and was not used as such.

5.2.5 Finances

Three questions about the state of participants' finances were asked most recently in the 2002 self-completion questionnaire.

5.2.5.1 Monthly household income bracket

In the 2002 questionnaire, participants classified their household income into one of ten bands, ranging from < 991 euro to ≥ 6098 euro (Appendix A: Table A.16). Equivalents in French francs were indicated in the questionnaire as the euro had been launched only days earlier on 1st January 2002. This variable was used as a categorical variable in the analyses.

5.2.5.2 Total assets band

In the 2002 questionnaire, participants were asked: *If you sold all of your assets (primary residence, secondary residence, furniture, vehicle, jewellery, etc. and after paying back any loans) what sum do you think that would represent?* They selected one of nine categories indicating the value of their assets. Accumulated assets are considered an appropriate measure of financial circumstances in this age group (Galobardes et al., 2006a; Wikman et al., 2011), because such measures capture the accumulation of economic advantage or disadvantage over the life course (von dem Knesebeck et al., 2007). Although this variable is ordinal, it has nine categories with a unimodal slightly negatively skewed distribution (skewness $= -0.93$, kurtosis $= 5.39$), and was therefore included in the structural equation model as a continuous variable, as is recommended (Johnson and Creech, 1983; Rhemtulla et al., 2012).

5.2.5.3 Confidence in finances over the next ten years

In 2002, participants indicated the degree of confidence they had in their finances over the next ten years in the self-completion questionnaire. The response categories were: Very confident, quite confident, not very confident, not confident at all. This variable was used as a categorical variable in all of the analyses.

5.2.6 Neighbourhood

In the 2003 questionnaire, a series of questions was posed about a range of potential neighbourhood problems. Individuals were asked about whether there were frequent annoyances in the neighbourhood, whether they were dissatisfied with access to local amenities, whether they felt insecure or thought that vandalism was a problem, whether any family or close friends lived nearby and how often they exchanged goods or services with neighbours. The questions and response modalities are listed in Appendix A: Table A.18.

Some of the cohort members had moved away from their neighbourhood between completing the questionnaire in 2003 and completing the 2005 questionnaire which contained the quality of life outcome variable. Consequently, participants' postcodes were examined, and where they had changed 2003–2005, which was the case for 1585 individuals, any data they provided about the neighbourhood was converted to missing. In France, the area of a postcode corresponds to an area a little larger than a *commune*, an area roughly equivalent to a British lower super-output area, therefore some individuals may have moved locally to an area with different characteristics without changing their postcodes.

5.2.7 Social relationships and social participation

5.2.7.1 Emotional support

Two variables were created which indicate the presence of *social and emotional support*, specifically whether individuals had a close, confiding relationship. The two questions concerned succeed each other in the 2004 questionnaire and were treated as two separate variables:

1. Is there somebody with whom you can discuss personal things or who can help you take an important decision? [Yes or no.]
2. Do you need more of this sort of support than you received? [Yes, a lot more support; yes, more support; yes, a little more support; no, it was enough.]

5.2.7.2 Caring for an adult

Information about caring responsibilities was obtained from the 2005 and 2009 self-completion questionnaires. Participants indicated whether they were caring for an adult "nearly every day", "nearly every week", "less frequently", or "never".

In the multivariate change analysis, a simplified version of this variable was used which indicated merely whether or not a participant was caring for an adult nearly every day. A variable of change in daily care for an adult was created in which individuals were classified as having no change in whether they provided care nearly every day, gained responsibilities of caring for an adult nearly every day or ceased caring for an adult nearly every day.

5.2.7.3 Social participation

Information about social participation was obtained from the 2005 and 2009 questionnaires. Individuals were asked how frequently they participated in a range of activities, choosing from "nearly every day" (coded with 1 unit), "nearly every week" (2 units), "less frequently" (3 units) or "never" (4 units). The level of participation in the following activities was summed: sports and other clubs, union and political activities, charitable activities, communal religious activities and taking part in a course. A three-level categorical variable was subsequently created. One category, containing around one quarter of responding participants, contained participants with the maximum score of 20 units, who had reported no participation in any of these social activities at all. The rest of the participants were split into two relatively evenly sized categories. Participants with scores of 17–19 units were placed into a category indicating low–medium levels of participation and participants scoring $\leq$16 units were placed into a category indicating relatively high participation.

A variable of change in social participation 2005–2009 was used in the multivariate change analysis. Individuals were classified as continuing the same level of social participation if their category of social participation did not change between 2005 and 2009. Individuals changing category were correspondingly categorized as increasing or decreasing in social participation.

5.2.8 Health

A range of measures of health and health behaviours are available in the GAZEL cohort. Only one measure, sickness absence, was obtained from administrative sources; the rest are self reports. No reliable objective measures of health status were available at the time of commencing the thesis, as is described more fully in section 5.2.8.9 on page 109. Available self-reported measures included: the SF-36 measures of physical and mental functioning, the CES-D depression scale, the Nottingham Health Profile, hearing problems, visual impairment, hospitalization, self-rated health, smoking status and alcohol use. Each health measure is described more fully in the sections below.

5.2.8.1 Short Form 36 Mental and Physical Component Summaries (SF-36 MCS & PCS)

Mental and physical component summary scores from the French standard version of the Short Form 36 Health Survey (SF-36) were used to measure health functioning in 2003 and 2007 (Leplège et al., 2001; Ware Jr and Sherbourne, 1992). The SF-36 questionnaire is an internationally validated measure of health functioning composed of 36 questions about physical and mental functioning which are grouped into eight subscales depicting different health domains. From version 2 of the questionnaire, two summary scores were derived following the standard protocol described in Leplège et al. (2001): a mental component summary score (SF-36 MCS) and a physical component summary score (SF-36 PCS), both ranging from 0–100 with higher scores indicating better health. The variables have acceptable properties for being used as mediating observed variables in structural equation models: SF-36 MCS in 2003 has a skewness of -1.17 and a kurtosis of 4.05; SF-36 PCS in 2003 has a skewness of -1.26 and a kurtosis of 5.09.

5.2.8.2 CES-D depression scale

Depression was defined using a validated French-language version of the CES-D scale (Center for Epidemiologic Studies Depression scale) from the 2005 questionnaire (Führer and Rouillon, 1989). The scale is based on symptoms of depression as seen in clinical cases. However, Radloff (1977) states that the scale is not intended as a clinical diagnostic tool, rather group averages should be interpreted in terms of levels of symptoms which accompany depression, not in terms of rates of illness.

The questions were reverse-coded when necessary and coded from 0–3 depending on the frequency of occurrence of the symptom, following Radloff (1977). The scores were summed and divided into three categories, designating a lack of symptoms of depression, mild symptoms of depression, and moderate to severe symptoms of depression at the following cut-off points: 0–15, 16–26 and ≥ 27, respectively (Zich et al., 1990).

This is in contrast to the specific cut-offs varying by gender which are usually used in France (Morin et al., 2011), in which the cut-off value for depressed male participants is 17 and for women it is 23 (Führer and Rouillon, 1989). I decided to maintain the same cut-offs for women and men, as having higher cut-off values for women might result in underestimating the prevalence of depressive symptomatology in women (Messing et al., 2003; Van de Velde et al., 2009).

Change in depression. A three-category variable was created, in which depression symptoms improved, stayed the same or worsened.

Individuals were classified as having *improving depression symptoms* 2005–2009 if they had been classified as having mild or moderate/severe depression symptoms in 2005 and as having insufficient depression symptoms to classify as a case in 2009. In addition, participants who had been classified as having moderate/severe depression symptoms in 2005 who progressed to mild depression symptoms were classified as having improved.

Individuals were classified as having *worsening depression symptoms* 2005–2009 if they had not originally been defined as a case but subsequently experienced mild or moderate/severe levels of depression symptoms in 2009. Similarly, those who had been classified as having mild depression symptoms in 2005 and progressed to moderate/severe levels of depression symptoms in 2009 were classified as having worsened.

Individuals who did not change category were classified as having levels of depression symptoms that stayed the same.

5.2.8.3 Physical limitations

The Nottingham Health Profile is a measure of general community health. It is available in the GAZEL cohort in the 2006 self-completion questionnaire in a validated French translation (Bucquet et al., 1990). In this thesis, rather than using the Nottingham Health Profile in its full form, a sum scale of physical limitations was created from those items which indicated limitations to physical functioning. These are listed in Appendix A: Table A.8. A trichotomous variable was created: no limitations to physical functioning, one limitation, or two or more limitations. As the data were collected in 2006, the year following the 2005 measurement of quality of life, this variable was used only to compare size effects, as has been done in previous studies (Blane et al., 2004; Demakakos et al., 2010; Netuveli et al., 2006). The Nottingham Health Profile was not used to measure general health because it can suffer from ceiling effects (Falcoz et al., 2002), particularly in healthy cohorts such as the GAZEL cohort, so the SF-36 was used instead.

5.2.8.4 Hearing problems and visual impairment

Participants indicated whether they had hearing problems or a visual impairment in each of the annual self-completion questionnaires. The first appearance of difficulties in hearing or vision in any year was interpreted as the development of hearing problems or a visual impairment. Participants who responded to the rest of a questionnaire but did not indicate a new hearing problem or visual impairment were classified as not having experienced a hearing problem or a visual impairment in that year.

5.2.8.5 Hospitalization

A question about whether participants had been hospitalized in the previous year was included in each annual questionnaire.[3] Two variables were created. The first variable, hospitalization during 2004, was obtained from the 2005 questionnaire from a question which asked whether the participant had been hospitalized during the previous year. The second variable, hospitalization during 2005–2008, describes whether participants reported a hospitalization when filling out any of the questionnaires between January 2006 and January 2009.

Participants who responded to the rest of a questionnaire but did not indicate that any life events had occurred were classified as not having experienced hospitalization in that year. Analyses of responses to other life event questions which could be verified (changes to marital status, retirement) from company records or other parts of the questionnaire suggested that participants were less conscientious in filling out this final section of the questionnaire, which might have weakened any associations between hospitalization and quality of life.

5.2.8.6 Self-rated health

Participants indicated their self-assessed health in the baseline 1989 questionnaire on an A–H scale with polar labelling (very good–very bad). Although this question was asked every year, it is not clear exactly which aspects of health this general, single item measures (Layes et al., 2012; Quesnel–Vallée, 2007), and therefore SF-36 was used instead to indicate general health functioning. Self-rated health in 1989 was used as a continuous auxiliary variable to improve the quality of the full information maximum likelihood estimation.

5.2.8.7 Smoking status

Sample members indicated their smoking status in the 1989 self-completion questionnaire from the following categories: smoker (at least one cigarette per day), non-smoker, ex-smoker (for at least one year). This variable was not included in any analytic models

[3]It is not necessarily straightforward to define hospitalization. However, in the French case, hospitalization is accompanied by a specific charge payable by the patient, the *forfait hospitalier*, so it is most likely that the GAZEL participants will equate payment of this charge with hospitalization.

but used as a set of dummy auxiliary variables to improve full information maximum likelihood estimation.

5.2.8.8 Alcohol use

A detailed set of questions in the 1989 questionnaire concerned alcohol consumption. Study members indicated how often they consumed each of wine, beer or cider, pastis, whiskey, or other spirits each week, choosing between the categories “never”, “occasionally”, “every day”. If they selected every day, they were asked to indicate the number of glasses of each beverage consumed per day. From this information, a five-category variable of overall alcohol consumption was created: abstainer, occasional, moderate, average and heavy, following Goldberg et al. (2006), as explained in Table 5.1.

Table 5.1: Alcohol consumption categories

Level of consumption	Males	Females
Abstainers	Never for all alcoholic beverages	Never for all alcoholic beverages
Occasional	No more often than on occasion for any beverage	No more often than on occasion for any beverage
Moderate	No spirits daily. 1–2 glasses of wine, beer or cider daily	No spirits daily. 1 glass of wine, beer or cider daily
Average	No spirits daily. 3–4 glasses of wine, beer or cider daily	No spirits daily. 2–3 glasses of wine, beer or cider daily
Heavy	Drink spirits daily. 5 or more glasses of wine, beer or cider daily	Drink spirits daily. 4 or more glasses of wine, beer or cider daily

This variable was not included in any analytic models but used as a series of dummy auxiliary variables to improve full information maximum likelihood estimation.

5.2.8.9 Measures of health available in the GAZEL cohort which were not used

The only data available from company physicians’ files are records of height and weight, which are available for a short series in the 1990s for some participants. However, these measurements were not obtained from a standardized protocol. Concerns about data reliability led to these measures not being used in the thesis.

Neither prescription nor medical records were available for use, although participants reported doctor-diagnosed diseases in the annual questionnaires. These reports will likely represent the tip of the clinical iceberg (Last, 1963). The possibility that individuals in a higher social position would be more likely to report illness led to measures of general health functioning being used in this thesis instead of reports of doctor-diagnosed illnesses (Thielen et al., 2009).

Around 3000 participants had undergone medical tests during visits to health screening centres (Léger, 2011; Zins et al., 2009) which might have provided objective health data. However, the small sample and differing collection methods between the 17 centres led to the data not being suitable for inclusion in this thesis. A second wave of visits to health centres using standardized procedures is being carried out, but the data are being collected too late for inclusion in this thesis.

5.2.9 Physical occupational exposures

Physical working conditions were distinguished into three types: (1) ergonomic strain, (2) physical danger and (3) exposures to chemicals.

5.2.9.1 Ergonomic strain

Ergonomic strain was measured with two indicators: i) a retrospective ergonomic strain score from the 2007 self-completion questionnaire and ii) a prospective score of ergonomic strain measured in the 1989 and 1990 self-completion questionnaires.

i) Retrospective ergonomic strain score. In the 2007 questionnaire participants were asked to indicate the start and end years of periods in which they were exposed to each of the following constraints at work:

- regularly carrying or moving heavy loads
- regularly bending forward or twisting the back or trunk
- driving a vehicle for two or more hours a day (including commuting to and from work)
- working on their knees
- going up or down more than ten flights of stairs a day
- climbing onto ladders or step-ladders
- working with the hands above the head
- carrying loads on the shoulder
- using vibrating tools.

A summed score of career-long exposure was constructed by adding the number of different constraints participants were subjected to in each year, and adding together these annual totals to create a summed score of career-long ergonomic exposures. Individuals were grouped into three categories ("no exposure": unexposed; "moderate exposure": exposure level at or below the median for those exposed; "high exposure": exposure level above the median for those exposed).

ii) Ergonomic strain score. In the 1989 and 1990 questionnaires participants were asked whether their current work included any of five types of activities:

- spending a long time on their feet
- spending a long time in another tiring posture
- long, frequent or rapid journeys in a vehicle

- carrying or moving heavy loads
- being subjected to shaking or vibrations.

Affirmative responses to each item were summed into a 0–5 score of total ergonomic strain for each year (Melchior et al., 2005). To minimize the influence of temporary activities and thereby reduce measurement error, the scores for 1989 and 1990 were averaged to produce a 1989/1990 score of ergonomic strain.

5.2.9.2 Physical danger

Physical danger was measured with two indicators: i) perception of physical hazards in 1989 and 1990 and ii) accident records.

i) Perception of physical hazards. In the 1989 and 1990 questionnaires, participants indicated whether they thought they were exposed to any of the following seven physical risks in the course of their work:

- breathing in gas
- serious falls
- minor falls
- being injured by a machine
- heat burns
- chemical burns
- having a road accident.

Affirmative responses to each item were summed to produce total scores of physical hazards in 1989 and 1990. In order to reduce the influence of short-term risks, as well as fluctuations in risk assessments, the scores for 1989 and 1990 were averaged to produce a 0–7 score indicating exposure to physical hazards for the period 1989/1990.

ii) Workplace accidents. Information regarding workplace accidents was provided from the company's medical examination files for sickness absence (*médecine de contrôle*). Whether individuals took at least one day off due to a workplace accident was recorded. Illnesses and injuries are verified by a company doctor who records the causes of the sickness absence and the number of days sickness leave in the company databases, now computerized. I classified sickness absence which was related to work tasks as a workplace accident, whether this was an accident at work (*accident de travail*) or a subsequent period off work as a result of the original accident (*rechute*). These subsequent periods off work were treated the same as accidents at work because, in many cases, the original accident had not been recorded.[4]

[4] Although the sickness absence data originates from the EDF-GDF administrative records, it is still the result of a social process. Sickness absence results from a negotiation between employees, their supervisors and managers, and EDF-GDF medical personnel; accidents are typically under-reported. Generally, in any organization, there is pressure on employees not to make the hierarchy appear at fault (Daubas-Letourneux and Thébaud-Mony, 2001), and the reporting of accidents goes through a filtering process which leads to many injuries remaining unrecorded (Azaroff et al., 2002; Webb et al., 1989).

Medically certified sickness absence data from administrative records were used to calculate total numbers of episodes of absences for each participant due to accidents at work between 1978 and 2009.

The distribution of accidents was non-normal, as most people had no accidents recorded and very few experienced more than two. For this reason the variable was trichotomized: a first group containing participants who did not have any accident episodes recorded (no exposure); the remainder were divided into two groups according to whether they had one accident (moderate exposure), or more than one accident (high exposure).

5.2.9.3 Exposure to chemicals

To measure exposure to chemicals, information from the company job-exposure matrix called MATEX (*matrice emplois-expositions*) was used. MATEX indicates each employee's estimated annual exposures to harmful chemicals for each year of their employment at EDF-GDF (Imbernon et al., 1996, 1991). Around 30 substances were selected for this matrix which had been classified by the International Agency for Research on Cancer into groups 1, 2A or 2B, meaning that they were known or suspected to cause cancer (IARC, 2013). Examples of chemical substances include asbestos, chromium and cadmium compounds, coal tars and crystalline silica.

In a first step, company occupational physicians regrouped jobs into 403 different occupations according to the tasks performed and likely exposure levels to each chemical. This work was carried out in about 1989, therefore estimations of earlier exposures used company archives as well as the expertise of company specialists (Imbernon et al., 1995). These estimations go back as early as the 1950s. Between 1989 and 1998, the exposures were re-evaluated annually, in order to take account of changing materials, technologies and practices.

In a second step, details about individuals' occupational histories from company records were used to attribute exposures to each employee (Martin et al., 2000). By 1998 the levels of chemical exposure had fallen to low levels among participants in the GAZEL cohort because participants had retired or had been promoted out of high-exposure posts and, consequently, record keeping with MATEX was discontinued (Sabbath et al., 2012). These are detailed data, containing information on dose and unit of exposure per year per participant for more than 30 chemical substances.

For this thesis, a measure of overall accumulated exposures to chemical carcinogens over the whole career was developed by adding the number of different chemicals to which individuals were exposed in each year and adding these annual totals together. These raw scores were used in the path analyses as a continuous variable. For the multiple regression analyses and reporting of descriptive results, individuals were regrouped into three categories ("no exposure": unexposed; "moderate exposure": exposure level at or below the median for those exposed; "high exposure": exposure level above the median for those exposed).

5.2.10 Psychosocial occupational exposures

Two measures of psychosocial occupational exposures have been collected from the self-completion questionnaires in the GAZEL cohort. The job content questionnaire was included in 1997 and 1999 while the effort-reward imbalance scale was included in 1998.

5.2.10.1 Job strain (Demand-control model)

The Karasek job strain or demand-control model is measured using the job content questionnaire (Karasek, 1979; Karasek et al., 1985). The original version of the scale incorporates two dimensions: psychological demands and decision latitude. Job demands, such as time pressure and difficult work, are psychological stressors at work while job decision latitude (or control) is composed of the worker's abilities to control their own activities and skill usage (de Jonge et al., 2000). An adverse situation of job strain will occur when the job demands are high and the worker's control is low.

The scale was translated into French by the GAZEL cohort team (Niedhammer, 2002). Responses were taken from the 1997 and 1999 questionnaires. Where respondents replied in both years, an average was taken for the demand and control scores. Where respondents replied in only one of the years, this year was used. In order to maintain comparability with the effort-reward imbalance scale, participants classified into both the tertile with the highest demands and the tertile with lowest control were categorized as experiencing job strain.

An incomplete version of the scale was used in the 1995 self-completion questionnaire, but has not been used in this thesis in favour of the more recent complete versions. While all individuals were asked to fill in the job strain questionnaires in 1997 and 1999, responses for individuals who were already retired were converted to missing, as their respones might have altered as a result of experiences during retirement and are therefore vulnerable to recall bias.

5.2.10.2 Effort-reward imbalance scale

The theoretical model for the Siegrist effort-reward imbalance scale is based on the notion of reciprocity between efforts spent on work tasks and rewards received (Siegrist et al., 2004). In the case of failed reciprocity, where efforts exerted are higher than rewards received, negative emotions may be elicited (Niedhammer et al., 2004).

The effort-reward imbalance scale was translated into French by the GAZEL cohort team for the 1998 self-completion questionnaire (Niedhammer, 2002) and its validity in the GAZEL cohort has been demonstrated (Siegrist et al., 2004). Participants falling into both the top tertile for effort and the lowest tertile for reward were classified as experiencing effort-reward imbalance. Although participants who were retired by 1998 when the questions were posed were invited to answer the questions, I have converted these responses to missing in order to reduce the possibility of recall bias.

5.2.11 Social position in mid-life

5.2.11.1 PCS

Each post occupied by participants throughout their careers is recorded in the company personnel files using the four-digit French national classifications of occupations for large companies, the PCS-ESE 1982 and PCS-ESE 2003 (*nomenclature des professions et catégories socioprofessionnelles des emplois salariés d'entreprise*). Although the PCS is often used as a social class scheme in France, it is not a theory-based classification and lacks any international equivalent. For these reasons, the French classifications were not used in their original forms in this thesis in favour of the ESeC measure of social class that is internationally comparable.[5]

Complete records of occupational positions held throughout the career are available for the great majority of EDF-GDF employees. It is possible to find a person's grade at any age and for any given year.

5.2.11.2 European Socio-economic classification

Social class was measured using the European Socio-economic Classification (ESeC) (Rose and Harrison, 2007). It categorizes individuals according to particular aspects of the work setting and the labour market situation. More specifically, occupations are grouped according to the degree of specificity of human assets they require and of the difficulty managers face in monitoring the quality and quantity of work produced (Rose et al., 2009).

To convert occupations recorded in the French nomenclature into ESeC, I used the four-digit French national social class classifications available in GAZEL and the conversion table with PCS 2003 developed by Louis-André Vallet and Christel Colin at the French National Institute of Statistics and Economic Studies (Brousse et al., 2007) as well as the conversion table provided by Insee between the older and new versions of the French national classification. See Appendix B for more details of the cross-walk between PCS and ESeC and its preparation for this thesis.

Because all the GAZEL participants were employed, only seven of the existing 10 ESeC classes were relevant to this study. These are: ESeC class 1 (Large employers, higher grade professionals, administrative and managerial occupations); ESeC class 2 (Lower grade professional, administrative and managerial occupations and higher grade technicians and supervisory occupations); ESeC class 3 (Intermediate occupations); ESeC class 6 (Lower supervisory and lower technician occupations); ESeC class 7 (Lower sales, services and clerical occupations); ESeC class 8 (Lower technical occupations); and ESeC class 9 (Routine occupations). For the structural equation modelling and regression analyses, a series of dummy variables was created in which ESeC class 1 was the reference category.

5.2.11.3 Occupational grade

Individuals' occupational grades throughout their careers were recorded in the company personnel records at two levels of detail. The first grading scheme (in French, the *collège*

[5] A four-category version of the PCS is available and was used in Figure 6.7.

or *groupe fonctionnel*) divides employees into three *functional groups*, which are arranged in a hierarchy. The three groups are: *cadres* (high-level employees), *maîtrise* (mid-level employees) and *exécutants* (lower level employees) (see Figure 5.2). The functional groups correspond to limits on the maximum possible salary employees can receive (CFDT, 2013a). They also correspond to status distinctions in French society, particularly the *cadre–non-cadre* distinction (Boltanski, 1982) and, as such, concern wider aspects of individuals' circumstances than their position at work (Marmot and Shipley, 1996).

Figure 5.2: The two occupational grade classifications available in the GAZEL cohort and typical occupations

Detailed occupational grade	1 2 3 4 5 6	7 8 9 10 11	12 13 14 15 16 17 18 19 51 52 53 60
Functional group	Low-level employees	Mid-level employees	High-level employees
Typical occupations	Clerical workers, manual workers, typists, cable fitters, electricians, accounting clerks, receptionists.	Technicians, supervisors, intermediate commercial professions.	Engineers, managers.

A second grading scheme sub-divides the three groups indicating the employee's position with greater precision, to produce a hierarchy of 23 grades, the grades running from 1–19, 51, 52, 53 and 60. For many analyses, including structural equation modelling, this variable was recoded to run continuously from 1–23. A salary band corresponds to each grade, with salaries progressively increasing as the grade rises. The salary bands are wide, consequently, individuals sharing a grade may not only be performing quite different functions but also receiving varying levels of salary (CFDT, 2013b). A cross-sectional analysis (not shown) found that participants who held higher grade posts tended to have higher household income. Higher grades are related to a higher position within the company, greater responsibility and autonomy, higher salary, and higher status (CFDT, 2013a).

Within each grade, participants had a wide range of job titles; similarly, each post is distributed across a range of grades. In the case of first-level supervisors, for example, individuals have held this post in 17 grades. In a similar manner, the middling grade 10 level contains a range of occupations including: human resources and public relations assistants, administrative supervisors, programmers, nurses, purchasers and purchasing assistants, and technicians providing IT support and services. Figure 5.2 displays the two occupational grade classifications side-by-side, as well as examples of typical occupations found at those grades.

5.2.11.4 Relationships between the different measures of mid-life social position available in the GAZEL cohort

Previous research has shown that different measures of social position are associated differently with health (Bartley et al., 1999; Torssander and Erikson, 2010). In the GAZEL cohort, ESeC social class and occupational grade do not correspond exactly, as shown in Figure 5.3. It is possible to see that the medians for several different social classes are found at about the same occupational grades: ESeC classes 3, 7, 8 and 9 are found at around the fourth and fifth occupational grades, while ESeC classes 2 and 6 are found at around the eighth grade. Only ESeC class 1, higher salariat, is found alone at the highest grades. Hence, occupational grade and social class are empirically describing different aspects of social position. In particular, white and blue-collar occupations are found at the same grades.

Using two separate measures of social position enables those aspects of social position such as prestige, wages and relative position in a hierarchy which are closely related to the occupational grade to be distinguished from those related to aspects of employment relations and regulation which are expressed as social class (Bartley, 2004, p. 24).

5.2.12 Retirement

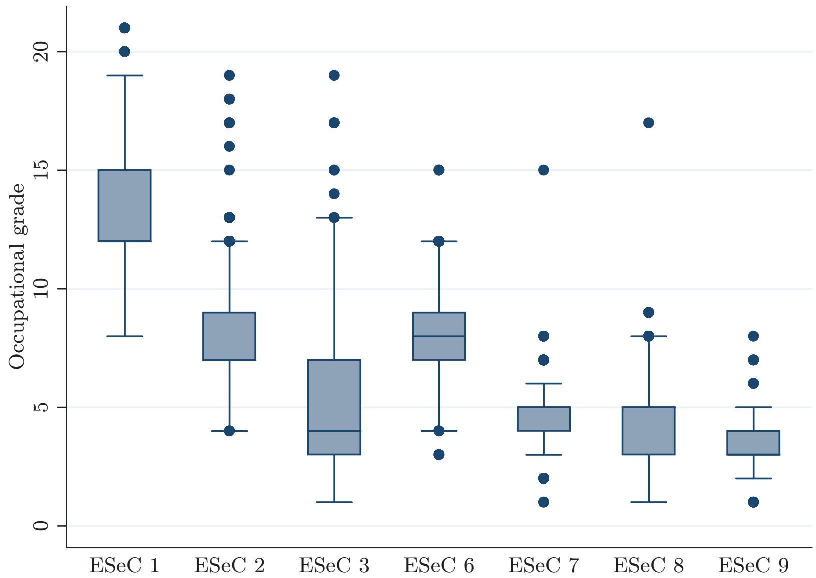
5.2.12.1 Retirement rules in the GAZEL cohort: Implications for the data

Information about retirement was taken from EDF-GDF's SCAST company files which provide the date of retirement for each GAZEL participant, and from which the age of the individual at retirement can be calculated. Although employees may have chosen to continue working elsewhere, this date represents the date of retirement from regular duties at EDF-GDF.

The date at which employees are due to retire is the result of a complex algorithm, calculated at the EDF-GDF personnel department, which takes many factors into account. There is a five-year window of standard retirement ages because the timing of retirement is related to the nature of earlier work tasks; individuals who worked in manual posts were entitled to retire up to five years earlier. In addition, there are exceptions to this main rule related to factors such as child-bearing, disability, or early retirement.

Unfortunately, it is not possible to know the date that retirement was planned by EDF-GDF's personnel department. This fact, as well as the complicated retirement rules, make it impossible to know whether participants retired prematurely or late in relation to the date of retirement planned. Often studies state a cut-off age before which individuals are considered to have retired prematurely; this is not a suitable approach with the GAZEL cohort data. As an example, if an individual is recorded as having retired at the age of 57 years, it is impossible to know from the data available in the SCAST company files whether this age was as planned, whether the individual was meant to retire at age 59 years and in fact retired two years early, or they were meant to have retired at age 56 years and finally retired later. Those retiring at younger ages, before age 55 years, are most likely to be former manual workers retiring slightly prematurely but might also

Figure 5.3: Box and whisker plot of occupational grade and the European Socio-economic Classification in the GAZEL cohort



The European Socio-economic classification classes are as follows: ESeC 1: Large employers, higher grade professionals, administrative and managerial occupations; ESeC 2: Lower grade professional, administrative and managerial occupations and higher grade technicians and supervisory occupations; ESeC 3: Intermediate occupations; ESeC 6: Lower supervisory and lower technician occupations; ESeC 7: Lower sales, services and clerical occupations; ESeC 8: Lower technical occupations; ESeC 9: Routine occupations.

The whiskers display the upper and lower values within 1.5 times the interquartile range beyond the 25th and 75th percentile. The dots represent outliers beyond these limits.

This figure was inspired by a similar chart contrasting social class and social status presented by Tak Wing Chan at the University of Oxford.

be workers previously holding non-manual posts who are retiring extremely prematurely. In the same manner, workers retiring at older ages, after age 60 years, are most likely to have had white-collar careers. Dividing up employees into those who retired before or after certain ages effectively organizes employees by their former working conditions, which in turn are associated systematically with differences in quality of life, confounding the relationship between age at retirement and quality of life. For this reason, analyses examining individuals' age at retirement need to be performed with full knowledge of these GAZEL cohort specificities.

5.2.12.2 Variables concerning retirement available from the questionnaires

Because the EDF-GDF personnel records provide only retirement dates, in order to probe more deeply into the nature of the retirement transition, it is necessary to use questionnaire data.

Retirement transition marked by ill health or disability. Participants were defined as having *retired in poor health*, or for health reasons, if they reported that their retirement had been preceded by a long period of sickness or disability leave in the 2000–2009 questionnaires, or if they had taken pre-retirement due to ill health or incapacity in the 1996–2001 questionnaires. Where responses in the year following retirement were missing, later questionnaires were examined for responses to these questions.

Continuation of professional activities following retirement from EDF-GDF. In three of the self-completion questionnaires (2000–2002) participants were asked whether they had carried out *professional activities since retiring* from the company. These questions can only be used for those who were retired by then: about half of the men and one-third of the women were. Unfortunately, details of why individuals maintained professional activities, what activities these were and how intensively individuals were working are not available.

Subjective evaluations of the retirement experience. A selection of variables from the 2001 questionnaire asked about more subjective aspects of the retirement experience such as individual perception of the quality of their retirement. Subjects included whether individuals had lots of time, or too much time now that they had retired, whether they were investing more in hobbies, and about whether there were positive aspects of retirement.

I did not use these questions, judging that high correlations between evaluations of retirement quality and quality of life would likely be due to individual differences, such as personality or response style, that it would not be possible to control for. An additional problem is that the questions were asked in 2001, a time when many participants had not retired yet, which means that many participants had missing data. Those participants who had already retired by 2001 were a particularly selected group in terms of certain characteristics: participants who had occupied more strenuous posts and were allowed to retire earlier, those who had negotiated early retirement, and older individuals. These individuals are consequently unlikely to be representative of the rest of the cohort.

A lack of questions about the retirement process makes it impossible to understand why participants retired, how much they could influence the timing of their retirement, whether the decision to retire was planned and how far they knew about it in advance, so it is not possible to address many interesting questions raised by the literature. However, to summarize, exactly when individuals retired is known; as is exactly how old participants were when they retired and, in most cases, whether participants experienced a retirement transition that was marked by ill health. If participants retired before 2002, it is possible to know whether they continued any professional activities.

5.3 Analyses

This section describes the analyses that were carried out as well as the samples that were used. However, firstly, the nature of missing data in the cohort and approaches that were used to tackle the problem of missing data are discussed. Next, each of the analyses that were carried out for the thesis are described. Initially, the cross-sectional multiple regression analysis of recent influences upon quality of life is presented, followed by the multivariate change analysis. The next section presents methods for descriptive analyses of social position over the career, followed by analyses of the influence of mid-life social position and occupational conditions upon quality of life following retirement. Methods for analyzing the relationships between the nature and timing of retirement and quality of life are described. In the final part, the manner in which path analyses were performed is introduced, before describing the two main models of the effects of working conditions and social position upon quality of life via mediating variables.

5.3.1 Missing data

5.3.1.1 Missing data patterns and mechanisms in the GAZEL cohort

In using data from the GAZEL study, just as for other prospective longitudinal surveys, it is necessary to consider data that are missing. Missing data raises two difficulties: 1) lack of data can lead to inefficient parameter estimations where data from incomplete cases are not used (White et al., 2011), and, 2) more seriously, if the remaining data are biased (Altman and Bland, 2007), analysis of complete cases can lead to biased parameter estimates. Therefore it is necessary to consider the missing data mechanism and take a principled approach to handling missing data (Carpenter and Kenward, 2007).

Data missing from the company records. The patterns of missing data in the GAZEL dataset are extremely complex, as a result of inclusion of variables from both administrative and questionnaire sources.

In terms of the mechanism of loss of the administrative data, it seems most probable that the data are *missing completely at random* (MCAR), because the nature of data loss, such as the simple loss of administrative files, is probably independent of the characteristics of the participants which are relevant for this study, such as their quality of life (Altman and Bland, 2007). An example of this are GAZEL participants with missing administrative records. Where data are missing completely at random, the missing data points are a simple random sample of the rest of the data (Enders, 2010), and the probability of data being missing does not depend on either observed or unobserved data (White et al., 2011). Expressed in another way, the probability of missing data for a variable Y is unrelated to the values of other variables as well as to the values of Y itself (Enders, 2010, p. 7). Although such data loss reduces the sample size, and the analysis will lose power, the results will remain unbiased, because the loss of data is truly random.

In section C.1 of Appendix C, I examine the dataset empirically in order to determine whether the missing completely at random missing data mechanism might apply. If the means for the outcome variable are the same, within the limits of sampling error, for those cases that have missing data and those cases that are complete, then it is likely that the data are missing completely at random (Enders, 2010, p. 8).

Missing data in the self-completion questionnaires. The picture is quite different for the questionnaire data. The pattern of data loss can be monotone in which some participants drop out and do not return, but more often is an arbitrary pattern where individuals may drop out for one or more wave(s) and reappear in subsequent waves (Enders, 2010). It seems less likely that this sort of data is missing completely at random, for previous studies examining the longitudinal characteristics of the sample have concluded that missingness can be predicted from baseline variables (Goldberg et al., 2006).

It may be that the data are *missing at random* (MAR). In this case, the probability of data being missing does not depend on unobserved factors, once relationships with observed data have been taken into account (White et al., 2011). Stated more mathematically, under the missing at random assumption, the probability of values of a variable Y being missing is still unrelated to the values of Y itself after taking associations with other measured variables into account.

Performing listwise deletion when data are missing at random will, aside from the loss of power caused by excluding individuals with incomplete data (Sterne et al., 2009), cause biased inference because the subset of data remaining is not representative of the full set of data (Carpenter and Kenward, 2007).

This situation can be described as *ignorable missingness*, which means that unbiased parameter estimates can be produced without specifying a model to explain missingness (Howell, 2007). However, for missingness to be ignorable, the assumption has to be made that the data are missing at random, conditional on a set of measured variables which predict when the values will be missing (Altman and Bland, 2007; Goldstein, 2009). It is not possible to tell from the observed data whether this assumption holds, although it is frequently argued that serious violations of this assumption are rare and reasonably accurate results can be obtained once the missing data have been accounted for by observed covariates included in the analytic model as well as additional, or auxiliary, variables (Carpenter and Kenward, 2007; Enders, 2010).

It is possible that the missingness is not ignorable, because the data are *missing not at random* (MNAR). In this case, even after conditioning on covariates, the reason for an observation being missing still depends on the unseen value of that observation (White et al., 2011). Analysing such data requires a joint model for the missingness mechanism as well as for the observed data, which is a major undertaking requiring other *a priori* assumptions which might be less plausible than the missing at random assumption (Carpenter and Kenward, 2007; Enders, 2010); the complex task of specifying missingness mechanisms models was beyond the scope of this thesis.

5.3.1.2 Strategies for tackling missing data in the GAZEL cohort

This thesis deals with missing data in two ways. The first is through *listwise deletion*, or the *analysis of complete cases*. This technique is suitable for data that are missing completely at random and perhaps provides good estimates even when the missing data are nonignorable (Allison, 2002). Analyses may have reduced power, but for many analyses this will not be a substantial difficulty since the GAZEL cohort is large. However, the missing completely at random assumption is not very plausible for missing questionnaire data and, consequently, the technique of *full information maximum likelihood estimation*, which is based on the less restrictive missing at random assumption, will be used.

5.3.1.3 Full information maximum likelihood estimation

Full information maximum likelihood (FIML) estimation is a technique that computes model parameter estimates based on incomplete as well as complete cases. In this thesis, all path analyses were carried out using FIML estimation, using the Mplus 7 program (Muthén and Muthén, 2012). FIML estimation was also carried out as sensitivity analyses for selected complete case analyses presented in the rest of the thesis.

The use of auxiliary variables. The missing at random assumption can be made more plausible and the analyses more efficient with the use of *auxiliary variables* (Spratt et al., 2010). These are variables that influence the process causing the missing data or which are predictive of the missing values themselves. The variables were selected based on the previous literature examining sample attrition and non-response in the GAZEL dataset (Goldberg et al., 2001, 2006), as well as testing that they predicted missingness in my samples by performing logistic regressions on whether individuals were absent from the complete case analyses (Twisk, 2003). Variables which came from the baseline survey in 1989 or from administrative data were preferred because they had lowest levels of missingness themselves. The auxiliary variables were: education level, occupational grade, self-assessed health status, reported smoking and reported alcohol consumption, all for the year 1989. However, these variables predicted whether responses were missing quite poorly, with the logistic regression model predicting missingness for the analysis carried out for Chapter 7, *Current influences upon quality of life*, having a pseudo R^2 of only 2.2%.

In certain analyses, this list was supplemented by values of variables from other waves, such as CASP-19 in 2009 being used as an auxiliary variable in analyses that contained CASP-19 in 2005. Any additional auxiliary variables selected are indicated in the sections that follow.

Limitations of full information maximum likelihood estimation. A major difficulty with the approach is that it is impossible to know how well the missing at random assumption has been met. Under certain circumstances where data are missing not at random, missing data techniques such as multiple imputation analysis can be more biased than a complete case analysis (Spratt et al., 2010). Therefore, it is wise to compared such analyses with complete case analyses. The only sure solution to missing data problems is avoiding having missing data in the sample. For this reason, wherever possible in this thesis, variables taken from complete administrative records have been used in preference to variables from the questionnaire data and variables were generated where possible from earlier waves of the questionnaire, when response rates were at their highest.

Multiple imputation: an alternative approach to missing data. An alternative technique for generating unbiased estimates where only the missing at random assumption applies is multiple imputation. This technique was not used in this thesis.[6] Although the approaches are equivalent in theory, in practice, the power of the multiple imputation procedure is lower than FIML at low numbers of imputations (Graham et al., 2007). In the case of this thesis, multiply imputing imputing complex models with several nominal variables in large datasets was problematic, as these models took long times to converge, if they did at all, making the imputation process prohibitive. One solution proposed is to omit such variables in order to simplify the imputation model (White et al., 2011); however, the price to pay is that the imputation model will be an imperfect match to the analytic model.

A traditional advantage of multiple imputation over FIML has been the ease with which auxiliary variables can be included in analyses (Graham et al., 2007); however, auxiliary variables can now be easily incorporated into full information maximum likelihood estimation in the Mplus 7 program (Muthén and Muthén, 2012).

5.3.2 Cross-sectional analyses

Multiple regression analysis was used to predict quality of life in 2005 from a range of life domains, including finances, health and social relationships.[7] This analysis answers the research question *Which current or recent factors predict quality of life?* presented in section 4.2.2 on page 95. The results are presented in Chapter 7, *Current influences upon quality of life*.

The analyses were carried out in Stata SE 12.1 (StataCorp, 2011). A complete case sample as described in Table 5.2 was used in which both genders were analyzed together.

Table 5.2: Sample characteristics for the cross-sectional analysis

Exclusions and sample	*n*
Excluded	
Participants who had died by 2005	909
Participants who had left the study or the company by 2005	245
Missing data for variables used in the analysis	11776
Final sample	7695

Firstly, the determinants of quality of life were divided up into a series of domains: demographics, family situation, financial adequacy, community and social relationships, and health. Each domain contained several factors which might be associated with quality of life.

Secondly, descriptive statistics were presented to allow comparison of the characteristics of this sample of complete cases with those of the whole cohort. Thirdly, to find

[6]Multiple imputation was used in the paper written during the course of this thesis (Platts et al., 2013).
[7]Quality of life in 2005 rather than in 2009 was predicted, because some of the possible determinants of quality of life were not measured more recently than 2002 or 2003.

out which current and recent factors predicted quality of life, bivariate statistics were presented to indicate the relationships between quality of life and each of its possible determinants. These statistics were presented as unstandardized coefficients because effect sizes presented in the original units are more easily interpretable and can be compared across studies (Nakagawa and Cuthill, 2007).

It is likely that the factors predicting quality of life overlapped to a certain extent. Therefore, in a fourth step, multivariate associations between all of the domains and quality of life were examined. The domains were entered in blocks, in the following order: demographics, family situation, financial adequacy, community and social relationships, and health. Examination of the unstandardized beta coefficients and their significance enabled those factors to be determined which predicted quality of life independently of the others. Standardized estimates were additionally presented in these analyses to allow comparison of effect sizes across variables measured with different metrics. The standardized estimates indicate the degree of change in the outcome variable, measured in standard deviations, of a one standard deviation change in the predictor variable.

Finally, the value for the overall explained variance, R^2, of quality of life in the final model was compared with the explained variance after backwards exclusion of each of the domains. This allowed calculation of how much each domain contributed independently to predicting quality of life.

Because previous research has demonstrated an n-shaped relationship between quality of life and age in late mid-life and early old age (Netuveli et al., 2006; Zaninotto et al., 2009), in addition to including age as a linear predictor, I included age as a quadratic term (age-squared) (Schmidt et al., 2013) in order to improve the specification of the functional form between those variables by allowing for non-linear relationships (Bland, 2000, p. 314–5). In order to prevent the variables age and age-squared from being highly correlated, age was centred before the polynomial terms were calculated.

5.3.2.1 Sensitivity analyses

Three sensitivity analyses were performed. Firstly, the analyses were stratified by gender. The same sample as displayed in Table 5.2 was used. The results are presented in Appendix E.

Secondly, the analyses were repeated using full information maximum likelihood estimation. The standard set of auxiliary variables was used in order to improve the plausibility of the missing at random assumption as well as CASP-19 in 2009, SF-36 PCS in 2007 and SF-36 MCS in 2007. Only individuals with missing data were included in the analyses; as in the main analysis, individuals who, by 2005, had died or had left the study or the company were excluded leaving a sample of 19 741 participants. The results from these analyses are presented in Appendix G: Table G.1.

Thirdly, the analyses were repeated using the reduced version of the CASP-19 scale: CASP-15. This scale excludes items related to specific factors which might influence quality of life (see section: 3.2.3 on page 53 for more details). The results from these analyses are presented in Appendix F: section F.1.

5.3.2.2 Assumption of independence of observations

It is extremely likely that some of the individuals in the GAZEL dataset are clustered into households, a fact which flouts a crucial assumption in regression analysis, that of independence of the observations (Field, 2009). Unfortunately, clustering individuals into households was not possible, because data are not available about which individuals cluster into households, despite the great likelihood that a good proportion of participants are married to each other. Early in the course of the thesis an attempt was made to cluster households by locality using post code data (which are roughly at the level of the French *commune*), but the overwhelming majority of the variance was between individuals rather than between localities. For this reason, multi-level analysis has not been used, and I have treated the individuals as independent, as is standard in almost all analyses using GAZEL data (see Zins et al. 2009 for a review).

5.3.3 Multivariate change analyses

A multivariate change analysis will be carried out to establish whether those factors known to predict quality of life in cross-sectional analyses can predict *change* in quality of life.

It is interesting to examine the relationships between change in CASP-19 and specific covariates because an aggregate pattern of change in quality of life might coexist with varying patterns of individual change (Plewis, 1985). In addition, demonstrating dynamic relationships between various life domains and quality of life strengthens the case that they influence quality of life because the method controls for time-invariant unobserved predictors, such as stable personality differences (Ballas and Dorling, 2007; Jenkins and Mostafa, 2013).

5.3.3.1 Description of the method used in this thesis

A multivariate change analysis was estimated in which the outcome of interest is the change in CASP-19 scores 2005–2009. This difference score is calculated as the difference between the second and first measure of quality of life, and will be treated as a continuous outcome in the regression analysis. A positive value for change would indicate that quality of life improved 2005–2009. Change in quality of life was examined in relation to baseline covariates as well as to changes in some of those covariates. The multiple change analysis was carried out in Stata SE 12.1 (StataCorp, 2011).

Table 5.3: Sample characteristics for the multivariate change analysis

Exclusions and sample	n
Excluded	
Participants who had died by 2009	1318
Participants who had left the study or the company by 2009	377
Missing data for variables used in the analysis	13499
Final sample	5431

The complete case sample used in this analysis is presented in Table 5.3. It contains 5431 participants. The complete case sample is smaller than the sample used in the previous analysis examining current influences upon quality of life because additional variables were used, such as follow-up measures of health, marital status and quality of life. (For the FIML sensitivity analysis presented in Appendix G: Table G.2, 13 499 participants with missing data were re-included to create a sample of 18 930 participants.)

The two genders were analysed together. This is because the changes of marital status affected fewer than 70 individuals and I feared that stratifying the analyses by gender might leave them underpowered (cf. Table 8.3).

The variables included at baseline are largely those used in the previous analysis, with the exception of certain health variables. Instead of the two global mental and physical health indicators measured by SF-36, four variables describing specific aspects of individuals' health circumstances have been used in order to understand how changes in individuals' quality of life are related to precise changes in their life circumstances. These variables are: visual impairment, hearing impairment, hospitalization and the physical functioning sub-score only from the SF-36.

Repeated measures were only available for some of the baseline covariates, concerning the family, activity and health domains. Therefore, it was not possible to explore changes in other life domains, such as financial circumstances or community/social relationships, as repeated measurements were not available in the GAZEL dataset for these domains.

The modelling strategy was as follows: in the first model, demographic characteristics only were included in the model: age, age-squared and gender. The second model additionally included covariates at baseline. The final model additionally included changes in certain domains where repeated measures were available: marital status (transition to widowhood and divorce/separation/becoming single), retirement and changes in health occurring between the two measurements (development of a visual impairment, development of hearing loss, development of two or more physical functioning limitations, reduction in the number of physical functioning limitations to less than two, a hospitalization).

5.3.3.2 Using the difference score as an outcome variable: some methodological complications

The multiple change analysis in this thesis was performed without controlling for baseline CASP-19 scores. In brief, the reason for this is that many of the covariates included in the model are correlated with quality of life at baseline (in other words, with CASP-19 in 2005). Therefore, including baseline quality of life would induce spurious associations between the covariates and change in quality of life. The size of the error would be proportional to the error in measuring quality of life and the strength of the relationship between the covariates and baseline quality of life (Glymour, 2006). If the reader is interested in a fuller description of the debate about the merits and pitfalls of including baseline scores, it is detailed in Appendix D. In addition, a directed acyclic graph (Figure D.1 on page 367) is provided in order to present the arguments in a visual form.

5.3.4 Mid-life social position

These analyses are presented in two chapters. In Chapter 6, describing the characteristics of the GAZEL cohort, participants' occupational position trajectories during their careers at EDF-GDF will be presented. In Chapter 9, participants' quality of life following retirement will be compared to their occupational position at one or more time points.

5.3.4.1 Analysis of individual trajectories over the career

Whole career trajectories. From company records describing when individuals changed posts, a dataset was created in which, for each year the individual was working at the company, their particular grade or social class is recorded. The samples used to create the chronograms for career trajectories for male and female participants are displayed in Table 5.4 for occupational grades and in Table 5.5 for ESeC social classes. In most cases, the reason for missing records is that the cohort member was not working at EDF-GDF during part of the period 1970–2000. Only small minority of individuals were working but had missing records.

Table 5.4: Sample characteristics for the occupational grade trajectory chronograms

Exclusions and sample	*n*
Men	
Excluded	
Participants lacking occupational grade records 1970–2000	10492
Final sample	4519
Women	
Excluded	
Participants lacking occupational grade records 1970–2000	4046
Final sample	1568

Table 5.5: Sample characteristics for the ESeC social class trajectory chronograms

Exclusions and sample	*n*
Men	
Excluded	
Participants lacking social class records 1970–2000	10503
Final sample	4508
Women	
Excluded	
Participants lacking social class records 1970–2000	4055
Final sample	1559

Using the *chronogram* command created by Brendan Halpin for Stata (Halpin, 2010), the individual sequences were aggregated to represent visually the whole cohort's career trajectories in a chronogram (or transversal state distribution). Chronograms are useful for understanding how the characteristics of the cohort changed over time as well as for understanding how trajectories of different groups, such as men and women, differed. They are displayed in section 6.3.7.3 from page 166.

Last or current social position and quality of life. These analyses aimed to answer the research question: *Is previous social position related to quality of life at older ages?* I examined whether final occupational position was related to quality of life in 2009 (the results are presented in section 9.2.1 on page 210). The analyses were stratified by gender, because different tendencies might be apparent for men and women. Table 5.6 displays the samples used in this analysis; in particular, individuals who had not retired by 2009 when quality of life was measured were excluded from the analysis.

The relationship between the detailed measure of occupational grade and quality of life in 2009 is displayed in Figure 9.1 on page 213. The same sample was used as in Table 5.6, this time composed of 12 153 men and women together, because the trend is easier to discern when the genders are displayed together.

Table 5.6: Sample characteristics for the analysis of quality of life by final occupational grade and social class

Exclusions and sample	*n*
Men	
Excluded	
Participants who had died by 2009	1116
Participants who were not retired by 2009	68
Participants who were retired by 1989	1
Participants who had worked ≤ 15 years at EDF-GDF	56
Missing data for CASP-19 (2009) or on their posts in the company	4347
Final sample	9423
Women	
Excluded	
Participants who had died by 2009	202
Participants who were not retired by 2009	917
Participants who were retired by 1989	4
Participants who had worked ≤ 15 years at EDF-GDF	79
Missing data for CASP-19 (2009) or on their posts in the company	1682
Final sample	2730

Figure 9.2 that appears on the same page, displaying individuals' quality of life in 2005 in relation to their occupational position in 1989 uses the sample described in Table 5.7 on the following page.

Table 5.7: Sample characteristics for the analysis of quality of life in 2005 by detailed occupational grade in 1989

Exclusions and sample	n
Excluded	
Participants who had died by 2005	909
Participants who were not retired by 2005	3093
Missing data for CASP-19 (2005) or on their posts in the company	5330
Final sample	11293

Modelling life course social position: Associations between intra-generational mobility and quality of life. These analyses aim to answer the research question: *Are trajectories in social position related to quality of life?* The results are displayed in section 9.2.1.1 on page 214. In these analyses, trajectories of social position were created using a range of measures of occupational position in order to examine relationships between occupational position and quality of life from a life course perspective.

In the first analysis, using the tripartite system of occupational grading into three functional groups, three time points were used: initial post upon entry to the company, in 1989 and at retirement from the company. The descriptive analysis was not stratified by gender in order to main large numbers of participants in each trajectory. The sample is described in Table 5.8 and the results are presented in a graph in section 9.2.1.1 on page 214.

Table 5.8: Sample characteristics for the analysis of transitions between three time points (functional group)

Exclusions and sample	n
Excluded	
Participants who had died by 2009	1116
Participants who were not retired by 2009	985
Participants who retired in 1989 or earlier	36
Participants who had worked $\leq$ 15 years at EDF-GDF	135
Missing data for CASP-19 (2009) or on their posts in the company	6258
Final sample	12095

The year 1989 was selected as a career mid-point for both practical and theoretical reasons. This year corresponds to when male participants are about 45 years old, an age which will correspond to a certain maturity in the career (cf. Figures 6.8, 6.9, 6.10 and 6.11). Since 1989 is the year of the baseline questionnaire survey, it is also a time point when largest numbers of participants were working at the company. Because a large number of trajectories were used, the analyses were not stratified by gender in order to preserve power.

A second analysis examined the cross-sectional relationships between social position at two time points and quality of life in 2009. The time points were entry to EDF-GDF and final post. The analyses were stratified by gender. Only complete cases were analysed, as described in Table 5.9.

Table 5.9: Sample characteristics for the analysis of quality of life in 2009 by final and initial occupational grade

Exclusions and sample	*n*
Men	
Excluded	
Participants who had died by 2009	1116
Participants who were not retired by 2009	68
Participants who were retired by 1989	1
Participants who had worked $\leq$ 15 years at EDF-GDF	56
Missing data for CASP-19 (2009) or occupational grade	4393
Final sample	9377
Women	
Excluded	
Participants who had died by 2009	202
Participants who were not retired by 2009	917
Participants who were retired by 1989	4
Participants who had worked $\leq$ 15 years at EDF-GDF	79
Missing data for CASP-19 (2009) or occupational grade	1770
Final sample	2642

In the third analysis examining the associations between social class trajectories and quality of life, the ESeC measure of social class was used. Two time points were chosen: the post at entry to EDF-GDF and the final post, and a categorical variable of ESeC social class trajectories was generated. The analyses were not stratified by gender in order to maintain large numbers of participants in each category. The characteristics of the sample are displayed in Table 5.10. Mean CASP-19 quality of life scores (and 95% confidence intervals) were calculated for each social class trajectory. The results are displayed in Figure 9.4 on page 215; trajectories containing fewer than 100 participants were not displayed.

5.3.5 Mid-life working conditions

These analyses aimed to answer the research question: *Are physical and psychosocial working conditions across the working life course related to subsequent quality of life?* Therefore they seek to predict CASP-19 quality of life in 2009 in relation to mid-life working conditions. Two aspects of mid-life working conditions were considered separately: physical occupational exposures and psychosocial occupational exposures. Each model was stratified by gender. This is because men and women in the GAZEL sample differ in the nature of their occupational exposures and the way in which these might influence quality of life (Kaikkonen et al., 2009; Messing et al., 2003).

Table 5.10: Sample characteristics for the analysis of transitions between two time points (European Socio-economic Classification)

Exclusions and sample	n
Excluded	
Participants who had died by 2009	1116
Participants who were not retired by 2009	985
Participants who retired in 1989 or earlier	36
Participants who had worked $\leq$ 15 years at EDF-GDF	135
Missing data for CASP-19 (2009) or on their posts in the company	6229
Participants in rare trajectories not displayed in Figure 9.4	574
Final sample	11550

5.3.5.1 Psychosocial occupational exposures and quality of life

This analysis examines variations in retired participants' quality of life in 2009 in relation to earlier psychosocial occupational exposures. The data collection for the psychosocial exposures took place between 1997 and 1999. Individuals who reported values for psychosocial exposures after having retired had these values converted to missing as I only wanted to include individuals' assessments of their current exposures, not as they remembered them. As described in section 5.2.10.1 on page 113, the job strain measure was generated by averaging results for both 1997 and 1999, if both measures were available and valid.

Table 5.11: Sample characteristics for multiple regressions of psychosocial occupational exposures and quality of life in 2009

Exclusions and sample	n
Men	
Excluded	
Participants who had died by 2009	1116
Participants who were not retired by 2009	68
Participants who had worked <15 years at EDF-GDF	42
Missing data for CASP-19 (2009), psychosocial or physical occupational exposures	9385
Final sample	4400
Women	
Excluded	
Participants who had died by 2009	202
Participants who were not retired by 2009	917
Participants who had worked <15 years at EDF-GDF	39
Missing data for CASP-19 (2009), psychosocial or physical occupational exposures	3378
Final sample	1078

The two psychosocial exposures, effort-reward imbalance (1998) and job strain (1997/99), were considered in separate models, but the same sample was used, which is described in Table 5.11. The results are presented in section 9.2.2 on page 216. Initially, the frequency and size of exposure to strenuous and dangerous working conditions were described in men and women. Secondly, the bivariate relationships between these exposures and quality of life were described, using a correlation matrix.

Multiple regression was performed in order to see whether these associations persisted after adjustment for important confounders. In particular, social position might confound the relationships between working conditions and quality of life. For this reason, in Model 1, two measures of social position in 1989 were included: ESeC social class, and the detailed measure of occupational grade as well as age and age-squared. In Model 2, to demonstrate whether the associations between psychosocial exposures and quality of life were independent of physical exposures, all five measures of physical occupational conditions were included.

Sensitivity analyses were performed using full information maximum likelihood estimation which is robust to the assumption being incorrect that the data are missing completely at random. The sample used in these analyses is the same as that displayed in Table 5.11, except that listwise deletion of missing data was not performed. The sensitivity analyses themselves are presented in Appendix G: Table G.3.

5.3.5.2 Physical occupational exposures and quality of life

CASP-19 quality of life in 2009 was used as the outcome variable. Each of the physical occupational exposures was considered in separate models: retrospective ergonomic strain (2007), ergonomic strain (1989/90), physical danger (1989/90), workplace accidents and accumulated exposure to hazardous chemicals. The sample is presented in Table 5.12.

Table 5.12: Sample characteristics for multiple regressions of physical occupational exposures and quality of life in 2009

Exclusions and sample	*n*
Men	
Excluded	
Participants who had died by 2009	1116
Participants who were not retired by 2009	68
Participants who had worked <15 years at EDF-GDF	42
Missing data for CASP-19 (2009), retrospective ergonomic strain (2007) or job strain (1997/9)	7397
Final sample	6388
Women	
Excluded	
Participants who had died by 2009	202
Participants who were not retired by 2009	917
Participants who had worked <15 years at EDF-GDF	39
Missing data for CASP-19 (2009), retrospective ergonomic strain (2007) or job strain (1997/9)	2612
Final sample	1844

The results are presented in section 9.2.3 on page 222. Initially, the frequency and size of exposures to strenuous and dangerous working conditions was described in men and women. In a second step, the bivariate relationships between these exposures and quality of life were described, using a correlation matrix.

Analysis using multiple regression was performed in order to see whether these associations persisted after adjustment for important confounders. For this reason, in model 1, two measures of social position in 1989 were included: ESeC social class, and the detailed measure of occupational grade. In model 2, a measure of psychosocial working conditions: job strain (measured in 1997 and 1999), was included in the models to demonstrate whether the associations between the physical occupational exposures and subsequent quality of life were independent of psychosocial working conditions. Effort-reward imbalance was not included in this analysis because so many participants had missing data that the sample became small and unrepresentative (particularly a problem in the estimates for women).

The sensitivity analyses using full information maximum likelihood estimation were performed using the samples displayed in Table 5.12, without performing listwise deletion of participants with missing data. The results are presented in Appendix G: Table G.4.

5.3.6 Retirement transitions and routes

In most cases, apart from where the sample size would be too small, the analyses were stratified by gender, because men and women were affected differently by the retirement rules, had contrasting earlier working conditions and had systematic variations in quality of life.

5.3.6.1 Describing time to retirement with Kaplan-Meier survival curves

In a first step to analysing the influence of retirement transitions upon quality of life, descriptive statistics for men and women are presented in Chapter 6, indicating the years and ages at which retirement occurred. Some sample members died before retiring while others had not yet retired by 29th February 2012, the last date for which I hold retirement data. Therefore, it is appropriate to use event history techniques which account for such right-censoring (Allison, 2004, p. 371). EDF-GDF company records enable the exact dates of retirement and death to be known, enabling a *Kaplan-Meier survival curve* to be drawn, which is a descriptive way of representing survival in one state, in this case, employment, over time. The cumulative proportion of survivors, representing individuals who are still working at each time point, can be displayed graphically. Several curves are depicted in section 6.3.6.2 from page 159, allowing comparison of retirement timing by gender or social class. These descriptive analyses were carried out on the entire sample, apart from seven individuals (five women and two men) who had retired before study onset in 1989 and who were excluded (cf. Table 5.13).

Table 5.13: Sample characteristics for descriptive analyses of year of retirement

Exclusions and sample	n
Excluded	
Participants who had retired by 1989	7
Final sample	20618

5.3.6.2 Cross-sectional modelling of time until retirement, time since retirement and quality of life

The aim of this analysis was to answer the research question: *Is retirement beneficial for quality of life?* There were too few quality of life data points to model within-individual longitudinal relationships between retirement and quality of life with techniques such as generalized estimating equations but it was possible to examine the cross-sectional relationship between timing of retirement and quality of life. Carrying out this analysis for each of the two measurements of CASP-19 can provide evidence suggesting that quality of life improved at retirement or, conversely, that retirement had little impact upon long-term trajectories related to ageing.

Initially, Tables 10.1 and 10.2 present descriptive statistics of year of retirement and quality of life. Only individuals who were already retired at study onset were excluded (cf. Table 5.13).

In a second step, the relationship between quality of life and retirement timing was described using graphs of mean CASP-19 scores and 95% confidence intervals. The results are presented in section 10.2.1 on page 237. Linear predictions of quality of life in 2005 and again in 2009 were generated for individuals who had retired different numbers of years before as well as individuals who had different numbers of years left until they retired. The samples used for this analysis are presented in Tables 5.14 and 5.15. Participants who were not retired by the end of 2011 or who retired in 1989 were also excluded because these small groups (under 40 people) had extremely wide confidence intervals. The upper graphs in Figures 10.1 and 10.2 predicted CASP-19 quality of life scores in 2005 and 2009 without inclusion of any covariates in the model. Year was treated as a categorical variable. These models are therefore statistically equivalent to displaying mean quality of life scores and 95% confidence intervals around those means. The lower graphs in each pair display predicted quality of life after including age and gender as covariates because these variables may be confounding the relationship between timing of retirement and quality of life.

In a third stage, the cross-sectional relationships were modelled using a range of models with different functional forms. As well as straight line relationships, a range of polynomial functions were used (see section 5.3.2 on page 123 for a brief presentation of polynomial functions) as well as piecewise regressions. In a piecewise regression,[8] a second intercept, or a knot, is placed at the time of retirement to model a break in the long-term trend in quality of life related to ageing that the moment of retiring might represent. A second coefficient allows for a change in slope after the break. It is possible to include polynomial

[8]The technique of piecewise regression is also described as segmented regression.

Table 5.14: Sample characteristics for cross-sectional analyses of quality of life in 2005 in relation to time of retirement

Exclusions and sample	*n*
Excluded	
Participants who had retired by 1989	7
Participants who are not retired or died before retiring	825
Participants retiring in 1989 or 2012	62
Missing data for CASP-19 (2005)	6847
Final sample	12884

Table 5.15: Sample characteristics for cross-sectional analyses of quality of life in 2009 in relation to time of retirement

Exclusions and sample	*n*
Excluded	
Participants who had retired by 1989	7
Participants who are not retired or died before retiring	825
Participants retiring in 1989 or 2012	62
Missing data for CASP-19 (2009)	7149
Final sample	12582

terms in piecewise regression models. Model fit was assessed with the AIC and BIC; the models with the lowest scores were retained.[9]

Models were estimated separately for male and female participants and for quality of life in 2005 and 2009. The results are presented in section 10.2.1.2. The samples are displayed in Tables 5.16 and 5.17. Participants whose quality of life or retirement date was unknown were excluded. Time since or up to retirement was included as a continuous variable, measured to the day in fractions of a year. Participants' current ages were included in every model. It was necessary to adjust for age and to model men and women separately because younger people might not yet have been experiencing age-related declines in quality of life and female participants had lower quality of life and were over-represented in groups that had yet to retire. The BIC and AIC were not reported for all the tested models, since more than 200 models were examined. Instead, the models which best fit the data are reported and depicted in tabular and graphical form in order to display the effects of the polynomial terms.

[9]It is not possible to determine whether a model fits the data, rather we can argue that the data support one model more than an alternative. In this analysis, non-nested models (using the same samples) were being tested, and therefore it was necessary to compare them using an information criterion such as *Akaike's information criterion* (AIC) and *Schwarz's Bayesian information criterion* (BIC), both of which are suitable for large samples. These measures of model fit penalize models progressively as they gain in complexity, but do this to different degrees with the BIC penalizing extra parameters more severely in large samples, such as in the GAZEL sample (Kuha, 2004).

Table 5.16: Sample characteristics for analyses modelling quality of life in 2005 in relation to time of retirement

Exclusions and sample	*n*
Men	
Excluded	
Participants who had retired by 1989	2
Participants who had died by 2005	767
Participants who were not recorded as retiring by 29th February 2012	28
Missing data for CASP-19 (2005)	4376
Final sample	9838
Women	
Excluded	
Participants who had retired by 1989	5
Participants who had died by 2005	141
Participants who were not recorded as retiring by 29th February 2012	351
Missing data for CASP-19 (2005)	2035
Final sample	3082

Table 5.17: Sample characteristics for analyses modelling quality of life in 2009 in relation to time of retirement

Exclusions and sample	*n*
Men	
Excluded	
Participants who had retired by 1989	2
Participants who had died by 2005	1115
Participants who were not recorded as retiring by 29th February 2012	21
Missing data for CASP-19 (2009)	4383
Final sample	9490
Women	
Excluded	
Participants who had retired by 1989	5
Participants who had died by 2005	202
Participants who were not recorded as retiring by 29th February 2012	329
Missing data for CASP-19 (2009)	1951
Final sample	3127

5.3.6.3 Interaction between earlier working conditions and retirement timing

This analysis builds on the cross-sectional analysis described in section 10.2.1.3 on page 244 by using the repeated measures of CASP-19 quality of life obtained in 2005 and 2009 to examine the degree to which individuals' quality of life changes at retirement are related to their earlier working conditions. Changing quality of life will be related to earlier working conditions by comparing mean change (and the corresponding 95% confidence intervals of these estimates) in quality of life between those who had more and less difficult earlier working conditions.

Only results for psychosocial exposures will be presented here, as the characteristics of the dataset precluded obtaining reliable results for physical occupational exposures in relation to retirement. In brief, firstly, fewer than 3000 participants retired 2005–2009. Secondly, many of the retirees during this period were female, and, as detailed in section 6.7 on page 163, women experienced little or no physical occupational exposures. In addition, men who retired 2005–2009 were retiring later than average and were strongly selected as a result of the EDF-GDF retirement rules to have had usually low levels of physical occupational exposures (see section 5.2.12 on page 116, for more detail). They are therefore unlikely to be typical of the rest of the cohort. In any case, I looked for any relationships between previous physical occupational exposures and developments in quality of life, but failed to find any consistent associations. The results are not shown because these problems of selection and low levels of exposures in participants who retired 2005–2009 are most likely to be the cause.

Consequently, this analysis solely examines the associations with psychosocial strain which shows a lot of variation for both men and women retiring during this period. It tests the hypothesis that participants who reported worse psychosocial working conditions before retiring experienced greater improvements in quality of life upon retirement. Two measures of psychosocial strain were used: effort-reward imbalance from 1998 and job strain from 1997 and 1999 (the average of both years was taken when both were available).

The sample used is described in Table 5.18. It became extremely small; therefore, male and female participants were analysed together. The results are presented in section 10.2.1.3 on page 244.

Table 5.18: Sample characteristics for change analysis of quality of life by earlier effort-reward imbalance or job strain for participants retiring 2005–2009

Exclusions and sample	*n*
Excluded	
Participants who had died by 2009	1318
Participants who retired before 2005 or after 2009	17240
Missing data for CASP-19 (2005 or 2009)	1006
Final sample	1061

5.3.6.4 Type of retirement transition and quality of life

These analyses aim to answer the research question: *How does quality of life following retirement relate to the type of retirement transition participants experienced?*. Three aspects of the retirement transition will be examined: the timing of retirement (age at retirement), whether professional activities were continued following retirement, and retiring in ill health. The results are presented in section 10.2.2 on page 244.

Modelling age at retirement and quality of life. For the first set of analyses, the sample used is displayed in Table 5.19. Tables 10.8 and 10.9, showing the number of participants who retired at each age as well as mean quality of life in 2009 (with 95% confidence intervals), were generated using this sample. Participants labelled as missing are those who were not retired by 29th February 2012, as well as a minority of participants who had left the study.

For the statistical modelling, the restricted sample used is displayed in Table 5.20. Only those participants who were retired were considered in this analysis. In addition, the sample was selected such that all the participants could have retired at any age. Therefore the few people who retired after age 61 years were excluded, as well as the participants who were not aged 62 years by 29th February 2012. This was in order to reduce strong biases that might have resulted from not including people who were still working because they had not yet reached the age at which they would retire. Otherwise, the youngest sample members (which is a large proportion, one third, of the women) could have retired early or on time but if they were going to retire late, then they were still in work. This would have resulted in a very selected sample.[10] With these participants excluded, everybody in the sample could have retired at any age within the range of retirement ages observed. After these exclusions, no sample members retired after 1st January 2009.

Table 5.19: Sample characteristics for examining quality of life in relation to retirement age

Exclusions and sample	*n*
Men	
Excluded	
Participants who had retired before 1989	2
Participants who died before retiring	370
Final sample	14639
Women	
Excluded	
Participants who had retired before 1989	5
Participants who died before retiring	112
Final sample	5497

The results are presented in section 10.2.2.1 on page 244. Initially, descriptive statistics of mean quality of life scores in relation to individuals' ages of retirement were presented, separately for men and women. These figures were graphed, with 95% confidence intervals. In a second step, regression modelling, stratified by gender, was used to seek a linear association between age at retirement and quality of life. Age at retirement was modelled as a continuous variable.

Sensitivity analyses using full information maximum likelihood estimation used the sample displayed in Table 5.20 without excluding participants who had missing data. The

[10] I am grateful to Morten Wahrendorf for this observation.

Table 5.20: Sample characteristics for the restricted sample used to model quality of life in relation to retirement age

Exclusions and sample	*n*
Men	
Excluded	
Participants who had retired before 1989	2
Participants who died before retiring or not retired yet	370
Participants who were younger than 62 years in January 2009	3756
Participants who retired after age 61 years	12
Missing data for CASP-19 (2009)	3850
Final sample	7021
Women	
Excluded	
Participants who had retired before 1989	5
Participants who died before retiring or not retired yet	112
Participants who were younger than 62 years in January 2009	3056
Participants who retired after age 61 years	3
Missing data for CASP-19 (2009)	971
Final sample	1467

results are presented in Appendix G: Table G.6.

Modelling quality of life in relation to whether participants continued professional activities since retiring. In this analysis, the relationship between quality of life in 2009 and whether participants reported in the self-completion questionnaires that they had continued professional activities since retiring was examined. Details about the post-retirement professional activities variable are provided in section 5.2.12.2 on page 118. Crucially, the variable was only included in questionnaires up to 2002.

Mean quality of life scores were compared in relation to whether individuals performed post-retirement professional activities; an independent samples t-test was used to ascertain whether the differences were statistically significant at the 95% level. The sample used in this analysis is displayed in Table 5.21. Individuals were excluded if they were retired after 2002, since information on post-retirement professional activities would not be available. The results are displayed in section 10.2.2.2.

Modelling quality of life in relation to whether participants experienced a retirement transition marked by ill health and disability. This analysis tested whether a retirement transition accompanied by ill health or disability was associated with quality of life following retirement. Details about the construction of ill health retirement variable were provided in section 5.2.12.2 on page 117; in short, cohort members were classified as retiring in ill health if they reported in the self-completion questionnaires that their retirement had been preceded by a long period of sickness or disability leave or

Table 5.21: Sample characteristics for modelling quality of life in relation to continuing professional activities following retirement

Exclusions and sample	*n*
Excluded	
Retired before 1989	7
Retired after 2002	7167
Missing data on post-retirement professional activities	2355
Final sample	11096

Table 5.22: Sample characteristics for modelling quality of life in relation to a retirement transition marked by ill health or disability

Exclusions and sample	*n*
Excluded	
Participants who had retired before 1989	7
Participants who retired after 2009	1469
Final sample	19149

that they had taken pre-retirement due to ill health or incapacity. The sample used is displayed in Table 5.22. Individuals who had retired by 1989 and who retired after the measurement of quality of life in 2009 were excluded.

Mean CASP-19 quality of life scores in 2009 were contrasted depending on whether retirement was accompanied by a lengthy period of illness or incapacity, and an independent samples t-test was performed to ascertain significance, at the 95% level, of the differences. The results are displayed in section 10.2.2.3.

5.3.6.5 Earlier working conditions and type of retirement transition

I aimed to answer the research question: *How do people's mid-life circumstances influence their chances of experiencing these different types of retirement?* Three analyses were performed, examining how earlier physical and psychosocial working conditions, as well as occupational grade and social class, might influence the risk of undergoing different sorts of retirement transitions, namely: retiring at older or younger ages, having a transition to retirement that was marked by ill health or incapacity, and continuing professional activities following retirement. The results are presented in section 10.2.3 on page 250. Each analysis used a different sample, in order to maximize the sample sizes. Specific details of the methods used in each analysis are presented in the sections that follow.

Mid-life employment characteristics and retirement age. In these analyses, men and women were analysed separately in both descriptive statistics and modelling of age at retirement and earlier working conditions and occupational position. As described in Chapter 9, *Social position and occupational conditions in mid-life*, men were exposed more frequently and to much higher levels of physical occupational exposure than women and

Table 5.23: Sample characteristics for age of retirement by mid-life employment characteristics

Exclusions and sample	*n*
Men	
Excluded	
Participants who had retired by 1989	2
Participants aged under 62 years at start of 2009	3870
Participants who retired after age 61 years	8
Participants who had not retired by 29th February 2012 or who died before retiring	260
Missing data for ESeC social class, occupational grade, or retrospective ergonomic strain (2007)	3057
Final sample	7814
Women	
Excluded	
Participants who had retired by 1989	5
Participants aged under 62 years at start of 2009	3135
Participants who retired after age 61 years	3
Participants who had not retired by 29th February 2012 or who died before retiring	33
Missing data for ESeC social class, occupational grade, or retrospective ergonomic strain (2007)	769
Final sample	1669

these were only associated with quality of life in men. Consequently, these analyses are stratified by gender.

In the modelling, only those participants who were retired were eligible. In addition, it is important to ensure that all the sample members could have retired at any age, as was outlined in section 5.3.6.4. Therefore participants who retired after age 61 years were excluded as well as those who were not aged 62 years by 29th February 2012. With these participants excluded, everybody in the sample could have retired at any age within the range of retirement ages observed. After these exclusions, nobody in the sample had retired after 1st January 2009. The sample is displayed in Table 5.23.

A three-stage modelling approach was taken: firstly, only current age was included; secondly, two measures of social position (ESeC class and detailed occupational grade) were included; thirdly, physical occupational exposures were included. The results are presented in section 10.2.3.1.

Mid-life employment characteristics and continuation of professional activities after retirement. This sample was composed of participants who had indicated in at least one of the questionnaires 2000–2002 whether they had continued professional activities after retiring, and who were retired by 2002. Complete cases were analysed. The sample is displayed in Table 5.24.

It was not possible to include the measures for psychosocial strain in this analysis, because they were recorded between 1997–99 and this would therefore have reduced the sample to a small and unrepresentative sub-group of individuals retiring between these years and 2002.

Table 5.24: Sample characteristics for continuing professional activities after retirement by mid-life employment characteristics

Exclusions and sample	*n*
Excluded	
Participants who had retired before 1989	7
Retired after 2002	7167
Missing data for CASP-19 (2009), all professional activity variables (2000–2002) or retrospective ergonomic strain (2007)	4215
Final sample	9236

Mid-life employment characteristics and transitions marked by ill health or disability. Individuals were excluded if they had not retired by 2009, which was the last date for which I had questionnaires indicating whether retirement was marked by ill health or disability. In addition, participants were excluded if they did not provide quality of life scores in 2009 or provided no responses to questions about retirement in ill health or disability since they retired. The sample of eligible participants is small (cf. Table 5.25); consequently, men and women were analysed together in order to provide sufficient power for the analyses.

Table 5.25: Sample characteristics for retiring in ill health by mid-life employment characteristics

Exclusions and sample	*n*
Excluded	
Participants who had retired before 1989	7
Participants still working in 2009	1469
Missing data for CASP-19 (2009), ill-health retirement, retrospective ergonomic strain (2007), effort-reward imbalance (1998), or occupation (1989)	12907
Final sample	6242

5.3.7 Modelling life course influences from mid-life

These analyses were carried out using path analysis. Therefore, before describing the two sets of analyses that were carried out, the technique of structural equation modelling will be introduced in general.

5.3.7.1 Description of structural equation modelling and path analysis

Structural equation modelling (SEM) is a way of analysing a system of relations among variables (Hoyle and Panter, 1995). The goal of structural equation modelling is to model the covariance between variables by testing alternative models specified by the researcher *a priori* that have a basis in theory or previous studies (Kline, 2005, pp. 9, 13). Although individual paths may be of interest, structural equation modelling allows for the evaluation of entire models, which can be presented visually (Kaplan, 2009, p. 37).

In this study, the utility of path analysis is in its capacity to robustly perform mediation analyses, in which variables can be both predictors and outcome variables, as well as simultaneously modelling multiple pathways. It enables both direct and indirect effects of one variable on another to be estimated, and the effect size and significance of any particular path to be examined.

Two sets of mediation analyses were performed for this thesis, with contrasting methods. The analysis examining mediation of the effect of physical occupational exposures upon quality of life following labour market exit used a saturated path analytic model which could be considered conceptually equivalent to a set of linked simultaneously estimated regression equations. Because the model was saturated, model fit statistics were not available, and the individual paths were examined in order to examine whether the data correspond to the hypothesis of mediation. The second analysis, examining mediation of the effect of mid-life social position upon quality of life, compared a pair of unsaturated models with model fit statistics. Therefore, a model testing approach was used to test for whether the data correspond with a mediation hypothesis.

In each case, the models and approach were defined *a priori*. It is a point of consensus in the structural equation modelling literature that model modification needs to be undertaken with extreme care. *Post-hoc* model modification increases the chance that the researcher begins to model the characteristics of the sample rather than its population (Hoyle, 2011, p. 54). Consequently, *post-hoc* model modification has been avoided, in favour of approaches that test hypotheses concerning the presence or absence of paths.

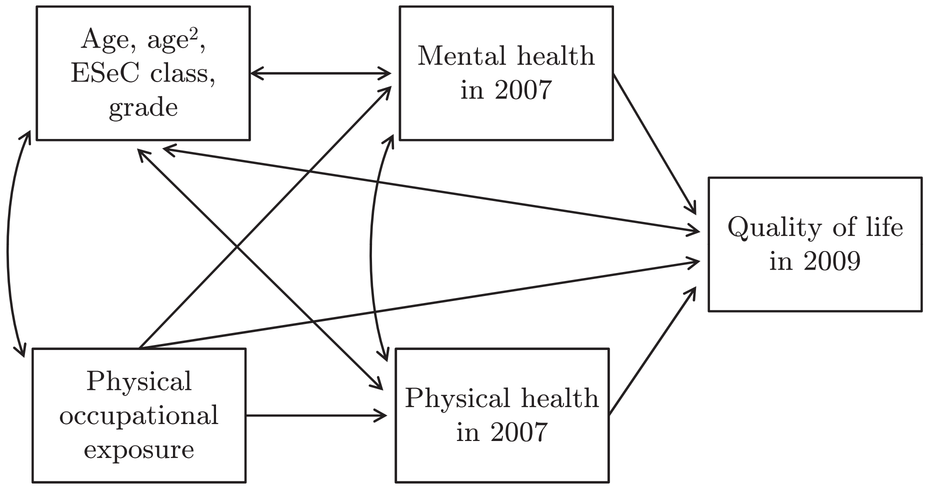
5.3.7.2 Mediation of the effect of mid-life physical occupational exposures upon quality of life in early old age

The first set of analyses examined mediation of the effect of physical occupational exposures upon quality of life following labour market exit. The interest of this analysis was to understand how physical occupational exposures influenced quality of life in old age. I hypothesized that variations in physical and mental health between individuals, measured recently in relation to quality of life, would account for the covariation in levels of physical occupational exposure and quality of life.

A general diagram of the models appears in Figure 5.4, which depicts the paths included in the model. For simplicity, the control variables are grouped together in the diagram; however, all associations between them were modelled.

In terms of hypothesis testing, if the direct path between a physical occupational

Figure 5.4: Diagram of the paths in the model from a physical occupational exposure to quality of life in 2009



Directional paths are depicted by straight arrows; associations are depicted by curved double-headed arrows.

exposure and subsequent quality of life is significant, it would falsify the hypothesis of complete mediation of this relationship by subsequent physical and mental health.

Full information maximum likelihood estimation with auxiliary variables was performed using Mplus 7 (Muthén and Muthén, 2012). For each exposure, a saturated model was created that consisted of both direct and indirect paths between the physical occupational exposure and quality of life. The exposures examined were: retrospective ergonomic strain (continuous variable), prospective ergonomic strain (1989/90), prospective physical hazards (1989/90), accumulated workplace accidents (dichotomized: 0, $\geq$1), accumulated exposures to harmful chemicals (continuous and divided by 100). A series of control variables was included: age, age^2, ESeC and occupational grade. These variables were correlated with all of the other variables in the model. CASP-19 in 2005, SF-36 mental and physical component summary scores in 2003, self-rated health in 1989, reported alcohol consumption in 1989, reported smoking status in 1989 and reported education level in 1989 were included as auxiliary variables in order to improve the plausibility of the missing at random assumption required for full information maximum likelihood estimation.

It can be necessary to transform the variables, in order that they have distributions that approximate well to the Normal distribution. The skew index should not be greater than three, and the kurtosis should not be over 10. This was the case for the SF-36 physical component score, the SF-36 mental component score, and for CASP-19 (cf. section 5.2.8.1 on page 106 for SF-36 and section 6.2.2 on page 150 for CASP-19), so they were not transformed for these analyses.

Outliers should not be further than three standard deviations beyond the mean (Kline, 2005), therefore, the form of the detailed occupational grade variable which ran from 0–23 was used in order to deal with outliers. The Mplus 7 program is able to estimate models using variables that depart from normality, such as categorical variables, so variables such as smoking status and ESeC were included as dummies, whether in the analytic model or as auxiliary variables.

A single sample (see Table 5.26) was created for these five analyses, examining the pathways from different physical occupational exposures to quality of life. Women were exposed to few physical occupational exposures and therefore these analyses were carried out for men only. Participants were excluded if they had died, had not retired yet, or had not worked at least 15 years at the company. Two individuals with missing data for occupation in 1989 were also excluded. This left a final sample of 13 785 eligible men.

Table 5.26: Sample characteristics for the analysis of the effect of mid-life physical occupational exposures upon quality of life in early old age

Exclusions and sample	n
Excluded	
Participants who had died by 2009	1318
Participants who had not retired by 2009	985
Participants who had worked <15 years at EDF-GDF by 2009	81
Women	4456
Missing data for ESeC	2
Final sample	13785

It is important to consider equivalent models at this stage. It could be that ESeC, rather than being associated with the physical occupational exposures, actually determines them (Hoven and Siegrist, 2013). This would be a valid equivalent model. However, the role of social position in these analyses is as a control for aspects of social position, such as earnings, or status, that might otherwise confound the relationship between physical occupational exposures and quality of life. Crucially, such equivalent models, differing only in whether associations are stated to be directional paths, are mathematically equivalent in terms of the structural equation estimation.

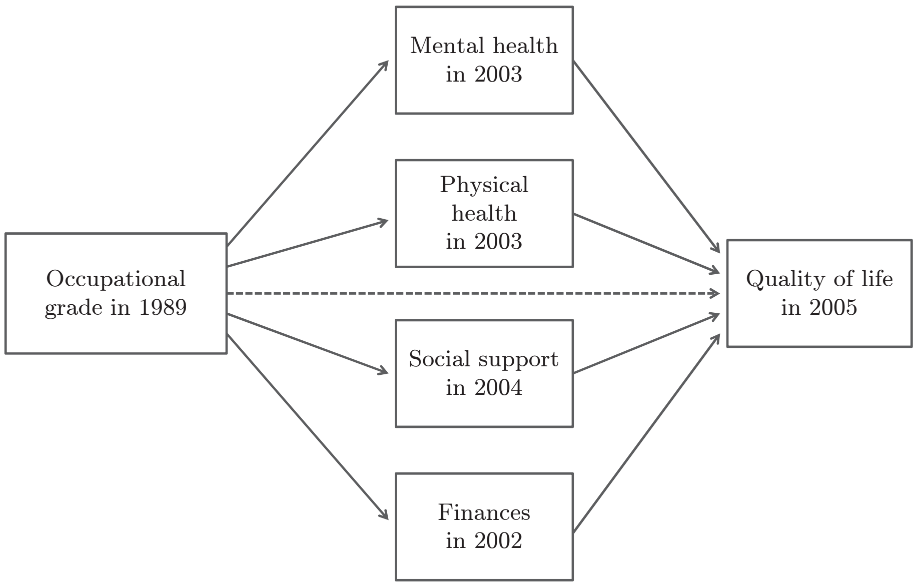
Two individuals had missing data for ESeC social class in 1989. It is most likely that the data are missing because of some problem with the company administrative records and, consequently, that this information is missing completely at random and performing list-wise deletion is an acceptable method for handling the missing data. Where other variables were missing, full information maximum likelihood estimation was used to obtain estimates for the whole sample, as was outlined in more detail in section 5.3.1.3 on page 121.

The standardized estimates were calculated using stdyx standardization in which both exogenous and endogenous variables were standardized.

5.3.7.3 Mediation of the effect of mid-life social position upon quality of life in early old age

A second set of analyses examined mediation of the effect of earlier social position upon quality of life following labour market exit. A diagram of this model appears in Figure 5.5.

Figure 5.5: Diagram of the modelled direct and indirect paths from mid-life social position to quality of life in early old age



The outcome was CASP-19 quality of life in 2005. The exposure was the detailed measure of occupational grade from 1989. Four mediating factors that are known to influence quality of life and which have been shown to be associated with social position were included in the analyses: physical health, mental health, wealth and emotional support (whether the individual had a close, confiding relationship). A set of questionnaire items from the baseline survey which have been shown to predict attrition (Goldberg et al., 2006) were used as auxiliary variables in order to improve the estimates in the full information maximum likelihood estimation procedure: education level, self-rated health, smoking status and alcohol use. Additional auxiliary variables provided indications of what the missing values might be for certain variables in the analytic model: CASP-19 recorded in 2009, SF-36 PCS and MCS recorded in 2007.

A sample was created for this analysis examining the pathways from different measure of social position in 1989 to quality of life in 2005. Certain individuals were excluded from this analysis: by January 1st 2005, 909 participants had died while 3093 individuals had not yet retired. Following these exclusions, the sample comprised 16 623 men and women (see Table 5.27).

In a first step, the data were analysed descriptively, using Stata 12.1 (StataCorp, 2011), in order to display the characteristics of the 16 623 participants included in the sample.

Table 5.27: Sample characteristics for the analysis of the effect of earlier social position upon quality of life following labour market exit

Exclusions and sample	*n*
Excluded	
Participants who had died by 2005	909
Participants who had not retired by 2005	3093
Final sample	16623

Structural equation modelling (SEM) was performed using the Mplus 7 program (Muthén and Muthén, 2012). The model was estimated from the covariance matrix which is reported. In order to deal with sample attrition, the models were estimated using full information maximum likelihood estimation with auxiliary variables that predicted missingness in a saturated correlates model (Graham et al., 2003).

A hierarchical model building approach was followed. Each of the two models was required to have at least acceptable model fit statistics. Model 1 contained only indirect effects via physical health, mental health, social support and financial situation upon quality of life. Model 2 additionally included a direct pathway between earlier social position and subsequent quality of life. The mediating variables (mental health, physical health, social support and wealth) were allowed to covary with each other, except in the case of mental health and physical health, which correlate very little as a result of the manner in which the SF-36 scale is constructed (Leplège et al., 2001). Excluding this association maintained over-identification of each model, conserving at least one degree of freedom necessary for model comparison. Paths between observed variables were calculated and the direct and indirect effects from mid-life social position upon quality of life were estimated.

Full information maximum likelihood estimation with the inclusion of auxiliary variables was carried out in Mplus 7 (Muthén and Muthén, 2012) (saturated correlates model). A hierarchical model building approach was followed in which two nested models were compared, beginning with the simplest (Hoyle, 2011, p. 49). The two models were:

Model 1: Indirect pathway model.

Model 2: Model 1 plus a direct pathway between social position in 1989 and CASP-19 in 2005.

Neither model was saturated, so it was possible to examine model fit. The models are evaluated in two ways. First, each model being evaluated needs to have at least acceptable overall model fit, meaning that the differences between the two covariance matrices are small enough that the model generated by the structural equations corresponds to the real data being modelled. This is done by comparing the predicted covariance matrix (generated by the values of the parameters substituted into the structural equations) with the observed covariance matrix generated by the data (Hoyle, 2011, pp. 10–11). The difference between the two covariance matrices is the residual covariance matrix; where the residual covariances are small, meaning that the observed matrix is much like the predicted matrix, model fit is acceptable or good. The main measures of model fit are the *Model* χ^2 *statistic* and a range of omnibus fit statistics.

The Model χ^2 statistic is a “badness-of-fit index” in which a value of 0 means that there is no difference between the observed and predicted covariance matrices. In other words that the model perfectly fits the data. Consequently, Hoyle (2011, p. 45) argues that this statistic tests a hypothesis of limited interest, that the model perfectly fits the data. In addition, in very large samples, such as n=5000, the value of χ^2 will be elevated and may lead to rejection of the model even though the differences between the matrices are trivially different (Kline, 2011, p. 201). However, there is a lively debate on this topic. Kline (2011) argues strongly that models that fail the model χ^2 should be rejected, as the test highlights discrepancies between model and data (Kline, 2011, p. 202). The model χ^2 is an ingredient of other indexes of model fit and is used to compare hierarchical models (Kline, 2005, p. 137).

As well as the Model χ^2 statistic, a range of omnibus fit indexes should be examined. Using different indexes of model fit should mean that a range of aspects of model fit are assessed. I have included the Root Mean Square Error of Approximation (RMSEA), the Comparative Fit Index (CFI), and the Tucker-Lewis Index (TLI). There are no set guidelines, and evaluating fit is a matter of debate (Hoyle, 2011, p. 44). I specify the following limits in Table 5.28 which lists values for omnibus model fit statistics.[11]

Table 5.28: Omnibus fit statistics

Fix index	Exact fit	Close fit	Adequate fit
Comparative Fit Index (CFI)	≥ 0.99	≥ 0.95	≥ 0.90
Tucker-Lewis Index (TLI)	≥ 0.99	≥ 0.95	≥ 0.90
Root Mean Square Error of Approximation (RMSEA)		≤ 0.05	≤ 0.08

Second, the different models can be compared, in a hypothesis-testing approach. The interest of this comparison between the simpler and more complex model is to test for mediation by other variables of the effect of one variable, denoted as X, upon another, denoted as Y. In the first simpler model, the direct path between X and Y would be constrained to zero, so that the total effect would have to pass via the mediating variable Z. If, upon freeing this path, the overall fit of this unconstrained model is not appreciably better than the one with the constrained path, then there would be support for the hypothesis of complete mediation of the relationship between X and Y by Z (Kline, 2011, pp. 214–215). The model fits of these models were compared using the χ^2 difference test.

[11]These values are broadly in line with those proposed by Hu and Bentler (1999) although the authors stressed that their figures were merely rules of thumb (Hooper et al., 2008; Hu and Bentler, 1999; Marsh et al., 2004).

5.4 Conclusion

This chapter has presented the dataset, variables, methods and analytic strategies pertaining to the investigations carried out for this thesis. Before the results are presented in a series of results chapters, some descriptive analyses will be presented, which help to describe the nature of the cohort and measures, as well as the nature of missing data, in more detail.

Chapter 6

Descriptive statistics

Summary

This chapter describes the GAZEL sample through presentation of descriptive statistics for the measures used in the thesis and details about missing data.

Since this is the first time that the CASP-19 quality of life measure has been used in the GAZEL dataset, information about the CASP-19 summary score will be presented in detail. In short, the unimodal, slightly skewed distribution of scores and high internal consistency of the items making up CASP-19 indicate that this measure of quality of life is suitable to be treated in this thesis as a continuous outcome.

Descriptive statistics of the contemporaneous and life course variables used throughout the thesis will be presented in this chapter, in order to describe the characteristics of the GAZEL sample. Finally, this chapter will present an analysis of missing data, and argues that the assumption that data are missing at random is more plausible than arguing for information being missing completely at random.

6.1 Introduction

This chapter presents the GAZEL sample. It provides descriptive statistics for the measures used in the thesis, as well as information about missing data.

6.2 Description of the CASP-19 measure of quality of life in the GAZEL cohort

6.2.1 The measurement properties of CASP-19 in the GAZEL cohort

The internal consistency, measured with Cronbach's alpha, of CASP-19 in both 2005 and 2009 was 0.89. This value is suitably high for CASP-19 to be used in its form as a first-order measurement model summarizing quality of life in this cohort.

Throughout this thesis, CASP-19 is used as an overall summary of quality of life and, therefore, the measurement properties of the four separate domains of quality of life were not examined.

6.2.2 The distribution of CASP-19 quality of life scores in the GAZEL cohort

In 2005, the mean CASP-19 score, for 13 114 participants responding to all the items, was 43.14 points (standard deviation: 7.86; 95% confidence intervals: 43.00 to 43.27). The distribution is displayed in Figure 6.1. The range was 6–57 points; some individuals thus attained the maximum score of 57 points, indicating "total satisfaction of all four domains" (Bowling, 2004). The CASP-19 distribution was slightly negatively skewed (skewness = −0.95) and leptokurtic (kurtosis = 3.98), values which are acceptable for structural equation and regression modelling.

In 2009, 12 797 participants responded to all of the CASP-19 items. The mean score was 43.06 (standard deviation: 7.80, 95% confidence intervals: 42.93 to 43.20). The range was 7–57. The distribution was again negatively skewed: skewness = −0.86 and leptokurtic: kurtosis = 3.76, and is displayed in Figure 6.2.[1]

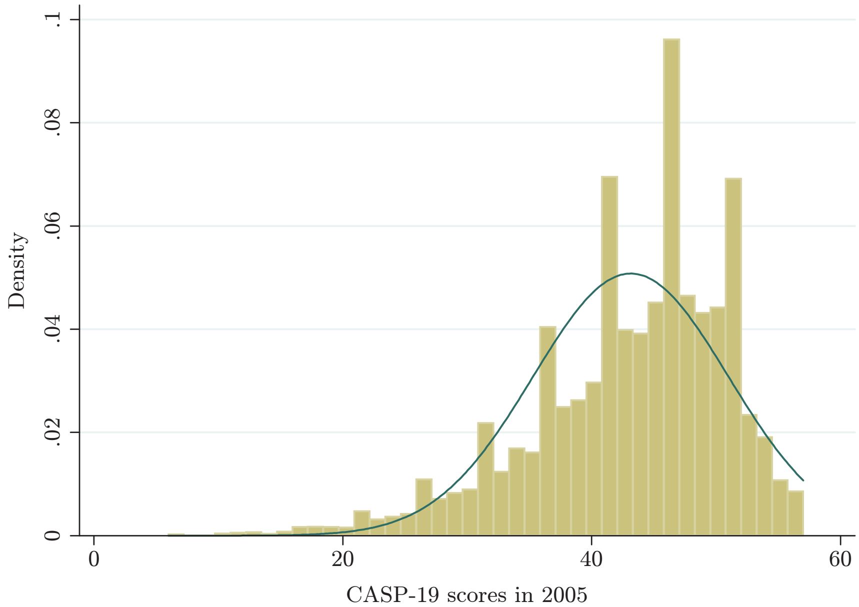
In terms of comparing results from 2005 and 2009, there was a great deal of consistency in CASP-19 scores between the two years, with the mean score, standard deviation, range and shape of the distribution changing little.

6.2.2.1 Comparison with other datasets

The mean CASP-19 score of 43.1 points reported in both years by the GAZEL cohort participants was similar to results from general ageing surveys such as the Irish Longitudinal Study of Ageing (43.8 points in Layte et al., 2013) and the English Longitudinal Study

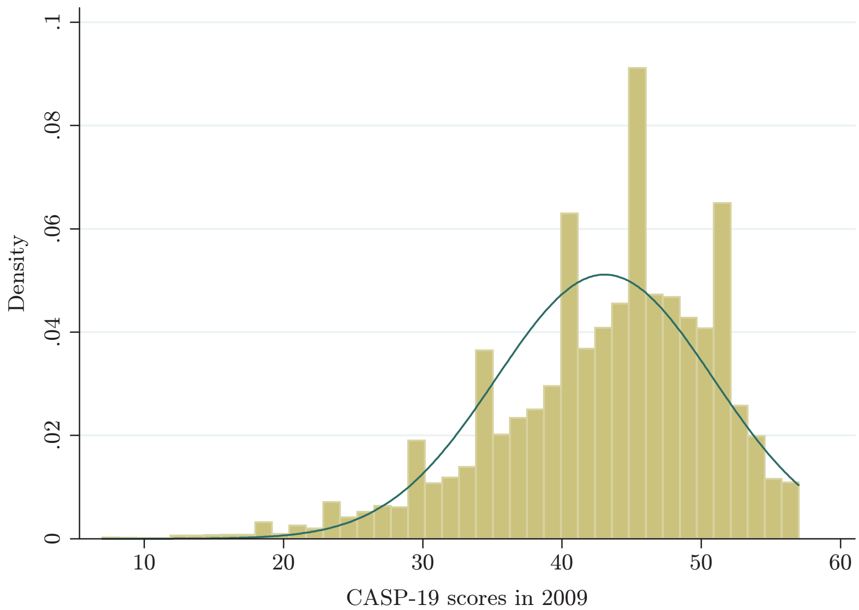
[1] Mean CASP-19 quality of life was higher in men than in women in both years. The values were for men in 2005: mean: 43.70, s.d.: 7.37; and 2009: mean: 43.39, s.d.: 7.38; for women in 2005: mean: 41.44, s.d.: 8.96; and 2009: mean: 42.11, s.d.: 8.84.

Figure 6.1: Histogram of CASP-19 quality of life scores in 2005 for 13 114 participants in the GAZEL cohort



A normal distribution is superposed upon the actual distribution.

Figure 6.2: Histogram of CASP-19 quality of life scores in 2009 for 12 797 participants in the GAZEL cohort



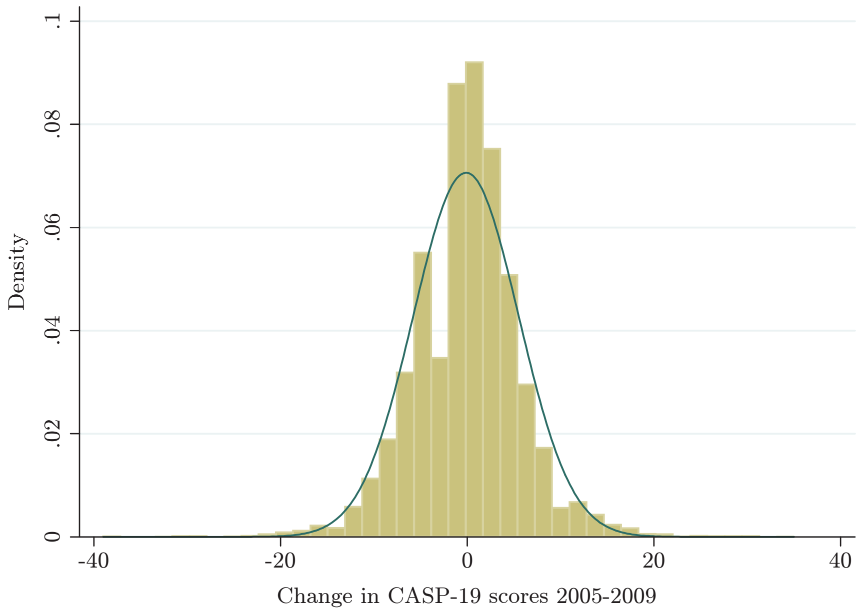
A normal distribution is superposed upon the actual distribution.

of Ageing (42.7 points in men aged 52–64 years; 43.6 points for women of the same age, Demakakos et al., 2010).

6.2.2.2 Change in quality of life

For 11 114 individuals providing CASP-19 scores in both 2005 and 2009, the mean change in CASP-19 was just under zero, at −0.13 points (standard deviation: 5.65, 95% confidence intervals: −0.24 to 0.00), suggesting a slight decline in quality of life overall. The median value was zero, meaning that about as many people experienced improvements in quality of life as experienced a worsening in quality of life. The range of the change in CASP-19 was −39 to +35 points. The distribution, displayed in Figure 6.3, was leptokurtic (kurtosis = 5.50) and almost entirely symmetrical (skewness = 0.00).

Figure 6.3: Histogram of change in CASP-19 quality of life scores between 2005 and 2009 for 11 114 GAZEL cohort participants



A normal distribution is superposed upon the actual distribution.

6.3 Description of covariates in the GAZEL cohort

In this section, a series of tables and graphs present descriptive results for the GAZEL cohort participants. Information for men and women is presented separately, as, particularly in relation to working life, they have quite contrasting characteristics.

6.3.1 Demographic characteristics and family situation

Information about the demographics and family situation of the sample is provided in Table 6.1. Missing responses correspond to deaths, survey non-response, question non-response, withdrawal from the cohort and leaving the company.

About three-quarters of the cohort, 73%, is male. In 2005, the average age of respondents was 60.2 years (61.0 years for males and 58.2 years for females). Women tended to be younger than men simply because women were eligible for recruitment into the cohort from a younger age, as was explained in section 5.1.4 on page 99.

Of those who responded to the 2005 survey, the overwhelming majority, 90%, of male participants were married, compared to 73% of female participants. Greater proportions of women were divorced, separated, widowed or single. In 2005, most participants were living in a household composed of two people, although a substantial minority (21%) of female participants responded that they were living alone in 2005. More than four-fifths of the GAZEL cohort indicated that children lived in their household for at least one of the survey years; again a slightly higher proportion of men than women indicated children were present at home.

Females in the GAZEL cohort had lower rates of living in a partnership and with

Table 6.1: Descriptive statistics of demographic characteristics and family situation for 20 625 men and women in the GAZEL cohort

Variable	Men			Women		
	n	Percent (%)	$\bar{x}$ (standard deviation)	n	Percent (%)	$\bar{x}$ (standard deviation)
Demographics (2005)						
Age	15011	100.0	61.0 (2.9)	5614	100.0	58.2 (4.2)
Family situation						
Marital status in 2005						
Single	199	1.3		210	3.7	
Married or cohabiting	9702	64.6		2684	47.8	
Divorced or separated	674	4.5		563	10.0	
Widowed	198	1.3		235	4.2	
Missing	4238	28.2		1922	34.2	
Household size in 2005						
Living alone	844	5.6		749	13.3	
Two people	7980	53.2		2211	39.4	
Three or more people	1865	12.4		693	12.3	
Missing	4322	28.8		1961	34.9	
Children ever recorded at home (1989, 2002, 2005)						
No	1950	13.0		969	17.3	
Yes	12788	85.2		4504	80.2	
Missing	273	1.8		141	2.5	
Total	15011	100.0		5614	100.0	

Table 6.2: Descriptive statistics of financial position of 20 625 men and women in the GAZEL cohort

Variable	Men		Women	
	Frequency	Percent (%)	Frequency	Percent (%)
Finances (2002)				
Net monthly household revenue				
<1372 euro	365	2.4	218	3.9
1372 – <1601 euro	230	1.5	81	1.4
1601 – <1982 euro	1985	13.2	538	9.6
1982 – <2592 euro	1654	11.0	318	5.7
2592 – <3811 euro	3777	25.2	1404	25.0
3811 – <4574 euro	977	6.5	291	5.2
≥4574 euro	1311	8.7	497	8.9
Missing	4712	31.4	2267	40.4
Household net worth				
<1525 euro	59	0.4	57	1.0
1525 – <4574 euro	27	0.2	30	0.5
4574 – <7623 euro	139	0.9	106	1.9
7623 – <15 245 euro	182	1.2	103	1.8
15 245 – <76 225 euro	1014	6.8	393	7.0
76 225 – <152 449 euro	2280	15.2	695	12.4
152 449 – <304 898 euro	3980	26.5	969	17.3
304 898 – <457 347 euro	1455	9.7	413	7.4
≥457 347 euro	623	4.2	178	3.2
Missing	5252	35.0	2670	47.6
Confidence in financial situation over the next ten years				
Very confident	1558	10.4	371	6.6
Quite confident	7132	47.5	2284	40.7
Not very confident	1661	11.1	714	12.7
Not confident at all	183	1.2	109	1.9
Missing	4477	29.8	2136	38.1
Total	15011	100.0	5614	100.0

children than the males; in this respect, the women are unusual and are distinct from women in the French population as a whole.

6.3.2 Financial adequacy

Table 6.2 presents descriptive characteristics concerning the GAZEL cohort participants' financial circumstances in 2002. Women responded to each question about finances less often than men. There were slightly higher proportions of missing data for household net worth (wealth) and household income than for participants' confidence in their financial situation.

Men and women presented similar levels of net monthly household incomes. The modal income band in both genders was 2592–3811 euro. Most participants had monthly

Table 6.3: Descriptive statistics of social participation and caring responsibilities for 20 625 men and women in the GAZEL cohort

Variable	Men		Women	
	Frequency	Percent (%)	Frequency	Percent (%)
Social participation (2005)				
Participation in clubs and societies				
None	2085	13.9	943	16.8
Low–medium level of participation	3800	25.3	1350	24.1
High level of participation	3658	24.4	1002	17.9
Missing	5468	36.4	2319	41.3
Caring responsibilities (2005)				
Caring for an adult				
Nearly every day	398	2.7	236	4.2
Nearly every week	665	4.4	288	5.1
Less frequently	1409	9.4	504	9.0
Never	7340	48.9	2398	42.7
Missing	5199	34.6	2188	39.0
Total	15011	100.0	5614	100.0

household incomes between 1601 and 3811 euro; 72.0% of male respondents to the income question and 67.5% of female respondents. Of the participants who responded to the income questions, only about 0.4% of men and 0.7% of women reported household earnings that were around or below the level of the French minimum full-time wage in 2002[2].

Women's levels of wealth were discernibly lower than those of the men, although the differences were not large. The modal level of household wealth in both genders was 152 449–304 898 euro.

Most of the participants were at least *quite* confident in their financial situation over the next ten years. Despite the small differences in household wealth and income between the genders, women seemed to feel less confident about their finances than men, perhaps because more of them in 2002 still had retirement to come (see section 6.3.6.3 on page 159), which will bring a drop in income.

6.3.3 Social participation and caring responsibilities

Of those participants responding to the 2005 survey, about 22% of men and 29% of women reported no participation in any kind of social activities, such as participation in religious offices, clubs, union activities and societies (Table 6.3). Men were more likely than women to report a high level of participation in organized social activities.

In contrast, women were about twice as likely as men to report that they cared for a sick or disabled adult nearly every day; however, most participants of both genders

[2]These figures can be compared with the 2002 minimum monthly salary, known as the SMIG, or with the poverty level. The SMIG, was set at 1 154.27 euro in 2002 in France. (Source: Insee *Salaire minimum interprofessionnel de croissance*. `http://www.insee.fr/fr/themes/tableau.asp?ref_id=NATnon04145`.) The relative poverty level for individuals set at 60% of the median monthly income in 2002 was 793 euros (Chevalier, 2005).

responding to the 2005 questionnaire reported that they did not care for a sick or disabled adult.

6.3.4 Neighbourhood and social support

Most individuals who responded to the neighbourhood questions from the 2003 questionnaire were content with the quality of their neighbourhood, whether this concerned local annoyances, access to local amenities or feeling secure (Table 6.4). Women were more likely than men to report frequent annoyances in the neighbourhood and dissatisfaction with access to local amenities. Similarly, women seemed to have lower connections to their neighbourhoods than men, more frequently having no family or close friends living nearby and declaring that they rarely or never exchanged good or services with neighbours.

The overwhelming majority of participants had somebody with whom they could discuss personal things or who could help them take an important decisions (a close, confiding relationship): 85% of men and 86% of women who responded to this question in the 2004 questionnaire. About 72% of men and 58% of women stated that they received enough of this sort of social support; women therefore being more likely to desire more such support.

6.3.5 Health

Most participants reported no depression symptoms, but more women than men reported symptoms of mild or more severe depression. About 15% of women and only 4% of men had scores for the CES-D scale which were over 27, indicating moderate to severe symptoms of depression.

Worse mental health for women than men is also displayed in the Short Form-36 Mental Component Score, where men's scores were close to the expected population mean of 50 while women's scores were about five points lower. In terms of physical health, both genders had close to the standardized mean score of 50 for the Short Form-36 Physical Component Score.

Of those responding to the 2006 questionnaire, most cohort members did not report any physical limitations recorded in the sub-scale of the Nottingham Health Profile: 67% of men and 57% of women. A minority of participants of both genders indicated two or more limitations to daily physical activities as a result of their health.[3]

A large minority of respondents to the 2005 questionnaire stated that they had a hearing impairment (26.3% of men and 16.3% of women), while a smaller fraction of respondents indicated difficulties with vision even when wearing glasses (7.9% of men and 15.0% of women). Around 10% of respondents of both genders reported, in 2005, a hospital stay that had taken place during the previous year.

[3] Physical limitations included: finding it hard to stand for long, finding it hard to bend, finding it hard to reach for things, and are listed in Table A.8 on page 333.

Table 6.4: Descriptive statistics of neighbourhood characteristics and emotional support for 20 625 men and women in the GAZEL cohort

Variable	Men		Women	
	Frequency	Percent (%)	Frequency	Percent (%)
Neighbourhood characteristics (2003)				
Frequent annoyances in the neighbourhood				
No	8690	57.9	2798	49.8
Yes	1424	9.5	642	11.4
Missing	4897	32.6	2174	38.7
Dissatisfaction with access to local amenities				
No	7906	52.7	2638	47.0
Yes	2161	14.4	781	13.9
Missing	4944	32.9	2195	39.1
Feel insecure or think vandalism is a problem				
No	7394	49.3	2478	44.1
Yes	2716	18.1	961	17.1
Missing	4901	32.7	2175	38.7
No family or close friends living nearby				
No	5335	35.5	1655	29.5
Yes	4766	31.8	1780	31.7
Missing	4910	32.7	2179	38.8
Rarely/never exchange goods/services with neighbours				
No	8536	56.9	2633	46.9
Yes	1569	10.5	806	14.4
Missing	4906	32.7	2175	38.7
Emotional support (2004)				
Close, confiding relationship				
No	1607	10.7	522	9.3
Yes	9160	61.0	3277	58.4
Missing	4244	28.3	1815	32.3
Sufficient social support				
No, a lot more support needed	263	1.8	280	5.0
No, more support needed	976	6.5	512	9.1
No, a little more support needed	1732	11.5	754	13.4
Yes	7614	50.7	2170	38.7
Missing	4426	29.5	1898	33.8
Total	15011	100.0	5614	100.0

Table 6.5: Descriptive statistics of health characteristics for 20 625 men and women in the GAZEL cohort

Variable	Men			Women		
	n	Percent (%)	$\bar{x}$ (standard deviation)	n	Percent (%)	$\bar{x}$ (standard deviation)
Health						
Depression (2005)						
No depression	8513	56.7		2154	38.4	
Symptoms of mild depression	1605	10.7		942	16.8	
Symptoms of more severe depression	339	2.3		464	8.3	
Missing	4554	30.3		2054	36.6	
SF-36 Mental component score (2003)	10598	70.6	49.0 (9.1)	3627	64.6	44.1 (11.5)
Missing	4413	29.4		1987	35.4	
SF-36 Physical component score (2003)	10598	70.6	50.7 (6.8)	3627	64.6	49.7 (8.2)
Missing	4413	29.4		1987	35.4	
Limitations to physical activities (2006)						
No limitations	7178	47.8		2139	38.1	
One limitation	1964	13.1		816	14.5	
Two or more limitations	1581	10.5		824	14.7	
Missing	4288	28.6		1835	32.7	
Hearing impairment (2005)						
No	7870	52.4		3048	54.3	
Yes	2810	18.7		592	10.6	
Missing	4331	28.9		1974	35.2	
Visual impairment (2005)						
No	9809	65.4		3098	55.2	
Yes	843	5.6		548	9.8	
Missing	4359	29.0		1968	35.1	
Hospitalization (2004)						
No	9301	62.0		3178	56.6	
Yes	1104	7.4		356	6.3	
Missing	4606	30.7		2080	37.1	
Total	15011	100.0		5614	100.0	

6.3.6 Retirement

6.3.6.1 Number of GAZEL participants who have retired

By 29th February 2012, 96.0% of the participants had retired: 14 621 men and 5179 women. The remainder of the participants had either died before retiring, which concerned 2.3% of the cohort, 370 men and 112 women, or were not recorded as retiring by end of February 2012, which concerned 1.7% of the cohort, 20 men and 323 women.[4]

6.3.6.2 Age at retirement

The oldest exit time (retirement or death) was 66.5 years for men and 66.1 years for women. Women started retiring from age 35.2 years, men from age 41.6 years, a reflection of the fact that women could be recruited into the cohort from age 35 years, compared to age 40 years for men. The male distribution of ages at retirement is markedly unimodal, with the modal retirement age being 55 years (Figure 6.4). Women's ages of retirement are more evenly distributed between the ages of 53 and 60 years, although the most frequent retirement age is also 55 years (Figure 6.4).

Using descriptive event history techniques, which take account of individuals dying before retiring as well as of individuals who had not retired by 2009, the nature of retirement in this cohort for almost all of the GAZEL participants was described. As a consequence of the company retirement rules, in which careers involving strenuous work were shortened, women tended to retire at slightly older ages then men: the median age at retirement was 55.0 years for men and 55.7 years for women (for women this age is likely to rise over the years to come). Three-quarters of the men were retired by age 56 years, in contrast to women where the retirement age was almost 59 years: this gap between the genders is clearly visible in Figure 6.5.

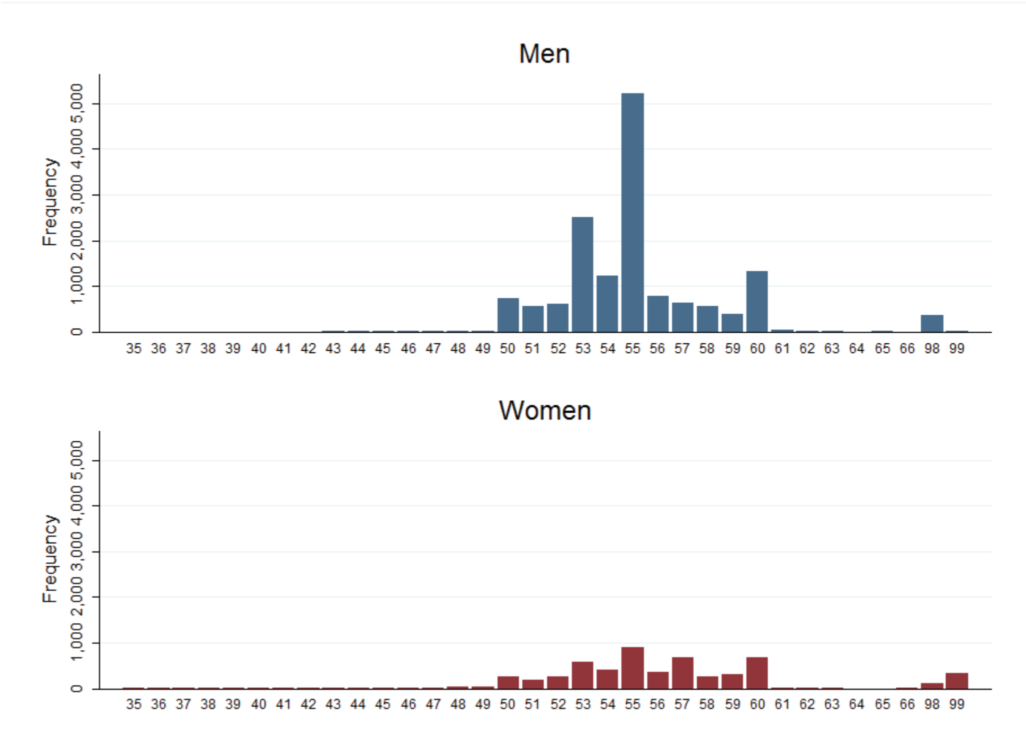
In Figure 6.6, participants from white-collar occupations, whether managers, professionals or employees, retired at older ages than people who worked in blue-collar occupations. This is as would be expected from the EDF-GDF retirement rules (see section 5.2.12 on page 116). Taking the genders separately (results not shown), the trends for men resemble those for both genders. However, in women alone no clear trends were apparent, most likely because few women were employed in the sorts of strenuous occupations that allowed them to retire earlier, as will be described in section 6.3.7.1 on page 162.

6.3.6.3 Timing of retirement

For those who had retired by 29th February 2012, the median date of retirement was 31st October 1999 for the men and 30th June 2002 for the women. Up to about 1994 there was little difference between the male and female rates of retirement; the gap opened up over the next ten years: women tended to be younger than the men and men could retire from around age 55 years if they had been employed in blue-collar occupations (Figure 6.7). Most retirement took place between around 1998 and 2003 in both genders; this could be

[4] In the case of this latter group, it is possible that a proportion of the women and perhaps all of the remaining men have been lost to follow-up as a result of leaving the company or the study.

Figure 6.4: Recorded ages of retirement for 15 009 men (above) and 5609 women (below) in the GAZEL cohort



Note: The category numbered 98 represents participants who died before retiring while 99 represents participants who were not recorded as having retired by 29th February 2012.

Figure 6.5: Kaplan-Meier failure estimates for retirement age for 15 009 male and 5609 female GAZEL participants up to February 29th 2012

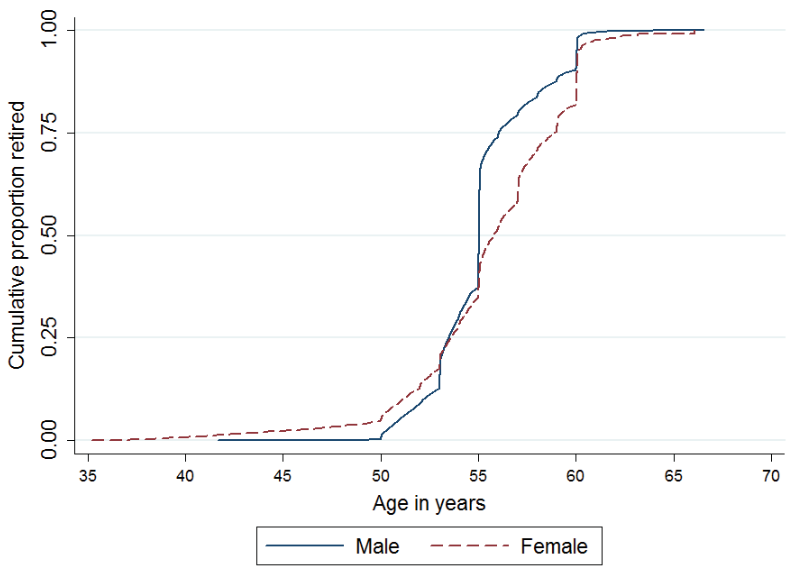


Figure 6.6: Kaplan-Meier failure estimates for retirement age by French occupational class in 1989 for men and women

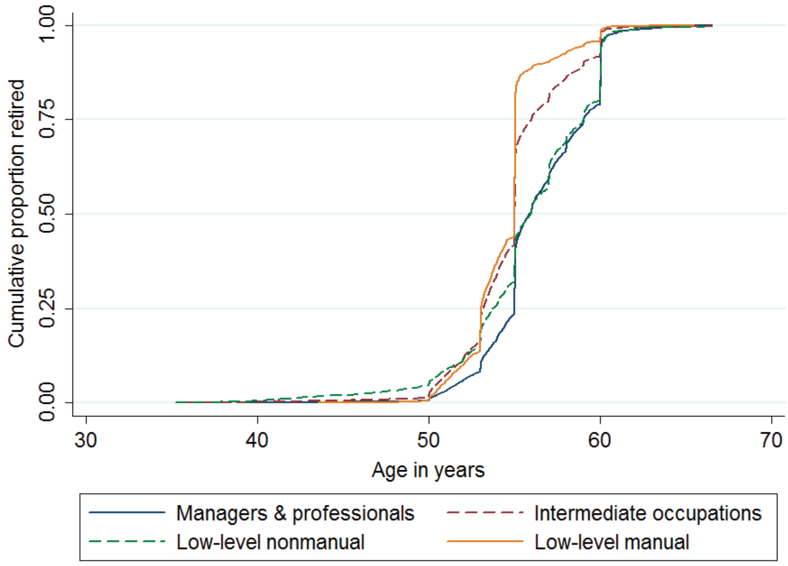
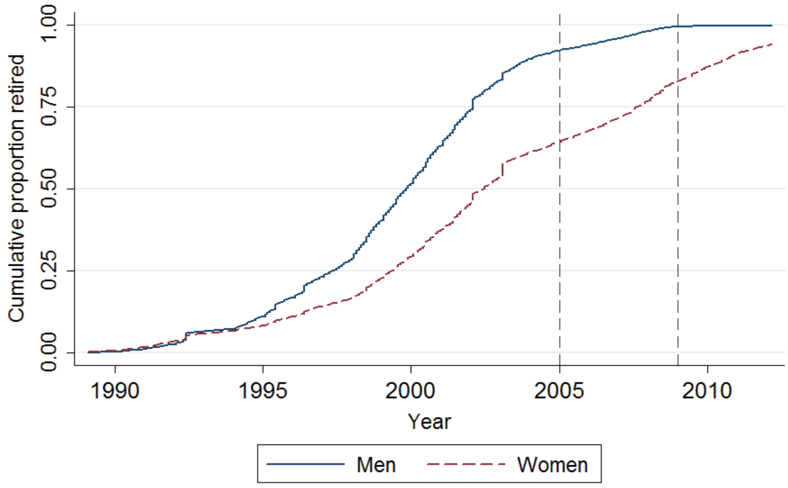


Figure 6.7: Kaplan-Meier failure estimates for retirement date for 15 011 male and 5614 female GAZEL participants up to 29^{th} February 2012



Note: The two vertical dashed lines represent measurement of CASP-19 in 2005 and 2009.

a result of a period effect, where the company encouraged a wave of retirements during these years, or an age effect.

6.3.6.4 Type of retirement transition

Table 6.6 describes the type of retirement transitions undergone by participants who had retired by 29th February 2012. Only a small minority of participants (540 men and 257 women) had a transition to retirement that they indicated was marked by ill health or disability. An even smaller proportion was recorded as continuing professional activities following retirement, around 500 men and 91 women.

Table 6.6: Descriptive statistics of type of retirement transition for 20 625 men and women in the GAZEL cohort

Variable	Men		Women	
	Frequency	Percent (%)	Frequency	Percent (%)
Type of retirement transition				
Retirement in ill health				
No	14471	96.4	5357	95.4
Yes	540	3.6	257	4.6
Post-retirement professional activities				
No	11820	78.7	4273	76.1
Yes	500	3.3	91	1.6
Missing or retiring after 2002	2691	17.9	1250	22.3
Total	15011	100.0	5614	100.0

6.3.7 Employment characteristics

6.3.7.1 Working conditions

The GAZEL cohort participants have experienced a range of physical and psychosocial occupational exposures. Two of the measures of physical occupational exposure: accumulated chemical exposures and accumulated workplace accidents were obtained from administrative files and two others from the baseline survey, therefore there were no missing data. In contrast, the retrospective measure of ergonomic strain, obtained from the 2007 questionnaire, suffers from considerable missing data.

The differences between men and women are large, therefore the two genders will be examined in turn. Women had been exposed to low levels of dangerous and strenuous working conditions; where they had been exposed, the exposure tended to be at low levels. It is possible that these values are too low to estimate with any precision the impact of these exposures upon quality of life in women. In contrast, male participants had experienced a range of exposures to ergonomic strain, physical danger and hazardous chemicals.

In terms of psychosocial working conditions, the proportions of participants experiencing job strain or effort-reward imbalance were low. Of those responding to the relevant questionnaires, about 8% of men and 17% of women reported job strain, and 6% of men and 8% of women reported effort-reward imbalance.

Table 6.7: Descriptive statistics of physical and psychosocial working conditions for 20 625 men and women in the GAZEL cohort

Variable	Men			Women		
	n	Percent (%)	$\bar{x}$ (standard deviation)	n	Percent (%)	$\bar{x}$ (standard deviation)
Physical working conditions						
Retrospective ergonomic strain (2007)						
None	3726	24.8		2854	50.8	
Exposed (<median level of exposure)	3106	20.7		674	12.0	
Exposed (≥median level of exposure)	3669	24.4		81	1.4	
Missing	4510	30.0		2005	35.7	
Ergonomic strain (1989/90)	15011	100.0	1.0 (1.1)	5614	100.0	0.3 (0.5)
Missing	0	0.0		0	0.0	
Physical danger (1989/90)	15011	100.0	1.7 (1.6)	5614	100.0	0.2 (0.5)
Missing	0	0.0		0	0.0	
Accumulated workplace accidents						
None	12031	80.2		4889	87.1	
One	1956	13.0		545	9.7	
Two or more	1024	6.8		180	3.2	
Missing	0	0.0		0	0.0	
Chemical exposures						
No exposure	5775	38.5		5538	98.7	
Exposed (<median level of exposure)	4591	30.6		66	1.2	
Exposed (≥median level of exposure)	4645	30.9		10	0.2	
Missing	0	0.0		0	0.0	
Psychosocial working conditions						
Job strain (1997/99)						
No	7795	51.9		2732	48.7	
Yes	684	4.6		565	10.1	
Missing	6532	43.5		2317	41.3	
Effort-reward imbalance (1998)						
No	5358	35.7		1784	31.8	
Yes	342	2.3		148	2.6	
Missing	9311	62.0		3682	65.6	
Total	15011	100.0		5614	100.0	

6.3.7.2 Occupational position

In 1989, at the onset of the GAZEL study, male employees were aged between 40–50 years old and female employees between 35–50 years old. Retirement rules in the GAZEL cohort generally provide for retirement ages between 55–60 years, although exceptions were made for individuals to retire at younger ages. Therefore, for most, 1989 marked a late

Table 6.8: Descriptive statistics of occupational position for 20 625 men and women in the GAZEL cohort

Variable	Men			Women		
	n	Percent (%)	$\bar{x}$ (standard deviation)	n	Percent (%)	$\bar{x}$ (standard deviation)
Social position (1989)						
Occupational grade (Functional group)						
Lower level (*exécutants*)	2151	14.3		1529	27.2	
Mid level (*maîtrise*)	8385	55.9		3635	64.8	
Higher level (*cadres*)	4460	29.7		442	7.9	
Missing	15	0.1		8	0.1	
Occupational grade (detailed)	14960	99.7	9.1 (3.5)	5585	99.5	6.9 (2.7)
Missing	51	0.3		29	0.5	
ESeC class						
ESeC 1: Higher salariat	4417	29.4		454	8.1	
ESeC 2: Lower salariat	2201	14.7		3085	55.0	
ESeC 3: Higher grade white-collar workers	758	5.1		1172	20.9	
ESeC 6: Higher grade blue-collar workers	5740	38.2		391	7.0	
ESeC 7: Lower grade white-collar workers	120	0.8		456	8.1	
ESeC 8: Lower grade blue-collar workers	1714	11.4		38	0.7	
ESeC 9: Semi and unskilled workers	44	0.3		4	0.1	
Missing	17	0.1		14	0.3	
Total	15011	100.0		5614	100.0	

stage in the career, when individuals are likely to have reached relatively senior positions. Career trajectories are displayed below (cf. section 6.3.7.3 on the facing page), but initially detailed information about employees' occupational positions will be presented here.

By 1989, most GAZEL participants were employed in the mid-level functional group, women more so than men (see Table 6.8). Male employees were more likely than female employees to be working in the highest *cadre* grades: almost 30% of men occupied such senior grades, compared to only 8% of women.

In terms of social class, categorized using the European Socio-economic Classification, the GAZEL employees were employed in 1989 in both white and blue-collar occupations at a variety of levels. A gender division is apparent, in which women tended to hold white-collar posts while men held blue-collar and managerial posts. Few employees were working in semi and unskilled worker posts (ESeC 9), and a high proportion had progressed to posts with supervisory responsibilities, whether white collar or blue collar (ESeC 2, ESeC 3 and ESeC 6). About 30% of male employees had attained higher salariat posts corresponding to high-level managerial and professional roles (ESeC 1), but only about 8.1% of women. In contrast, over half of women occupied the lower salariat posts (ESeC 2).

6.3.7.3 Describing social position over the life course in the GAZEL cohort

In this section, descriptive information for individuals' career trajectories will be displayed. The GAZEL participants' social position can be described using occupational grade or social class, which are contrasting measures of social position (see section 5.2.11.4 on page 116). Therefore, this section will present individuals' career trajectories for each of these measures in turn.

Figures 6.8 and 6.9 display trajectories for men and women working at EDF-GDF 1970–2000 by occupational grade, using the functional group measure. These are illustrative of the nature of the careers in the GAZEL cohort and, as such, only individuals who are working for the company between these years are included. It is possible that those individuals working for the company for a shorter period of time had trajectories that were different. These graphs do not display individual trajectories, instead the participants are all amalgamated together. As such, these graphs can be thought of as providing a series of snap-shots in each year of the proportions of individuals working in each grade.

In Figure 6.8, it is apparent that most men were working in lower level grades in the early 1970s, and were gradually promoted, about half into mid-level and the other half into higher grades by the 1980s. In contrast, a slightly larger proportion of women were employed in the lower grades in the early 1970s and rates of promotion were slightly lower (Figure 6.9). Most strikingly, while most women were promoted into the mid-level grades, only a small proportion, about 15%, were promoted into the higher, managerial, grades.

Turning to social class, measured with the European Socio-economic Classification (ESeC), the career trajectories of men and women are marked by contrasting trends.

In Figure 6.10, in 1970, a period towards the start of most men's careers, men were working across posts that corresponded to a variety of social classes. More precisely, almost half of the men were working in posts that corresponded to ESeC 8 skilled manual occupations, while another large proportion were employed in high-level white-collar (ESeC 3) posts. Over the course of the earlier part of their careers, they were promoted into ESeC 2 lower salariat and into ESeC 6 high-level blue-collar classes, both classes that have substantial supervisory responsibilities, whether for white-collar or blue-collar employees. By 2000, about half of the men had achieved promotion into posts corresponding to ESeC 1 higher salariat.

In Figure 6.11, women, in 1970, towards the start of their careers, were overwhelmingly employed in ESeC 3 high-level white collar occupations. Between 1970 and 1982, women's roles diversified. The vast majority of women were promoted into ESeC 2 lower salariat, roles with supervisory responsibilities towards other white-collar employees. A minority of women were promoted into posts corresponding to higher level blue collar occupations (ESeC 6) or moved sideways into lower level white-collar occupations (ESeC 7), while around 15% progressed into the higher salariat (ESeC 1).

Figure 6.8: Chronogram of functional group trajectories for 4519 men from the GAZEL cohort employed at EDF-GDF between 1970 and 2000

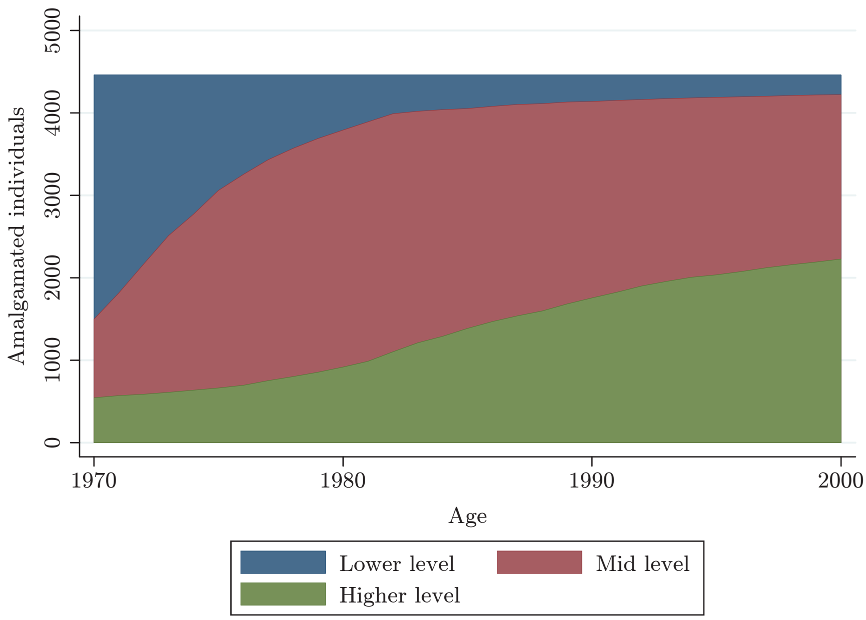


Figure 6.9: Chronogram of functional group trajectories for 1568 women from the GAZEL cohort employed at EDF-GDF between 1970 and 2000

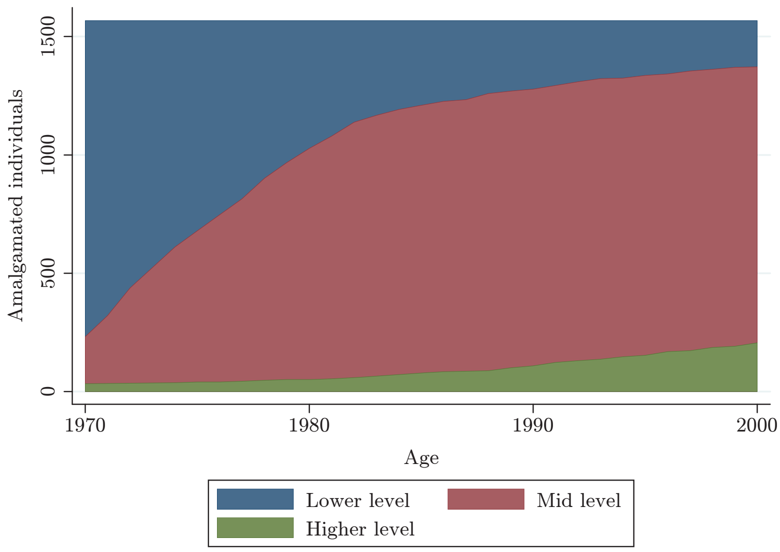
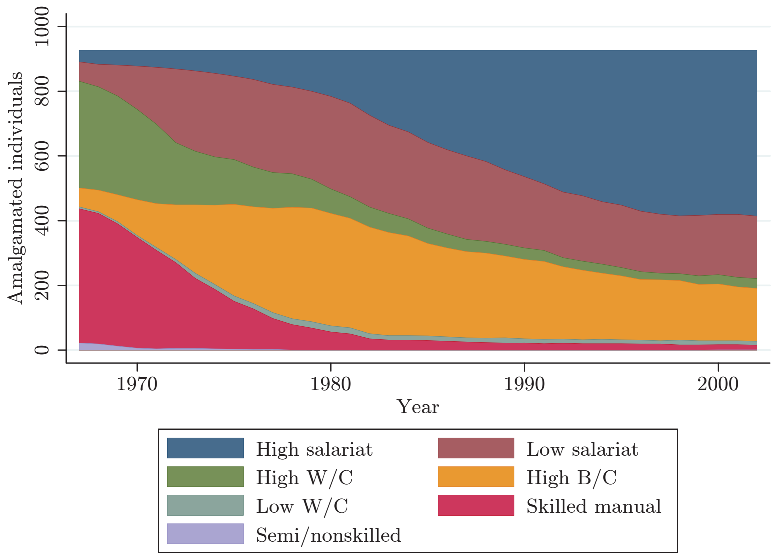
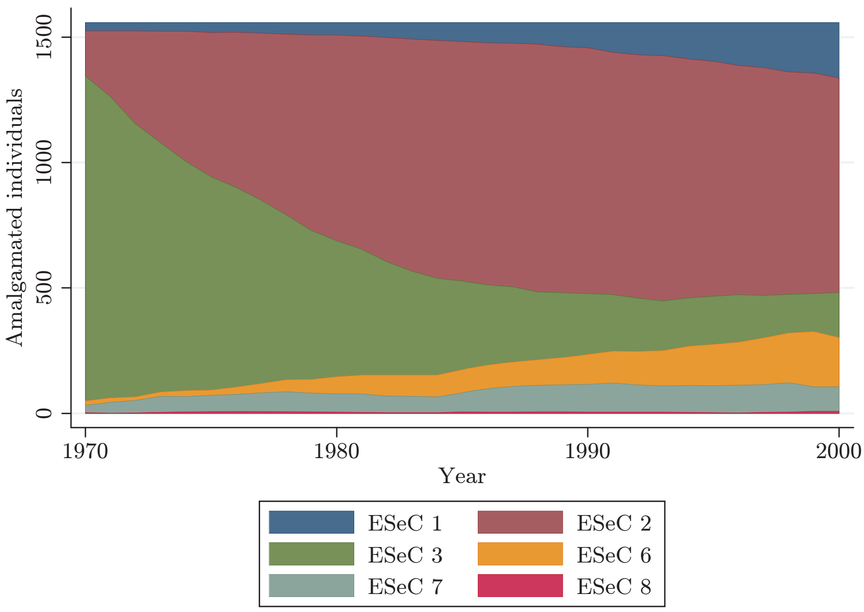


Figure 6.10: Chronogram of ESeC social class trajectories for 4508 men from the GAZEL cohort employed at EDF-GDF between 1970 and 2000



ESeC 1 (Large employers, higher grade professionals, administrative and managerial occupations), ESeC 2 (Lower grade professional, administrative and managerial occupations and higher grade technicians and supervisory occupations), ESeC 3 (Intermediate occupations), ESeC 6 (Lower supervisory and lower technician occupations), ESeC 7 (Lower sales, services and clerical occupations), ESeC 8 (Lower technical occupations) and ESeC 9 (Routine occupations).

Figure 6.11: Chronogram of ESeC social class trajectories among 1559 women from the GAZEL cohort employed at EDF-GDF between 1970 and 2000



See above for ESeC class categories.

6.4 Conclusion

To summarize, in terms of the variables relating to individuals' current circumstances, most participants were married, in good physical health and felt they received adequate social support. Male-female differences were relatively small, and concerned higher rates of reported depression symptoms for women, lower rates of marriage for women, a higher proportion of men being retired, and a higher proportion of women than men caring for an adult almost every day.

Differences between the genders for variables describing employment characteristics were larger. Men tended to be working in higher job grades in 1989 and in social classes with substantial managerial or supervisory responsibility, a consequence of having been promoted more rapidly than women over their careers. Similar, and small, proportions of men and women were exposed to effort-reward imbalance; women were more likely to report job strain. In contrast to men, who often experienced substantial physical occupational exposures, women were less often exposed to strenuous and dangerous working conditions, and of those women who were, they were exposed to a lesser degree than men.

To conclude, this chapter has described the CASP-19 measure of quality of life and the characteristics of the GAZEL cohort. In the first part, the CASP-19 measure of quality of life was found to have suitable measurement properties for use as an outcome variable in analyses such as multiple regression. Other variables used in the thesis have been presented, providing a base for comparison with the descriptive tables contained in the results chapters.

Chapter 7

Current influences upon quality of life

Summary

This chapter presents cross-sectional associations between individuals' current and recent circumstances and their quality of life. Variables have been selected from a wide range of domains that have been shown to predict CASP-19 quality of life in British and other European cohorts. Those domains include socio-demographic characteristics, state of physical and mental health, neighbourhood characteristics, financial adequacy and social relationships.

Using the GAZEL dataset, CASP-19 quality of life in 2005 was regressed on each of each of its possible determinants, before a multiple regression analysis was performed predicting quality of life in relation to all of the domains. In total, these domains predicted 54% of the variability in quality of life between individuals. Although quality of life was predicted by several domains, the mental and physical health domain contributed the majority of the independently explained variation to quality of life.

7.1 Introduction

The review of the literature on current determinants on quality of life, presented in section 3.4.1 on page 55, demonstrated that a wide range of individuals' current circumstances predicted their quality of life in early old age. Important domains for quality of life included age, neighbourhood characteristics, relationships, health, and, to certain extent, socio-economic characteristics. However, this research primarily uses British and Irish cohorts, supplemented by a number of single or multi-country analyses of the European SHARE survey. The current thesis extends this work to the French context, examining whether the same factors predict quality of life in older people from the large French GAZEL cohort.

This section answers the research question: *Which current and recent factors predict quality of life at older ages?* and is represented in the model depicted in Figure 4.1 in Chapter 4 by the arrow from *current and recent factors* to *quality of life*. This chapter, in analysing the influences of individuals' current and recent circumstances, represents an important first step towards modelling longer term influences upon quality of life in early old age.

7.2 Results

The methods are fully described in section 5.3.2 on page 122. Initially, descriptive statistics will be presented, in order to discuss the characteristics of this sample used in this analysis. Secondly, to find out which current and recent factors predict quality of life, bivariate statistics will be presented, indicating the relationships between quality of life and each of its possible determinants. The determinants of quality of life have been divided up into a series of domains: demographics, family situation, financial adequacy, community and social relationships, and health. These enable the unadjusted associations between quality of life and each of its domains to be examined. It is likely that the factors predicting quality of life overlap to a certain extent. Therefore, multivariate associations between all of the domains and quality of life will be examined. In a final step, a comparison will be performed of how much variation in quality of life was predicted independently by each domain.

In this chapter, men and women are analysed together. This makes the results more comparable with previous studies examining cross-sectional associations between current circumstances and quality of life (Layte et al., 2013; Netuveli et al., 2006). However, for interest, results stratified by gender are presented in Appendix E.

7.2.1 Description of sample

The description of the complete case sample used for this analysis is provided in Table 7.1. A similar table, stratified by gender, is presented in Appendix E: Table E.1.

Table 7.1: Descriptive results for 7695 GAZEL participants (complete cases only)

Variable	n (%)	$\bar{x}$ (standard deviation)
Quality of life (2005)	7695 (100.0%)	43.1 (7.9)
CASP-19		
Demographics		
Gender		
Male	5941 (77.2%)	
Female	1754 (22.8%)	
Age (2005)	7695 (100.0%)	60.4 (3.4)
Family situation		
Children ever recorded at home (1989, 2002, 2005)		
No children	1021 (13.3%)	
One or more children	6674 (86.7%)	
Marital status in 2005		
Single	187 (2.4%)	
Married or cohabiting	6741 (87.6%)	
Divorced or separated	569 (7.4%)	
Widowed	198 (2.6%)	
Household size in 2005		
Living alone	722 (9.4%)	
Two people	5557 (72.2%)	
Three or more people	1416 (18.4%)	
Financial adequacy & activity		
Net monthly household revenue (2002)		
<1372 euro	239 (3.1%)	
1372 – <1601 euro	168 (2.2%)	
1601 – <1982 euro	1355 (17.6%)	
1982 – <2592 euro	1159 (15.1%)	
2592 – <3811 euro	2970 (38.6%)	
3811 – <4574 euro	760 (9.9%)	
≥4574 euro	1044 (13.6%)	
Confidence in financial situation for next ten years (2002)		
Very confident	1160 (15.1%)	
Quite confident	5244 (68.2%)	
Not very confident	1165 (15.1%)	
Not confident at all	126 (1.6%)	

Continued on next page

Table 7.1 – ***continued from previous page***

Variable	n (%)	$\bar{x}$ (standard deviation)
Labour market status (2005)		
Working	1004 (13.1%)	
Retired	6691 (87.0%)	
Community & social relationships		
Participation in clubs and societies (2005)		
No participation	1682 (21.9%)	
Low–medium level of participation	3038 (39.5%)	
High level of participation	2975 (38.7%)	
Frequent annoyances in the neighbourhood (2003)		
No	6567 (85.3%)	
Yes	1128 (14.7%)	
Dissatisfaction with access to local amenities (2003)		
No	5979 (77.7%)	
Yes	1716 (22.3%)	
Feel insecure or think vandalism is a problem (2003)		
No	5691 (74.0%)	
Yes	2004 (26.0%)	
No family or close friends living nearby (2003)		
No	3975 (51.7%)	
Yes	3720 (48.3%)	
Rarely or never exchange goods/services with neighbours (2003)		
No	6353 (82.6%)	
Yes	1342 (17.4%)	
Close, confiding relationship (2004)		
No	1080 (14.0%)	
Yes	6615 (86.0%)	
Sufficient social support (2004)		
No, a lot more support needed	248 (3.2%)	
No, more support needed	720 (9.4%)	
No, a little more support needed	1332 (17.3%)	
Yes	5395 (70.1%)	

Continued on next page

Table 7.1 – *continued from previous page*

Variable	n (%)	$\bar{x}$ (standard deviation)
Caring for an adult (2005)		
Nearly every day	334 (4.3%)	
Nearly every week	516 (6.7%)	
Less frequently	1117 (14.5%)	
Never	5728 (74.4%)	
Health		
Depression (2005)		
Few or no depression symptoms	5960 (77.5%)	
Symptoms of mild depression	1359 (17.7%)	
Symptoms of more severe depression	376 (4.9%)	
SF-36 Mental component score (2003)	7695 (100.0%)	48.2 (9.8)
SF-36 Physical component score (2003)	7695 (100.0%)	50.6 (7.1)
Limitations to physical activities (2006)		
No limitations	4906 (63.8%)	
One limitation	1416 (18.4%)	
Two or more limitations	1191 (15.5%)	
Missing	182 (2.4%)	
Total	7695 (100.0%)	

Comparison of these tables with those for the complete sample presented in section 6.3 on page 152, does not reveal large differences in the proportions or mean scores. However, compared to the cohort as a whole, individuals providing enough information to include them in these complete case analyses reported slightly better mental health, fewer symptoms of depression, more participation in social activities, and female members were more often satisfied with the level of emotional support they received.

7.2.2 Cross-sectional bivariate associations between quality of life and individuals' recent circumstances

The bivariate relationships between the recent or current factors and CASP-19 quality of life in 2005 are presented in Table 7.2. Results stratified by gender are presented in Appendix E: Tables E.2 and E.3.

Table 7.2: Bivariate relationships between contemporaneous predictors and CASP-19 quality of life for 7695 GAZEL participants

Variable	Coefficient	SE	p-value	95% CI
Demographics				
Gender				
Male	*Reference*	*Reference*	*Reference*	*Reference*
Female	−2.53	0.21	<0.001	−2.94 to −2.11
Age and age-squared				
Age	−0.05	0.03	0.046	−0.10 to 0.00
Age-squared	−0.05	0.01	<0.001	−0.06 to −0.04
Family				
Children				
No children	*Reference*	*Reference*	*Reference*	*Reference*
One or more children	0.96	0.26	<0.001	0.45 to 1.48
Marital status (2005)				
Single	−3.60	0.58	<0.001	−4.73 to −2.48
Married or cohabiting	*Reference*	*Reference*	*Reference*	*Reference*
Divorced or separated	−3.54	0.34	<0.001	−4.20 to −2.87
Widowed	−1.52	0.56	0.007	−2.62 to −0.42
Household size (2005)				
Living alone	−3.15	0.31	<0.001	−3.76 to −2.55
Two people	*Reference*	*Reference*	*Reference*	*Reference*
Three or more people	−1.26	0.23	<0.001	−1.71 to −0.80
Financial adequacy & activity				
Net monthly household revenue (2002)				
<1372 euro	−4.00	0.52	<0.001	−5.02 to −2.98
1372 – <1601 euro	−2.51	0.61	<0.001	−3.71 to −1.30
1601 – <1982 euro	−1.48	0.25	<0.001	−1.98 to −0.98
1982 – <2592 euro	−0.79	0.27	0.003	−1.32 to −0.27
2592 – <3811 euro	*Reference*	*Reference*	*Reference*	*Reference*
3811 – <4574 euro	1.16	0.31	<0.001	0.54 to 1.77
≥4574 euro	1.70	0.28	<0.001	1.15 to 2.24

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Table 7.2 – *continued from previous page*

Variable	Coefficient	SE	p-value	95% CI
Confidence in finances (2002)				
Very confident about finances	*Reference*	*Reference*	*Reference*	*Reference*
Quite confident about finances	−3.00	0.24	<0.001	−3.47 to −2.52
Not very confident about finances	−7.74	0.31	<0.001	−8.34 to −7.13
Not confident at all about finances	−11.00	0.70	<0.001	−12.38 to −9.63
Labour market status (2005)				
Working	*Reference*	*Reference*	*Reference*	*Reference*
Retired	2.26	0.26	<0.001	1.75 to 2.78
Community & social relations				
Social participation (2005)				
No participation	*Reference*	*Reference*	*Reference*	*Reference*
Low–medium participation	1.37	0.24	<0.001	0.90 to 1.83
High participation	3.09	0.24	<0.001	2.63 to 3.55
Frequent annoyances in the neighbourhood (2003)				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	−2.44	0.25	<0.001	−2.93 to −1.95
Dissatisfaction with access to local amenities (2003)				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	−2.50	0.21	<0.001	−2.92 to −2.08
Feel insecure or think vandalism is a problem (2003)				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	−2.11	0.20	<0.001	−2.51 to −1.71
No family or close friends living nearby (2003)				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	−0.75	0.18	<0.001	−1.10 to −0.40
Rarely or never exchange goods/services with neighbours (2003)				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	−2.65	0.23	<0.001	−3.11 to −2.19
Close, confiding relationship (2004)				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	4.77	0.25	<0.001	4.28 to 5.26

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Table 7.2 – *continued from previous page*

Variable	Coefficient	SE	p-value	95% CI
Perceived adequacy of social support (2004)				
Much more social support needed	−11.70	0.47	<0.001	−12.63 to −10.78
More social support needed	−6.48	0.29	<0.001	−7.04 to −5.91
A little more social support needed	−4.44	0.22	<0.001	−4.87 to −4.00
Enough social support	*Reference*	*Reference*	*Reference*	*Reference*
Caring for an adult (2005)				
Nearly every day	−2.44	0.44	<0.001	−3.31 to −1.58
Nearly every week	−0.80	0.36	0.025	−1.51 to −0.10
Less frequently	−0.06	0.26	0.820	−0.56 to 0.44
Never	*Reference*	*Reference*	*Reference*	*Reference*
Health				
Depression symptoms (CES-D) (2005)				
Few or no depression symptoms	*Reference*	*Reference*	*Reference*	*Reference*
Symptoms of mild depression	−8.77	0.18	<0.001	−9.12 to −8.42
Symptoms of moderate/severe depression	−19.23	0.32	<0.001	−19.86 to −18.61
Short-form 36 mental health (2003)				
SF-36 mental component summary	0.40	0.01	<0.001	0.39 to 0.42
Short-form 36 physical health (2003)				
SF-36 physical component summary	0.31	0.01	<0.001	0.29 to 0.33
Limitations to physical activities (NHP) (2006)				
No limitations to physical activities	*Reference*	*Reference*	*Reference*	*Reference*
One limitation to physical activities	−3.65	0.22	<0.001	−4.08 to −3.21
Two or more limitations to physical activities	−7.27	0.24	<0.001	−7.73 to −6.80
Missing	−3.40	0.55	<0.001	−4.49 to −2.31

Quality of life was associated with all of the domains examined. Worse mean quality of life was reported by women and by older respondents. The negative and significant coefficient for age-squared suggests that the relationship between age and quality of life is not linear. In terms of family characteristics, having had children was associated with higher average quality of life. Poorer mean quality of life was associated with living alone, or in a household with three or more people, compared to living in a two-person household, as well as with being single, divorced/separated or widowed, compared to respondents who were married or cohabiting.

In terms of the financial adequacy and activity domain, participants in a worse financial situation (whether in terms of household income or confidence in finances) reported lower mean CASP-19 scores in a graded relationship. Participants who were still working also reported lower scores.

All the factors from the community and social relations domain were associated with quality of life. Cohort members who reported difficulties in their neighbourhoods, lack of social support or who were caring for an adult nearly every day or every week tended to report lower quality of life. In contrast, participants who had close, confiding relationships and who participated in organized social activities reported higher mean quality of life.

In terms of the health domain, participants who reported symptoms of depression and worse physical and mental health and functioning reported lower quality of life scores, on average.

The sizes of these effects will be compared to the difference in CASP-19 quality of life scores between participants who reported no limitations to physical functioning and those who reported two or more difficulties with physical functioning, a difference of about −7.2 CASP-19 points, which would be interpreted as a large effect (Layte et al., 2013). Similarly large effects were found for participants reporting symptoms of mild depression (−8.8 points, compared to few or no depression symptoms), reporting that they required more social support (−6.5 points, compared to participants reporting enough social support), and who did not feel very confident about their finances (−7.7 points, compared to the minority who were very confident about their finances).

Substantially larger differences were seen for participants reporting symptoms indicating moderate/severe depression (−19.2 points, compared to few or no depression symptoms), who required *much* more social support (−11.7 points, compared to participants reporting receiving enough social support), and who were not confident at all about their finances (−11.0 points, compared to participants who were very confident).

Smaller effects were seen for cohort members having a close, confiding relationship (+4.8 points), who were in the lowest income band of <1372 euro (−4.0 points, compared to earning 2592 to under 3811 euro), single or divorced/separated (−3.5 points, compared to married or cohabiting respondents), female (−2.5 points), very active in organized activities (+3.1 points, compared to non-participants), retired (+2.3 points), and cohort members who were dissatisfied with their access to local amenities (−2.5 points), who felt insecure in their local area (−2.1 points), or who did not exchange goods/services with their neighbours (−2.7 points).

To conclude, a wide range of current and recent life circumstances were associated with quality of life, including those related to participants' physical and mental health, financial situation, social participation, marital status, adequacy of social support and perceived characteristics of their communities. It is likely that some of these domains overlap; for example, participants who are married are likely to receive emotional support from their spouse. Therefore, the next section describes results from multiple regression models, in order to determine whether each variable predicts quality of life independently of the others.

7.2.3 Cross-sectional multivariate relationships between quality of life and individuals' current circumstances

Variables were introduced into a series of nested models in blocks, beginning with demographic variables, before adding variables related to participants' family, financial, community and health circumstances (Table 7.3). The proportion of explained variability (R^2) in the outcome variable CASP-19 is provided for each model, as well as the log-likelihood and AIC. A presentation of results stratified by gender can be found in Appendix E, in Tables E.4 and E.5.

A sensitivity analysis was performed for the final model "Health", using full information maximum likelihood estimation, a more robust approach than listwise deletion for handling missing data. The results obtained were substantively the same and are displayed in Table G.1 in Appendix G.

Table 7.3: Nested models of the current factors predicting 2005 CASP-19 scores in the GAZEL cohort study (unstandardized β coefficients; n=7695)

Variable	Demographics	Family	Finances	Community	Health
Demographics					
Gender					
Male	*Reference*	*Reference*	*Reference*	*Reference*	*Reference*
Female	−2.36***	−1.94***	−1.73***	−0.99***	0.91**
Age					
Age	0.05	0.08**	0.16***	0.16***	0.10***
Age-squared	−0.03***	−0.02**	−0.01	−0.01	−0.01
Family					
Children					
No children		*Reference*	*Reference*	*Reference*	*Reference*
One or more children		0.40	0.25	0.12	−0.16
Marital status					
Single		−2.72***	−1.91**	−1.56*	−0.97
Married or cohabiting		*Reference*	*Reference*	*Reference*	*Reference*
Divorced or separated		−3.08***	−1.66***	−1.03*	−0.59
Widowed		−0.90	−0.51	−0.31	0.73
Household size					
One person		−0.13	−0.13	−0.07	0.28
Two people		*Reference*	*Reference*	*Reference*	*Reference*
Three or more people		−1.32***	−1.12***	−0.70***	−0.84***

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Table 7.3 – *continued from previous page*

Variable	Demographics	Family	Finances	Community	Health
Financial adequacy & activity					
Monthly household income					
<1372 euro			−0.90	−0.08	−0.26
1372 – <1601 euro			−1.03	−0.68	−0.74
1601 – <1982 euro			−0.53*	−0.40	−0.45*
1982 – <2592 euro			−0.67**	−0.64**	−0.71***
2592 – <3811 euro			*Reference*	*Reference*	*Reference*
3811 – <4574 euro			0.71*	0.76**	0.39
≥4574 euro			1.37***	1.20***	0.81***
Confidence in finances over the next 10 years					
Very confident			2.53***	2.17***	1.33***
Quite confident			*Reference*	*Reference*	*Reference*
Not very confident			−4.19***	−3.07***	−1.57***
Not confident at all			−6.82***	−4.74***	−2.51***
Labour market status					
In work			*Reference*	*Reference*	*Reference*
Retired			1.77***	1.31***	0.46*
Community & social relationships					
Social participation					
No participation				*Reference*	*Reference*
Low–medium participation				1.06***	0.54***
High participation				2.20***	1.26***
Frequent annoyances in the neighbourhood					
No				*Reference*	*Reference*
Yes				−0.87***	−0.05
Dissatisfaction with access to local amenities					
No				*Reference*	*Reference*
Yes				−1.32***	−0.41***
Feel insecure or think vandalism is a problem					
No				*Reference*	*Reference*
Yes				−0.80***	0.09
No family or close friends living nearby					
No				*Reference*	*Reference*
Yes				−0.09	−0.13

Continued on next page

Table 7.3 – *continued from previous page*

Variable	Demographics	Family	Finances	Community	Health
Rarely or never exchange goods/services with neighbours					
No				*Reference*	*Reference*
Yes				−1.37***	−0.99***
Close, confiding relationship					
No				*Reference*	*Reference*
Yes				2.22***	1.09***
Perceived adequacy of social support					
Much more support needed				−8.23***	−2.21***
More social support needed				−4.61***	−1.49***
A little more social support needed				−3.51***	−1.44***
Enough social support				*Reference*	*Reference*
Caring for an adult					
Less than daily				−1.73***	−0.89**
Less than weekly				−0.52	−0.05
Less than monthly				−0.33	0.09
Not caring for an adult				*Reference*	*Reference*
Health					
Depression symptoms (CES-D)					
Few or no depression symptoms					*Reference*
Symptoms of mild depression					−5.81***
Symptoms of moderate/severe depression					−13.33***
SF-36 mental component summary					0.17***
SF-36 physical component summary					0.19***
Constant	44.12***	44.22***	42.80***	42.05***	25.74***
R^2	0.02	0.04	0.12	0.26	0.54
Log likelihood	−26679	−26616	−26246	−25589	−23750
AIC	53366	53252	52532	51245	47576

* p<0.05; ** p<0.01; *** p<0.001.

All the domains predicted CASP-19 quality of life, accounting for about 54% of the variability in CASP-19 in the fully adjusted model.

Turning initially to the demographic domain, women had poorer quality of life than men, until health (particularly depression) was adjusted for in the final model, which reversed the sign of the association. This suggests that poorer reported health in later life might be responsible for the difference in genders in quality of life. Higher age was non-significantly associated with better quality of life, an association which strengthened and became significant after conditioning on the other domains. This was the case in both genders, as reported in the Appendix, Tables E.4 and E.5. The term for age-squared was non-significant after inclusion of other domains.

In terms of the family domain, compared to married participants, single and divorced/separated participants reported significantly lower quality of life. These associations were attenuated after inclusion of the financial, community/social relationships and health domains, becoming insignificant at the 95% level. There was little association between widowhood and quality of life. Living in a three-person household was associated with lower quality of life, particularly for women (for women, see Table E.5).

In the financial adequacy and activity domain, both being retired and having confidence in finances were associated with quality of life, even following adjustment for physical and mental health. In contrast, the associations of quality of life with monthly household income weakened after inclusion of other aspects of the financial adequacy and activity domain.

Individuals who participated more intensely and frequently in social activities had higher quality of life, in a graded relationship. Associations with neighbourhood characteristics were in the directions that one might expect, although associations with feelings of insecurity and reporting annoyances became insignificant after inclusion of the health domain. There were no associations between quality of life and lack of family or friends living nearby. Dissatisfaction with access to local amenities and little contact with neighbours seemed to be the most relevant neighbourhood factors for quality of life. Lack of emotional support or insufficient emotional support was associated with poorer quality of life, including after including the mental and physical health domain. Individuals caring for adults only reported significantly lower quality of life if they were doing this activity regularly (at least weekly).

In terms of the health domain, better physical and mental health was strongly associated with better quality of life, whether this concerned depression symptoms or the SF-36 physical and mental component summary scores.

To conclude, in the fully adjusted analyses presented in the final model "Health", CASP-19 quality of life scores were significantly lower ($p<0.001$) when participants were frequently providing care to an adult, had medium to high levels of depression symptoms, recalled more problems in their neighbourhood, or needed much more social support than they had received. CASP-19 scores were significantly higher when participants had better physical and mental health; relatively high levels of social participation; a close, confiding relationship; had higher incomes and felt financially secure.

Using standardized coefficients allows for the effect sizes to be compared to each other, despite variables being measured with greatly varying metrics. Therefore, Table 7.4 displays standardized beta coefficients for both genders together.

Table 7.4: Nested models of the current factors predicting 2005 CASP-19 scores in the GAZEL cohort study (standardized β coefficients; n=7695)

Variable	Demographics	Family	Finances	Community	Health
Demographics					
Gender					
Male	*Reference*	*Reference*	*Reference*	*Reference*	*Reference*
Female	−0.126***	−0.104***	−0.092***	−0.053***	0.049***
Age					
Age	0.022	0.034**	0.069***	0.068***	0.042***
Age-squared	−0.045***	−0.040**	−0.016	−0.022	−0.011
Family					
Children					
No children		*Reference*	*Reference*	*Reference*	*Reference*
One or more children		0.017	0.011	0.005	−0.007
Marital status					
Single		−0.053***	−0.038**	−0.031*	−0.019
Married or cohabiting		*Reference*	*Reference*	*Reference*	*Reference*
Divorced or separated		−0.103***	−0.056***	−0.034*	−0.020
Widowed		−0.018	−0.010	−0.006	0.015
Household size					
One person		−0.005	−0.005	−0.002	0.010
Two people		*Reference*	*Reference*	*Reference*	*Reference*
Three or more people		−0.065***	−0.055***	−0.035***	−0.042***
Financial adequacy & activity					
Monthly household income					
<1372 euro			−0.020	−0.002	−0.006
1372 – <1601 euro			−0.019	−0.013	−0.014
1601 – <1982 euro			−0.026*	−0.019	−0.022*
1982 – <2592 euro			−0.031**	−0.029**	−0.032***
2592 – <3811 euro			*Reference*	*Reference*	*Reference*
3811 – <4574 euro			0.027*	0.029**	0.015
≥4574 euro			0.060***	0.052***	0.035***

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Table 7.4 – ***continued from previous page***

Variable	Demographics	Family	Finances	Community	Health
Confidence in finances over the next 10 years					
Very confident			0.116***	0.099***	0.061***
Quite confident			*Reference*	*Reference*	*Reference*
Not very confident			−0.192***	−0.140***	−0.072***
Not confident at all			−0.110***	−0.077***	−0.041***
Labour market status					
In work			*Reference*	*Reference*	*Reference*
Retired			0.076***	0.057***	0.020*
Community & social relationships					
Social participation					
No participation				*Reference*	*Reference*
Low–medium participation				0.066***	0.034***
High participation				0.137***	0.078***
Frequent annoyances in the neighbourhood					
No				*Reference*	*Reference*
Yes				−0.039***	−0.002
Dissatisfaction with access to local amenities					
No				*Reference*	*Reference*
Yes				−0.070***	−0.022**
Feel insecure or think vandalism is a problem					
No				*Reference*	*Reference*
Yes				−0.045***	0.005
No family or close friends living nearby					
No				*Reference*	*Reference*
Yes				−0.006	−0.008
Rarely or never exchange goods/services with neighbours					
No				*Reference*	*Reference*
Yes				−0.067***	−0.048***
Close, confiding relationship					
No				*Reference*	*Reference*
Yes				0.098***	0.049***

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Table 7.4 – *continued from previous page*

Variable	Demographics	Family	Finances	Community	Health
Perceived adequacy of social support					
Much more support needed				−0.186***	−0.050***
More social support needed				−0.171***	−0.056***
A little more social support needed				−0.169***	−0.069***
Enough social support				*Reference*	*Reference*
Caring for an adult					
Less than daily				−0.045***	−0.023**
Less than weekly				−0.017	−0.001
Less than monthly				−0.015	0.004
Not caring for an adult				*Reference*	*Reference*
Health					
Depression symptoms (CES-D)					
Few or no depression symptoms					*Reference*
Symptoms of mild depression					−0.283***
Symptoms of moderate/severe depression					−0.367***
SF-36 mental component summary					0.215***
SF-36 physical component summary					0.174***

* p<0.05; ** p<0.01; *** p<0.001.

The results suggest the great importance of the health domain for quality of life, since the standardized beta coefficients for for symptoms of moderate/severe depression were large, as well as those for physical and mental health measured with SF-36. Associations of aspects of the community and social relationships domain were also moderately large, particularly: perceived adequacy of social support; having a close, confiding relationship and participating in organized social activities.

7.2.4 Contribution of separate domains to quality of life

In order to compare the domains with each other, an analysis was performed in which the variance explained by each domain was estimated, after having taken into account the variance explained by all the others. Table 7.5 displays the results. The demographic and family domains contributed little independent variation to quality of life. The domains concerning financial adequacy and activity, on the one hand, and community and social relationships, on the other, were associated with a moderate amount of independent variation in quality of life. However, it was physical and mental health which predicted the largest amount of variation in quality of life which was not associated with other domains.

Table 7.5: Explained variance after backward extraction of each domain from the fully adjusted model of cross-sectional influences upon quality of life in 2005 measured with CASP-19 in the GAZEL cohort (complete cases, n=7695)

Domain	R^2 after extraction	Absolute change in R^2	Percent change in R^2 (%)
Demographic	0.537	0.003	0.6
Family situation	0.538	0.002	0.4
Financial adequacy and activity	0.524	0.016	3.0
Community and social relationships	0.522	0.018	3.3
Physical and mental health	0.259	0.281	48.0

The R^2 before extraction of any domains was 0.540.

7.3 Conclusion

In summary, a range of domains predicted quality of life in the cross-sectional multiple regression analyses presented in this chapter. Measures of physical and mental health explained most of the variability in quality of life, although the domains of financial adequacy and activity as well as community and social relationships also contributed to predicting a small amount of variation in quality of life.

Chapter 8

Predicting change in quality of life

Summary

The previous chapter demonstrated how a range of health, social, financial and demographic factors predict quality of life in cross-sectional analyses. Building on these results, in this chapter, a longitudinal approach is taken which controls for stable unobservable individual differences in responding. Therefore, this chapter presents a stronger case that a range of individual circumstances influence quality of life.

Quality of life, measured by the CASP-19 scale, was included in the GAZEL cohort self-completion questionnaires on two occasions, in 2005 and 2009, which provides the opportunity to study quality of life trajectories. Therefore, this chapter aims to answer the research question: *Which characteristics predict change in quality of life at older ages?* The first analysis presented in this chapter examines whether quality of life changes in the sample as a whole over the four-year period. The results show that aggregate quality of life is broadly stable in the GAZEL cohort. Subsequent sections describe differences between sub-groups, in terms of both individual characteristics at baseline in 2005 and in relation to how individual characteristics change over the four-year period. The results from these multivariate change models show differing trends in quality of life trajectories over time by sub-group. In particular, quality of life tended to decline when health measures worsened or when participants began to provide daily care for another adult, while retiring from work was associated with improvement in quality of life.

8.1 Introduction

The previous chapter described those factors which predicted Third Age quality of life in 2005, examining cross-sectional associations between quality of life and individual characteristics such as social support, financial adequacy and health. This chapter draws on a second measurement of quality of life taken in 2009 in order to generate a score of change in quality of life over the period 2005–2009.

Taking a prospective approach, I aim to examine the influences of these individual characteristics at baseline upon change in quality of life, as well as how changes in certain common characteristics might be associated with improvements or declines in quality of life. This approach of analysing change presents the advantage of controlling for unobservable and stable individual heterogeneity, as well as examining how common changes in life circumstances might affect quality of life.

In particular, this chapter will examine whether those factors shown to predict quality of life in cross-sectional analyses also predict change in quality of life. In terms of the overall objectives of this thesis, the analyses presented here will answer the research question: *Which characteristics predict change in quality of life at older ages?*, which, like the previous chapter, corresponds to the part of the model indicated by the arrow linking *current and recent factors* to *quality of life* (cf. Figure 4.1 on page 94).

In order to answer the research question, a multivariate change analysis will be performed in which changes in quality of life will be operationalized as changes in CASP-19 scores over the four-year period between 2005 and 2009 in relation to a range of baseline and changing covariates. I hypothesize that quality of life will be associated with a range of life domains, rather than one single life domain. In terms of changing circumstances, in particular, I expect that negative life events and worsening health will be associated with decreases in quality of life over time, while improving health and positive life events will be associated with improvements in quality of life over time.

8.2 Methods

The methods for this section are fully described in section 5.3.3 on page 124. In brief, multivariate change analysis will be performed upon the change in CASP-19 scores 2005–2009 to discern how particpants' characteristics at baseline as well as changes in some of those characteristics might be associated with change in quality of life.

As discussed in the methods section and Appendix D, inclusion of the baseline values of the outcome variable should be avoided when there are correlations between other variables included in the multivariate change model and the baseline values of the outcome variable. Therefore, all of the analyses were performed without including individual baseline CASP-19 scores in the modelling.

8.3 Results

8.3.1 Overall change in CASP-19 quality of life

The complete case sample contains 5431 GAZEL participants of both genders who provided questionnaire responses to each of the items required for the change analysis. In this sample, the average change in CASP-19 scores 2005–2009 was −0.11 (standard deviation: 5.53; range −39 to +30 points) (see Table 8.2 on page 193). This value represents a slightly smaller decline than for all individuals who provided CASP-19 scores in both years, but is a value within the 95% confidence intervals for that estimate (cf. section 6.2.2.2 on page 152). These results imply that the participants excluded from this sample because they had missing data for other covariates tended to have slightly lower quality of life and slightly larger declines in quality of life than those included in the analyses presented in this chapter.

As in the whole sample, the median value for change in CASP-19 quality of life was zero and its distribution symmetrical (skewness = −0.07). The distribution was leptokurtic (kurtosis = 5.58), which highlights a certain stability in quality of life scores over the four-year period in this cohort.

8.3.2 Bivariate associations

This section presents the bivariate associations between individuals' circumstances and CASP-19 scores in 2005 as well as change in CASP-19 scores between 2005 and 2009.

8.3.2.1 Bivariate associations between CASP-19 quality of life at baseline and covariates at baseline

Table 8.1 presents CASP-19 mean scores in 2005 at baseline by the covariates at baseline. The interest of this table is to indicate the similarities between the smaller sample available for the analyses presented in this chapter and the larger sample used in the previous Chapter 7. The four new health variables used in these analyses are also described in Table 8.1.

The mean CASP-19 score in this sample in 2005 was 43.42 points, which is slightly higher than the mean score reported by all individuals who responded to the CASP-19 questions in 2005 (cf. section 6.2.2 on page 150).

In terms of associations between the covariates and baseline quality of life scores, the results presented in Table 8.1 for this more restricted sample correspond to those reported in Chapter 7 *Current influences upon quality of life*. Participants reported lower quality of life if they were female, in the youngest age group, without children, unmarried, living alone, in worse financial circumstances, in work, with lower social participation, reporting more neighbourhood problems, less social support and were caring for an adult almost every day. In terms of health, participants reporting more depression symptoms had lower quality of life.

Table 8.1: Mean 2005 CASP-19 scores by baseline covariates for 5431 GAZEL participants included in the complete case analysis

Variables	n	Mean baseline CASP-19 score	Standard error	95% confidence intervals
Total	5431	43.42	0.10	43.21 to 43.62
Demographics				
Gender				
Male	4189	43.95	0.11	43.73 to 44.17
Female	1242	41.64	0.25	41.14 to 42.13
Age-group (2005)				
52–56 years	480	41.19	0.41	40.39 to 42.00
57–61 years	2918	43.90	0.14	43.62 to 44.18
62–66 years	2033	43.25	0.17	42.93 to 43.57
Family situation				
Children				
No	704	42.59	0.32	41.97 to 43.22
Yes	4727	43.54	0.11	43.32 to 43.76
Married or cohabiting (2005)				
No	660	40.67	0.37	39.95 to 41.39
Yes	4771	43.80	0.11	43.59 to 44.01
Household size (2005)				
Living alone	492	40.99	0.41	40.19 to 41.79
Two people	3957	43.87	0.12	43.64 to 44.10
Three or more people	982	42.81	0.25	42.32 to 43.29
Financial adequacy & activity				
Monthly household income (2002)				
<1372 euro	154	40.03	0.73	38.59 to 41.47
1372 – <1601 euro	117	42.03	0.78	40.51 to 43.56
1601 – <1982 euro	923	41.80	0.27	41.27 to 42.32
1982 – <2592 euro	846	42.67	0.26	42.16 to 43.19
2592 – <3811 euro	2109	43.72	0.16	43.40 to 44.04
3811 – <4574 euro	564	44.67	0.31	44.08 to 45.27
≥4574 euro	718	45.45	0.27	44.93 to 45.97

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Table 8.1 – *continued from previous page*

Variables	n	Mean baseline CASP-19 score	Standard error	95% confidence intervals
Confidence in financial situation (2002)				
Very confident	834	46.72	0.22	46.28 to 47.15
Quite confident	3717	43.80	0.12	43.57 to 44.03
Not very confident	797	38.91	0.31	38.30 to 39.53
Not confident at all	83	36.35	1.14	34.12 to 38.58
Labour market status (2005)				
Working	696	41.44	0.34	40.77 to 42.11
Retired	4735	43.71	0.11	43.50 to 43.92
Community & social relationships				
Social participation (2005)				
No participation	1245	41.82	0.25	41.34 to 42.31
Low–medium level of participation	2129	43.09	0.17	42.76 to 43.43
High level of participation	2057	44.72	0.15	44.43 to 45.01
Frequent local annoyances (2003)				
No	4654	43.69	0.11	43.48 to 43.91
Yes	777	41.76	0.31	41.15 to 42.37
Dissatisfaction with access to local amenities (2003)				
No	4209	44.02	0.11	43.80 to 44.24
Yes	1222	41.35	0.24	40.87 to 41.83
Feel insecure or think vandalism is a problem (2003)				
No	4039	43.94	0.12	43.71 to 44.17
Yes	1392	41.89	0.22	41.45 to 42.33
No family or close friends living locally (2003)				
No	2790	43.74	0.14	43.46 to 44.01
Yes	2641	43.08	0.16	42.77 to 43.39
Rarely or never exchange goods/services with neighbours (2003)				
No	4493	43.86	0.11	43.64 to 44.08
Yes	5431	41.30	0.29	40.73 to 41.86
Close, confiding relationship (2004)				
No	752	39.38	0.34	38.71 to 40.06
Yes	4679	44.07	0.11	43.86 to 44.27

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Table 8.1 – ***continued from previous page***

Variables	n	Mean baseline CASP-19 score	Standard error	95% confidence intervals
Perceived adequacy of social support (2004)				
Much more social support needed	150	33.51	0.80	31.94 to 35.08
More social support needed	511	38.63	0.41	37.83 to 39.43
A little more social support needed	926	40.63	0.25	40.14 to 41.12
Enough social support	3844	45.11	0.11	44.90 to 45.32
Caring for an adult almost daily (2005)				
No	5187	43.50	0.11	43.29 to 43.71
Yes	244	41.68	0.55	40.60 to 42.76
Health				
Depression symptoms (2005)				
No depression	4258	45.82	0.09	45.65 to 45.98
Symptoms of mild depression	916	36.94	0.23	36.49 to 37.39
Symptoms of more serious depression	257	26.77	0.44	25.91 to 27.64
Hearing impairment reported (2005)				
No	4185	43.75	0.12	43.52 to 43.98
Yes	1246	42.31	0.22	41.87 to 42.75
Visual impairment reported (2005)				
No	4929	43.80	0.11	43.59 to 44.01
Yes	502	39.65	0.38	38.90 to 40.40
Two or more physical functioning limitations (2003)				
No	4099	44.63	0.11	44.41 to 44.84
Yes	1332	39.70	0.23	39.24 to 40.15
Participant hospitalized (2004)				
No	4883	43.57	0.11	43.36 to 43.78
Yes	548	42.06	0.36	41.36 to 42.76

Four new health variables were used in this analysis in order to examine change over time in quality of life in relation to very specific changes in circumstances. Reporting a hearing impairment in 2005 was relatively common (22.9% of participants in this sample), and was associated with a 1.5-point lower CASP-19 quality of life score. Fewer participants, only 9%, reported a visual impairment, and had a 4.1-point lower quality of life score. Having two or more physical functioning limitations, which affected 24.1% of participants, was associated with a 5.0-point lower quality of life score than those who did not report this. Finally, the 9.8% of participants in the sample who reported being hospitalized in 2004 had a 1.5-point lower quality of life score.

8.3.2.2 Bivariate associations between change in CASP-19 quality of life and covariates at baseline

The associations between change in CASP-19 quality of life between 2005 and 2009 and the covariates at baseline are presented in Table 8.2. While change in overall quality of life scores was almost zero (−0.11, 95% CIs: −0.25 to 0.04), there was a great deal of variability in change scores by the baseline levels of variables from a range of life domains. This is in accordance with the first hypothesis, that changes in quality of life will be associated with a range of life domains.

Table 8.2: Change in CASP-19 mean scores by baseline covariates for 5431 GAZEL participants included in the complete case analysis

Variables	Mean CASP-19 change score	Standard error	95% confidence intervals
Total	−0.11	0.08	−0.25 to 0.04
Demographics			
Gender			
Male	−0.40	0.08	−0.56 to −0.25
Female	0.89	0.19	0.53 to 1.26
Age-group (2005)			
52–56 years	1.60	0.31	1.00 to 2.21
57–61 years	−0.20	0.10	−0.40 to −0.00
62–66 years	−0.37	0.11	−0.60 to −0.15
Family situation			
Children			
No	0.03	0.21	−0.37 to 0.44
Yes	−0.13	0.08	−0.29 to 0.03
Married or cohabiting (2005)			
No	0.95	0.25	0.46 to 1.44
Yes	−0.25	0.08	−0.41 to −0.10
Household size (2005)			
Living alone	1.09	0.28	0.55 to 1.64
Two people	−0.35	0.08	−0.52 to −0.19
Three or more people	0.28	0.19	−0.09 to 0.65

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Table 8.2 – ***continued from previous page***

Variables	Mean CASP-19 change score	Standard error	95% confidence intervals
Financial adequacy & activity			
Monthly household income (2002)			
<1372 euro	0.12	0.49	−0.85 to 1.08
1372 – <1601 euro	−0.58	0.47	−1.51 to 0.35
1601 – <1982 euro	−0.10	0.19	−0.47 to 0.27
1982 – <2592 euro	−0.36	0.19	−0.73 to 0.01
2592 – <3811 euro	0.00	0.12	−0.23 to 0.24
3811 – <4574 euro	−0.41	0.22	−0.85 to 0.02
≥4574 euro	0.12	0.20	−0.27 to 0.51
Confidence in financial situation (2002)			
Very confident	−0.37	0.18	−0.72 to −0.02
Quite confident	−0.20	0.09	−0.37 to −0.03
Not very confident	0.40	0.23	−0.05 to 0.84
Not confident at all	1.75	0.65	0.47 to 3.02
Labour market status (2005)			
Working	2.07	0.25	1.58 to 2.56
Retired	−0.43	0.08	−0.58 to −0.28
Community & social relationships			
Social participation (2005)			
No participation	0.27	0.18	−0.07 to 0.62
Low–medium level of participation	−0.01	0.12	−0.25 to 0.22
High level of participation	−0.44	0.11	−0.65 to −0.22
Frequent local annoyances (2003)			
No	−0.12	0.08	−0.28 to 0.03
Yes	−0.01	0.20	−0.40 to 0.39
Dissatisfaction with access to local amenities (2003)			
No	−0.12	0.08	−0.29 to 0.04
Yes	−0.05	0.16	−0.37 to 0.26
Feel insecure or think vandalism is a problem (2003)			
No	−0.12	0.09	−0.29 to 0.05
Yes	−0.07	0.15	−0.37 to 0.23
No family or close friends living locally (2003)			
No	−0.14	0.10	−0.34 to 0.06
Yes	−0.08	0.11	−0.29 to 0.14

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Table 8.2 – *continued from previous page*

Variables	Mean CASP-19 change score	Standard error	95% confidence intervals
Rarely or never exchange goods/services with neighbours (2003)			
No	−0.20	0.08	−0.36 to −0.04
Yes	0.33	0.20	−0.06 to 0.71
Close, confiding relationship (2004)			
No	0.05	0.23	−0.41 to 0.50
Yes	−0.13	0.08	−0.29 to 0.02
Perceived adequacy of social support (2004)			
Much more social support needed	1.59	0.63	0.35 to 2.83
More social support needed	0.48	0.31	−0.12 to 1.08
A little more social support needed	0.20	0.19	−0.17 to 0.57
Enough social support	−0.33	0.08	−0.49 to −0.16
Caring for an adult (2005)			
No	−0.14	0.08	−0.28 to 0.01
Yes	0.48	0.40	−0.31 to 1.27
Health			
Depression symptoms (2005)			
No depression	−0.61	0.08	−0.76 to −0.45
Symptoms of mild depression	0.71	0.20	0.31 to 1.11
Symptoms of more serious depression	5.23	0.48	4.29 to 6.17
Hearing impairment reported (2005)			
No	−0.04	0.09	−0.20 to 0.13
Yes	−0.35	0.15	−0.65 to −0.04
Visual impairment reported (2005)			
No	−0.09	0.08	−0.25 to 0.06
Yes	−0.25	0.26	−0.76 to 0.27
Two or more physical functioning limitations (2003)			
No	−0.15	0.08	−0.31 to 0.02
Yes	0.01	0.17	−0.32 to 0.33
Participant hospitalized (2004)			
No	−0.11	0.08	−0.27 to 0.04
Yes	−0.04	0.24	−0.52 to 0.43

Participants whose quality of life improved over the follow-up period tended to be those who were at an initial disadvantage in 2005: they were female, in the youngest age group, not married or cohabiting, less confident about their finances, were working, reported a lack of social support and reported symptoms of major or minor depression. There were no associations between change in quality of life and whether the participants had had children, with other community and social relations characteristics or with other aspects of their health, despite most of these characteristics being associated with quality of life in 2005.

In contrast, one group of participants at an initial disadvantage experienced a worsening of quality of life. Participants in the oldest age group, aged 62–66 years old, reported a more negative trajectory in quality of life than participants in younger age groups.

8.3.2.3 Bivariate associations between baseline CASP-19 quality of life and changing covariates

Table 8.3 presents, for changes in covariates, the CASP-19 score at baseline. It shows whether participants who experienced changes in circumstances had higher or lower quality of life at the outset than participants whose circumstances remained the same.

Often, participants who were exposed to difficult life events during the four-year period were those who had lower quality of life scores in 2005. Participants who were subsequently widowed had more than two-point lower CASP-19 scores in 2005 than participants who were not; the same directional trend and similar size of effects is perceptible for divorce/separation/becoming single, development of a visual impairment, development of worse physical limitations, and smaller effects for development of hearing loss and hospitalization.

In contrast, participants who experienced the positive events of retiring 2005–2009 or a reduction in physical limitations also had lower scores in 2005. Similarly, participants whose depression improved had much lower CASP-19 scores at baseline than those whose depression worsened, which were in turn lower than the great majority of participants who reported stability.

Changes in social participation and caring responsibilities were not associated with quality of life at baseline at the 95% significance level, nor was getting married or beginning a cohabitation.

8.3.2.4 Bivariate associations between change in CASP-19 quality of life and changing covariates, 2005–2009

Table 8.4 presents change in CASP-19 score by changing covariates. None of the three types of changes in marital status were associated with changes in quality of life. In terms of participants' activity, both participants who were still working in 2009 and participants who retired 2005–2009 experienced improvements, on average, in quality of life. Participants who had already retired by 2005 experienced declines in mean quality of life, a trend which might relate in part to an age-related decline in quality of life.

Table 8.3: Baseline CASP-19 mean scores by changing covariates for 5431 GAZEL participants included in the complete case analysis

Variables	n	Mean baseline CASP-19 score	Standard error	95% confidence intervals
All	5431	43.42	0.10	43.21 to 43.62
Family situation				
Divorced/separated/became single (2005–2009)				
No	5364	43.44	0.11	43.23 to 43.65
Yes	67	41.70	1.00	39.74 to 43.67
Widowed (2005–2009)				
No	5373	43.44	0.11	43.23 to 43.65
Yes	58	41.40	1.17	39.10 to 43.69
Married or began cohabiting (2005–2009)				
No	5369	43.40	0.11	43.20 to 43.61
Yes	62	44.74	0.89	43.00 to 46.49
Financial adequacy & activity				
Labour market status				
Working in 2009	224	40.15	0.64	38.89 to 41.41
Retired 2005–2009	472	42.05	0.40	41.27 to 42.83
Retired by 2005	4735	43.71	0.11	43.50 to 43.92
Community & social relationships				
Change in social participation 2005–2009				
No change in social activities	3577	43.47	0.13	43.21 to 43.72
Increase in social activities	760	42.94	0.29	42.36 to 43.51
Decrease in social activities	1094	43.60	0.23	43.15 to 44.05
Change in caring responsibilities 2005–2009				
No change in daily caring responsibilities	5094	43.46	0.11	43.25 to 43.67
Loss of daily caring responsibilities	165	42.30	0.64	41.06 to 43.55
Gain of daily caring responsibilities	172	43.19	0.61	41.98 to 44.39
Health				
Change in depression symptoms 2005–2008				
Depression symptoms improve	553	36.32	0.35	35.64 to 37.00
Depression symptoms stay the same	4388	44.69	0.11	44.48 to 44.89
Depression symptoms worsen	490	40.08	0.34	39.40 to 40.75
Hearing loss 2005–2009				
No	4785	43.50	0.11	43.28 to 43.72
Yes	646	42.78	0.30	42.19 to 43.38
Vision impaired 2005–2009				
No	4731	43.79	0.11	43.57 to 44.00
Yes	700	40.93	0.32	40.31 to 41.55
Development of two or more physical limitations 2003–2007				
No	4851	43.67	0.11	43.45 to 43.88
Yes	580	41.34	0.33	40.69 to 41.98
Cessation of two or more physical limitations 2003–2007				
No	5027	43.50	0.11	43.29 to 43.72
Yes	404	42.36	0.36	41.66 to 43.06
Any hospitalization 2005–2009				
No	3614	43.74	0.13	43.50 to 43.99
Yes	1817	42.77	0.19	42.40 to 43.15

Table 8.4: Change in CASP-19 score by changing covariates for 5431 GAZEL participants included in the complete case analysis

Variables	Mean CASP-19 change score	Standard error	95% confidence intervals
All	−0.11	0.08	−0.25 to 0.04
Family situation			
Divorced/separated/became single (2005–2009)			
No	−0.09	0.07	−0.24 to 0.05
Yes	−1.36	0.98	−3.29 to 0.57
Widowed (2005–2009)			
No	−0.11	0.08	−0.26 to 0.04
Yes	0.16	1.00	−1.81 to 2.12
Married or began cohabiting (2005–2009)			
No	−0.10	0.08	−0.25 to 0.05
Yes	−0.73	0.96	−2.61 to 1.16
Financial adequacy & activity			
Labour market status			
Working in 2009	1.81	0.44	0.95 to 2.66
Retired 2005–2009	2.20	0.30	1.60 to 2.79
Retired by 2005	−0.43	0.08	−0.58 to −0.28
Community & social relationships			
Change in social participation 2005–2009			
No change in social activities	−0.08	0.09	−0.26 to 0.09
Increase in social activities	0.51	0.22	0.07 to 0.94
Decrease in social activities	−0.61	0.17	−0.95 to −0.28
Change in caring responsibilities 2005–2009			
No change in daily caring responsibilities	−0.10	0.08	−0.25 to 0.05
Ceasing daily caring responsibilities	1.33	0.49	0.37 to 2.29
Gain of daily caring responsibilities	−1.82	0.43	−2.67 to −0.97
Health			
Change in depression symptoms 2005–2008			
Depression symptoms improve	2.85	0.28	2.30 to 3.40
Depression symptoms stay the same	−0.19	0.08	−0.34 to −0.04
Depression symptoms worsen	−2.67	0.29	−3.25 to −2.09
Hearing loss 2005–2009			
No	−0.07	0.08	−0.22 to 0.09
Yes	−0.41	0.22	−0.84 to 0.02
Vision impaired 2005–2009			
No	−0.09	0.08	−0.24 to 0.06
Yes	−0.23	0.24	−0.69 to 0.24
Development of two or more physical limitations 2003–2007			
No	−0.05	0.08	−0.20 to 0.10
Yes	−0.58	0.26	−1.09 to −0.07
Cessation of two or more physical limitations 2003–2007			
No	−0.15	0.08	−0.30 to 0.01
Yes	0.36	0.29	−0.21 to 0.92
Any hospitalization 2005–2009			
No	0.05	0.09	−0.12 to 0.23
Yes	−0.43	0.13	−0.69 to −0.17

Turning to social relationships, individuals who increased their levels of social activities also reported average improvements in quality of life over the four-year period; the trend was inversed for individuals who decreased their level of social activities. Participants who began to care for another adult almost once a day (or more often) experienced declines in average CASP-19 quality of life approaching two points, while the average tendency for individuals who ceased caring for another adult almost every day was to experience improvement in quality of life.

Reductions in depression symptoms were associated with improvement in quality of life while worsening symptoms were associated with decline in quality of life; the differences between these groups corresponded to almost 5.5 CASP-19 points. The associations between changes in quality of life and changes in the other health variables were suggestive, but not significant.

8.3.3 Multivariate change analysis

This section presents three multivariate models. The first model predicted average change 2005–2009 in quality of life in relation to demographic characteristics. The second model additionally included individual characteristics at baseline and a third model also incorporated changing characteristics.

8.3.3.1 Model 1: Demographics and change in CASP-19 quality of life, 2005–2009

Model 1 predicted average change in CASP-19 scores between 2005 and 2009 after inclusion of demographic variables (gender, age and age-squared). Results from Model 1 are displayed in Table 8.5. The model, which accounted for only 1% of the variability in the change score, predicted an average decline in quality of life over the four-year period of -0.47 CASP-19 points for a man aged 60 years in 2005. Women had a 0.91-point larger change score β coefficient than men, indicating that women tended to experience an increase in quality of life over the four-year period of 0.44 points, other aspects of the model remaining equal.

Both age and age-squared were included in the model in order to model a quadratic relationship between age and change in quality of life. Associations between quality of life and both age and age-squared were significant, which indicates that the relationship between age and change in quality of life is curvilinear. The negative coefficient for age indicates that quality of life declined more quickly on average for older participants than for younger participants, for whom it tended to improve. However, the sizes of the differences by age were smaller in older participants than in younger participants, a result of the negative β coefficient for age-squared (a graph of the relationship is not shown here).

It is possible that the age and gender differences in the change score were a result of younger and female members of the cohort having a greater likelihood of retiring between 2005 and 2009, the retirement process tending to be associated with improvements in quality of life. Therefore, the next model includes this factor as well as other predictors of quality of life, including characteristics concerning participants' family situation, finances, neighbourhood quality, social support and state of health.

Table 8.5: Multiple linear regression model of change in CASP-19 scores between 2005 and 2009 in 5431 GAZEL cohort participants: demographics

Variable	β coefficient	p-value	95% CI	Standardized β
Demographics				
Gender				
Male	*Reference*	*Reference*	*Reference*	*Reference*
Female	0.91	<0.001	0.51 to 1.31	0.069
Age (2005)				
Age	−0.07	0.002	−0.12 to −0.03	−0.045
Age-squared	0.01	0.012	0.00 to 0.03	0.037
Constant	−0.47	<0.001	−0.67 to −0.28	

The R^2 for this model is 0.01.

8.3.3.2 Model 2: Demographics and covariates at baseline and change in CASP-19 quality of life, 2005–2009

Model 2 included a range of factors which were associated with baseline quality of life (Table 8.6). These increased the predictive power of the model, which accounted for 8% of the individual variation in change in CASP-19 quality of life scores.

The quality of life change score is no longer associated with age or gender at the conventional 95% level of statistical significance, nor with many of the covariates which were associated with quality of life scores in 2005, such as having had children, marital status, financial adequacy, social participation, neighbourhood characteristics, adequacy of social support or caring for an adult almost every day (cf. the cross-sectional analyses presented in Table 7.3 on page 178). Individuals experienced improvements in quality of life in the 2005–2009 period on average if they, in 2005: had been living alone or had reported symptoms corresponding to mild or more severe depression. In contrast, participants who had already retired by 2005, who had reported a visual impairment or two or more physical functioning limitations tended to experience a negative change in quality of life.

The strongest effect was observed for labour market status at baseline: individuals who had already retired by the beginning of 2005 reported a decrease in quality of life scores of more than two points. This is perhaps because, after controlling for age effects, participants who had retired at younger ages were more often those who had retired for reasons of poor health. The relationship between retirement and quality of life will be examined more closely in Chapter 10 of this thesis.

Table 8.6: Multiple linear regression model of change in CASP-19 scores between 2005 and 2009 in 5431 GAZEL cohort participants: baseline covariates.

Variable	β coefficient	p-value	95% CI	Standardized β
Demographics				
Gender				
Male	*Reference*	*Reference*	*Reference*	*Reference*
Female	0.26	0.218	−0.15 to 0.67	0.020
Age (2005)				
Age	0.04	0.132	−0.01 to 0.09	0.024
Age-squared	0.00	0.587	−0.01 to 0.01	−0.008
Family situation				
Children				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	0.08	0.713	−0.36 to 0.53	0.005
Married or cohabiting (2005)				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	0.22	0.588	−0.58 to 1.03	0.013
Household size (2005)				
Living alone	1.02	0.026	0.12 to 1.92	0.053
Two people	*Reference*	*Reference*	*Reference*	*Reference*
Three or more people	0.27	0.168	−0.12 to 0.66	0.019
Financial adequacy & activity				
Net revenue (2002)				
<1372 euro	−0.75	0.105	−1.67 to 0.16	−0.023
1372 – <1601 euro	−0.80	0.123	−1.81 to 0.22	−0.021
1601 – <1982 euro	−0.34	0.119	−0.77 to 0.09	−0.023
1982 – <2592 euro	−0.24	0.280	−0.67 to 0.19	−0.016
2592 – <3811 euro	*Reference*	*Reference*	*Reference*	*Reference*
3811 – <4574 euro	−0.39	0.122	−0.89 to 0.11	−0.022
≥4574 euro	−0.15	0.518	−0.62 to 0.31	0.009
Confidence in finances (2002)				
Very confident	−0.05	0.802	−0.46 to 0.36	−0.003
Quite confident	*Reference*	*Reference*	*Reference*	*Reference*
Not very confident	0.16	0.465	−0.27 to 0.58	0.010
Not confident at all	1.05	0.083	−0.14 to 2.24	0.023

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Table 8.6 – *continued from previous page*

Variable	β coefficient	p-value	95% CI	Standardized β
Labour market status (2005)				
Working	*Reference*	*Reference*	*Reference*	*Reference*
Retired	−2.07	<0.001	−2.61 to −1.53	−0.125
Community				
Social participation (2005)				
No participation at all	*Reference*	*Reference*	*Reference*	*Reference*
Low–medium level of participation	−0.19	0.324	−0.57 to 0.19	−0.017
High level of participation	−0.32	0.106	−0.70 to 0.07	−0.028
Frequent local annoyances (2003)				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	−0.18	0.408	−0.59 to 0.24	−0.011
Dissatisfaction with access to local amenities (2003)				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	−0.20	0.247	−0.55 to 0.14	−0.015
Feel insecure or think vandalism is a problem (2003)				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	−0.14	0.402	−0.48 to 0.19	−0.011
No family or close friends living locally (2003)				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	−0.12	0.402	−0.41 to 0.17	−0.011
Rarely or never exchange goods/services with neighbours (2003)				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	0.07	0.710	−0.31 to 0.46	0.005
Close, confiding relationship (2004)				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	0.42	0.057	−0.01 to 0.86	0.026
Perceived adequacy of social support (2004)				
Much more social support needed	−0.08	0.873	−1.00 to 0.85	−0.002
More social support needed	0.01	0.978	−0.51 to 0.53	0.000
A little more social support needed	0.08	0.692	−0.32 to 0.48	0.005
Enough social support	*Reference*	*Reference*	*Reference*	*Reference*

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Table 8.6 – *continued from previous page*

Variable	β coefficient	p-value	95% CI	Standardized β
Caring for an adult every day (2005)				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	−0.36	0.311	−0.33 to 1.05	−0.013
Health				
Depression symptoms (CES-D) (2005)				
No depression	*Reference*	*Reference*	*Reference*	*Reference*
Symptoms of mild depression	1.31	<0.001	0.90 to 1.71	0.088
Symptoms of more serious depression	5.69	<0.001	4.96 to 6.43	0.219
Hearing impairment reported (2005)				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	−0.20	0.249	−0.55 to 0.14	−0.015
Visual impairment reported (2005)				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	−0.71	0.006	−1.22 to −0.21	−0.037
Two or more physical functioning limitations (2003)				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	−0.44	0.014	−0.79 to −0.09	−0.034
Participant hospitalized (2004)				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	−0.14	0.561	−0.61 to 0.33	−0.008
Constant	1.12	0.062	−0.06 to 2.30	

The R^2 for this model is 0.08.

8.3.3.3 Model 3: Demographics, covariates at baseline, changing covariates and change in CASP-19 quality of life, 2005–2009

Model 3 is a fully adjusted change model, predicting change in quality of life between 2005 and 2009 in relation to both baseline and changing covariates. Table 8.7 displays the results of Model 3 for the change covariates only.[1]

About 11% of the variability in changes in CASP-19 quality of life scores were accounted

[1] Similar results for this model with changing covariates were obtained using full information maximum likelihood estimation and are displayed in Appendix G: Table G.2.

for by the fully adjusted model, which included changes in health, social participation, marital status and activity domains. The low value for the explained variability suggests that important changes in life domains had been left out, such as changes in social support and financial circumstances, for which repeated measures were not available in the GAZEL cohort.

A breakdown in a relationship was associated with a 1.4-point greater decline in quality of life change scores; other changes in marital status were not significant at the 95% level. In terms of labour market status, participants who retired 2005–2009 had an average improvement in quality of life of about one point compared to those who did not undergo a retirement transition during this period, a significant result at the conventional 95% level of statistical significance.

Changes in social activities and caring responsibilities were associated with changes in quality of life. Compared to individuals who did not change their level of social activities, individuals who reported a decrease in their social activities also tended to report a decline in quality of life of about half a point. Changes in quality of life in relation to changes in caring responsibilities were large. Individuals who were no longer caring for an adult almost every day (or more often) had a CASP-19 change score which was predicted to be 2.6 points higher than individuals who reported no change in daily caring responsibilities. In contrast, individuals who began to carry out almost daily caring responsibilities reported relatively large declines in quality of life. The mean difference between the group of participants gaining caring responsibilities and the group ceasing caring responsibilities was over four CASP-19 points.

Most of the changes in health were associated with corresponding changes in quality of life. Reduction of physical limitations between 2003 and 2007 from two or more limitations to one or no limitations was associated with a small average improvement in quality of life. In contrast, the development of two or more physical limitations was associated with a small average decline, with negative change scores also being reported for depression symptoms remaining constant or worsening, or reports of the development of a visual impairment or a hospitalization. Development of a hearing impairment was also associated with worsening CASP-19 scores, but below the 95% significance level.

Table 8.7: Multiple linear regression model of change in CASP-19 scores between 2005 and 2009 in 5431 GAZEL cohort participants: change covariates.

Variable	β coefficient	p-value	95% CI	Standardized β
Marital status				
Divorced/separated/became single 2005–2009				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	−1.38	0.033	−2.65 to −0.11	−0.028

Continued on next page

Table 8.7 – *continued from previous page*

Variable	β coefficient	p-value	95% CI	Standardized β
Widowed 2005–2009				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	−0.20	0.770	−1.17 to 1.57	−0.004
Married or began cohabiting 2005–2009				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	−1.05	0.141	−2.45 to 0.35	−0.020
Activity				
Retired 2005–2009				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	1.06	0.028	0.11 to 2.01	0.054
Community and social relationships				
Change in social participation 2005–2009				
No change in social activities	*Reference*	*Reference*	*Reference*	*Reference*
Increase in social activities	0.16	0.471	−0.28 to 0.60	0.010
Decrease in social activities	−0.49	0.009	−0.86 to −0.12	−0.035
Change in caring responsibilities 2005–2009				
No change in daily caring responsibilities	*Reference*	*Reference*	*Reference*	*Reference*
Ceasing daily caring responsibilities	2.56	<0.001	1.15 to 3.98	0.080
Gain of daily caring responsibilities	−1.61	<0.001	−2.41 to −0.81	−0.051
Health				
Change in depression symptoms 2005–2008				
Depression symptoms improve	*Reference*	*Reference*	*Reference*	*Reference*
Depression symptoms stay the same	−1.18	<0.001	−1.80 to −0.56	−0.084
Depression symptoms worsen	−3.55	<0.001	−4.31 to −2.79	−0.184
Hearing loss 2005–2009				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	−0.39	0.084	−0.84 to 0.05	−0.023
Vision impaired 2005–2009				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	−0.43	0.051	−0.86 to 0.00	−0.026
Development of two or more physical limitations 2003–2007				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	−0.64	0.007	−1.11 to −0.18	−0.036

Continued on next page

Table 8.7 – *continued from previous page*

Variable	β coefficient	p-value	95% CI	Standardized β
Cessation of two or more physical limitations 2003–2007				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	0.77	0.015	0.15 to 1.40	0.037
Any hospitalization 2005–2009				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	−0.37	0.016	−0.67 to −0.07	−0.032
Constant	1.97	0.013	0.42 to 3.52	

The R^2 for this model is 0.11.
All effects shown are of the change in covariates over the follow-up period. Baseline covariates are included in the model but their effects are not shown.

8.4 Conclusion

This chapter presented analyses of changes in quality of life between 2005 and 2009, in analyses that control for individuals' stable and unobservable differences in order to find out which characteristics predicted change in quality of life at older ages.

Overall change in quality of life was close to zero, but there was considerable heterogeneity in tendencies by sub-group. In model 2 of the multivariate analysis, many of the factors that were associated with quality of life in 2005 in cross-sectional analyses were not associated with changes in quality of life, perhaps because unobserved individual differences had confounded the cross-sectional analyses, or because these factors did not drive further changes in quality of life.

In the fully adjusted multivariate analysis of change model (Table 8.7), some of the variability in change in quality of life was accounted for by characteristics of individuals that changed over time. Associations with change in quality of life were found for a range of life domains, including health, marital status, social relationships, caring responsibilities and activity. In terms of the hypotheses outlined in the introduction to this chapter, a range of changing life circumstances were associated with changes in quality of life between 2005 and 2009. It was also found that negative life events, such as hospitalization, development of a visual impairment, gaining substantial caring responsibilities or relationship breakdown, were associated with declines in quality of life, while positive life events, such as an improvement in physical functioning and no longer having to provide daily care to another adult, were associated with average improvements in quality of life.

However, the fully adjusted multivariate change model only explained about 11% of the variation in changes to quality of life scores. The relatively low proportion of explained variance suggests that changes in other life domains which were not included in the model are important, such as changes to financial circumstances or to social support.

This chapter provides some evidence to strengthen the conclusions arrived at in the previous chapter: in a multivariate change analysis, the development of poorer circumstances in a range of life domains was associated with lower quality of life for reasons other than individual outlook or the nature of individual reports. Therefore, it provides stronger evidence that factors such as retirement, caring responsibilities, relationship breakdown and declining health are actually determinants of quality of life.

The results from the bivariate analyses (presented in section 8.3.2.3 on page 196) finding that it was often individuals at an initial disadvantage who experienced gains in quality of life indicate the role of individuals' baseline characteristics in exposing them to later risks. In particular, being married or cohabiting exposes people to the risk of losing the partner through divorce or death, while being in work exposes people to the possibility of retiring. In addition, individuals were more likely to experience a decline in quality of life if they already had a visual impairment or physical functioning limitations in 2005.

Therefore, turning to more theoretical ideas of the life course, this chapter has also shown that the probability of experiencing these life events may depend on individuals' circumstances, which have been shaped by their life course. It is therefore to these upstream, or life course, determinants of quality of life in old age that this thesis now turns. In order to develop a model of long-term influences upon quality of life, the next chapter will examine individuals' circumstances in mid-life and how these might relate to their quality of life in early old age.

Chapter 9

Social position and occupational conditions in mid-life

Summary

This chapter relates quality of life after labour market exit to conditions from an earlier stage in the life course: mid-life. Two classes of exposures from mid-life were examined: social position and occupational conditions.

The associations between mid-life social position and quality of life in early old age were studied from a life course perspective. A first analysis examined whether quality of life was associated with recent and mid-life social class and occupational grade. In a second step, career trajectories were examined in relation to quality of life in order to find out whether intra-generational social mobility was associated with higher quality of life.

Associations between quality of life and both psychosocial and physical working conditions were also analysed. Three types of physical working conditions were studied: chemical exposures, physical danger and ergonomic strain. Psychosocial working conditions were examined using two measures: job strain and effort-reward imbalance. The hypotheses were that participants who had suffered more strenuous, dangerous and stressful jobs would have lower quality of life and that this relationships would be graded in relation to the severity of exposure. Apart from chemical exposures, all the measures of psychosocial and physical occupational exposures were associated with quality of life following retirement. These relationships were often graded.

9.1 Introduction

This chapter will examine whether individuals' life course employment characteristics predict their quality of life in early old age. It will study quality of life after labour market exit in the light of two aspects of individuals' mid-life characteristics: social position and working conditions. Therefore, in terms of the overall conceptual model for the thesis, this chapter examines associations between *mid-life employment characteristics* and *quality of life*.[1]

The first part of this contribution will study the associations between quality of life and mid-life social position, measured with social class and occupational grade. It will answer the research question: *Is previous social position related to quality of life?* I hypothesize that such long-term influences upon quality of life after labour market exit will be observed, as has been found using British data (Blane et al., 2007a), that these relationships will be graded and, because occupational grade and social class describe distinct aspects of social position, they will have distinctive patterns.

The second part will answer a second research question: *Are trajectories in social position related to quality of life?* In this section I will attempt to discern influences of individuals' earlier social class or occupational grade, by examining the sorts of trajectories individuals have had within in the company and the relationships between these trajectories and quality of life in early old age. This section will analyse whether certain sorts of transitions influence quality of life, over and above associations with the most recent class position. I hypothesize that it will be possible to observe such traces from the life course.

The third part of this chapter will focus on the long-term effects of working conditions upon quality of life at older ages, using a range of measures of both psychosocial and physical working conditions. It will answer the research question *Are physical and psychosocial working conditions across the working life course related to subsequent quality of life?* Believing that different sorts of working conditions might operate through distinct pathways, I will analyse the influences of chemical exposures, exposure to hazards and ergonomic strain separately. I hypothesize that, in each case, these relationships will be graded. In addition, two sorts of psychosocial working conditions will be considered: job strain and effort-reward imbalance. Whether the associations between quality of life and physical and psychosocial occupational exposures are independent of each other will also be studied.

9.2 Results

Details about the samples and analytical methods used in this chapter are provided in section 5.3.4 on page 126.

9.2.1 Life course social position and quality of life

Initially, cross-sectional relationships between former social position and quality of life will be examined, before creating trajectories of social position in order to examine these

[1] This chapter is part-published in an international peer-reviewed journal (Platts et al., 2013).

relationships from a life course perspective.

This section will firstly study the associations between the functional group categories and quality of life. The results given in Table 9.1 display a large and significant graded relationship between the occupational grade that corresponds to the final post that employees held before retiring and their quality of life in 2009. Men who had completed their careers in the lower level group (*exécutant*) reported a mean quality of life 3.0 points lower than those who were working or completed their careers at higher level (*cadre*) level. For women, the variation by occupational grade was larger, at 3.7 points between the highest and lowest groups.

There are also variations in quality of life by latest social class, measured by the European Socio-economic Classification. In a way that is consistent with the career trajectories presented in section 6.3.7.3 on page 165, most women completed their careers in ESeC class 2 *Lower managers and professionals, higher supervisory and technicians*. Relatively few women held blue-collar occupations, classes 6 and 8. No women were classified into ESeC class 9 *Routine occupations*. Men predominantly completed their careers in ESeC classes 1 *Large employers, higher managers/professionals* and 6 *Lower supervisors and technicians*. Most of the remaining men were classified into ESeC 2 *Lower managers and professionals, higher supervisors and technicians*.

In both genders, participants in the highest social class, ESeC 1 *Large employers, higher managers and higher professionals*, had the highest quality of life, followed by participants in ESeC classes 6 *Lower supervisors and technicians* and 2 *Lower managers and professionals, higher supervisors and technicians*, two classes containing posts which also have responsibilities for supervising others. Women in ESeC 3 *Intermediate classes* and ESeC 7 *Lower sales and services* occupations reported lowest quality of life. Among men, it was participants terminating their careers in posts corresponding to ESeC 8 *Lower technical* and ESeC 9 *Routine occupations* who reported lowest quality of life.

Occupational grade is available at a more detailed scale. Figure 9.1 displays a graded cross-sectional relationship between final occupational grade and quality of life in 2009, with a difference of more than 7.0 points between participants in the lowest grades (1–3) and those in the highest management grades. Here men and women have been presented together, but similar broad patterns exist in both men and women (data not shown here).

Figure 9.2 displays a graded relationship between occupational grade in 1989 and quality of life 16 years later following retirement, with a difference of more than five points between participants who had held posts in the lowest (1–3) and highest grades. The sample used in this analysis is described in Table 5.27 on page 146. The relationship seems linear although it is slightly weaker than in the upper graph which used a more recent measure of occupational position.

Table 9.1: Unadjusted CASP-19 quality of life scores in 2009 for 9423 male and 2730 female retired participants in the GAZEL cohort by final occupational grade and social class

	Male				Female			
	n	Mean	Std dev.	95% CI	n	Mean	Std dev.	95% CI
All	9423	43.4	7.4	43.2 to 43.5	2730	42.4	8.8	42.0 to 42.7
Grade								
Lower level (*Exécutant*)	711	41.4	7.9	40.8 to 42.0	369	40.2	9.8	39.2 to 41.2
Mid-level (*Maîtrise*)	4570	42.8	7.3	42.6 to 43.0	1943	42.4	8.6	42.1 to 42.8
Higher level (*Cadre*)	4142	44.4	7.2	44.2 to 44.6	418	43.9	8.4	43.1 to 44.7
*ESeC Social class**								
ESeC 1	3965	44.4	7.2	44.2 to 44.6	430	43.9	8.4	43.1 to 44.7
ESeC 2	1470	42.9	7.5	42.5 to 43.3	1506	42.4	8.6	42.0 to 42.8
ESeC 3	266	42.2	7.4	41.3 to 43.1	332	40.5	10.0	39.4 to 41.5
ESeC 6	3041	42.8	7.2	42.5 to 43.0	294	42.8	8.4	41.8 to 43.7
ESeC 7	64	42.6	8.3	40.5 to 44.6	153	40.8	9.2	39.4 to 42.3
ESeC 8	593	42.0	7.8	41.3 to 42.6	15	42.0	9.0	37.0 to 47.0
ESeC 9	24	39.9	10.3	35.5 to 44.2	0	–	–	–

*ESeC 1: Higher salariat; ESeC 2: Lower salariat; ESeC 3: Higher grade white collar workers; ESeC 6: Higher grade blue collar workers; ESeC 7: Lower grade white collar workers; ESeC 8: Skilled workers; ESeC 9: Semi & non-skilled workers.

Figure 9.1: CASP-19 quality of life scores (with 95% confidence intervals) in 2009 by final occupational grade for 12 153 retired participants in the GAZEL cohort

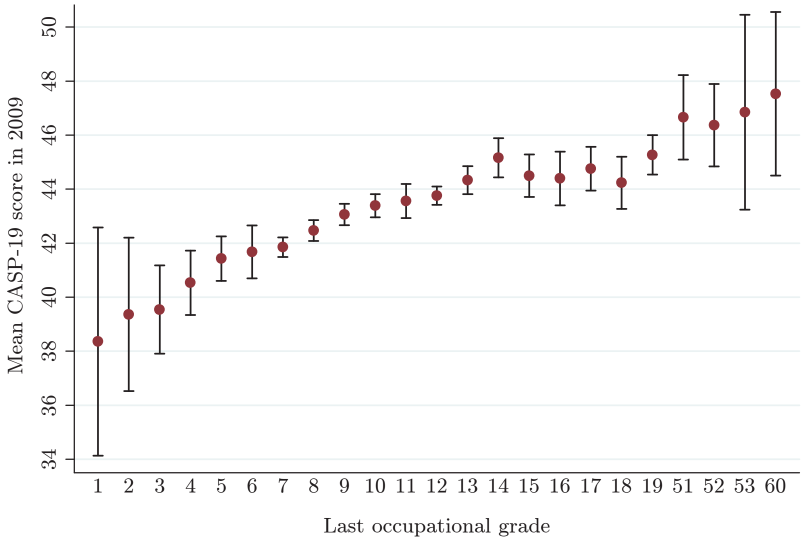
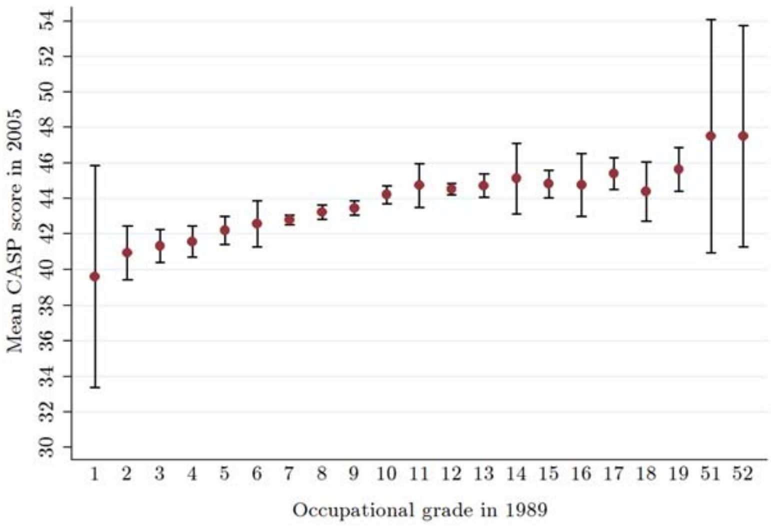


Figure 9.2: CASP-19 quality of life scores (with 95% confidence intervals) in 2005 by occupational grade in 1989 for 11 293 retired participants in the GAZEL cohort

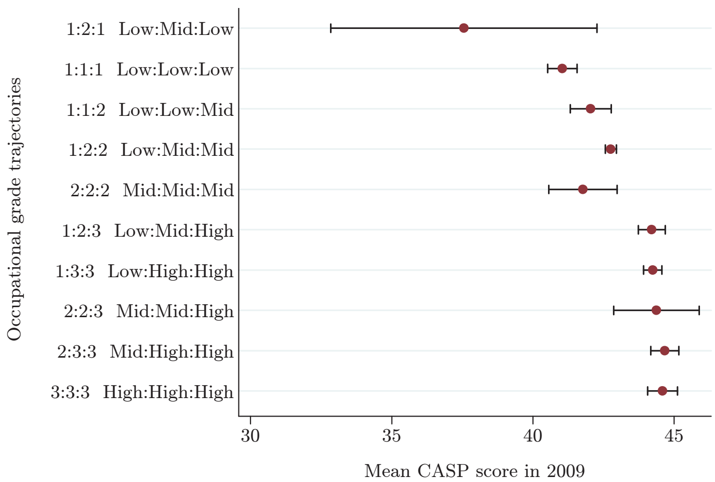


9.2.1.1 Modelling life course social position: Associations between intra-generational mobility and quality of life

This analysis examines quality of life in relation to participants' career histories, not just their final grade. Figure 9.3 displays quality of life in relation to the functional group trajectories of retired participants. The chart is organized to display variations in quality of life according to functional group in participants' first post, the post they held in 1989 and their final post.

Little distinguished subgroups with differing careers who terminated their employment in the same functional group. Comparing the top two groups: while the mean quality of life score for the small group of 35 people who were promoted into intermediate categories and then demoted back into executing functions is much lower than for participants who remained in the lowest grades, this unusual profile is likely a to be result of disciplinary proceedings, from an employer unable to dismiss individuals.

Figure 9.3: Quality of life in 2009 by occupational grade trajectories in the GAZEL cohort (n=12 095)



The bars represent 95% confidence intervals. The time points are first post, post in 1989 and final post. Two trajectories are not displayed on the chart: 1:1:3 (containing two participants) and 1:3:2 (containing one participant).

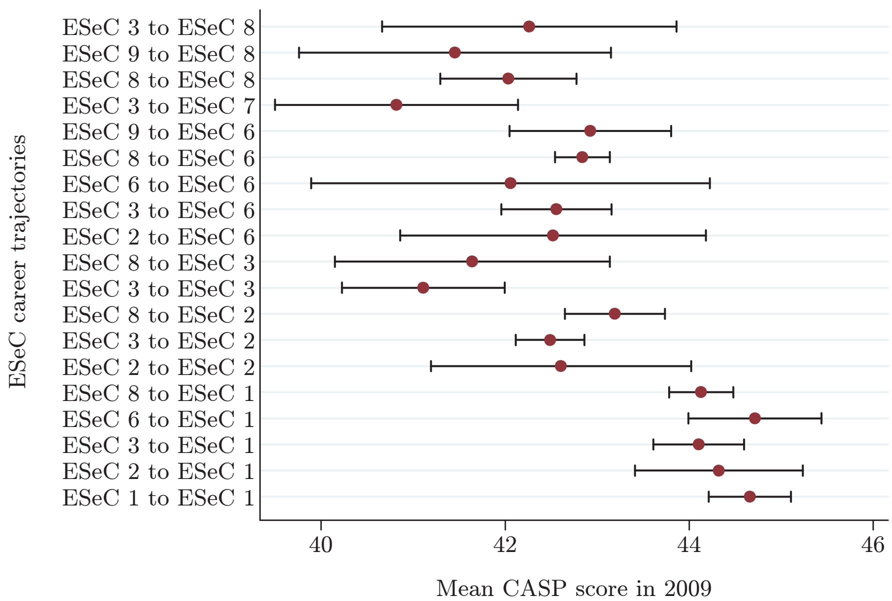
When occupational grade was considered at a more finely grained level, in both men and women, having had a higher grade at entry to the organization was associated with higher quality of life after retirement in unadjusted models (Table 9.2: Model 1). After inclusion of occupational grade at departure from EDF-GDF, higher grade at departure was associated with higher quality of life in both men and women. In contrast, occupational grade at entry was now negatively associated with quality of life (Table 9.2: Model 2). This change of sign indicates that ascension within the organization, as well as final occupational grade, was related to quality of life after retirement.

Turning to ESeC social class trajectories, this section considers whether they are associated with quality of life following retirement. Because of the extremely large number of possible transitions, the analysis was limited to only two time points: the first and

Table 9.2: CASP-19 quality of life scores in 2009 by final and initial detailed occupational grade for 9377 men and 2642 women in the GAZEL cohort

	Model 1			Model 2		
Variable	Coefficient	S.E.	95% CI	Coefficient	S.E.	95% CI
Men						
Grade at entry	0.15	0.02	0.11 to 0.20	−0.11	0.03	−0.17 to −0.05
Grade at departure	–	–	–	0.34	0.03	0.29 to 0.39
Constant	42.86	0.11	42.64 to 43.08	40.03	0.24	39.57 to 40.49
Women						
Grade at entry	0.08	0.08	−0.08 to 0.25	−0.28	0.10	−0.47 to −0.09
Grade at departure	–	–	–	0.53	0.07	0.39 to 0.66
Constant	42.12	0.29	41.56 to 42.69	38.6	0.55	37.51 to 39.68

Figure 9.4: Mean quality of life in 2009 by ESeC social class at initial and final post in the GAZEL cohort (n=11 550)



ESeC 1: Higher salariat; ESeC 2: Lower salariat; ESeC 3: Higher grade white collar workers; ESeC 6: Higher grade blue collar workers; ESeC 7: Lower grade white collar workers; ESeC 8: Skilled workers; ESeC 9: Semi & non-skilled workers.
Trajectories containing fewer than 100 participants are not displayed on this graph.

final posts at EDF-GDF (Figure 9.4). Due to the large number of subgroups, men and women were considered together. The trajectories are ordered by final social class to aid comparison of participants who had varying trajectories up to their final social class.

The results showed little life course effects of career trajectories in social class. In no cases were differences in quality of life between career trajectories sharing the same end points statistically significant. For example, among the large numbers of people who completed their career in ESeC class 1: *Large employers, higher managers/professionals*, participants who had been promoted from lower positions had similar levels of quality of life as those who had continuously held ESeC 1 posts.

To conclude, inconsistent results were provided by the different measures of occupational position over the life course. Any associations between life course career trajectories and quality of life were small or non-existent. Associations between quality of life and career trajectories were not found when either the tripartite measure of occupational grade (functional groups) or the ESeC social class measure are used. In contrast, using the detailed measure of occupational grade revealed small associations between career histories and quality of life. In particular, men and, especially, women who experienced greater occupational mobility had higher quality of life.

9.2.2 Psychosocial occupational exposures

9.2.2.1 Descriptives

Table 9.3 displays descriptive statistics for the 5478 participants included in the analysis. There were large differences in work characteristics between men and women. In terms of professional characteristics, in 1998, women were employed in lower occupational grades on average than men. By 1998, almost half of the men were employed in posts corresponding to ESeC class 1: *Higher managers and professionals*, and nearly all of the rest in other social classes with supervisory roles, whether in the ESeC class 2 *Lower managers and professionals* or ESeC class 6 *Lower supervisors and technicians*. In contrast, fewer than one in six women were employed in occupations classified as *Higher managers and professionals* (ESeC class 1) and about half were employed as *Lower managers and professionals* (ESeC class 2).

The proportion of women reporting job strain (14.2%, or 153 participants) was almost double that of men (7.2%, or 318 participants), which corresponds to the difference between the genders reported for the whole sample in section 6.3.7.1 on page 162. A smaller proportion of participants reported effort-reward imbalance and in this case the gender difference was small: 5.5% of men reported effort-reward imbalance compared to 6.2% of women. The proportions of participants reporting job strain or effort-reward imbalance in this sample were generally slightly smaller than for the GAZEL cohort as a whole, indicating some selective attrition. On average, women were exposed to lower levels of strenuous and hazardous working conditions than men, except in the case of reported accidents, where differences between the grades were small. Like in the cohort as a whole, quality of life was lower in women than in men (cf. section 6.2.2 on page 150).

Table 9.3: Description of measures and sample for 5478 participants included in the complete case analysis

		Male (n=4400)		Female (n=1078)	
Variable (year)	Categories or range	% or mean	n or sd	% or mean	n or sd
Demographics					
Age (2009)	61–70 years (men); 56–70 years (women)	63.8	2.2	62.0	3.2
Social position					
Occupational grade (1998)	1–60	11.7	6.8	8.5	3.6
ESeC social class (1998)*	ESeC 1	48.3%	2126	16.7%	180
	ESeC 2	13.1%	575	56.0%	604
	ESeC 3	2.0%	89	7.6%	82
	ESeC 6	30.2%	1330	12.7%	137
	ESeC 7	0.7%	32	6.1%	66
	ESeC 8	5.6%	243	0.8%	9
	ESeC 9	0.1%	5	0.0%	0
Psychosocial occupational exposures					
Karasek job strain (1997/99)	No	92.8%	4082	85.8%	925
	Yes	7.2%	318	14.2%	153
Effort-reward imbalance (1998)	No	94.5%	4160	94.0%	1013
	Yes	5.5%	240	6.0%	65
Physical occupational exposures					
Ergonomic strain					
Retrospective ergonomic constraints (2007)	No exposure	38.1%	1676	78.4%	845
	Moderate exposure	30.1%	1323	19.2%	207
	High exposure	31.8%	1401	2.4%	26
Ergonomic strain score (1989/1990)	0–5	0.9	1	0.2	0.5
Physical danger					
Physical hazards score (1989/1990)	0–7	1.6	1.6	0.3	0.5
Accumulated accidents (1978–2009)	No exposure	84.7%	3726	88.0%	949
	Moderate exposure	10.8%	473	8.8%	95
	High exposure	4.6%	201	3.2%	34
Exposure to harmful chemicals					
Accumulated chemical exposures (1956–1998)	No exposure	43.3%	1904	98.9%	1066
	Moderate exposure	31.3%	1375	1.1%	12
	High exposure	25.5%	1121	0.0%	0
Quality of life					
CASP-19 (2009)		43.9	7.2	42.9	8.6

*ESeC 1: Higher salariat; ESeC 2: Lower salariat; ESeC 3: Higher grade white collar workers; ESeC 6: Higher grade blue collar workers; ESeC 7: Lower grade white collar workers; ESeC 8: Skilled workers; ESeC 9: Semi & non-skilled workers.

9.2.2.2 Bivariate analyses

Age was associated with occupational grade in men but not in women (Tables 9.4 and 9.5). Age and ESeC class were negatively associated in both men and women indicating that older participants who were still working were more likely to be in higher ESeC classes, such as the managerial and professional social classes 1 and 2. In both genders, older participants reported poorer quality of life. There were significant correlations between social class and occupational grade in both men and women. These were negative because ESeC classes 1 and 2 are the highest social classes.

Table 9.4: Intercorrelations between the main variables in men in the GAZEL cohort (n=4400 men)

	1. Age	2. Grade	3. ESeC	4. Job strain	5. ERI	6. CASP
Demographics						
1. Age	1.00					
2. Occupational grade	0.20	1.00				
3. ESeC social class	−0.19	−0.50	1.00			
Psychosocial strain						
4. Job strain	−0.04	−0.10	0.09	1.00		
5. Effort-reward imbalance	−0.05	−0.08	0.09	0.16	1.00	
Quality of life						
6. CASP-19	−0.04	0.12	−0.09	−0.10	−0.10	1.00

All correlation coefficients are significant at $p<0.05$.

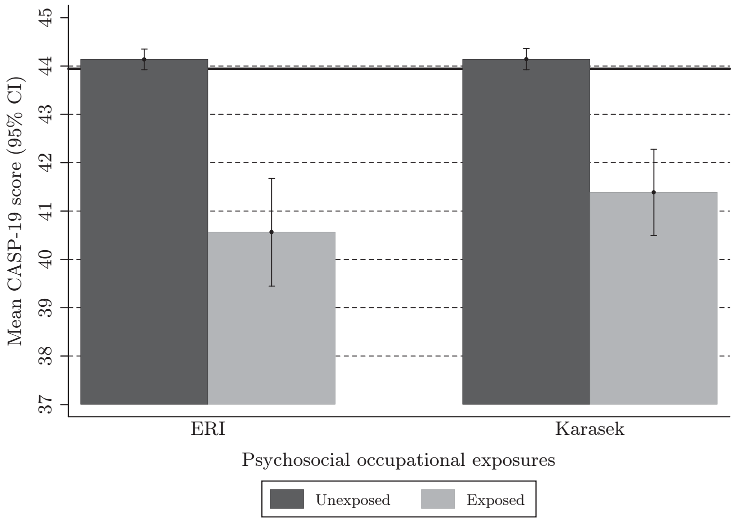
Table 9.5: Intercorrelations between the main variables in women in the GAZEL cohort (n=1078 women)

	1. Age	2. Grade	3. ESeC	4. Job strain	5. ERI	6. CASP
Demographics						
1. Age	1.00					
2. Occupational grade	0.01	1.00				
3. ESeC social class	−0.06	−0.37*	1.00			
Psychosocial strain						
4. Job strain	0.05	−0.12*	0.09*	1.00		
5. Effort-reward imbalance	0.05	−0.02	0.01	0.09*	1.00	
Quality of life						
6. CASP-19	−0.08*	0.07*	−0.05	−0.16*	−0.09*	1.00

* significant at the 5% level

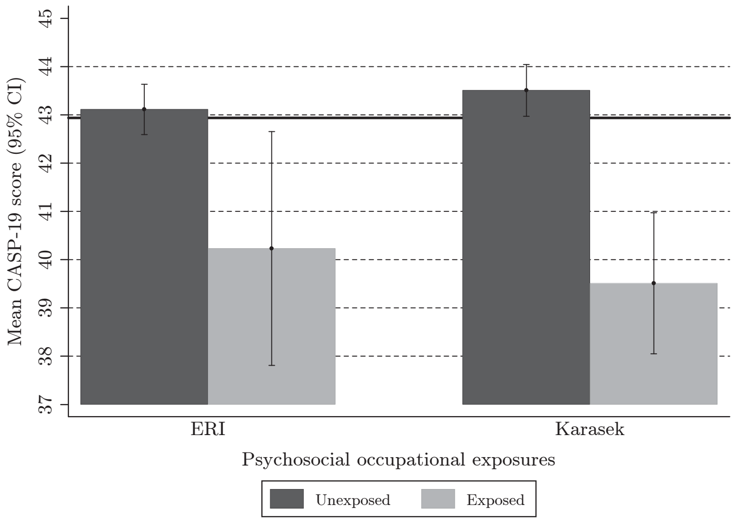
In both genders, the two measures of psychosocial strain were weakly associated with each other. Higher levels of both measures of psychosocial strain were associated with younger ages in men, but not in women. Higher occupational grade and higher social class were associated with lower levels of psychosocial stress, although these associations were not significant in the case of effort-reward imbalance for women. In both men and women, psychosocial strain, whether measured as job strain or effort-reward imbalance, was associated with poorer quality of life.

Figure 9.5: Quality of life in 2009 by psychosocial working conditions among 4400 retired men in the GAZEL cohort



The overall mean CASP-19 score for the 4400 men included in the complete case analysis is indicated by the horizontal bar at 43.9 points.

Figure 9.6: Quality of life in 2009 by psychosocial working conditions among 1078 retired women in the GAZEL cohort



The overall mean CASP-19 score for 1078 women included in the complete case analysis is indicated by the horizontal bar at 42.9 points.

Figures 9.5 and 9.6 display quality of life in 2009, following labour market exit, for both

Table 9.6: Quality of life in 2009 by psychosocial working conditions among 4400 men and 1078 women in the GAZEL cohort

	Men		Women	
Exposure	Mean	95% CIs	Mean	95% CIs
Job strain				
No	44.1	43.9 to 44.4	43.5	43.0 to 44.0
Yes	41.4	40.5 to 42.3	39.5	38.1 to 41.0
Effort-reward imbalance				
No	44.1	43.9 to 44.4	43.1	42.6 to 43.6
Yes	40.6	39.4 to 41.7	40.2	37.8 to 42.7

men and women.[2] The figures are provided in Table 9.6. There were large and significant contrasts in quality of life after retirement by both measures of reported psychosocial exposures 1997–9, and in both genders. In these unadjusted analyses, the reduction in quality of life in men associated with reporting psychosocial strain was of similar size regardless of the measure used: quality of life was 3.5 points lower for male participants reporting effort-reward imbalance and 2.7 points lower for those reporting job strain. The sizes of the associations in women were similar to those seen in men (Figure 9.6). Women reporting effort-reward imbalance experienced on average 2.9-point lower quality of life score in 2009 after retirement, while women reporting job strain had an average level of quality of life in 2009 that was 4.0 points lower.

To summarize, the associations between the psychosocial occupational exposures measured at the end of the 1990s and quality of life measured in 2009 were substantial and were similarly sized in men and women. Despite their longitudinal aspect, they were about half of the size of the difference seen in the cross-sectional analyses between having two or more limitations to physical activities compared to having none, reported in Chapter 7 *Current influences on quality of life*.

Do these associations persist after adjustment for important confounders? This question is answered in the models presented below, which controlled for social position and age in a first step, and for physical occupational exposures in a second step. Each time, the analyses have been stratified by gender.

9.2.2.3 Multivariate analyses

In the multivariate models, presented in Tables 9.7 and 9.8, both measures of psychosocial strain, in both men and women, were associated with lower quality of life, after adjustment for age, age-squared, occupational grade and ESeC social class.

The variability in quality of life explained by the first models, expressed in the R^2 value, was small, at under 4% in each model. There was little difference between the job strain model and the effort-reward imbalance model in the proportion of variation in quality of life that was explained, although in women it appeared that the effort-reward

[2] Morten Warhendorf helped to prepare these figures.

imbalance model explained less of the variability in quality of life than the job strain model.

Table 9.7: Associations between psychosocial occupational exposures and quality of life in 2009 for 4400 retired men: Results of multivariate linear models

	Model 1			Model 2		
	Coefficient	SE	R^2	Coefficient	SE	R^2
Job strain			0.032			0.038
No exposure (reference)	–	–		–	–	
Exposed	−2.41***	0.42		−2.29***	0.42	
Effort-reward imbalance			0.035			0.040
No exposure (reference)	–	–		–	–	
High exposure	−3.22***	0.48		−3.06**	0.48	

Note. * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.
Model 1: Associations between each psychosocial occupational exposure and quality of life, controlled for age, age-squared, occupational grade (1998) & social class (1998).
Model 2: Model 1 + adjustments for five physical occupational exposures.

Table 9.8: Associations between psychosocial occupational exposures and quality of life in 2009 for 1078 retired women: Results of multivariate linear models

	Model 1			Model 2		
	Coefficient	SE	R^2	Coefficient	SE	R^2
Job strain			0.039			0.048
No exposure (reference)	–	–		–	–	
Exposed	−3.83***	0.75		−3.80***	0.75	
Effort-reward imbalance			0.021			0.030
No exposure (reference)	–	–		–	–	
High exposure	−2.70*	1.09		−2.52*	1.10	

Note. * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.
Model 1: Associations between each psychosocial occupational exposure and quality of life, controlled for age, age-squared, occupational grade (1998) & social class (1998).
Model 2: Model 1 + adjustments for five physical occupational exposures.

Introduction of the five physical occupational exposures in Model 2 did little to change the relationships between either measure of psychosocial strain and quality of life (Tables 9.7 and 9.8). This was the case for both men and women. In men, the effect sizes of the estimates decreased slightly and the significance level in the case of effort-reward imbalance dropped, suggesting some confounding. In the case of women, there was little change overall, particularly for job strain measure. These results indicated that the associations between psychosocial strain and quality of life were distinct from any relationship between physical occupational exposures and quality of life.

9.2.3 Physical occupational exposures

9.2.3.1 Descriptives

This section presents associations between physical occupational exposures and quality of life. As described more fully in section 5.3.5.2 on page 131, five different measures of physical occupational exposures were used. In order to keep the sample large and representative, only the job strain measure of psychosocial occupational exposures could be included in this analysis because there was less non-response to this measure than to the alternative effort-reward imbalance measure.

Before examining the main research questions, the sample will be briefly described, in Table 9.9. In comparison to the main GAZEL sample (cf. Table 6.7 on page 163), occupational grade in this sample for both men and women was slightly higher, indicating some selection into the sample of participants in more advantaged circumstances. Similarly, individuals working in managerial and professional posts (ESeC 1) appear in larger proportions in this sample and participants in blue-collar posts (ESeC 6, 8 and 9) appear in smaller proportions. Participants in this complete case sample had lower average levels of exposures to the five measures of strenuous and dangerous working conditions than the GAZEL cohort as a whole (cf. Table 6.7 on page 163).

There were striking gender differences in terms of employment characteristics. Mean employment grade was higher for men than women and men were more likely to hold management and professional positions and supervisory blue-collar roles. In contrast, women tended to occupy white-collar posts; very few women held blue collar roles. Regarding the exposures of interest, men had been exposed to more strenuous and dangerous working conditions than women, particularly for exposure to ergonomic strain and harmful chemicals where high levels of exposures were nearly non-existent for women. Those women who had been exposed tended to be exposed at low levels, apart from in the case of accumulated accidents. In contrast, women were exposed to doubly high rates of psychosocial strain than men, measured here by the demand-control job strain model. Male participants reported better quality of life than female participants.

9.2.3.2 Bivariate analyses

Table 9.10 displays all the correlation coefficients between the main variables in men. In summary, in men, the physical occupational exposures were positively correlated with each other, including the retrospective and prospective indicators of ergonomic strain, which provides some support for the reliability of the self-reported measures. There were positive correlations between the physical and psychosocial occupational exposures.

Turning to the associations between social position and working conditions, higher grade and higher social class (the highest ESeC classes 1, 2, and 3 are non-manual) are associated with lower levels of physical and psychosocial exposures in men. All types of physical and psychosocial working conditions were weakly negatively correlated with quality of life at older ages.

Women working in higher grades were exposed to lower levels of job strain and had

Table 9.9: Description of measures and sample for analyses of associations between physical occupational exposures and quality of life with a sample of 8232 GAZEL cohort participants

		Male (n=6388)		Female (n=1844)	
Variable (year)	Categories or range	% or mean	n or sd	% or mean	n or sd
Demographics					
Age (2009)	61–70 years (men); 56–70 years (women)	64	2.4	62.3	3.3
Social position					
Occupational grade (1989)	1–60	9.67	3.62	7.18	2.5
ESeC social class (1989)*	ESeC 1	36.0%	2301	8.4%	154
	ESeC 2	14.7%	939	60.9%	1123
	ESeC 3	3.6%	232	16.9%	311
	ESeC 6	36.2%	2311	6.5%	120
	ESeC 7	0.6%	40	6.9%	128
	ESeC 8	8.6%	552	0.4%	7
	ESeC 9	0.2%	13	0.1%	1
Physical occupational exposures					
Ergonomic strain					
Retrospective ergonomic constraints (2007)	No exposure	37.4%	2390	78.0%	1439
	Moderate exposure	30.1%	1924	19.7%	363
	High exposure	32.5%	2074	2.3%	42
Ergonomic strain score (1989/1990)	0–5	0.9	1.0	0.3	0.5
Physical danger					
Physical hazards score (1989/1990)	0–7	1.6	1.6	0.2	0.5
Accumulated accidents (1978–2009)	None	83.7%	5346	87.5%	1614
	One	11.4%	727	9.1%	168
	Two or more	4.9%	315	3.4%	62
Exposure to harmful chemicals					
Accumulated chemical exposures (1956–1998)	No exposure	42.6%	2721	98.9%	1823
	Moderate exposure	30.9%	1971	1.0%	19
	High exposure	26.6%	1696	0.1%	2
Psychosocial occupational exposure					
Job strain (1997/9)	No	92.4%	5905	83.9%	1548
	Yes	7.6%	483	16.1%	296
Quality of life					
CASP-19	0–57	43.8	7.3	42.6	8.8

*ESeC 1: Higher salariat; ESeC 2: Lower salariat; ESeC 3: Higher grade white collar workers; ESeC 6: Higher grade blue collar workers; ESeC 7: Lower grade white collar workers; ESeC 8: Skilled workers; ESeC 9: Semi- & non-skilled workers

higher quality of life (Table 9.11). While the measure of psychosocial stress was significantly associated with poorer quality of life, none of the measures of strenuous and dangerous working conditions were. In most cases, the measures of physical working conditions were positively correlated with each other. The associations between psychosocial job strain and the physical occupational exposures were inconsistent and insignificant.

Table 9.10: Intercorrelations between the main variables in male GAZEL cohort participants (n=6388 men)

	1	2	3	4	5	6	7	8	9	10
Demographics										
1. Age	1.00									
Social position										
2. Occupational grade	0.24	1.00								
3. ESeC social class	−0.23	−0.71	1.00							
Physical occupational exposures										
4. Retrospective ergonomic strain	−0.16	−0.39	0.45	1.00						
5. Ergonomic strain	−0.14	−0.35	0.43	0.39	1.00					
6. Perceived danger	−0.16	−0.32	0.44	0.40	0.62	1.00				
7. Accidents at work	−0.10	−0.26	0.27	0.21	0.28	0.25	1.00			
8. Chemical exposures	−0.18	−0.44	0.55	0.48	0.36	0.47	0.24	1.00		
Psychosocial strain										
9. Job strain	−0.04	−0.11	0.07	0.05	0.06	0.04	0.06	0.03	1.00	
Quality of life										
10. CASP-19	−0.04	0.12	−0.09	−0.07	−0.08	−0.06	−0.09	−0.05	−0.11	1.00

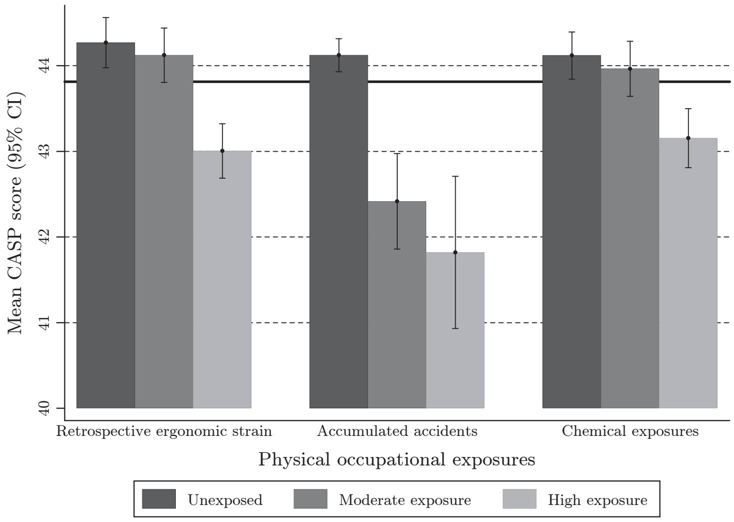
All correlation coefficients are significant at $p<0.05$.

Table 9.11: Intercorrelations between the main variables in female GAZEL cohort participants (n=1844 women)

	1	2	3	4	5	6	7	8	9	10
Demographics										
1. Age	1.00									
Social position										
2. Occupational grade	0.08*	1.00								
3. ESeC social class	−0.12*	−0.45*	1.00							
Physical occupational exposures										
4. Retrospective ergonomic strain	0.02	−0.01	0.04	1.00						
5. Ergonomic strain	0.02	0.04	−0.01	0.32*	1.00					
6. Perceived danger	0.02	0.11*	0.00	0.30*	0.46*	1.00				
7. Accidents at work	−0.05*	−0.03	0.02	0.10*	0.05*	0.08*	1.00			
8. Chemical exposures	−0.01	−0.02	0.17*	0.12*	0.11*	0.18*	0.07*	1.00		
Psychosocial strain										
9. Job strain	0.02	−0.12*	0.09*	0.02	0.00	−0.04	0.03	−0.02	1.00	
Quality of life										
10. CASP-19	−0.08*	0.06*	−0.03	−0.02	−0.04	0.04	−0.02	0.01	−0.12*	1.00

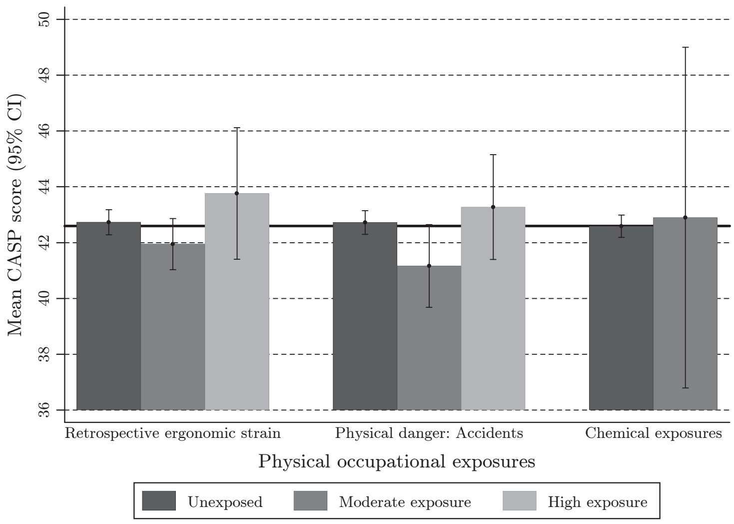
* significant at the 5% level

Figure 9.7: Quality of life in 2009 by physical working conditions among 6388 retired men in the GAZEL cohort



The overall mean CASP-19 score for 6388 men included in the complete case analysis is indicated by the horizontal bar at 43.8 points.

Figure 9.8: Quality of life in 2009 by physical working conditions among 1844 retired women in the GAZEL cohort



The overall mean CASP-19 score for 1844 women included in the complete case analysis is indicated by the horizontal bar at 42.6 points.

Figure 9.7 and Table 9.12 display mean CASP-19 scores and 95% confidence intervals for the three categorical indicators of working conditions under study (retrospective ergonomic constraints, accumulated accidents and accumulated chemical exposure) in

Table 9.12: Quality of life after labour market exit by selected physical working conditions among 6388 men and 1844 women in the GAZEL cohort

	Men		Women	
Exposure	Mean	95% CIs	Mean	95% CIs
Retrospective ergonomic strain				
Unexposed	44.3	44.0 to 44.6	42.7	42.3 to 43.2
Moderate exposure	44.1	43.8 to 44.4	42.0	41.0 to 42.9
High exposure	43.0	42.7 to 43.3	43.8	41.4 to 46.1
Accumulated accidents				
Unexposed	44.1	43.9 to 44.3	42.7	42.3 to 43.1
Moderate exposure	42.4	41.9 to 43.0	41.2	39.7 to 42.6
High exposure	41.8	40.9 to 42.7	43.3	41.4 to 45.2
Accumulated chemical exposures				
Unexposed	44.1	43.8 to 44.4	42.6	42.2 to 43.0
Moderate exposure	44.0	43.6 to 44.3	42.9	36.8 to 49.0
High exposure	43.2	42.8 to 43.5	48.0	−15.5 to 111.5

men.[3] In each case, the most exposed men reported lowest levels of quality of life, while quality of life was highest among those with no exposure. For the accumulated accidents measure of physical danger the difference in mean scores between the unexposed and highly exposed groups was almost two CASP-19 points in men.

In contrast, in women, there were no clear associations between physical working conditions and quality of life (Figure 9.8 and Table 9.12). Apart from in the unexposed groups, the confidence intervals for the estimates are extremely large, a result of few women being subjected to moderate or high levels of physical occupational exposures.

Do the associations seen in men persist after adjustment for important confounders? This question is answered in the models presented below, which controlled for age and social position. The models were also estimated for women, in case these factors were masking associations between physical occupational exposures and quality of life.

9.2.3.3 Multivariate analyses

The findings of the multivariate analyses support the relationships between CASP-19 and occupational exposures which had been suggested by the bivariate analyses in men and women.

Associations with quality of life were found in men for the prospective measure of ergonomic strain and of physical danger, but not for chemical exposures or the retrospective measure of ergonomic strain (Table 9.13).[4] The associations of the measure of ergonomic strain and both measures of physical danger with quality of life remained statistically significant in men after adjusting for the possible confounders of the detailed measure

[3] Morten Wahrendorf helped to prepare these figures.

[4] The results concerning the retrospective measure of ergonomic strain were inconsistent. Sensitivity analyses that included a larger, less selected sample or which treated the measure as a continuous variable tended to find negative associations between the retrospective measure of ergonomic strain and quality of life.

Table 9.13: Associations between physical occupational exposures and quality of life: Results of multivariate linear models for 6388 retired men from the GAZEL cohort

	Model 1			Model 2		
	Coefficient	Std error	R^2	Coefficient	Std error	R^2
Ergonomic strain						
Retrospective ergonomic strain			0.024			0.033
No exposure	*Reference*	*Reference*		*Reference*	*Reference*	
Moderate exposure	0.02	0.22		−0.01	0.22	
High exposure	−0.63	0.25		−0.60	0.25	
Ergonomic strain	−0.33**	0.10	0.024	−0.31**	0.10	0.033
Physical danger						
Physical hazards	−0.17**	0.07	0.024	−0.16*	0.07	0.032
Accident episodes			0.027			0.036
None	*Reference*	*Reference*		*Reference*	*Reference*	
One	−1.31***	0.29		−1.23***	0.29	
Two or more	−1.58***	0.43		−1.56***	0.43	
Exposure to harmful chemicals						
Chemical exposures			0.023			0.032
No exposure	*Reference*	*Reference*		*Reference*	*Reference*	
Moderate exposure	0.13	0.23		0.12	0.23	
High exposure	−0.02	0.28		−0.06	0.28	

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$
Model 1: Associations between each physical occupational exposure and quality of life, controlled for age, age-squared, occupational grade and ESeC social class.
Model 2: All adjustments as for model 1 + psychosocial strain (Karasek job strain scale).

Table 9.14: Associations between physical occupational exposures and quality of life: Results of multivariate linear models for 1844 retired women from the GAZEL cohort

	Model 1			Model 2		
	Coefficient	Std error	R^2	Coefficient	Std error	R^2
Ergonomic strain						
Retrospective ergonomic strain			0.018			0.030
No exposure	*Reference*	*Reference*		*Reference*	*Reference*	
Moderate exposure	−0.72	0.51		−0.67	0.51	
High exposure	1.30	1.37		1.42	1.36	
Ergonomic strain	−0.75	0.41	0.018	−0.74	0.41	0.030
Physical danger						
Physical hazards	0.59	0.40	0.017	0.54	0.40	0.030
Accident episodes			0.019			0.032
None	*Reference*	*Reference*		*Reference*	*Reference*	
One	−1.68*	0.71		−1.67*	0.70	
Two or more	0.53	1.13		0.70	1.12	
Exposure to harmful chemicals						
Chemical exposures			0.016			0.029
No exposure	*Reference*	*Reference*		*Reference*	*Reference*	
Moderate exposure	0.55	2.12		0.13	2.11	
High exposure	4.21	6.21		5.15	6.18	

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$
Model 1: Associations between each physical occupational exposure and quality of life, controlled for age, age-squared, occupational grade and ESeC social class.
Model 2: All adjustments as for model 1 + psychosocial strain (Karasek job strain scale).

of employment grade, ESeC social class and age of the study participants. In addition, the associations between physical occupational exposures and quality of life in men were robust to adjustment for psychosocial stress, measured using the Karasek job strain scale.

In contrast, in women, the only significant negative association was between the measure of accumulated accidents and quality of life (Table 9.14). This relationship was robust to the inclusion of social position and psychosocial strain in the model. In general, physical occupational exposures were not associated with poorer quality of life in women, after inclusion of controls.

The results of additional analyses using FIML estimation described in the methods section did not differ substantially from those displayed in Tables 9.13 and 9.14. The magnitude and statistical significance of coefficients were similar for each measure of occupational exposure.

9.3 Conclusion

This chapter presented original prospective analyses demonstrating associations between quality of life in early old age with individuals' mid-life employment characteristics. Although previous social position (occupational grade and social class) was associated in a finely graded manner with quality of life, results were weak and inconsistent concerning associations between trajectories of social position during working life and quality of life following retirement.

Previous working conditions were associated with quality of life. In men, a range of measures of physical working conditions were associated with quality of life following retirement, associations which were graded, albeit small; in both men and women, measures of psychosocial strain were associated with quality of life. In addition, these associations of physical and psychosocial working conditions with quality of life were independent of each other.

The only significant and negative association between quality of life and physical occupational exposures in women, after inclusion of controls, was with the accumulated accidents measure. This is likely to be because of lack of power in the analysis due to the smaller sample size, few women being exposed to adverse working conditions and that those who had been were generally received low levels of exposure. It is notable that the only significant association in women concerned the accumulated accidents measure: the only exposure to which women were exposed at similar levels to men (cf. Table 9.9 on page 223). Therefore, the possibility that strenuous and dangerous working conditions harm women's quality of life after retirement in the same way they seem to in men cannot be excluded.

The next chapter will model how quality of life changes during the transition to retirement. In particular, it will explore whether working conditions can be linked to different sorts of retirement transitions which, in turn, have implications for quality of life following retirement.

Chapter 10

Retirement transitions and routes

Summary

This chapter discusses both the possible impacts of retirement upon quality of life and how the nature of the transition to retirement might be affected by mid-life characteristics.

Firstly, analyses were presented examining how quality of life changed in the periods leading up to and following retirement. They indicated that quality of life improved around the time of retirement, an improvement which lasted several years. There was an indication that reporting more difficult psychosocial working conditions was associated with larger improvements in quality of life upon retirement.

Variations in how people retired were also studied in order to see how the type of retirement transition related to earlier working conditions as well as to quality of life. Results showed that participants who had more strenuous and dangerous working conditions were more likely to have a retirement transition marked by disability and ill health, a transition which was in turn associated with poorer quality of life later on. In contrast, participants with less harmful working conditions and who were working at higher grades were more likely to continue professional activities following retirement, a retirement route which was associated with slightly better quality of life than average. Age at retirement was associated with subsequent quality of life in men only.

10.1 Introduction

This chapter addresses the aim: *Examine whether retirement circumstances and routes are associated with subsequent quality of life.* In the model depicted in Figure 4.1 on page 94, the analyses are represented, on the one hand, by the arrows from *retirement routes and circumstances* to *quality of life*, on the other, by the arrows from *mid-life employment characteristics* to *retirement routes and circumstances*.

The format of the chapter is as follows: I will firstly examine whether retirement is beneficial for quality of life, and whether the degree to which individuals derive any benefits from retirement depends on their earlier working conditions. In particular, I am interested in how quality of life changes around the time of retirement, and whether it is possible to find evidence for an improvement in quality of life might correspond to predictions generated by Third Age theory.

Next, the types of retirement transition will be analysed: age at retirement, continuing professional activities following retiring and retirement in ill health. These will be discussed in two ways: firstly, in terms of their impact upon subsequent quality of life, secondly, in terms of whether earlier working conditions influence individuals' chances of experiencing these sorts of retirement transition. In this way, it might be possible to suggest a pathway from earlier working conditions to quality of life via their associations with the type of retirement transition individuals are differentially likely to experience.

10.2 Results

10.2.1 Retiring and quality of life

In section 8.3.3.3 on page 203, individuals who retired during the four-year follow-up period 2005–2009 experienced an improvement in their reported quality of life. In this section, that analysis is developed, examining, in a first step, individuals' quality of life in relation to the timing of retirement and, in a second step, whether earlier working conditions might moderate this relationship.

Descriptive statistics concerning the timing and nature of retirement in the GAZEL cohort were provided in Chapter 6: section 6.3.6, highlighting the wide range of variation among the GAZEL cohort participants in the timing and nature of retirement, particularly differences between men and women.

10.2.1.1 Describing quality of life over time in relation to the retirement transition

In order to examine the associations between retiring and quality of life, cross-sectional analyses were performed which compared participants' quality of life in relation to when they retired. More specifically, in two separate analyses, I compared the quality of life in 2005 and in 2009 of individuals who had retired different numbers of years before as well as individuals who had different numbers of years left until they retired. More details about the methods and sample used in this analyses were provided in section 5.3.6.2 on page 133. Tables 10.1 and 10.2 provide descriptive statistics as well as mean quality of life scores in 2005 and 2009 in relation to participants' year of retirement. Mean quality of life scores tended to be lower before retirement as well as for participants who had retired more than about 10 years before.

These average quality of life scores with 95% confidence intervals are displayed on two graphs in order to make the trends clearer to observe (Figure 10.1 and 10.2).

Table 10.1: Descriptive statistics of timing of retirement and quality of life in 2005 for 20 618 GAZEL cohort participants

Retirement year	n in sample	n providing CASP-19 scores	Mean CASP-19 score (2005)	Std dev.	95% CIs
2012	10	5	39.6	8.6	28.9 to 50.3
2011	136	73	41.5	8.8	39.5 to 43.6
2010	235	145	40.2	8.8	38.8 to 41.6
2009	263	148	40.8	9.7	39.2 to 42.4
2008	513	300	41.5	9.0	40.5 to 42.5
2007	609	372	41.2	9.3	40.3 to 42.2
2006	511	330	41.7	8.4	40.8 to 42.6
2005	437	240	42.5	7.9	41.5 to 43.5
2004	530	325	43.8	7.7	43.0 to 44.7
2003	1337	891	43.6	8.0	43.1 to 44.1
2002	1761	1186	44.0	7.6	43.6 to 44.5
2001	2056	1410	43.9	7.6	43.5 to 44.3
2000	2153	1455	43.6	7.7	43.2 to 44.0
1999	2025	1385	43.3	7.7	42.9 to 43.7
1998	2032	1348	43.7	7.2	43.3 to 44.0
1997	983	649	43.5	7.3	43.0 to 44.1
1996	1097	700	43.4	7.2	42.9 to 44.0
1995	1011	662	43.3	7.2	42.7 to 43.8
1994	654	422	42.5	7.2	41.8 to 43.2
1993	166	95	41.5	8.6	39.8 to 43.3
1992	727	445	42.0	8.1	41.3 to 42.8
1991	311	197	42.6	7.7	41.5 to 43.7
1990	184	106	41.4	8.6	39.8 to 43.1
1989	52	31	39.7	9.1	36.4 to 43.1
Not retired by 29th Feb. 2012	825	193	39.0	9.8	37.6 to 40.5
Total	20618	13113	–	–	–

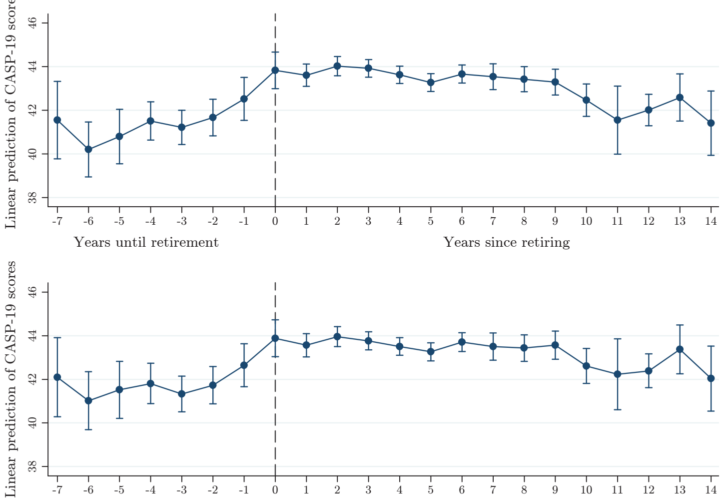
Seven individuals who retired before 1989 were not included in this table.

Table 10.2: Descriptive statistics of timing of retirement and quality of life in 2009 for 20 618 GAZEL cohort participants

Retirement year	n in sample	n providing CASP-19 scores	Mean CASP-19 score (2009)	Std dev.	95% CIs
2012	10	4	44.5	4.2	37.8 to 51.2
2011	136	80	41.2	8.1	39.3 to 43.0
2010	235	151	40.9	8.7	39.5 to 42.3
2009	263	156	42.9	8.9	41.5 to 44.4
2008	513	334	44.4	8.2	43.6 to 45.3
2007	609	380	43.7	8.8	42.8 to 44.6
2006	511	325	42.9	8.6	42.0 to 43.9
2005	437	262	43.6	8.3	42.6 to 44.6
2004	530	344	43.5	7.8	42.6 to 44.3
2003	1337	882	43.6	7.9	43.0 to 44.1
2002	1761	1162	43.4	8.0	42.9 to 43.9
2001	2056	1381	43.8	7.5	43.4 to 44.2
2000	2153	1382	43.3	7.6	42.9 to 43.7
1999	2025	1328	42.8	7.9	42.4 to 43.2
1998	2032	1305	43.1	7.4	42.7 to 43.5
1997	983	622	43.0	7.3	42.4 to 43.6
1996	1097	689	42.6	7.5	42.0 to 43.2
1995	1011	618	43.0	7.3	42.4 to 43.6
1994	654	390	42.1	7.0	41.4 to 42.8
1993	166	82	41.0	7.8	39.3 to 42.7
1992	727	428	41.9	7.9	41.2 to 42.7
1991	311	184	42.8	7.2	41.7 to 43.8
1990	184	97	40.8	8.0	39.2 to 42.4
1989	52	31	40.3	9.4	36.8 to 43.7
Not retired by 29th Feb. 2012	825	176	39.2	9.1	37.9 to 40.6
Total	20618	12793	–	–	–

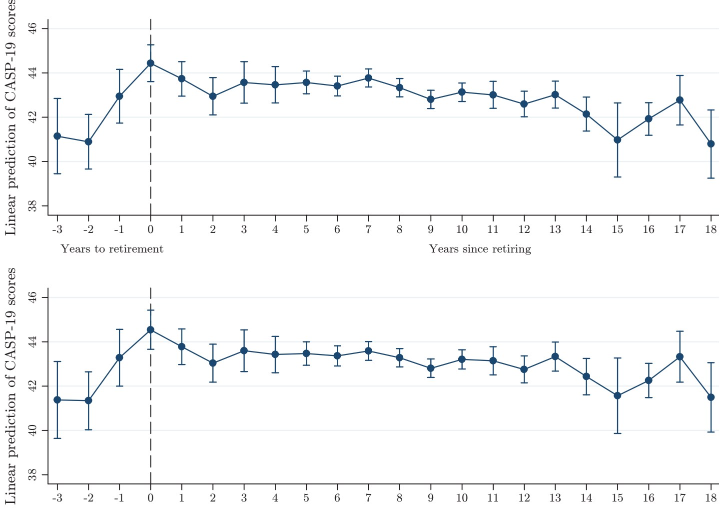
Seven individuals who retired before 1989 were not included in this table.

Figure 10.1: Unadjusted (above) and adjusted (below) predictions of quality of life in 2005 in relation to years since and up to retirement for 12 884 GAZEL cohort participants



Men and women are modelled together. The timing of retirement is indicated by a vertical dashed line. 95% confidence intervals are displayed. Model 1 (above) shows predicted quality of life in 2005 by years since and until retirement. Model 2 (below) shows predicted quality of life after additionally including age and gender as covariates.

Figure 10.2: Unadjusted (above) and adjusted (below) predictions of quality of life in 2009 in relation to years since and up to retirement for 12 582 GAZEL cohort participants



Men and women are modelled together. The timing of retirement is indicated by a vertical dashed line. 95% confidence intervals are displayed. Model 1 (above) shows predicted quality of life in 2005 by years since and until retirement. Model 2 (below) shows predicted quality of life after additionally including age and gender as covariates.

The upper pane of Figure 10.1 displays linear predictions of quality of life in 2005 in relation to how recently participants retired.[1] The model predicted quality of life in a linear regression in which year was treated as a categorical variable. Quality of life was over two points higher for participants who had retired within about the last nine years (a statistically significant difference at the 95% level) than for those who were not retired yet.

In the upper pane of Figure 10.2 showing linear predictions of quality of life in 2009, there are similar relationships between how recently participants had retired and their quality of life, indicating that these are individual trajectories rather than period effects, since this trend at the point of retirement concerned different people in 2005 and 2009.

Although cross-sectional, these analyses suggest that quality of life improved for a temporary period following retirement from the labour market, a result which corresponds to those of the multivariate change analysis reported in section 8.3.3.3 on page 203.

However, these analyses were not adjusted for covariates. Gender, in particular, might be confounding the relationship between timing of retirement and quality of life, because women reported lower mean quality of life scores and a higher proportion of women than men were not yet retired in 2005 and in 2009 (cf. Figure 6.7 on page 161). Therefore, in the lower panes of Figures 10.1 and 10.2, gender and age were included as covariates. In both years the trends persisted after inclusion of age and gender as covariates.

10.2.1.2 Modelling quality of life over time in relation to the retirement transition

In this part, the cross-sectional association of quality of life in relation to the recency of retirement is modelled using time since or until retirement as a continuous variable (instead of as a categorical variable). More details about the methods and samples used are provided in section 5.3.6.2 on page 133. Briefly, a wide variety of models were tested on the data, including linear models, piecewise models with quadratic terms and a range of fractional polynomials. Models were estimated separately for male and female participants and in 2005 and 2009. The models that were found to have the best fit, in terms of having the lowest values for BIC and AIC, are described in the following sections.

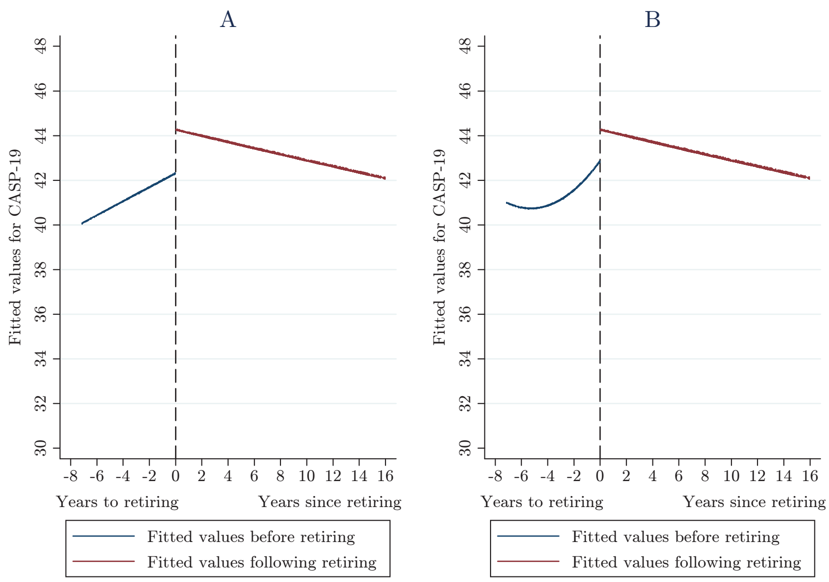
Modelling quality of life in 2005 in relation to the timing of retirement. For quality of life in 2005, the simplest straight line models of declining quality of life over the whole period were rejected by the BIC and AIC in both men and women in favour of n-shaped polynomial or piece-wise models. In men, the BIC and AIC gave divergent results. The BIC score was lowest for a piece-wise model with two straight line terms. Table 10.3, Model A, displays the coefficients for this model and it is depicted by Graph A in Figure 10.3. The lowest AIC score in men was obtained for a piecewise regression model incorporating a squared coefficient for the time preceding retirement. Table 10.3, Model B, displays the coefficients for this model. It is depicted by Graph B in Figure 10.3.

[1] The actual timing of individual departures from EDF-GDF is not the same as the retirement date provided in the company's SCAST files, since individuals used up sometimes lengthy paid leave in the run-up to retirement and consequently left the company some time in advance of their retirement date (Westerlund et al., 2010).

Table 10.3: Description of the retained models for retirement timing and quality of life in 2005 for 9838 male GAZEL cohort participants

Covariate	Coefficient	SE	p-value	95% CIs
Model A				
Intercept 1	42.82	0.52	<0.001	41.81 to 43.83
Intercept 2	44.62	0.20	<0.001	44.23 to 45.02
Time up to retirement	0.10	0.21	0.621	−0.31 to 0.52
Time following retirement	−0.14	0.04	<0.001	−0.21 to −0.07
Age-centered (2005)	−0.03	0.04	0.488	−0.11 to 0.05
Model B				
Intercept 1	41.17	0.71	<0.001	42.79 to 45.55
Intercept 2	44.61	0.20	<0.001	44.22 to 45.01
Time up to retirement	1.55	0.56	0.006	0.46 to 2.64
Time up to retirement^2	0.27	0.10	0.005	0.82 to 0.46
Time following retirement	−0.13	0.04	<0.001	−0.20 to −0.06
Age-centered (2005)	−0.03	0.04	0.438	−0.11 to 0.05

Figure 10.3: The retained piecewise models showing showing time leading up to and since retirement and 2005 quality of life in 9838 men from the GAZEL cohort

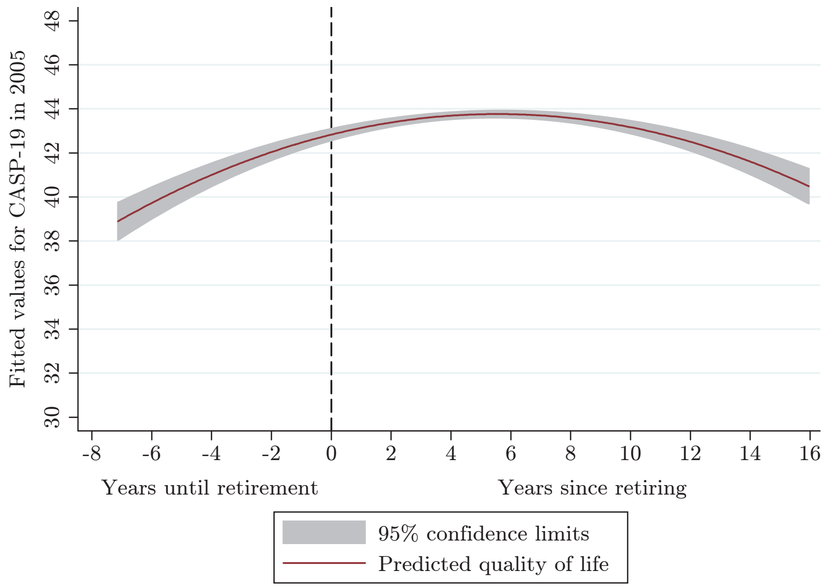


The model with the lowest score for BIC is displayed in Graph A (left); Graph B (right) shows the model with the lowest score for AIC. Both graphs are only indicative because age could not be adjusted for in these graphs although age was included in both models displayed in the table.

Table 10.4: Description of the retained model for retirement timing and quality of life in 2005 for 3082 female GAZEL cohort participants

Covariate	Coefficient	SE	p-value	95% CIs
Years since/up to retirement: 1st term	1.03	0.77	0.182	−0.48 to 2.55
Years since/up to retirement: 2nd term	−1.70	2.21	0.443	−6.03 to 2.64
Age-centered (2005)	−0.15	0.06	0.010	−0.27 to −0.04

Figure 10.4: Predicted 2005 quality of life scores from a polynomial regression of time leading up to and since retirement for 3082 female GAZEL cohort participants



The retirement time provided in the SCAST files is indicated at zero on the horizontal axis by the black dashed vertical line. 95% confidence intervals are shaded in grey.

In women, the lowest BIC and AIC scores were obtained for the same model, incorporating a squared and a cubic term. The equation for this model was:

$$y = \beta_0 + \beta_1 ln(x) + \beta_2 x^{\frac{1}{2}} + \beta_3 z \tag{10.1}$$

where x is time since or up to retirement and z is age. The coefficients for the covariates are displayed in Table 10.4 and the model is graphed in Figure 10.4. The trend for quality of life in relation to the timing of retirement was a shallow ∩-shaped curve, the peak of which corresponded to several years following retirement.

Modelling quality of life in 2009 in relation to the timing of retirement. Turning to quality of life in 2009, in both genders, different models were favoured by the two information criteria. In the case of men, the preferred model according to the BIC was the simplest model of a negative linear relationship between time since or up to retirement and quality of life. This model is described in Table 10.5, model A. The lowest AIC score was for a fractional polynomial model with the following equation:

$$y = \beta_0 + \beta_1 x + \beta_2 x \ln(x) + \beta_3 z \tag{10.2}$$

where x is time since or up to retirement and z is age. The model is described in Table 10.5, model B; Figure 10.5 depicts the relationship visually.

In women, again, the simplest model with a negative linear relationship between time and quality of life had the lowest BIC score. Its details are provided in Table 10.6, model A. The preferred model according to the AIC was a piecewise regression. It is graphed in Figure 10.6 and described in Table 10.6, model B.

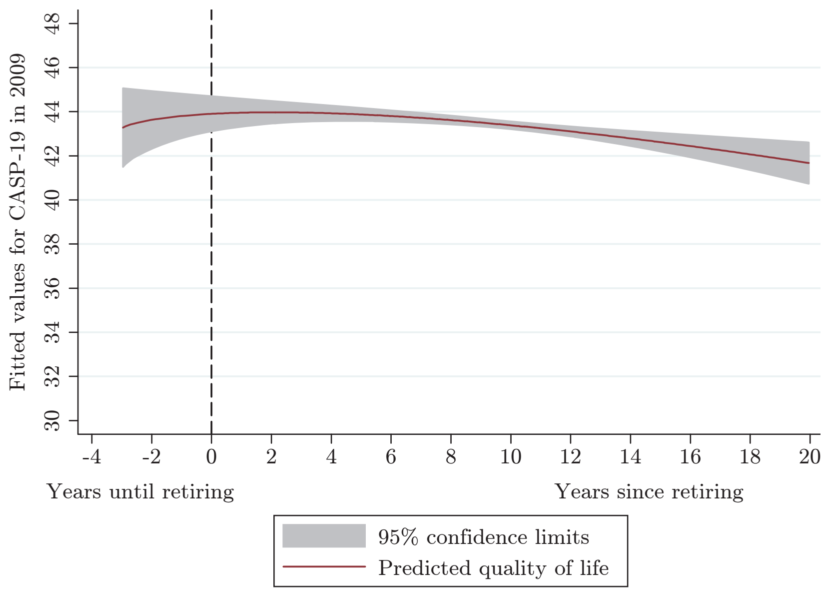
Overall, the models of quality of life in 2009 in relation to retirement timing in both men and women suggest a linear decline in quality of life over time, with the possibility of an increase in quality of life around the time of retirement in the more complex models.

Summary. To summarize, the preferred models of quality of life in 2005 all modelled a non-linear relationship between quality of life and timing of retirement in which quality of life increased at the moment of retirement before decreasing thereafter. The simpler models for 2009 quality of life suggested a linear decline in quality of life over time; the more complex models again suggested an increase in quality of life at the time of retirement.

Table 10.5: Description of the retained models for retirement timing and 2009 quality of life for 9490 male GAZEL cohort participants

Covariate	Coefficient	SE	p-value	95% CIs
Model A				
Time up to and following retirement	−0.08	0.04	0.033	−0.16 to −0.01
Age-centered (2005)	−0.11	0.03	<0.001	−0.17 to −0.05
Constant	44.44	0.27	<0.001	43.91 to 44.98
Model B				
Time up to & since retirement: 1st term	0.43	0.93	0.641	−1.39 to 2.26
Time up to & since retirement: 2nd term	−1.37	0.80	0.087	−2.94 to 0.20
Age-centered (2005)	−0.07	0.04	0.073	−0.15 to 0.07
Constant	43.47	0.09	<0.001	43.30 to 43.65

Figure 10.5: Predicted 2009 quality of life scores from a polynomial regression of time leading up to and since retirement for 9490 male GAZEL cohort participants

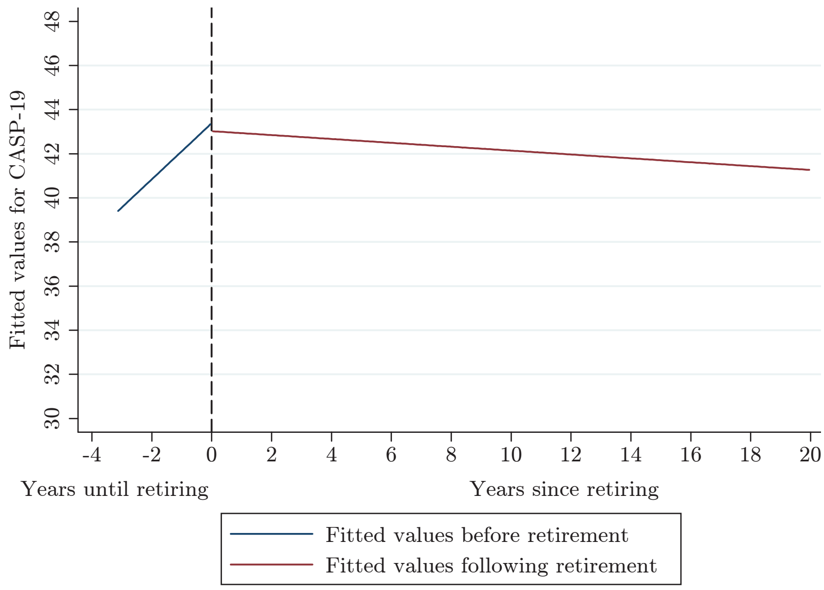


The retirement time provided in the SCAST files is indicated at zero on the horizontal axis by the black dashed vertical line. 95% confidence intervals are shaded in grey.

Table 10.6: Description of the retained models for retirement timing and 2009 quality of life for 3127 female GAZEL cohort participants

Covariate	Coefficient	SE	p-value	95% CIs
Model A				
Time up to and following retirement	−0.12	0.05	0.022	−0.23 to −0.02
Age-centered (2005)	0.03	0.04	0.444	−0.05 to 0.11
Constant	41.83	0.39	<0.001	41.07 to 42.59
Model B				
Intercept 1	42.62	0.45	<0.001	41.73 to 43.51
Intercept 2	41.81	0.58	<0.001	40.67 to 42.94
Time up to retirement	1.31	0.36	<0.001	0.61 to 2.01
Time following retirement	0.03	0.06	0.628	−0.08 to 0.14
Age-centered (2005)	−0.12	0.05	0.022	−0.23 to 0.02

Figure 10.6: Predicted 2009 quality of life scores from a polynomial regression of time leading up to and since retirement for 3127 female GAZEL cohort participants



The retirement time provided in the SCAST files is indicated at zero on the horizontal axis by the black dashed vertical line. 95% confidence intervals are shaded in grey. Age is not controlled for in this graph.

10.2.1.3 Modelling changing quality of life during the retirement transition in relation to mid-life working conditions

This section will develop the analysis presented in Table 8.7 on page 204 showing that retiring was associated with an improvement in quality of life, in order to establish whether participants' employment characteristics altered the association between retiring and quality of life. This section answers the question: *Is the degree to which individuals' quality of life changes at retirement related to their earlier working conditions?* Unlike the cross-sectional analyses presented in the previous section, these are longitudinal analyses, using repeated measures data for quality of life, which was measured in 2005 and 2009.

Only results for psychosocial exposures will be presented here, as the characteristics of the dataset precluded obtaining reliable results for physical occupational exposures in relation to retirement. I analysed whether participants who had worse psychosocial working conditions before retiring experienced greater improvements in quality of life once they had retired. Two measures of psychosocial strain were used: effort-reward imbalance from 1998 and job strain from 1997 and 1999 (the average of both years was taken when both were available). Full details of the analytic strategy and sample were given in section 5.3.6.3 on page 135, while section 5.2.10 on page 113 provides more information about the construction of the psychosocial strain measures.

The results from these analyses are presented in Table 10.7 and show that participants who reported worse psychosocial working conditions experienced greater improvements in quality of life upon retiring. Although this was the case for both measures of psychosocial strain, for the effort-reward imbalance measure the association did not reach statistical significance at the 95% level. A lack of people (only 33 participants) in the exposed category may be at cause.

In the case of job strain, the effects were significant and large. Participants who did not report job strain experienced a two-point improvement in quality of life on average, while participants reporting job strain experienced an improvement that was double this. This result indicates that participants exposed to difficult psychosocial working conditions experienced a greater relative improvement in their circumstances at retirement than participants who did not report psychosocial strain.

10.2.2 Retirement route and quality of life

This section aimed to answer the research question: *How does quality of life following retirement relate to the type of retirement transition participants experienced?* Three aspects of the retirement process were examined: individuals' ages at retirement, whether retirement occurred during a lengthy period of serious ill health or incapacity, and whether retirement marked a complete termination of professional activities.

10.2.2.1 Modelling age at retirement and quality of life

These analyses aimed to examine whether the age at which participants retired was associated with their quality of life. The sample characteristics and methods were described

Table 10.7: Moderation of the association between retirement and change in quality of life (2005–2009) by earlier psychosocial working conditions for 1061 GAZEL cohort participants

Variable	n	Mean CASP-19 change score	SE	95% confidence intervals
Effort-reward imbalance				
No	662	2.31	0.24	1.83 to 2.79
Yes	33	3.48	1.25	0.93 to 6.04
Missing	366	2.19	0.37	1.47 to 2.91
Total	1061	–	–	–
Job strain				
No	888	2.09	0.22	1.66 to 2.52
Yes	113	4.30	0.65	3.02 to 5.58
Missing	60	1.78	0.89	0.12 to 3.55
Total	1061	–	–	–

in section 5.3.6.4 on page 137.

Descriptive results. Tables 10.8 and 10.9 present descriptive statistics of age at retirement and quality of life in 2009 for women and men, respectively. Men tended to have slightly higher quality of life scores if they retired at older ages. Little trend was visible for women, although women seemed to have lower quality of life if they retired late, in their late fifties, than if they retired earlier.

Figure 10.7 displays mean quality of life in 2009 for a slightly reduced range of retirement ages for men and women in the GAZEL cohort. Men who retired at older ages seemed to have slightly higher quality of life than those who retired at younger ages. In women, no trend was apparent.

Results from the modelling. The results presented in Table 10.10 display the unadjusted associations between age at retirement and quality of life for the restricted sample created to deal with selection bias, as described fully in section 5.3.6.4 on page 137. In men, retiring at an older age was associated with higher quality of life, just as was apparent in Figure 10.7. In contrast, there appeared to be no association between age at retirement and quality of life in women. Sensitivity analyses using FIML estimation are displayed in Table G.6 on page 412.

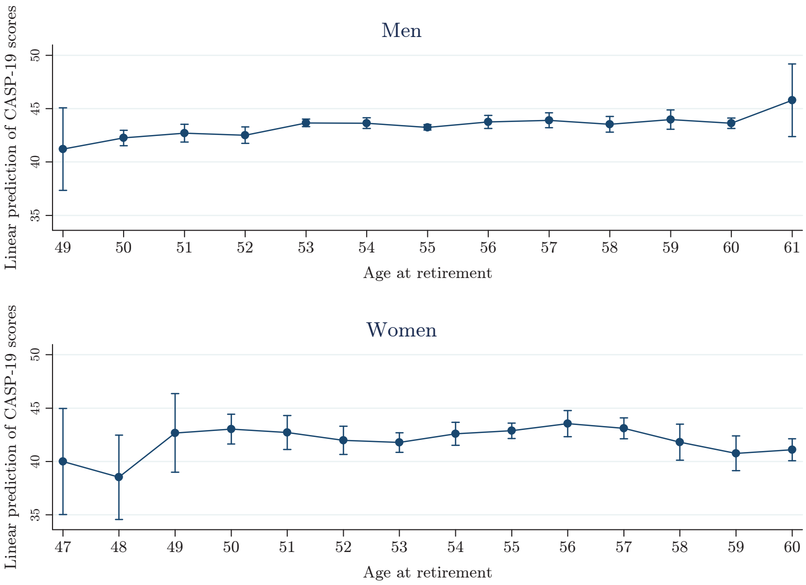
Table 10.8: Descriptive statistics of age at retirement and quality of life in 2009 for 14 639 male GAZEL cohort participants

Retirement age (years)	n in sample	n providing CASP-19 scores	Mean CASP-19 score (2009)	Standard deviation	95% confidence intervals
43	1	0	–	–	–
44	2	0	–	–	–
45	5	0	–	–	–
46	4	0	–	–	–
47	2	0	–	–	–
48	8	1	–	–	–
49	25	14	41.2	5.5	38.1 to 44.4
50	720	412	42.3	8.0	41.5 to 43.0
51	552	298	42.7	7.5	41.8 to 43.6
52	608	349	42.5	7.0	41.8 to 43.3
53	2495	1631	43.7	7.3	43.3 to 44.0
54	1219	799	43.6	7.1	43.1 to 44.1
55	5228	3428	43.3	7.3	43.0 to 43.5
56	785	550	43.8	7.6	43.1 to 44.4
57	633	427	43.9	7.1	43.2 to 44.6
58	561	385	43.5	7.3	42.8 to 44.3
59	384	256	44.0	7.6	43.0 to 44.9
60	1325	896	43.6	7.9	43.1 to 44.2
61	35	22	44.6	9.6	40.4 to 48.9
62	13	12	44.4	5.5	40.9 to 47.9
63	11	9	43.2	9.0	36.3 to 50.2
64	0	0	–	–	–
65	3	1	–	–	–
Missing	20	12	37.6	5.9	38.6 to 46.1
Total	14639	9502	–	–	–

Table 10.9: Descriptive statistics of age at retirement and quality of life in 2009 for 5497 female GAZEL cohort participants

Retirement age (years)	n in sample	n providing CASP-19 scores	Mean CASP-19 score (2009)	Standard deviation	95% CIs
35	2	2	37.5	–	–
36	6	2	44.0	–	–
37	7	4	47.3	7.1	36.0 to 58.5
38	16	10	39.8	10.1	32.5 to 47.1
39	15	8	43.4	7.9	36.8 to 50.0
40	13	7	43.3	8.0	35.9 to 50.6
41	19	12	41.0	10.8	34.2 to 47.8
42	17	9	47.6	4.4	44.2 to 50.9
43	20	12	38.6	9.4	32.6 to 44.5
44	17	10	44.5	5.3	40.7 to 48.3
45	14	7	40.0	10.8	30.0 to 50.0
46	25	17	39.2	8.0	35.1 to 43.3
47	25	12	40.0	10.2	33.5 to 46.5
48	29	19	38.5	10.6	33.4 to 43.7
49	47	22	42.7	8.6	38.9 to 46.5
50	253	153	43.0	9.0	41.6 to 44.5
51	183	117	42.7	8.7	41.1 to 44.3
52	270	171	42.0	8.7	40.7 to 43.3
53	569	348	41.8	9.1	40.8 to 42.7
54	403	252	42.6	8.5	41.5 to 43.6
55	898	572	42.9	8.2	42.2 to 43.5
56	354	221	43.8	8.0	42.7 to 44.8
57	690	418	42.9	8.8	42.1 to 43.7
58	253	154	41.3	8.7	39.9 to 42.7
59	321	178	41.1	9.1	39.7 to 42.4
60	679	372	41.2	9.5	40.2 to 42.2
61	16	10	35.3	9.7	28.4 to 42.2
62	10	6	42.2	8.6	33.2 to 51.2
63	2	1	44.0	–	–
64	0	0	–	–	–
65	0	0	–	–	–
66	1	1	37.0	–	–
Missing	323	161	39.1	9.0	37.7 to 40.5
Total	5497	3288			

Figure 10.7: Age at retirement and quality of life in 2009 for male and female GAZEL cohort participants



The bars represent 95% confidence intervals. Certain ages were excluded from display on this graph because few cohort members retired at these ages; women: <47 years and >60 years; men: <49 years and >61 years.

Table 10.10: Age at retirement and quality of life in 2009 for 7021 men and 1467 women in the GAZEL cohort

Variable	Coefficient	Standard error	95% confidence intervals
Men			
Age at retirement	0.13***	0.04	0.06 to 0.19
Constant	43.15***	0.09	42.98 to 43.33
Women			
Age at retirement	−0.11	0.07	−0.26 to 0.03
Constant	41.81***	0.23	41.35 to 42.26

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$.

It is possible that retiring later in men was associated with higher quality of life because this implies a progressively lower risk of having retired early due to ill health or incapacity. In order to exclude this possibility, variables indicating departures marked by ill health or disability were added to the model. However, the association between age of retirement and quality of life in men remained unchanged (results not shown), while in women there was still no relationship between age of retirement and quality of life.

10.2.2.2 Modelling quality of life in relation to whether participants continued professional activities since retiring

This section aimed to examine whether continuing professional activities after retirement was associated with higher subsequent quality of life. The sample used for this analysis, as well as the methods, was outlined in section 5.3.6.4 on page 138. In brief, only 11 096 cohort members were included in this analysis, in great part because the variable for post-retirement professional activities was only included in the 2000–2002 questionnaire and therefore participants retiring after 2002 were excluded from this analysis. A minority of the sample, 574 cohort members, or 5.2%, reported taking part in professional activities following retirement from their main occupation at EDF-GDF.

Participants who reported continuing professional activities after retiring reported quality of life in 2009 that was almost one point higher than those who reported no further professional activities following retirement (see Table 10.11). This difference was significant (independent samples t-test: 2.49, d.f.=8278, p=0.007).

Table 10.11: Post-retirement professional activities and quality of life in 2009 for 11 096 GAZEL participants

Post-retirement professional activities	n in sample	n providing CASP scores	Mean CASP score (2009)	Std dev.	95% confidence intervals
No	10522	7821	42.96	7.53	42.79 to 43.13
Yes	574	459	43.86	7.52	43.17 to 44.55
Total	11096	8280			

10.2.2.3 Modelling quality of life in relation to whether participants experienced a retirement transition marked by ill health and disability

This section examines the question of the long-term implications for quality of life of retirement transitions that were marked by ill health or disability. The methods and sample used in this analysis were described in section 5.3.6.4 on page 138.

In Table 10.12, of 19 149 cohort members who had retired by the start of 2009, 796 individuals (4.2%) reported having had a retirement transition that was marked by ill health or disability.

A large number of individuals (12 226 participants) provided enough information to calculate their CASP-19 quality of life scores in 2009. The fourth column of Table 10.12 displays mean quality of life scores in relation to whether retirement was accompanied by a lengthy period of illness or incapacity or not. Participants who experienced a retirement transition marked by long-term ill health or disability had quality of life scores in 2009 that were over four points lower than those who had not, differences that were statistically significant (independent samples t-test: 12.74, d.f. 12 224, $p<0.001$).

Table 10.12: Retirement related to illness and quality of life in 2009 for 19 149 GAZEL cohort participants

Retired in ill health	*n* in sample	*n* providing CASP scores	Mean CASP score (2009)	Std dev.	95% confidence intervals
No	18353	11718	43.34	7.61	43.20 to 43.48
Yes	796	508	38.91	9.18	38.11 to 39.71
Total	19149	12226			

10.2.2.4 Summary

Retiring at older ages was associated with higher mean quality of life in male participants only. Retirement transitions after which participants continued some professional activities were associated with better subsequent quality of life, while retirement transitions accompanied by ill health or disability were associated with poorer subsequent quality of life. These associations might be due to the nature of the retirement process itself, or it could be that these sorts of retirement transitions merely signal effects of earlier deleterious or positive working conditions.

Having examined associations between quality of life in early old age and different sorts of retirement transitions, the next section attempts to determine whether the risks of experiencing these variations in retirement transition were associated with participants' earlier circumstances, in particular their physical and psychosocial working conditions and social position in mid-life.

10.2.3 Mid-life circumstances and retirement route

This section analyses whether social position from mid-life, measured by social class and occupational grade in 1989, as well as physical and psychosocial working conditions, predicted the nature of participants' retirement transitions. This section answers the research question: *How do people's mid-life circumstances, working conditions and social position influence their chances of experiencing these different types of retirement?* I hypothesized that individuals experiencing strenuous and dangerous working conditions, as well as high levels of psychosocial strain, would be most likely to have a retirement transition marked by ill health. In contrast, participants in the most advantaged social positions, with better working conditions, would be more likely to experience a retirement transition marked by subsequent continuation of professional activities.

10.2.3.1 Prediction of age of retirement from mid-life working conditions and social position

This section examines whether mid-life working conditions and social position predicted the age at which participants retired. A sample with a restricted age range was used in order to deal with selection bias, as described fully in in section 5.3.6.5 on page 139. This analysis was stratified by gender.

Initially, mean ages at retirement are presented in Table 10.13 according to earlier social position and physical working conditions.[2] There were clear tendencies for male participants in higher occupational grades in 1989 to retire at older ages, as well as those in posts corresponding to ESeC social classes 1, 7 and 9. Male participants exposed to lower levels of strenuous and dangerous working conditions tended to retire at older ages.

In women, these tendencies were less consistent. Participants in ESeC classes 1, 3 and 8 tended to retire at older ages, but numbers of participants in these classes were often small. Participants in ESeC class 6 tended to retire at a younger age as did participants who were exposed to more chemical exposures (but numbers exposed were extremely small). Overall, however, the bivariate relationships in women were inconsistent.

It is possible that the bivariate associations reported between social class and age at retirement are a result of differences in physical working conditions. Therefore, in a second step, multiple regression analysis was performed to examine associations of age at retirement with, in model 1: current age, in model 2: social position and, in model 3: physical occupational exposures.[3] In the final model displayed in Table 10.14, certain social classes, occupational grades, and working conditions were associated with age at retirement. Male participants exposed to more retrospective ergonomic strain and higher chemical exposures tended to retire 6–15 months earlier than participants who did not experience these occupational exposures. Men employed in higher occupational grades in 1989 tended to retire at older ages. Similarly, compared to participants in ESeC class 1 in 1989, those in ESeC class 9 and particularly in class 7 tended to retire at older ages, while those in classes 2 and 6 tended to retire about 2 and 10 months sooner, respectively. These associations are likely in large part to be an outcome of the retirement rules, in which participants who were in manual (*actifs*) occupations, as defined by the company, were able to retire at younger ages.

[2] Sensitivity analyses were performed with and without the two measures of psychosocial strain. The results for the other variables were very similar despite so many people having to be excluded from the study because they were already retired in 1997–1999, when psychosocial strain was measured. The risk of selection bias was very high, so in the models presented here, these variables were not included. (In any case, in results not shown here, I did not find associations between the measures of psychosocial strain and age at retirement, perhaps because of these selection problems.)

[3] Since few women in the sample were exposed to strenuous or dangerous working conditions and quite inconsistent associations between physical working conditions and age at retirement were reported in the bivariate analyses, the results from the modelling are reported for men only.

Table 10.13: Descriptive statistics for age at retirement by mid-life working conditions and occupational position in 7814 men and 1669 women

	Men			Women		
	n	Mean age at retirement	Std dev.	n	Mean age at retirement	Std dev.
All	7814	55.2	2.4	1669	55.7	3.0
Demographics						
Age (1989)						
35–39 years	0	–	–	0	–	–
40–45 years	3351	55.1	2.3	747	55.4	2.9
46–50 years	4463	55.3	2.5	922	55.9	3.1
Socio-economic position						
Occupational grade (1989)						
Low	789	54.9	2.4	328	56.0	3.2
Middle	4306	54.6	2.1	1183	55.5	2.9
High	2719	56.3	2.6	158	56.1	3.2
ESeC social class (1989)						
ESeC 1	2701	56.3	2.6	165	56.0	3.2
ESeC 2	1158	55.3	2.5	1012	55.7	2.9
ESeC 3	320	55.0	2.4	278	56.0	3.1
ESeC 6	2914	54.4	2.0	97	54.9	3.3
ESeC 7	44	56.8	2.4	107	55.3	3.1
ESeC 8	659	54.3	1.9	8	56.6	4.6
ESeC 9	18	56.2	2.9	2	55.3	6.6
Physical working conditions						
Accumulated ergonomic strain						
None	2793	56.1	2.6	1281	55.7	3.0
Exposed: below median	2337	55.2	2.4	332	55.4	3.1
Exposed: above median	2684	54.3	2.0	56	56.5	2.6
Ergonomic strain (1989/90)						
Unexposed	2826	55.7	2.5	1168	55.7	3.0
Exposed	4988	55.0	2.4	501	55.6	3.1
Hazards (1989/90)						
Unexposed	1667	56.2	2.6	1257	55.7	3.0
Exposed	6147	55.0	2.4	412	55.6	3.1
Accumulated accidents						
None	6481	55.3	2.5	1468	55.7	3.0
One	929	54.7	2.2	151	55.7	3.1
Two or more	404	54.5	2.3	50	56.2	2.9
Chemical exposures						
None	3113	56.5	2.6	1652	55.7	3.0
Exposed: below median	2375	54.5	2.0	16	54.6	2.1
Exposed: above median	2326	54.3	1.9	1	51.2	–

Table 10.14: Modelling age at retirement by mid-life working conditions and occupational position for 7814 men in the GAZEL cohort

	Model 1			Model 2			Model 3		
	Coefficient	SE	95% CI	Coefficient	SE	95% CI	Coefficient	SE	95% CI
Demographics									
Age	0.03**	0.01	0.01 to 0.06	0.00	0.01	−0.02 to 0.02	−0.01	0.01	−0.03 to 0.02
Social position									
Social class (1989)									
ESeC 1 (reference)				–	–	–	–	–	–
ESeC 2				−0.15	0.10	−0.35 to 0.05	−0.31**	0.10	−0.50 to −0.12
ESeC 3				0.25	0.17	−0.08 to 0.59	0.10	0.16	−0.22 to 0.42
ESeC 6				−0.89***	0.09	−1.07 to −0.71	−0.39***	0.09	−0.57 to −0.21
ESeC 7				2.18***	0.36	1.47 to 2.88	1.30***	0.34	0.63 to 1.98
ESeC 8				−0.35*	0.15	−0.66 to −0.05	0.23	0.15	−0.08 to 0.53
ESeC 9				1.77**	0.55	0.69 to 2.85	1.70***	0.52	0.67 to 2.72
Occupational grade (1989)				0.20***	0.01	0.17 to 0.23	0.14***	0.01	0.12 to 0.17
Physical occupational exposures									
Retrospective ergonomic strain (2007)									
None/low (reference)							–	–	–
Exposed: below median							−0.51***	0.06	−0.63 to −0.39
Exposed: above median							−0.59***	0.07	−0.72 to −0.45
Ergonomic strain (1989/1990)							0.03	0.03	−0.03 to 0.09
Danger (1989/1990)							−0.04	0.02	−0.08 to 0.00
Accumulated accident episodes									
None (reference)							–	–	–
One							0.02	0.08	−0.13 to 0.17
Two or more							0.06	0.11	−0.17 to 0.28
Accumulated chemical exposures									
None (reference)							–	–	–
Exposed: below median							−1.45***	0.06	−1.58 to −1.33
Exposed: above median							−1.34***	0.08	−1.49 to −1.19
Constant	53.74***	0.54	52.68 to 54.81	53.79***	0.53	52.75 to 54.83	55.47**	0.51	54.48 to 56.47
R^2	0.00			0.15			0.24		

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$.

10.2.3.2 Predicting retirement transitions marked by continuation of professional activities

This section examines whether continuing professional activities after retirement in the GAZEL cohort was associated with factors from earlier working life, particularly physical working conditions and mid-life social position. The sample used in this analysis was described in section 5.3.6.5 on page 140. Initially, descriptive results are presented, before multivariate analyses are presented that predicted such retirement transitions on the basis of mid-life social position and physical working conditions.

The questions on the continuation of professional activities were posed in the 2000–2002 questionnaires, so of those participants who responded to one of these questionnaires and who retired before the year 2002, 5.5%, or 504 participants, reported carrying out professional activities after retiring. Men were more likely to have carried out professional activities than women, as were participants who had held a post at a higher occupational grade in 1989 or who were in ESeC classes 1 or 3. There were few perceptible differences by earlier working conditions, although participants with moderate ergonomic and chemical exposures were more likely to have continued professional activities.

Many of these variables were correlated with each other, therefore it is difficult to assess the importance of these differences from bivariate analysis. Therefore, the results from multiple regression modelling will be presented. Because the numbers of women continuing professional activities after retirement were so small (73 women), the genders were analysed together.

In the full model displayed in Table 10.16, it appears that the main factor from mid-life occupational circumstances that predicted continuation of professional activities after retiring was occupational grade in 1989. A one-step increase in grade increased the risk of continuing professional activities by about 13% (OR: 1.13, 95% CI: 1.08; 1.19). There was a less significant but substantial association with being in ESeC class 3: intermediate occupations, who had a doubled risk of continuing professional activities (OR: 2.00, 95% CI: 1.18; 3.41) compared to participants in ESeC class 1. There were no significant associations with any physical occupational exposure, gender or age in the fully adjusted model.

Table 10.15: Descriptive results of retirement marked by continuation of professional activities by earlier working conditions for 9236 GAZEL participants

	Continuation of prof. activities		Prof. activities not continued		
	n or mean	Percent or std dev.	*n* or mean	Percent or std dev.	Total
All	504	5.5%	8732	94.5%	9236
Demographics					
Gender					
Male	431	5.7%	7135	94.3%	7566
Female	73	4.4%	1597	95.6%	1670
Age	65.3	3.0	65.2	2.9	9236
Social position					
Occupational grade	9.9	3.5	8.8	3.1	9236
Social class					
ESeC 1	189	7.9%	2199	92.1%	2388
ESeC 2	101	4.8%	2025	95.2%	2126
ESeC 3	36	6.2%	543	93.8%	579
ESeC 6	148	4.5%	3138	95.5%	3286
ESeC 7	4	2.8%	139	97.2%	143
ESeC 8	26	3.6%	688	96.4%	714
Physical working conditions					
Accumulated ergonomic strain (2007)					
None	194	5.3%	3488	94.7%	3682
Exposed: below median	160	6.1%	2458	93.9%	2618
Exposed: above median	150	5.1%	2786	94.9%	2936
Ergonomic strain (1989/90)	0.8	0.9	0.8	1.0	9236
Hazards (1989/90)	1.4	1.3	1.4	1.5	9236
Accumulated accidents					
None	419	5.5%	7219	94.5%	7638
One	62	5.5%	1062	94.5%	1124
Two or more	23	4.9%	451	95.1%	474
Chemical exposures					
None	237	5.7%	3927	94.3%	4164
Exposed: below median	171	6.5%	2444	93.5%	2615
Exposed: above median	96	3.9%	2361	96.1%	2457

Table 10.16: Logistic model of risk of continuing professional activities after retiring for 9236 GAZEL cohort participants

	Model 1			Model 2			Model 3		
	OR	SE	95% CI	OR	SE	95% CI	OR	SE	95% CI
Demographics									
Gender	0.76*	0.10	0.59 to 0.98	0.85	0.13	0.63 to 1.15	0.96	0.16	0.69 to 1.35
Age	1.00	0.02	0.97 to 1.04	0.98	0.02	0.95 to 1.01	0.98	0.02	0.95 to 1.02
Social position									
Occupational grade (1989)				1.12***	0.03	1.07 to 1.18	1.13***	0.03	1.08 to 1.19
Social class (1989)									
ESeC 1 (reference)				–	–	–	–	–	–
ESeC 2				1.06	0.19	0.75 to 1.51	1.07	0.19	0.75 to 1.52
ESeC 3				2.01*	0.54	1.19 to 3.42	2.00*	0.54	1.18 to 3.41
ESeC 6				0.95	0.16	0.68 to 1.33	0.93	0.16	0.66 to 1.31
ESeC 7				0.97	0.54	0.32 to 2.88	1.04	0.58	0.35 to 3.10
ESeC 8				1.11	0.33	0.62 to 2.00	1.15	0.36	0.61 to 2.14
Physical occupational exposures									
Retrospective ergonomic strain (2007)									
None (reference)							–	–	–
Exposed: below median							1.15	0.13	0.91 to 1.44
Exposed: above median							1.16	0.16	0.89 to 1.52
Ergonomic strain (1989/1990)							1.10	0.07	0.97 to 1.24
Danger (1989/1990)							1.02	0.04	0.94 to 1.11
Accident episodes									
None (reference)							–	–	–
One							1.17	0.17	0.88 to 1.55
Two or more							1.10	0.25	0.70 to 1.72
Chemical exposures									
None (reference)							–	–	–
Exposed: below median							1.12	0.14	0.88 to 1.43
Exposed: above median							0.74	0.12	0.54 to 1.02
Constant	0.05**	0.05	0.01 to 0.37	0.07*	0.08	0.01 to 0.65	0.05**	0.05	0.00 to 0.42
Pseudo R^2	0.00			0.02			0.02		

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$.

10.2.3.3 Predicting retirement transitions marked by ill health or disability

This section examines whether mid-life working conditions and social position predicted whether an individual had a retirement transition marked by ill health or disability. The sample used in this analysis was described in section 5.3.6.5 on page 141. Firstly, descriptive statistics are presented for men and women together. Secondly, using multiple regression analysis, associations of this retirement route were modelled with, in model 1: gender and age, in model 2: social position and, in model 3: physical occupational exposures.

The overall probability of a retirement transition that was marked by ill health is 3%; 186 participants reported such a transition (Table 10.17). Women were more than twice as likely than men to undergo a retirement transition accompanied by ill health. Participants working in lower occupational grades, in ESeC class 7, who had had no accidents or who reported effort-reward imbalance in 1998 were more likely to retire in ill health. Differences by other mid-life occupational exposures were small or inconsistent.

In the multivariate models, the factors associated with early retirement in the complete model at conventional levels of statistical significance were: effort-reward imbalance, having had two or more accidents at work and reporting ergonomic strain in 1989/1990 (Table 10.18). After including measures of social position in model 2, gender was no longer associated with risk of retirement through illness or disability.

As the risks of experiencing the event in all groups were small (mainly under 5% and all were under 10%), the odds ratios can be interpreted much like relative risks (Davies et al., 1998). Participants who had had two or more accidents at work were about two and a half times more likely (OR: 2.41, 95% CI: 1.46 to 3.98), in the full model, to experience a retirement transition marked by ill health than those who had had no accidents at work. Similarly, employees who experienced effort-reward imbalance in 1998 were more than two and a half times as likely to have this sort of retirement than those not experiencing this (OR: 2.67, 95% CI: 1.77 to 4.02). There was also a small increase in risk for participants reporting ergonomic strain in 1989/90 (OR: 1.29, 95% CI: 1.05 to 1.57).

Table 10.17: Descriptive statistics of ill health and disability retirement and earlier working conditions and social position in the GAZEL cohort for 6242 participants

	Retirement in ill health		No retirement in ill health		
	n or mean	Percent or std dev.	*n* or mean	Percent or std dev.	Total
All	186	3.0%	6056	97.0%	6242
Gender					
Male	125	2.5%	4857	97.5%	4982
Female	61	4.8%	1199	95.2%	1260
Age	62.9	2.6	63.0	2.6	9236
Social position					
Occupational grade	7.8	2.9	9.4	3.6	9236
Social class					
ESeC 1	28	1.4%	1960	98.6%	1988
ESeC 2	62	4.2%	1410	95.8%	1472
ESeC 3	20	5.2%	363	94.8%	383
ESeC 6	49	2.6%	1838	97.4%	1887
ESeC 7	9	8.3%	99	91.7%	108
ESeC 8	18	4.5%	386	95.5%	404
Physical occupational exposures					
Accumulated ergonomic strain (2007)					
Unexposed	85	2.9%	2815	97.1%	2900
Exposed: below median	46	2.7%	1682	97.3%	1728
Exposed: above median	55	3.4%	1559	96.6%	1614
Ergonomic strain (1989/90)	1.0	1.1	0.8	1.0	9236
Hazards (1989/90)	1.4	1.7	1.3	1.5	9236
Occupational accidents					
None	138	4.0%	3296	96.0%	3434
One	25	1.6%	1525	98.4%	1550
Two or more	23	1.8%	1235	98.2%	1258
Chemical exposures					
None	108	3.2%	3296	96.8%	3404
Exposed: below median	34	2.2%	1525	97.8%	1559
Exposed: above median	44	3.4%	1235	96.6%	1279
Psychosocial occupational exposures					
Effort-reward imbalance					
Yes	32	8.5%	345	91.5%	377
No	154	2.6%	5711	97.4%	5865

Table 10.18: Logistic model of risk of retirement through illness or disability for 6242 GAZEL cohort participants

	Model 1			Model 2			Model 3			Model 4		
	OR	SE	95% CI	OR	SE	95% CI	OR	SE	95% CI	OR	SE	95% CI
Demographics												
Gender	2.03***	0.34	1.47 to 2.81	1.30	0.27	0.87 to 1.95	1.45	0.34	0.91 to 2.31	1.44	0.34	0.91 to 2.30
Age	1.02	0.03	0.96 to 1.08	1.04	0.03	0.98 to 1.10	1.05	0.03	0.99 to 1.11	1.04	0.03	0.98 to 1.10
Social position												
Occupational grade (1989)				0.92	0.04	0.84 to 1.01	0.93	0.04	0.85 to 1.02	0.94	0.04	0.85 to 1.03
Social class (1989)												
ESeC 1 (reference)				–	–	–	–	–	–	–	–	–
ESeC 2				1.81	0.61	0.93 to 3.50	1.78	0.60	0.91 to 3.46	1.69	0.58	0.87 to 3.31
ESeC 3				1.74	0.86	0.66 to 4.59	1.68	0.84	0.63 to 4.45	1.63	0.82	0.61 to 4.34
ESeC 6				1.25	0.42	0.64 to 2.43	1.04	0.38	0.51 to 2.12	1.04	0.38	0.51 to 2.11
ESeC 7				2.74	1.54	0.91 to 8.25	2.90	1.64	0.96 to 8.81	2.57	1.48	0.83 to 7.94
ESeC 8				1.66	0.85	0.61 to 4.52	0.93	0.51	0.32 to 2.74	0.96	0.53	0.33 to 2.81
Physical working conds												
Retrospective erg. strain (2007)												
None (reference)							–	–	–	–	–	–
Exposed: below median							1.02	0.20	0.69 to 1.50	0.98	0.19	0.66 to 1.44
Exposed: above median							1.10	0.27	0.68 to 1.77	1.01	0.25	0.63 to 1.63
Ergonomic strain (1989/90)							1.30*	0.13	1.07 to 1.58	1.29*	0.13	1.05 to 1.57
Danger (1989/90)							0.96	0.07	0.83 to 1.12	0.96	0.07	0.82 to 1.11
Accident episodes												
None (reference)							–	–	–	–	–	–
One							1.28	0.29	0.82 to 2.01	1.25	0.29	0.80 to 1.96
Two or more							2.60***	0.66	1.58 to 4.27	2.41**	0.62	1.46 to 3.98
Chemical exposures												
None (reference)							–	–	–	–	–	–
Exposed: below median							0.83	0.21	0.51 to 1.35	0.86	0.22	0.53 to 1.41
Exposed: above median							0.97	0.28	0.56 to 1.70	1.02	0.29	0.58 to 1.79
Psychosocial working conds												
Effort-reward imbalance (1998)										2.67***	0.56	1.77 to 4.02
Constant	0.01**	0.02	0.00 to 0.28	0.00**	0.01	0.00 to 0.15	0.00**	0.00	0.00 to 0.09	0.00**	0.00	0.00 to 0.10
Pseudo R-squared	0.01			0.03			0.05			0.06		

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$.

10.3 Conclusion

This chapter analysed quality of life in relation to the transition to retirement from two perspectives: (1) examining how quality of life changed as individuals retired and, (2) examining how previous working conditions might generate different retirement routes which, in turn, have implications for quality of life in old age.

This chapter has managed to describe processes in which working in manual occupations and at lower level exposed participants to a greater risk of a retirement process marked by ill health and lower risk of a retirement in which professional activities were maintained. In turn, these retirement processes were differentially associated with quality of life following retirement: retirement in ill health was associated with poorer than average outcomes and retirement with the continuation of professional activities was associated with better than average outcomes. Although it is not possible to attribute causality to the role of retirement processes in particular, it is possible to see a chain of events in which mid-life circumstances expose individuals to different sorts of retirement processes which are associated, in turn, with varying levels of quality of life.

Chapter 11

Life course processes and quality of life

Summary

In this final results chapter, exposures from different stages in the life course are integrated into models that explore indirect and direct effects of earlier circumstances upon quality of life. The analysis focuses on two aspects of mid-life circumstances: social position and physical working conditions.

Results from Chapters 7 and 8 demonstrated the importance of current and recent circumstances for predicting quality of life. This final results chapter examines whether the effects of mid-life circumstances are mediated by more recent circumstances, and if so, through which contemporary influences individuals' earlier circumstances might be affecting quality of life.

In the first set of analyses, examining quality of life after labour market exit in relation to physical occupational exposures in men, the results suggest that pathways via physical and mental health accounted for these associations. A second set of analyses suggested that physical and mental health as well as wealth in later life accounted, in part, for the association between mid-life occupational grade and quality of life after retirement.

11.1 Introduction

There is a strong case for understanding quality of life in older people within the perspective of their life courses. Taking inequalities in social position and in working conditions in mid-life as a starting point, in this chapter pathway life course models of the development of inequalities in quality of life after individuals have retired will be constructed and tested. This is in order to examine whether recent circumstances thought to influence quality of life account for the relationships between circumstances in mid-life and quality of life in early old age. These recent circumstances are physical health, mental health, wealth and social support.

The overall aim for this chapter is to examine how mid-life occupational conditions and social position influence quality of life. More specifically, the research questions are:

1. How do physical occupational exposures influence quality of life following labour market exit?
2. How does mid-life social position influence quality of life at old ages?

I hypothesize that more recent circumstances will account for those differences in quality of life observed in previous chapters which relate to individuals' earlier working conditions and social position. This study will take a structural equation modelling approach, in order to model all of the pathways simultaneously, as well as adjusting for interrelationships between the recent circumstances. An important question which will be asked is whether, after taking more recent circumstances into account, there are still unexplained associations between mid-life circumstances and quality of life. In other words, the models will be examined in order to ascertain whether direct effects between mid-life circumstances and quality of life in early old age remain after inclusion of these factors. If this is the case, then these direct effects are best described as pathways between earlier circumstances and later quality of life that are unexplained by the measures of recent circumstances included in the model.

11.2 Results

In the first part of the chapter, the pathways between physical working conditions and subsequent quality of life will be examined. Each of the five types of physical working conditions discussed in Chapter 9 will be examined in turn: retrospective ergonomic strain (2007), ergonomic stain (1989/1990), occupational hazards (1989/1990), occupational accidents (1978–2008), exposure to chemicals (1950–1998).[1] These analyses will only be performed using the male cohort participants, because physical occupational exposures in women were rare and associations for physical occupational exposures and subsequent quality of life were weak and inconsistent for women (see Table 6.7 on page 163 and Table 9.11 on page 226).

[1] These results have been part-published in a simpler form using multiple regression rather than structural equation modelling in an international peer-reviewed journal (Platts, 2012).

Next, the pathways linking quality of life to social position will be examined. Social position will be operationalized by occupational grade. In order to retain a large sample size, the two genders were analysed together.

11.2.1 Does health mediate the relationships between physical occupational exposures and quality of life?

The sample used for this analysis as well as how the analysis was carried out were described in section 5.3.7.2 on page 142, and Figure 5.4 depicted the paths included in the model.

Table 11.1 displays descriptive statistics for the male cohort participants included in the analysis. Some values were missing from the retrospective measure of ergonomic strain and occupational grade; a large proportion of values were missing from the measures of mental and physical health in 2007 and quality of life in 2009. The levels of health and quality of life reported in this sample corresponded to the levels reported by men in the cohort as a whole (cf. 6.3.5 on page 156). Levels of physical occupational exposures were also typical of those recorded in the whole cohort (cf. 6.3.7.1 on page 162).

The correlation coefficients between all of the variables used in this analysis are displayed in Table 11.2. Higher quality of life scores were reported by participants in better mental and physical health, and by those who held posts corresponding to higher occupational grades in 1989. Older age was negatively correlated with quality of life, as was greater ergonomic strain. The occupational exposures were positively correlated with each other, including the retrospective and prospective indicators of ergonomic strain, which provides some support for the reliability of the self-reported measures. Turning to the associations between social position in 1989 and physical working conditions, higher grade and higher social class (the highest ESeC classes 1, 2 and 3 are non-manual) were associated with lower levels of exposures in men. Physical working conditions were weakly negatively correlated with physical and mental health functioning in men. There were positive correlations between physical and mental health functioning and quality of life. All types of physical working conditions were weakly negatively correlated with quality of life at older ages. All five types of physical working conditions were positively correlated with each other. For example, there was a correlation of 0.46 between accumulated chemical exposures and individuals' perceptions of physical hazards. These associations were not taken into account in the construction of the separate path models and will be discussed in section 12.3.2.6 on page 292.

The results of the path analyses for each type of physical occupational exposure are provided in turn over the next few pages. Each of the covariance matrices used in the calculations of these models is provided in Appendix H.

Table 11.1: Descriptive statistics for 13 783 male GAZEL cohort participants included in the analysis

Variable	Categories or range	Percent or mean	Standard deviation	n in category	n	Percent missing (%)
Quality of life						
Quality of life (CASP-19)	8.0–57.0	43.4	7.4	–	9431	31.6
Mental & physical health						
Mental health (SF-36 MCS)	0.3–71.3	49.3	8.9	–	9741	29.3
Physical health (SF-36 PCS)	14.3–68.9	50.1	6.9	–	9741	29.3
Physical working conditions						
Retrospective ergonomic strain	0–375	44.7	60.8	–	10347	24.9
Ergonomic strain	0–5	1.0	1.1	–	13783	0.0
Physical hazards	0–7	1.7	1.6	–	13783	0.0
Occupational accidents				–	13783	0.0
	0	80.4%		11075		–
	≥1	19.6%		2708		–
Accumulated chemicals	0–4.5	0.6	0.8	–	13783	0.0
Controls						
Age	41–50	44.9	2.8	–	13783	0.0
Occupational grade	1–52	9.1	3.5	–	13753	0.2
ESeC class					13783	0.0
	ESeC 1	30.0%		4133		–
	ESeC 2	14.7%		2022		–
	ESeC 3	4.8%		657		–
	ESeC 6	38.6%		5314		–
	ESeC 7	0.8%		107		–
	ESeC 8	11.0%		1511		–
	ESeC 9	0.3%		39		–

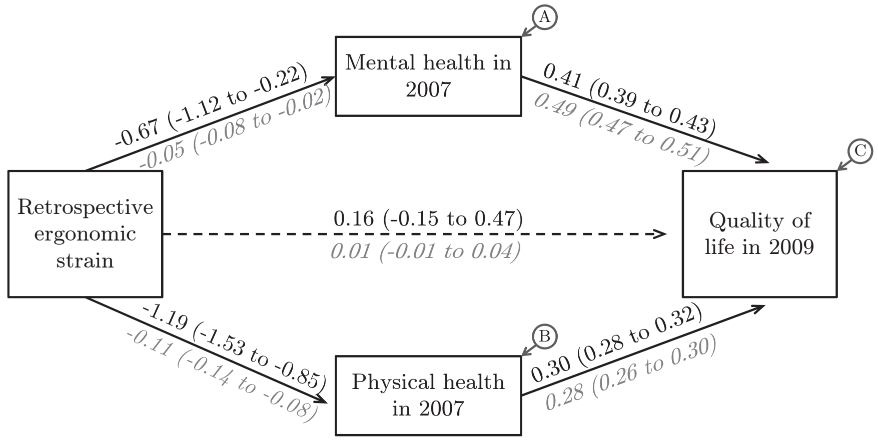
Table 11.2: Correlation matrix for the variables used in the path analyses examining physical working conditions and quality of life for 13 783 participants from the GAZEL cohort

	1. CASP	2. MCS	3. PCS	4. Acc. erg. strain	5. Erg. score	6. Hazards. score	7. Acc. accidents	8. Acc. chem exposures	9. Age	10. Age^2	11. Grade	12. ESeC
Quality of life												
1. CASP-19 quality of life	1.00											
Physical & mental health												
2. Mental health (SF-36 MCS)	0.51	1.00										
3. Physical health (SF-36 PCS)	0.30	0.06	1.00									
Physical working conditions												
Ergonomic strain												
4. Accumulated ergonomic strain	−0.08	−0.05	−0.12	1.00								
5. Ergonomic strain score	−0.09	−0.05	−0.10	0.46	1.00							
Dangerous work												
6. Physical hazards score	−0.06	−0.03	−0.07	0.42	0.61	1.00						
7. Accumulated accidents	−0.08	−0.05	−0.09	0.23	0.28	0.21	1.00					
Exposures to harmful chemicals												
8. Accumulated chem. exposures	−0.06	−0.01	−0.07	0.42	0.40	0.46	0.25	1.00				
Controls												
9. Age	−0.07	−0.02	−0.10	−0.05	−0.06	−0.08	−0.05	−0.02	1.00			
10. Age^2	−0.02	0.00	−0.03	−0.02	−0.01	−0.02	−0.01	−0.03	0.30	1.00		
11. Occupational grade	0.13	0.06	0.09	−0.37	−0.36	−0.29	−0.27	−0.39	0.11	0.01	1.00	
12. ESeC class	−0.10	−0.03	−0.07	0.45	0.42	0.41	0.27	0.51	−0.10	−0.02	−0.70	1.00

11.2.1.1 Retrospective ergonomic strain and quality of life in 2009

The model, depicting direct and indirect paths between retrospective ergonomic strain and quality of life, is shown in Figure 11.1. The two indirect paths, via mental and physical health, were significant at the 99% level and were similarly sized (Table 11.3). A small proportion of the total effect was direct, and this direct path was not significant. The effect of accumulated ergonomic strain upon quality of life in 2009, following retirement, was fully mediated by physical and mental health in 2007.

Figure 11.1: Standardized and unstandardized path coefficients with 99 % confidence intervals from the full information maximum likelihood estimation path model for 13 783 male GAZEL cohort participants



Unstandardized coefficients are above the arrows; standardized coefficients are displayed in *italic* beneath. Dashed arrows represent insignificant paths. Correlations between the mediating variables are not shown. Disturbances expressed as proportions of unexplained variances are: A: 0.991; B: 0.967; C: 0.641.

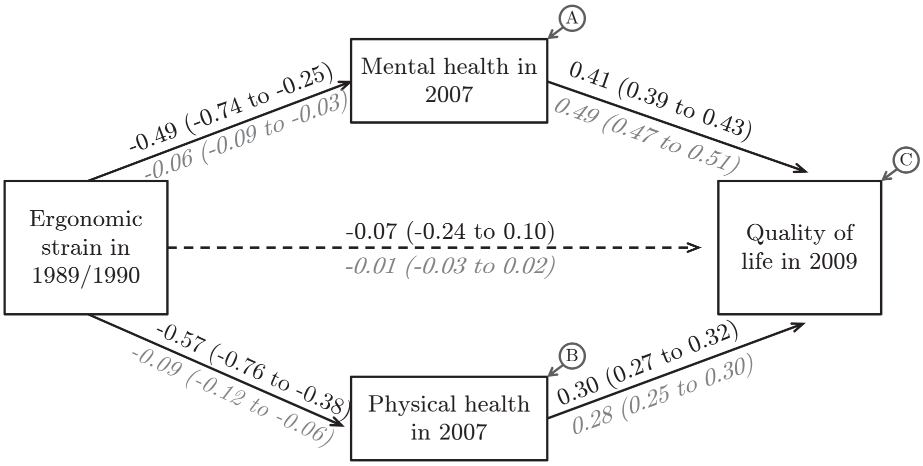
Table 11.3: Standardized and unstandardized coefficients for the paths between retrospective ergonomic strain and quality of life in 2009 for 13 783 male GAZEL cohort participants

Path	Unstandardized estimate	Standard error	P-value	Standardized estimate
Total	−0.471	0.145	0.001	−0.039
Direct	0.159	0.121	0.189	0.013
Total indirect	−0.631	0.084	<0.001	−0.052
via mental health	−0.273	0.071	<0.001	−0.022
via physical health	−0.357	0.041	<0.001	−0.029

11.2.1.2 Ergonomic strain in 1989/90 and quality of life in 2009

In Table 11.4, the direct effect of ergonomic strain in 1989/1990 upon quality of life in 2009 was small and insignificant. This indicates that physical and mental health fully mediated the effect of ergonomic strain upon quality of life. Both of these indirect paths were significant at the 99% level and were similarly sized. In Figure 11.2, depicting the path model, greater reported ergonomic strain was associated with worse mental and physical health in 2007. In turn, better mental and physical health were associated with higher quality of life in 2009.

Figure 11.2: Standardized and unstandardized path coefficients from the full information maximum likelihood estimation path model for 13 783 male GAZEL cohort participants



Unstandardized coefficients are above the arrows; standardized coefficients are displayed in *italic* beneath. The standardized estimates were calculated using stdyx standardization in which both exogenous and endogenous variables were standardized. Insignificant paths are represented by dashed arrows. Figures in brackets are 99 % confidence intervals. Correlations between the mediating variables are not shown. Disturbances expressed as proportions of unexplained variances are: A: 0.989; B: 0.969; C: 0.641.

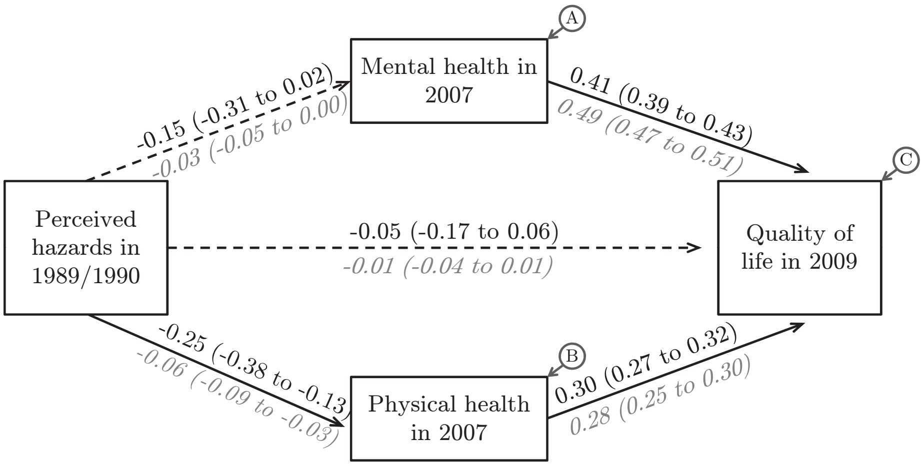
Table 11.4: Standardized and unstandardized coefficients for the paths between ergonomic strain in 1989/1990 and quality of life in 2009 for 13 783 GAZEL cohort participants

Path	Unstandardized estimate	Standard error	P-value	Standardized estimate
Total	−0.437	0.078	<0.001	−0.063
Direct	−0.067	0.066	0.314	−0.010
Total indirect	−0.371	0.045	<0.001	−0.053
via mental health	−0.200	0.039	<0.001	−0.029
via physical health	−0.171	0.022	<0.001	−0.025

11.2.1.3 Perceived hazards in 1989/1990 and quality of life in 2009

In the case of the relationships between the perception of occupational hazards and quality of life, a small and insignificant proportion of the total effect was direct (Table 11.5). This suggests that the effects of perceived occupational hazards upon subsequent quality of life were fully mediated via physical and mental health in 2007. The association with mental health was of borderline significance for such a large sample size, with a p-value of 0.024, because of the weak association between perceived hazards in 1989/1990 and mental health in 2007 (Figure 11.3). Reporting more perceived hazards in 1989/1990 was associated with worse physical health in 2007. Both physical and mental health in 2007 were positively associated with quality of life in 2009.

Figure 11.3: Standardized and unstandardized path coefficients from the full information maximum likelihood estimation path model for 13 783 male GAZEL cohort participants



Unstandardized coefficients are above the arrows; standardized coefficients are displayed in *italic* beneath. The standardized estimates were calculated using stdyx standardization in which both exogenous and endogenous variables are standardized. Insignificant paths were represented by dashed arrows. Figures in brackets are 99 % confidence intervals. Correlations between the mediating variables are not shown. Disturbances expressed as proportions of unexplained variances are: A: 0.992; B: 0.973; C: 0.641.

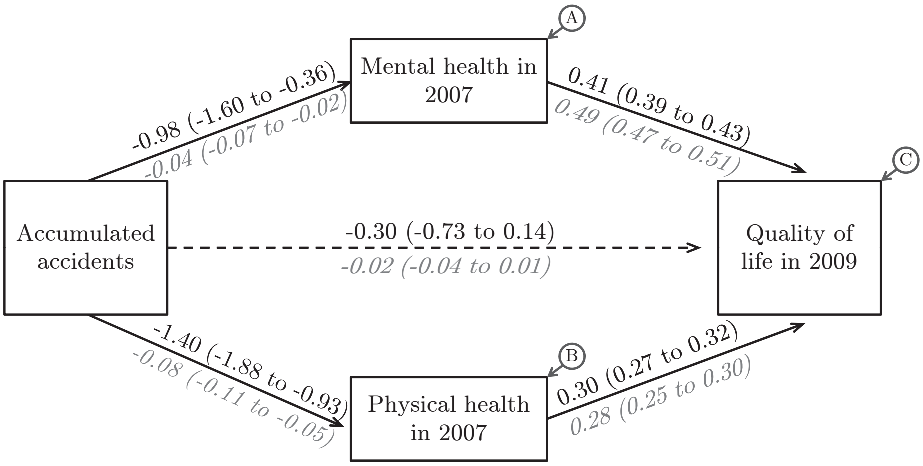
Table 11.5: Standardized and unstandardized coefficients for the paths between perceived hazards in 1989/1990 and quality of life in 2009 for 13 783 male GAZEL cohort participants

Path	Unstandardized estimate	Standard error	P-value	Standardized estimate
Total	−0.186	0.052	<0.001	−0.063
Direct	−0.052	0.044	0.239	−0.010
Total indirect	−0.134	0.030	<0.001	−0.053
via mental health	−0.059	0.026	0.024	−0.029
via physical health	−0.075	0.015	<0.001	−0.025

11.2.1.4 Accumulated accidents and quality of life in 2009

Table 11.4 shows that the direct path between accumulated accidents and quality of life in 2009 did not reach statistical significance. Consequently, it is possible to reject a direct pathway between accumulated accidents and subsequent quality of life (Figure 11.4). The indirect paths via mental and physical health are similarly sized and highly significant, suggesting full mediation by recent health of the effect of occupational accidents upon quality of life.

Figure 11.4: Standardized and unstandardized path coefficients from the full information maximum likelihood estimation path model for 13 783 male GAZEL cohort participants



Unstandardized coefficients are above the arrows; standardized coefficients are displayed in *italic* beneath. The standardized estimates were calculated using stdyx standardization in which both exogenous and endogenous variables are standardized. Insignificant paths are represented by dashed arrows. Figures in brackets are 99 % confidence intervals. Correlations between the mediating variables are not shown. Disturbances expressed as proportions of unexplained variances are: A: 0.991; B: 0.969; C: 0.641.

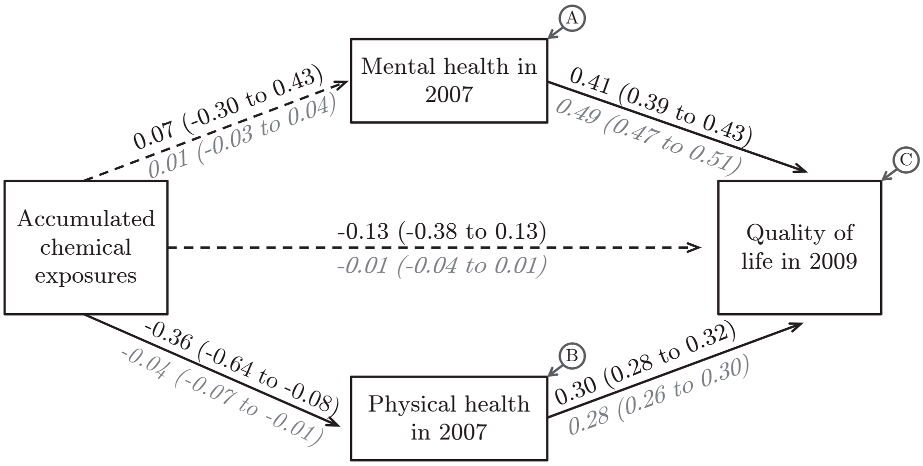
Table 11.6: Standardized and unstandardized coefficients for the paths between accumulated accidents and quality of life in 2009 for 13 783 male GAZEL cohort participants

Path	Unstandardized estimate	Standard error	P-value	Standardized estimate
Total	−1.115	0.196	<0.001	−0.059
Direct	−0.300	0.169	0.076	−0.016
Total indirect	−0.815	0.114	<0.001	−0.043
via mental health	−0.397	0.098	<0.001	−0.021
via physical health	−0.418	0.056	<0.001	−0.022

11.2.1.5 Accumulated chemical exposures and quality of life in 2009

The association between quality of life and previous exposures to hazardous chemicals, reported in Chapter 9, was not significant after adjusting for social position and age. The results presented here tend to confirm this finding. The total effect upon quality of life did not reach significance, with a p-value of 0.075. Similarly, neither the total indirect effect nor the direct effect path achieved significance. However, the small path between accumulated chemical exposures and quality of life via physical health was significant at the 99% level (Table 11.7). It seems that greater chemical exposures may worsen quality of life through their impact upon physical health alone.

Figure 11.5: Standardized and unstandardized path coefficients from the full information maximum likelihood estimation path model for 13 783 male GAZEL cohort participants



Unstandardized coefficients are displayed above the arrows; standardized coefficients are displayed in *italic* beneath the arrows. The standardized estimates were calculated using stdyx standardization in which both exogenous and endogenous variables were standardized. Insignificant paths are represented by dashed arrows. Figures in brackets are 99 % confidence intervals. Correlations between the mediating variables are not shown. Disturbances expressed as proportions of unexplained variances are: A: 0.992; B: 0.974; C: 0.695.

Table 11.7: Standardized and unstandardized coefficients for the paths between accumulated chemical exposures and quality of life in 2009 for 13 783 male GAZEL cohort participants

Path	Unstandardized estimate	Standard error	P-value	Standardized estimate
Total	−0.205	0.116	0.075	−0.021
Direct	−0.127	0.099	0.198	−0.013
Total indirect	−0.079	0.067	0.239	−0.008
via mental health	0.028	0.058	0.628	0.003
via physical health	−0.107	0.033	0.001	−0.011

11.2.1.6 Summary of results for mediation by health of the effect of physical occupational exposures upon quality of life

In general, the effects of the physical occupational exposures upon quality of life were mediated by recent physical and mental health. In many cases, the coefficients for the mental and physical health paths were similarly sized. However, in the model of perceived hazards, the path between the physical occupational exposure and mental health was not significant, suggesting that the effect was mediated primarily via recent physical health. The effect of accumulated chemical exposures upon quality of life was not significant, although there was a small significant path via the physical health pathway.

11.2.2 How does social position influence quality of life?

The sample used for this analysis as well as the manner in which the analysis was carried out are described in section 5.3.7.3 on page 145. Figure 5.5 on page 145 depicts the paths included in the two models.

11.2.2.1 Descriptive results

Table 11.8 displays descriptive data for all of the 16 623 participants. Some values were missing from the occupational grade, wealth, mental and physical health, social support and CASP-19 quality of life variables, with the variable for wealth being the worst affected.

Table 11.9 displays the correlations between all of the variables. Higher quality of life scores were reported by participants in better physical and mental health and who reported greater social support and wealth. There was a positive correlation between occupational grade in 1989 and quality of life in 2005. Occupational grade correlated positively with physical health, mental health and wealth, but not with social support. There were some correlations between the mediating variables, particularly between wealth and physical and mental health. Older individuals were employed in higher occupational grades in 1989, but also had worse subsequent physical health, better mental health and lower quality of life. Women were employed in lower occupational grades, and reported poorer mental and physical health and worse quality of life. The covariance matrix is displayed in Table H.6 in Appendix H.

Table 11.8: Descriptive statistics for 16 623 GAZEL cohort participants included in the analysis of mid-life social position and quality of life following labour market exit

Variable (year)	Categories or range	Percent or mean	Standard deviation	n in category	n	Percent missing
Quality of life						
CASP-19 (2005)	6–57	43.5	7.6	–	11308	32.0%
Controls						
Age (1989)	36–50	45.0	3.1	–	16623	0.0%
Gender					16623	0.0%
	Male	78.9%	–	13117		
	Female	21.1%	–	3506		
Mediating variables						
Wealth (2002)	0–8	5.6	1.3	–	10873	34.6%
SF-36 PCS (2003)	8.3–69.0	50.4	7.1	–	12175	26.8%
SF-36 MCS (2003)	5.7–71.7	48.4	9.7	–	12175	26.8%
Social support (2004)					12495	24.8%
	No	14.4%	–	1799		
	Yes	85.6%	–	10696		
Social position						
Occupational grade (1989)	1–52	8.7	3.5	–	16597	0.2%

Table 11.9: Correlation matrix for the variables used in the analysis examining pathways from social position to subsequent quality of life for 16 623 participants from the GAZEL cohort

	1. CASP	2. MCS	3. PCS	4. Social support	5. Wealth	6. Gender	7. Age	8. Grade
Quality of life								
1. CASP-19 quality of life (2005)	1.00							
Mediating variables								
2. Mental health SF-36 MCS (2003)	0.50	1.00						
3. Physical health SF-36 PCS (2003)	0.31	0.04	1.00					
4. Social support (2004)	0.19	0.04	0.03	1.00				
5. Wealth (2002)	0.17	0.11	0.08	0.04	1.00			
Controls								
6. Gender	−0.09	−0.17	−0.08	0.02	−0.06	1.00		
7. Age (1989)	−0.04	0.02	−0.09	−0.02	0.04	−0.15	1.00	
Social position								
8. Occupational grade (1989)	0.15	0.11	0.10	0.01	0.30	−0.25	0.16	1.00

11.2.2.2 Path analyses

Full information maximum likelihood (FIML) estimation with auxiliary variables was used in order to include all 16 623 individuals in the analysis.

The model fit statistics for Model 1, containing only indirect paths between occupational grade and quality of life, were: $\chi^2 = 43.358$ (2 d.f., $p < 0.001$), CFI = 0.994, TLI = 0.924 and RMSEA = 0.035. These were all at least acceptable, indicating that the estimated covariance matrix was reasonably close to the observed covariance matrix. The model fit statistics for Model 2, which additionally included a direct path between occupational grade and quality of life, were also acceptable: $\chi^2 = 4.822$ (1 d.f., $p = 0.028$), CFI = 0.999, TLI = 0.986 and RMSEA = 0.015. There was one degree of freedom difference between the two models. Using the χ^2 difference test, in which an improvement in fit of ≥ 6.635 is considered to be a significant improvement, the difference is 38.536. This was a significant improvement, which supported retaining the more complex Model 2 which incorporates the direct pathway between occupational grade and quality of life and which is depicted in Figure 11.6.

The effect of occupational grade in 1989 upon quality of life in 2005, following retirement, was mediated via three of the four recent influences: wealth, physical health and mental health (Figure 11.6). The indirect paths via wealth, physical health and mental health were similarly sized (Table 11.10). A path between occupational grade and social support was not supported in the retained model (Figure 11.6); it seems that social support predicted quality of life independently of participants' earlier social positions. A direct path between occupational grade and quality of life was present in the retained model.

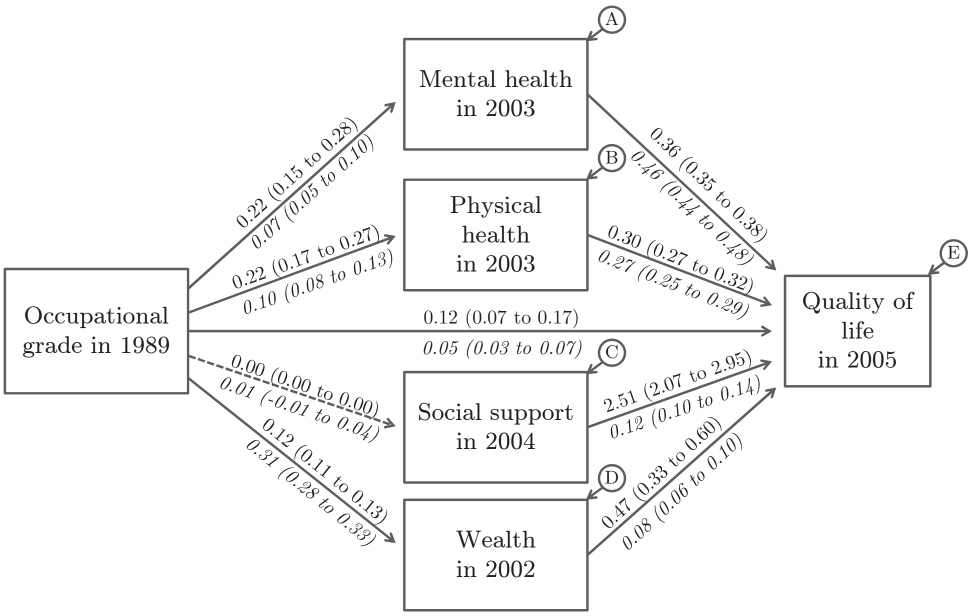
Table 11.10: Standardized and unstandardized coefficients for the paths between occupational grade in 1989 and quality of life in 2005 for 16 623 GAZEL cohort participants.

Path	Unstandardized estimate	Standard error	P-value	Standardized estimate
Total	0.324	0.021	<0.001	0.140
Direct	0.120	0.019	<0.001	0.052
Total indirect	0.205	0.014	<0.001	0.088
via mental health	0.078	0.010	<0.001	0.034
via physical health	0.066	0.006	<0.001	0.029
via social support	0.004	0.003	0.135	0.002
via wealth	0.057	0.007	<0.001	0.025

11.3 Conclusion

This chapter integrated exposures from different stages in the life course into two sets of models. The first set of models, estimated for men alone, suggested that the association between strenuous and dangerous working conditions and quality of life following retirement

Figure 11.6: Standardized and unstandardized path coefficients from the retained full information maximum likelihood estimation path model for 16 623 participants in the GAZEL cohort



Unstandardized coefficients are displayed above the arrows; standardized coefficients are displayed in *italic* beneath the arrows. The standardized estimates were calculated using stdyx standardization in which both exogenous and endogenous variables are standardized. Figures in brackets are 99% confidence intervals.
Correlations between the mediating variables are not shown, nor are gender and age which were included in the model as control variables. Disturbances for the endogenous variables are in the form of the proportion of unexplained variance. A: 0.967; B: 0.973; C: 1.000; D: 0.908; E: 0.647.

was accounted for by participants' recent physical and mental health.

The second model, for both genders, demonstrated that the fine-grained association between social position and quality of life 16 years later following retirement was accounted for, to some extent, by individuals' assessments of their health and financial situation.

Chapter 12

Discussion

Summary

In this final chapter, the results presented over the previous five chapters are reviewed and discussed in the light of the existing literature. The strengths and limitations of the thesis are described. The meaning of the study in terms of its implications for policy makers is discussed and possibilities for future work are outlined.

12.1 Principal findings

This thesis used a multi-dimensional and subjective measure of quality of life, CASP-19, and the French GAZEL occupational cohort to explore influences upon quality of life from a life course perspective. The CASP-19 measure of quality of life captures whether individuals are able to live their lives in ways that are meaningful and enjoyable to them. Therefore, this thesis hoped to examine the immediate and distal factors which affect whether individuals are able to experience the "good life" in old age. The results were presented in five results chapters, and, in the sections that follow, are briefly resumed and placed into the context of the existing literature.

12.1.1 Current influences upon quality of life

Chapter 7 presented cross-sectional results showing that a range of current factors predicted CASP-19 quality of life in 2005 in the GAZEL cohort. About 54% of the variation in participants' quality of life was explained in terms of physical and mental illness, depression, objective and subjective financial situation, social support, social participation, neighbourhood characteristics, caring for an adult, labour market status, and family and demographic characteristics, results which are similar to those of Netuveli et al. (2006) using the English Longitudinal Study of Ageing (ELSA). Other studies from the UK and Ireland have also found that a broad range of current circumstances are associated with quality of life measured with CASP-19 (Layte et al., 2013; Wiggins et al., 2004).

The quality of participants' physical and mental health was the most important factor predicting their quality of life, independently contributing 48% of the explained variation between individuals (cf. Table 7.5). However, aspects of participants' neighbourhoods, social relationships and social participation, as well as, to a lesser degree, their financial adequacy and whether they were in work were additional important factors in predicting quality of life. These results are in line with those reported by Layte et al. (2013) using the Irish Longitudinal Study on Ageing.

Women reported lower quality of life than men in unadjusted analyses (cf. Table 7.3), a finding which contrasted with results from other research using the CASP family of quality of life measures (McGee et al., 2011; Netuveli et al., 2006; Siegrist and Wahrendorf, 2009; Stafford et al., 2007; Wiggins et al., 2004; Zaninotto et al., 2009), but which was more in line with the wider well-being literature (Pinquart and Sörensen, 2001). After inclusion of mental and physical health in the models, women's quality of life was greater than men's, suggesting that it was poorer physical and mental health in women which accounted for the gender differences in the GAZEL cohort.

Older individuals had higher quality of life than younger individuals, even following adjustment for all of the domains. The coefficient for age-squared was significant in the unadjusted model, and suggested a diminishing improvement in quality of life at older ages, consistent with an age-related maximum in quality of life in the late sixties, as has been previously reported (Layte et al., 2013; Netuveli et al., 2006) and as might be predicted from Third Age theory (Laslett, 1991).

In terms of the family domain, the association reported in this thesis between being divorced, separated or single and having lower quality of life has been well documented (Argyle, 1999; Netuveli et al., 2006; von dem Knesebeck et al., 2007). The attenuation of the effect after inclusion of community and social relationships variables corresponds to reports from Layte et al. (2013) and Netuveli et al. (2006). Living in a three-person household was associated with poorer quality of life (McGee et al., 2011), a result which might be explained by the presence of a parent or parent-in-law who required care or by a child remaining at home.

In terms of the financial adequacy and activity domain, being retired was associated with higher quality of life compared to being in work, a result which corresponded to reports from other European and British surveys (Emmerson and Muriel, 2008; von dem Knesebeck et al., 2007). Similarly, the association reported in this thesis between good financial circumstances and high quality of life corresponds to other reports (Blane et al., 2012; Netuveli et al., 2006; von dem Knesebeck et al., 2007; Webb et al., 2011).

Greater social connections and social participation were correlated with higher quality of life, a result which corresponds to previous research on other cohorts, whether this concerned participation in social activities (Levin, 2013; Timonen et al., 2011; Wahrendorf and Siegrist, 2010), or the quality of social relationships (Litwin and Stoeckel, 2013a; Wiggins et al., 2004; Zaninotto et al., 2009). This thesis reported associations between regular caring responsibilities for an adult and lower quality of life; however previous research using the multinational European cohort SHARE and the British ELSA survey found inconsistent associations (McMunn et al., 2009; Siegrist and Wahrendorf, 2009; Wahrendorf et al., 2006; Zaninotto et al., 2013). Perhaps the intensity of caring was a relevant factor; in this thesis the association was found only among participants who reported caring less often than daily (Ross et al., 2008, p. 44). Various aspects of the neighbourhood, including aspects of neighbourhood quality, were also associated with quality of life, a result which corresponds to previous research using British cohorts (Netuveli et al., 2006; Wiggins et al., 2004).

Finally, previous reports correspond to the results found here for close relationships between physical and mental health and quality of life (see: Howel 2012 and Netuveli et al. 2006, for examples). As in a previous study examining the relative influence of life domains in an Irish cohort, health accounted for most of the explained variation in quality of life (Layte et al., 2013).

To conclude, the results described in Chapter 7 of this thesis were largely in line with those previously described in the empirical literature describing cross-sectional associations between a range of covariates and quality of life measured by one of the CASP family of quality of life measures.

12.1.2 Change in common circumstances and change in quality of life

In Chapter 8, analyses were presented of change in quality of life between 2005 and 2009 in relation to both characteristics measured at baseline and changes in some of those characteristics over time. Although based on observational data, this multivariate change analysis provides stronger evidence that these domains might determine quality of life because they control for participants' stable individual variations in response.

Average change in quality of life was close to zero, indicating that overall levels of quality of life in the cohort were stable, but there were substantial variations in degree and direction of change by sub-group. As has been found in previous studies (Jivraj et al., 2013; Zaninotto et al., 2009), older individuals were more likely to report declines in quality of life. Being female was associated with an improvement in quality of life, a result which contrasts with a previous multivariate change analysis using SHARE data which found a decline in quality of life in women (Wahrendorf and Siegrist, 2010). It may be that the members of the GAZEL industrial cohort may be specific in this regard, perhaps because a larger proportion of women were yet to retire than men.

Many of the baseline factors which were associated with quality of life in the cross-sectional analyses were not associated with changes in quality of life (Table 8.6 on page 201). These factors included marital status, objective and subjective measures of financial adequacy, social participation, neighbourhood characteristics and social support. This is in contrast to previous change analyses with CASP-19 in ELSA which did find associations between a wide range of characteristics at baseline and change in quality of life (Webb et al., 2011, see also Zaninotto et al., 2010), although, unlike the results reported in this thesis, these studies used a different method which involved conditioning on baseline quality of life (cf. the discussion about the appropriateness of adjusting for baseline scores in section 5.3.3.2 on page 125 and in Appendix D). In some cases, being in poorer circumstances at the first time point was associated with improvements in quality of life. For example, being in work was associated with poorer quality of life in cross-sectional fully adjusted analyses, but was associated with improving quality of life over time, presumably because it exposed individuals to retirement, which was shown to be positive for change in quality of life. Similarly, participants reporting depression symptoms in the first wave tended to experience improvements in quality of life.

A second stage of the multivariate change analysis predicted change in quality of life in relation to changes in a range of covariates (Table 8.7 on page 204). Worsening health (whether the development of a visual impairment, development of two or more physical limitations or worsening depression symptoms), decreasing social activities, taking up almost daily caring responsibilities for an ill or disabled adult and relationship dissolution were each associated with worsening quality of life. Improvement in physical functioning, reduction in depressive symptoms, ceasing to provide almost daily care for an adult, and retiring from work were associated with improvements in quality of life.

Associations between changes in CASP quality of life and changes in health have previously been demonstrated in British and European samples (Emmerson and Muriel, 2008; Wahrendorf and Siegrist, 2010). Similarly, the close associations between changes in CASP-19 quality of life and changes in social activities have previously been demonstrated in the SHARE sample (Wahrendorf and Siegrist, 2010) and in ELSA (Gjonça et al., 2010). In addition, previous work has demonstrated a positive relationship between recently retiring and quality of life in ELSA and SHARE (Emmerson and Muriel, 2008; Wahrendorf and Siegrist, 2010).

However, the picture for changes to marital status and changes in quality of life is more mixed. Only relationship dissolution was associated with decline in quality of life in the GAZEL cohort; neither beginning a marriage or a cohabitation nor being widowed were associated with any changes in quality of life. These results for widowhood are congruent with previous work using ELSA data (Demakakos et al., 2008; Emmerson and Muriel, 2008) although Webb et al. (2011) reported an improvement in quality of life following widowhood. The results for marital breakdown also correspond to previous reports examining relationships with a range of quality of life and well-being indicators (Argyle, 1999; Ballas and Dorling, 2007; Lucas, 2005).

Associations with changes in caring responsibilities were particularly large. Although these results contrasted with those of a previous study examining change in CASP-12 quality of life in SHARE, which did not find any relationship with changes in caring responsibilities (Wahrendorf and Siegrist, 2010), they were consistent with evidence demonstrating impacts of caring on a broad range of mental health and subjective well-being measures (Breeze and Stafford, 2010; OECD, 2011b; Pinquart and Sörensen, 2003; Ross et al., 2008), especially at high caring intensity (Hirst, 2005).

12.1.3 Circumstances in mid-life and quality of life in early old age

Although associations were much weaker than those with contemporaneous circumstances, influences from earlier circumstances upon quality of life in early old age were discerned.

12.1.3.1 Mid-life social position and quality of life following retirement

Previous social position (occupational grade and social class) was associated with quality of life following retirement, results which correspond to findings from other cohorts (Blane et al., 2007a; von dem Knesebeck et al., 2007; Netuveli et al., 2006). Even minor differences in social position in mid-life seemed to be related to differences in quality of life over a decade later. The graded relationship between occupational grade and quality of life 16 years later following retirement was observable across much of the company's lengthy occupational hierarchy (cf. 9.2 on page 213). To my knowledge, this is the first time such finely graded distinctions in quality of life by previous social position have been found.

In terms of social class, there were also associations between the European Socio-economic Classification (ESeC) class corresponding to participants' final post and quality of life following retirement (cf. Table 9.1 on page 212.). This result corroborated the findings published by Netuveli and Bartley (2012) using the NS-SEC in ELSA.

Associations between trajectories of social position during working life and quality of life following retirement were weak and inconsistent, in line with the previous literature which tends to find absence of association (Blane et al., 2004; Houle, 2011).

12.1.3.2 Mid-life working conditions and quality of life following retirement

Previous psychosocial working conditions were associated with quality of life following retirement in both male and female GAZEL cohort participants, whether those were measured by the effort-reward imbalance scale or the job strain scale, and after inclusion of controls including physical occupational exposures and social position. While such working conditions have been shown to affect mental and physical health (von Bonsdorff et al., 2014; Levy et al., 2011) as well as well-being (Dolan et al., 2008; Suppa, 2012), they have not previously been shown to affect quality of life following retirement.

Similarly, in men, three measures of physical working conditions were associated with quality of life following retirement, in fully adjusted models, associations which were graded, albeit small. One measure, a retrospective assessment of ergonomic strain, was inconsistently associated with quality of life, and another measure, exposure to harmful chemicals, was not associated with quality of life. These findings correspond to and build upon previous results demonstrating associations between employment characteristics and CASP-19 quality of life (Blane et al., 2004). Such associations were not found for women, most likely because relatively few women were exposed to strenuous and dangerous working conditions and those women who were tended to receive lower levels of exposure. In addition, these associations of physical and psychosocial working conditions with quality of life were independent of each other.

To conclude, participants who had held stressful, dangerous or strenuous jobs tended to have lower quality of life following retirement. The associations between quality of life following retirement and earlier working conditions were largely independent of employees' occupational grade and social class. These results extend earlier findings of long-term effects of conditions in previous life stages on quality of life (Blane et al., 2004) by studying the interrelations between previous working conditions, health in later life and quality of life after labour exit within a life course framework. In addition, these results develop those previously presented in Platts et al. (2013) by including psychosocial working conditions in the models of physical occupational exposures and quality of life.

12.1.4 Retirement and quality of life

The results from Chapter 10 showed that retiring was associated with an improvement in quality of life. In addition, the nature of the retirement transition was associated with quality of life: having retired in ill health was associated with poorer quality of life, while having maintained professional activities was associated with higher quality of life. In turn, the chance of undergoing these different sorts of retirement transitions were related to characteristics of the posts individuals had held throughout their careers. These results will be discussed in more detail in the sections below in the context of the existing empirical literature.

12.1.4.1 Retiring and quality of life

The cross-sectional results presented in Chapter 10 concerning the transition to retirement and quality of life corroborated the results reported in Chapter 8 that quality of life altered as participants retired. It seems that the transition to retirement is associated with an improvement on average in quality of life, an improvement which is robust to taking effects of gender and age into account. These results are in accordance with growing evidence in the literature for the positive effects of retirement upon mental health and fatigue (Vogel, 2002; Vahtera et al., 2009), which correspond to Laslett's theory of the Third Age (Laslett, 1991). In empirical studies, the gain in health at retirement corresponded to a gain of about 8–10 years; a period which was in line with results from the cross-sectional analysis presented in this thesis. It seems most likely that quality of life is behaving in a similar dynamic fashion to variables such as depression and self-rated health used in those studies.

In addition, results from this chapter suggest, albeit inconclusively, that where retirement frees individuals from stressful working conditions, quality of life at retirement "catches up" (Andersson, 2005). The four-point improvement in quality of life upon retirement asssociated with earlier job strain is a medium-sized effect, comparable to being in the lowest income band, or lacking a close, confiding relationship (cf. chapter 7, section 7.2.2). These result are consistent with studies finding similar results upon health and fatigue upon freedom from strenuous and stressful working conditions (Westerlund et al., 2009, 2010).

12.1.4.2 Nature of the retirement transition and quality of life

Associations between age at retirement and quality of life were only found among the male members of the cohort, with men who retired at older ages experiencing higher quality of life. This may have resulted from several factors: a progressively higher chance of having enjoyed working life enough to negotiate to remain in work longer, a progressive lower risk of having taken early retirement as part of the 1990s EDF-GDF layoffs in return for a lower pension, and a lower risk of having worked in "actif" or manual occupations.

Having continued professional activities following retirement was associated with higher mean quality of life. This is a result that corresponds to relationships reported in the literature describing the psychological, social and economic rewards gained from carrying out fulfilling work (Topa et al., 2013; Wahrendorf et al., 2006). Another possibility is simply that the desire to continue working life beyond the formal period in which individuals are required to earn a living signals better previous physical and psychosocial working conditions during working life.

Participants who reported retirement transitions marked by ill health and disability experienced poorer quality of life in early old age. This could be a result of long-standing health problems which influenced both the retirement process and subsequent quality of life; the retirement transition in itself may merely be signalling debilitating health problems (Jokela et al., 2010).

12.1.4.3 Earlier working conditions and the nature of the retirement transition

Turning to the influences of earlier working conditions upon type of retirement, difficult earlier working conditions and lower social position were associated with retiring in ill health. In contrast, the opportunity to continue professional activities was more common among people working in certain occupations and in higher grades.

Men who were exposed to higher levels of ergonomic strain and chemical exposures retired at younger ages, as did men in blue-collar social classes in 1989 (ESeC classes 6 and 8) and men working in lower occupational grades. Previous research has found that skilled manual workers tend to retire sooner, whether through illness or through their access to financially attractive early retirement schemes (Polvinen et al., 2013; Radl, 2013). In the case of the GAZEL cohort specifically, the EDF-GDF retirement rules allow individuals who held manual posts to retire up to five years younger than workers who held non-manual posts. In women, the associations between these factors and age at retirement were more inconsistent. This is perhaps a result of women receiving family-related derogations allowing early retirement independently of work circumstances and because few women were working in blue-collar occupations allowing access to earlier retirement.

12.1.5 Integrated models predicting quality of life in early old age

In the final set of results from this thesis, presented in Chapter 11, exposures from different stages in the life course were integrated into two sets of models. The first set of models, in men alone, showed that associations between strenuous and dangerous working conditions and quality of life were accounted for by more recent physical and mental health. The second set of models, in both genders, demonstrated that associations between earlier social position and quality of life were accounted for, to some extent, by individuals' assessments of their health, financial situation and the emotional support they received from others.

12.1.5.1 Pathways from physical occupational exposures to quality of life

The first set of analyses, presented in section 11.2.1 from page 263, showed that higher levels of physical occupational exposures in mid-life were associated with poorer quality of life following retirement, a relationship which was explained once physical and mental health were taken into account. The results suggest that the effect of physical occupational exposures upon quality of life are fully mediated by physical and mental health. This finding is in line with previous work demonstrating adverse effects of physical working conditions upon later health (Bodin et al., 2012; Descatha et al., 2011; Niedhammer et al.,

2008) and effects of health on quality of life (Farquhar, 1995; Webb et al., 2011; Zaninotto et al., 2009). The results presented in this chapter add to the existing literature of the life course determinants of quality of life in older ages by highlighting the possible role of health in mediating between mid-life physical working conditions and quality of life following retirement.

12.1.5.2 Pathways from occupational grade to quality of life

The second set of analyses showed that recently measured economic and health circumstances accounted for much of the relationship between earlier social position and quality of life following retirement, providing support for a pathway model of life course influences upon quality of life. This finding is in line with previous work using British datasets. A study of the British Boyd-Orr cohort found that the influence of the life course upon quality of life was limited mainly to shaping individuals' material circumstances and health problems in later life (Blane et al., 2004). An analysis of the 1958 British birth cohort study found effects of social class at 33 years upon quality of life at age 50 years that were direct as well as indirect via individuals' current financial situation and level of limiting illness (Blane et al., 2012).

Associations were found between occupational grade and individual wealth and physical and mental health, but no support was provided for a path between occupational position and level of social support. Evidence from the previous literature is mixed (Taylor and Seeman, 1999; Gorman and Sivaganesan, 2007) but it seems that in the GAZEL cohort social position in mid-life is not related to subsequent levels of social support. However, it might be that a class-based measure of social position would reveal differences in social support between social groups (Turner and Marino, 1994), or that there are differences by gender (Stringhini et al., 2012).

There was support for a direct path between occupational grade and quality of life, in other words, that social support, wealth and physical and mental health did not account entirely for the association between occupational grade and quality of life. It is possible that other proximal determinants of quality of life would account for the unexplained covariance between quality of life and occupational position. These factors concern, among others: material factors (von dem Knesebeck et al., 2007), cognitive function (Llewellyn et al., 2008), depression (Netuveli et al., 2006), and aspects of the neighbourhood (Netuveli et al., 2006).

12.2 Strengths

This thesis benefits from a number of strengths. To summarize, it is a prospective study that uses a validated multi-dimensional measure of quality of life in a large and diverse occupational cohort which has information for a wide range of employment characteristics as well as retirement transitions. It is one of few studies examining quality of life from a life course perspective, and it extends the approach to a continental European society.

12.2.1 A theoretically informed measure of quality of life

This study uses a theoretically informed measure of quality of life which has been validated in several surveys in the UK and in Europe. It is the first time that the CASP-19 scale has been used in such a large sample from continental Europe. The good distribution of scores and high internal consistency of the CASP-19 items indicate that this measure of quality of life has suitable psychometric properties in this French cohort to be used as a summary scale of quality of life.

12.2.2 Specificities of the GAZEL cohort

12.2.2.1 A large prospective cohort combining decades of administrative and questionnaire data

A major strength of this thesis is that it uses data from a prospective cohort containing a wide range of measures of occupational exposures, which are often obtained from the company rather than from participants. Uniquely, the GAZEL cohort provides detailed information on three different types of occupational physical exposures, based on both administrative data and on self-reports, which cover a lengthy time-frame. It also includes a large array of measures of psychosocial and physical working conditions, as well as health outcomes, and many of these are measured using internationally validated scales.

Administrative data are available on chemical exposures, workplace accidents and occupational grade, which reduces the problem of common method variance which would result from relying solely on self-reported measures. Mid-life social position was measured by individuals' employment grade and social class, two contrasting measures of social position, and variables which it has been suggested provide more robust findings in analyses of socioeconomic position and health than measures such as education or income (Hoven and Siegrist, 2013). Occupations were coded to an extremely fine detail and were reclassified into the European Socio-economic Classification, an internationally comparative social class measure.

The wide range of variables available has made it possible to control for important confounders, such as social position, in the relationship between working conditions and quality of life. Similarly, the long time-frame of the measures has enabled the development of pathway models, in which earlier exposures are mediated via more recent circumstances.

12.2.2.2 A cohort incorporating repeated measures of quality of life and its determinants

Two repeated measures of the CASP-19 quality of life measure are available, as well as repeated measures of some important determinants of quality of life. This allowed the use of a multivariate change analysis which has enabled the difficulty of stable individual heterogeneity in responses to be circumvented, making a stronger case that these factors are influencing quality of life rather than merely being associated with it.

12.2.2.3 A cohort containing data on retirement

The GAZEL cohort has complete data on retirement dates, obtained from administrative records, enabling exact ages at retirement to be calculated. In addition, individuals have standard careers in which there is a clear demarcation and transition between working life and retirement. Sufficient numbers of people retired between the two time points at which quality of life was measured that, with certain provisos, it was possible to examine dynamic changes in quality of life around retirement, results which tended to corroborate those from cross-sectional analyses. Another strength of the study, derived from the characteristics of the GAZEL cohort, is the unique opportunity to link information about retirement with information from administrative records about the earlier career, whether this concerns mid-life social position or occupational exposures.

12.2.2.4 A diverse study population of individuals in early old age

The study design of the GAZEL cohort, in particular its large sample and low attrition rates, is a particular strength (Zins et al., 2009). The GAZEL cohort is especially interesting in that it includes a large number of people in manual or blue collar occupations who have been exposed to strenuous and risky working conditions.

12.2.3 An innovative life course perspective to understanding quality of life in early old age

This study is the first to my knowledge to combine a life course perspective with the use of administrative data on employment characteristics and a theoretically informed measure of quality of life. The lengthy time period of the measures included in the study, a period spanning over fifty years, enabled processes of life course development of differences in quality of life from mid-life to early old age to be examined.

However, several limitations of this study must be discussed.

12.3 Limitations

12.3.1 Particularities of the GAZEL cohort

First, despite the great social and geographic diversity of the sample (Goldberg et al., 2007), GAZEL participants worked in certain contexts, specifically for a state-owned company in the electricity and gas industry (nuclear power plants, hydroelectric dams and gas distribution centres). Therefore, conclusions from analyses of the GAZEL cohort data must be drawn carefully, since important parts of the French population (e.g. private sector employees, self-employed workers and the unemployed) are absent. In addition, it is likely that the GAZEL employees display a healthy worker effect, particularly because many of the posts were physically demanding, since potential employees would have required a certain level of health to be recruited and to remain in the company (Fox and Collier, 1976). For this reason, the analyses carried out in this thesis have focussed on comparing groups within the cohort (Li and Sung, 1999).

An additional factor is that, because participants held protected posts in a nationalized and unionized company, working conditions of the GAZEL cohort are likely to have been better than in equivalent private sector posts. Consequently, in the GAZEL cohort, the impacts of dangerous and strenuous working conditions upon quality of life may have been attenuated, much as has been found in cross-country analyses between countries with more or less protective labour market policies (Wahrendorf et al., 2013). For example, physical and psychosocial strain may be more damaging when employees on temporary contracts lack options, such as to change to another unit, to speak up, or to go on sick leave. An additional difficulty is that employees in the company were protected such that some may have stopped carrying out heavy work as a result of injury and have been transferred to occupations requiring light work. This will weaken the associations between physical working conditions and quality of life, since some men with apparently low exposures in 1989 may already have been manifesting health problems caused by heavy work earlier in their career (Östlin, 1988).

Similarly, the full impact of social position upon quality of life may be diminished in this sample, if one of the important mechanisms through which social position can harm health and wellbeing is through the risk of unemployment. This will also reduce the size of associations between social position and mediating variables such as wealth or physical and mental health, because it is workers in lower-level occupations who are more vulnerable to unemployment spells (Bartley and Plewis, 2002).

In addition, although the nature of the GAZEL cohort is such that individuals have clear transitions to retirement, this is also the result of very specific situation in which employees had stable employment in the civil servant model and received relatively comfortable and secure retirement packages. The retirement rules in the cohort are unusual (particularly compared to the British or American context); which makes it difficult to generalize some of the results to other, less protected, working populations, which may face substantial drops in income upon retiring.

12.3.1.1 Women in the GAZEL cohort

The women in the GAZEL cohort were working in gas and electricity distribution in a period in France when this was unusual, therefore they may be poorly representative of French women as a whole. As was typical in the labour markets of advanced industrialized nations at the time, the female members of the cohort were often found in office roles within the organization and their rates of advancement within the organization were lower than for men (Rosenfeld, 1979). However, the female cohort participants also present characteristics that are atypical for French women, such as their high rates of divorce and living alone. These factors reduce the generalizability of the results obtained from the thesis for women.

In terms of exposures, the emphasis in the GAZEL cohort is upon physical and psychosocial working conditions. Information on whether individuals were working full-time or part-time is not provided, nor is any information about career breaks for having children or for other reasons, factors which might explain women's smaller career progression. In addition, women's levels of psychosocial strain may be underestimated compared to that of men's; information on factors such family-friendly policies, discrimination and sexual harassment was not recorded (Messing et al., 2003).

Because only one quarter of the respondents in the GAZEL study were female, the numbers of women often became too small to analyse the genders separately. In addition, because women tended to hold white-collar posts, few women were exposed to strenuous and dangerous working conditions. Therefore, the lack of relationship between physical occupational exposures and subsequent quality of life in women could be a question of sample size rather than any differences in the risks from these exposures for women (Messing et al., 2003).

12.3.1.2 Non-response and attrition in the GAZEL cohort

Since CASP-19 quality of life scores were obtained from questionnaires completed 15 years into the study, it is likely that the responses are biased by non-random temporary or permanent voluntary withdrawal. Participants in lower job grades were more likely to withdraw as were participants in poor health (Goldberg et al., 2006). Both of these factors are associated with quality of life, therefore it is likely that the pattern of missing data is related to the quality of life variable and the data are not missing completely at random (MCAR). The availability of administrative data for participants as well as information provided at baseline mean that much is known about the nature of attrition in the cohort, and it is possible to create auxiliary variables that inform on missingness.

Therefore, in sensitivity analyses, a technique suitable for dealing with missing data: full information maximum likelihood estimation has been used in this thesis (Hoyle, 2011). Auxiliary variables known to predict attrition were included in these analyses and the findings were replicated (Graham et al., 2003). Use of such techniques enables the missing at random assumption (MAR) to be made, rather than the more restrictive missing completely at random (MCAR) assumption required for correct estimation with listwise deletion (Howell, 2007).

However, it is not possible to verify the MAR assumption and it is possible that missing data have biased the estimates if the missing data are non-ignorable, being missing not at random (MNAR). It would be necessary in such a case to model the missing data mechanism, a substantial and difficult task (Carpenter and Kenward, 2007; Enders, 2010), which was beyond the bounds of this thesis.

12.3.2 Variables

Interpretations of the results reported in this thesis are subject to some limitations relating to the variables which were available for use from the GAZEL dataset. Some important variables may have been omitted; in other cases retrospective variables have been used. The outcome variable, quality of life, is self-reported, which can raise difficulties in analyses where other self-reported variables are used as possible determinants. The following sections describe these difficulties and the strategies employed to circumvent them more fully.

12.3.2.1 Reliance on self-reports

The outcome of the study is a subjective perception of quality of life; therefore, great care must be taken in the use of other self-reported measures in order to avoid difficulties of interpretation stemming from common method variance, such as results being confounded by heterogeneity in response styles between individuals.[1] This is particularly problematic in mediation analyses, where the use of self-perceived measures for the outcome, exposure and mediators may lead to apparent shared variance being modelled which is in fact merely individual heterogeneity in response style.

Consequently, wherever possible, administrative data have been used to replace or complement questionnaire records. In the case of physical occupational exposures, subjective evaluations of ergonomic strain and danger were supplemented by the use of company records of sickness absence and a job-exposure matrix. Similarly, retirement dates provided by administrative records were used instead of information on the timing of retirement provided by participants.

The health data used in this study rely heavily on self-reports, such as responses to a questionnaire regarding health functioning or depressive symptoms. Data on psychosocial stress was obtained through the Karasek job strain and Siegrist effort-reward imbalance measures in the self-completion questionnaires. Since psychosocial strain was subjectively assessed, it is possible that some of the relationship between psychosocial stress and quality of life is compounded by individual personality factors or reporting bias which may have generated perceptions of both stress at work and poor quality of life (Kolstad et al., 2011). Consequently, the associations between psychosocial strain and quality of life should be interpreted with caution (Macleod et al., 2002). For this reason, I did not perform modelling of the relationships between perceived psychosocial strain and quality of life via more recent factors, also generally subjective assessed.

12.3.2.2 Retrospective data on occupational exposures

The data on the cumulative biomechanical exposures from the 2006 questionnaire are retrospective, requiring participants to recall duration of exposures to certain types of biomechanical strain, a procedure vulnerable to recall bias (Rothman et al., 2008). However, only one retrospective measure was used in this study and the associations obtained with the prospective measure of ergonomic strain from the 1989/90 questionnaires were in the same direction and similar in size, indicating that retrospective assessments of physical occupational exposures may be reliable.

[1] However, I do agree that the use of self-report data is an appropriate way to measure subjective variables, such as perceived quality of life, perceptions of health and psychosocial working conditions.

12.3.2.3 Timing of variables

A difficulty in comparing size effects is that some of the variables were obtained from questionnaires that preceded the measurement of CASP-19 by several years. Where characteristics may have changed in the meantime, the associations with quality of life in 2005 reported in Chapter 7 as well as with change in quality of life 2005–2009 reported in Chapter 8 are likely to have been weakened. The measures of household incomes and confidence in finances, measured in 2002, as well as physical and mental health, measured in 2003, are most vulnerable to this difficulty.

A related problem concerns the neighbourhood characteristics, which were obtained from the 2003 survey. It is possible that participants changed locality between the 2003 and 2005 surveys, when they provided details about their quality of life. In this case, the reliability of the measures was improved, as outlined in the methods chapter, by removing responses from people who had moved away from their local area, but they are still vulnerable to measurement error resulting in changes to local area characteristics or participants moving to a contrasting locality within their local area.

The inconsistency in the timing of variables and the measurement error consequently generated makes close comparison of coefficients between variables measured at different times difficult. This has been borne in mind during the interpretation of the results.

12.3.2.4 A non-specific measure of accumulated exposures to carcinogenic chemicals

This thesis failed to find associations between chemical exposures and quality of life, although small associations were found with physical health measured with SF-36. It is possible that the impact of such exposures to chemicals on quality of life is non-existent or small, but the way the measure was constructed for this thesis may also be at cause. Previous work in the GAZEL cohort has demonstrated long-term effects of solvents on cognition at high levels of exposure (Berr et al., 2010; Sabbath et al., 2012); perhaps a lack of association with quality of life in the current study was a result of using a nonspecific measure of lifetime chemical exposure. It was, however, difficult to decide *a priori* which chemicals and levels of exposures would impact most upon quality of life.

12.3.2.5 Omission of important information

Certain variables were not included in the study. For example, lack of company information about individuals' salaries led to the use of self-reported incomes. Similarly, independent data on health status was not available, only individuals' reports of doctor-diagnosed diseases. These reports can be unreliable (Last, 1963); consequently, measures of health functioning were used instead.

A further difficulty is the lack of information about participants' decision-making processes about retirement. Retirement decisions are made within couples and families (Moen and Huang, 2006), yet there was no information about how individuals chose or negotiated their retirement dates or planned their retirement. Having had such information would have greatly enriched the possibilities for examining the influences of different retirement processes upon quality of life after labour market exit. In addition, because there is no set retirement age, it was near to impossible to determine whether individuals took early retirement from their retirement age alone.

A related problem is that crucial domains such as economic circumstances, social support and community factors were only measured in one recent year of the survey. Consequently, the amount of explained variability in the change analysis presented in Chapter 8 is relatively low, because only changes in health, employment and marital status could be included.

An important source of specification error in the path models is the omission of important variables which might influence quality of life. In building structural equation models it is necessary to balance completeness and parsimony, however, if other variables correlated with those included in the model have been excluded, the estimates of those coefficients may be biased. In the case of the mediation model from occupational grade to quality of life, described in section 11.2.2.2 on page 274, it seems that the proximal determinants of quality of life included in the model do not account for the whole relationship between occupational grade and quality of life, suggesting that certain important proximal determinants have been excluded.

12.3.2.6 Correlations between physical occupational exposures

An important limitation of examining the relationships between the physical occupational exposures and quality of life results from the correlations between the different measures of physical occupational exposures. Participants in manual occupations often experienced a range of exposures in the course of their work, and it is not necessarily appropriate to attempt to isolate one set of exposures. This means that the path analyses presented in Chapter 11, section 11.2.1 should be interpreted as the impacts of physical occupational exposures as a whole upon quality of life in early old age.

12.3.2.7 Life events data

In a short four-year period between the measurements of quality of life, many events, such as marriage, widowhood or divorce, occurred in small numbers. It had originally been hoped to examine the influences of different years separately, but the four-year period was taken together in order to accumulate enough life events. Where the impacts of life events are temporary (and an individual may return partially or completely to their previous quality of life set point), the apparent associations between life events and quality of life will be weakened, particularly for participants who experienced an event several years before (Clark and Georgellis, 2012; Lucas, 2007).

12.3.3 Quality of life variable

12.3.3.1 Interpreting CASP-19 scores

It is difficult to know how to interpret CASP-19 quality of life scores and, in particular, the importance of any changes in quality of life (Howel, 2012). Is a change in quality of life scores of two points important? In an effort to produce results that are comparable to those of other studies, unstandardized results have been presented in full, particularly unadjusted associations between quality of life and its determinants. In an effort to anchor differences in quality of life to a meaningful metric, univariate CASP-19 quality of life scores have been compared to the the seven-point difference in scores between participants who reported having two or more limitations to daily activities compared to not having any such limitations (see Table 7.2 on page 174).

12.3.3.2 Distinguishability of quality of life from its predictors

Lastly, some readers may be concerned that the measures of health (SF-36) and quality of life (CASP-19) used in this analysis overlap, because SF-36 is sometimes used to measure health-related quality of life (Niedzwiedz et al., 2012; Schlenk et al., 1997). I would argue that the measures are conceptually distinct, as CASP-19 explicitly focuses on aspects of quality of life that are not reducible to physical and mental health.

This thesis also reported an extremely close relationship between CASP-19 quality of life and depression measured with CES-D in Chapters 7 and 8. While the concepts are theoretically distinct, close relationships between positive and negative well-being have previously been found, and in this case are likely to be at least partially due to similarities in item wording between items in the scales, such as: “I thought that my life had been a failure” (CES-D) and “On balance, I look back on life with a sense of happiness” (CASP-19), or “I felt hopeful about the future” (CES-D, reverse-scored) and “I feel that the future looks good for me” (CASP-19). For this reason, the depression scale was not used in analyses examining mediation between earlier exposures and subsequent quality of life.

A further problem is that four items of CASP-19 refer to factors that are considered to be objective measures of quality of life: “My age prevents me from doing the things I would like to”, “family responsibilities prevent me from doing what I want to do”, “my health stops me from doing the things I want to do” and “shortage of money stops me from doing the things I want to do”. It is therefore entirely understandable that age, caring responsibilities, health and financial insecurity are associated with CASP-19 quality of life, which makes it difficult to study these factors as antecedents to high quality of life (Kashdan et al., 2008). One option for tackling this problem would be to repeat the analyses in Chapters 7 and 8 without these four items (Vanhoutte, 2012) (see Appendix F for such sensitivity analyses).

12.3.4 Analytic models

12.3.4.1 Equivalent path analytic models

Although the models presented in Chapter 11 were consistent with the observed data, other equivalent models may exist that fit the data just as well (Hoyle, 2011, p. 73). In each case, the models follow a theoretically reasoned temporal logic, so it is difficult to justify *a priori* why another model should be selected. However, for example, it may be that perceived quality of life influences evaluations of mental and physical health or social support, and it is not possible to eliminate such possibilities in an observational study.

12.3.4.2 Latent variables

Another assumption is that the exogenous variables are measured without error. This is a heroic assumption and the consequences of violating it are attenuated regression coefficients and biased standard errors (Kaplan, 2009, p. 37). For example, it is possible that there is error in the measurement of quality of life or health, which could have been avoided by modelling CASP-19 or SF-36 as latent variables. However, treating CASP-19 and SF-36 in this matter would make comparison of scores with other articles and datasets, as well as between different analyses presented in this thesis, more difficult. Despite the important limitation of measurement error, the current approach is suitable for the problem at hand, which is to examine the coefficients of the explanatory variables.

12.3.4.3 Timing of events

In analyses examining how changing circumstances might influence changes in quality of life, the precise timing of external events and of changes in quality of life are not known. It could be that the change in quality of life actually occurred before the event took place. This is a particular problem when the outcome variable, CASP-19 quality of life, is based on a self-report, because perceptions of reduced quality of life may influence how individuals report their circumstances, such as health functioning or depression.

12.3.4.4 Change analyses

A great problem when using two measurements to analyse change is that it is impossible to distinguish true change from measurement error (Singer and Willett, 2003). It was not possible to use three waves to apply a latent variable modelling approach because the data containing the third wave of CASP-19 were only released in July 2013, too late for timely completion of this thesis. Results published using a change analysis from two waves of data can differ greatly from those published using three waves that use latent growth curve methods (compare Christensen et al., 1997, and Christensen et al., 2001); consequently, the results from the change analysis should be treated as provisional, and subject to confirmation from analysis of a third wave of quality of life data.

12.4 Policy perspectives

This research project contributes to policy debates concerning two societal challenges: social progress and population ageing. In terms of social progress, indicators of subjective well-being such as quality of life are increasingly being monitored by policy makers, despite their novelty and difficulties in interpreting them. Population ageing is bringing new challenges, particularly in terms of supporting older people to remain active and healthy, in a context of rising retirement ages and substantial family care responsibilities for some in later life as well as concerns about how equitable current arrangements are.

12.4.1 Measuring social progress

Across industrialized countries, long-running public policy concerns with how best to measure social and economic progress crystallized in the late 2000s with the desire to develop better indicators (Bowling and Stenner, 2011; European Commission, 2009; Scrivens and Iasiello, 2010). In 2009, the Stiglitz-Sen-Fitoussi Commission, a high-profile initiative launched by the French government, reported on a range of alternative approaches for measuring social progress, including using subjective measures of citizens' well-being (Stiglitz et al., 2009). Among advanced industrial economies, the Organisation for Economic Co-operation and Development recently began monitoring a range of measures of societal welfare, including subjective well-being (OECD, 2011a); since 2009, the European Commission has commissioned a special Eurobarometer survey series on the Social Climate which regularly questions citizens of EU member states and candidate countries on aspects of their life satisfaction (European Commission, 2012); and, in the United Kingdom, subjective well-being measures are now being monitored by the Office for National Statistics (Office for National Statistics, 2013) with the intention that the results will inform government policy-making (Cameron, 2010).

Subjective measures provide alternative metrics for identifying population groups that need special protection (which might not always be visible through the use of economic indicators alone), and new evidence to help compare policies (Eurofound, 2013). One approach in considering new policies would be for policy-makers to incorporate likely impacts upon well-being explicitly into cost-benefit analyses of new policies (see Oswald and Powdthavee, 2007, for an example) in what has been described as a social welfare approach (Frey and Stutzer, 2012). However, more likely, results from academic studies such as this thesis would contribute to democratic debate and policy development as one consideration among many (Stutzer and Frey, 2012).

However, while subjective well-being indicators are increasingly used to measure some aspects of the progress of societies and even to weigh up policies, the nature of well-being and the factors that affect it over the life course need to be better understood (Thompson and Marks, 2008). To that end, both the Organization for Economic Co-operation and Development and the European Foundation for the Improvement of Living and Working Conditions have recently commissioned reports into the factors influencing well-being (Eurofound, 2013; OECD, 2011a). This research project contributes to that body of knowledge, in demonstrating the close relationship between quality of life in older people and a range of factors including aspects of social relationships and health, as well as how quality of life is strongly associated with individuals' present circumstances rather than their past histories.

12.4.2 Maintaining high quality of life in an ageing population

As labour market participation across Europe in older workers slumped (Walker, 2005b, p. 6) and the proportion of older people grows in Europe (European Commission, 2006), policy makers have felt increased pressure to encourage active ageing, whether through postponing retirement or by encouraging older people to make further valuable contributions to their families and communities (Eurofound, 2002; Keese, 2006; WRVS, 2011). Crucial to this is an understanding of the factors that will help people in later life age in better health and remain actively engaged in their families and communities (European Commission, 2010). This research piece contributes to this agenda by displaying how factors including social relationships and social participation are related to quality of life. It is therefore likely that policies that successfully increase older people's freely chosen participation in social activities and support older people to maintain their social networks are likely also to be improving older people's quality of life. Similarly, policies that enhance older people's physical and mental health are likely to improve their well-being (Layard, 2012).

Another important issue in maintaining older people's high quality of life is supporting them in the caring responsibilities that they have. This is a relatively new public policy arena in Europe, which came onto the mainstream political agenda in the UK in 1999 with the publication of the first prime minister's strategy for carers (Department of Health, 1999) and in France about 5–10 years later with the specific incorporation of carers into various public health strategies (CNSA, 2011, p. 25). The numbers of people affected by caring responsibilities are high, estimated at 10% of British people (HM Government, 2008, p. 2), a proportion likely to increase as the population ages. Caring for people in old age forms a large part of the picture: in France, half of all carers for ill or disabled family members are aged between 50 and 75 years, and most care was provided to spouses and parents (CNSA, 2011, p. 21). In both countries, strategies and frameworks to better support carers across the range of social services that they access have been developed in recent years, with great similarities in policy lines across both countries (CNSA, 2011; HM Government, 2008, 2010). The results of this PhD thesis would suggest the importance of these developments and of keeping policies to support carers high on the public policy agenda (Dolan et al., 2008). They also suggest the importance of targeting resources towards those most vulnerable carers who are providing high levels of care (Hirst, 2004).

12.4.3 Social inequalities over the life course

This thesis has demonstrated how inequalities in well-being are generated over the life course and, in particular, how earlier working conditions can influence well-being following retirement. The long-term impacts of working conditions are an important policy issue, for job strain can be seen as a "fundamental cause" of work-related disease, and one that is amenable to intervention (LaMontagne, 2012).

In order to compensate blue-collar workers for the health hazards of their employment, it is common for arrangements to be provided in which they become eligible for retirement at younger ages than people employed in less strenuous jobs (Lasfargues, 2005) or for early retirement to be provided if occupational illness occurs (Descatha et al., 2013). Such policies acknowledge the long-term impacts of dangerous and strenuous physical conditions on later health and well-being. However, individuals are exposed to a wide range of exposures, and there is no way currently to measure exposure to this "global burden" (Descatha et al., 2013). In addition, the growing impact of psychosocial strain and its interactions with physical strain are not currently taken into account (Lasfargues, 2005). Research examining these interactions between different types of exposures is sorely needed.

Pressure on public budgets is growing as a result of ending of a period of demographic dividend in modern industrialized nations, in which the proportion of the working-age population is shrinking (Giannakouris, 2008). An important public policy response to this challenge has been the introduction of measures aiming to raise effective retirement ages. These increase the implications of previous working conditions in several ways: firstly, because older workers can be more vulnerable to injuries and work-related illness (Jones et al., 2013), secondly, because worker with lengthier careers will receive higher levels of accumulated occupational exposures and, thirdly, because the fact that employees are keen to leave high physical and psychosocial strain jobs may undermine the effectiveness of these policies for poor quality jobs (Siegrist et al., 2007). For these reasons, it is likely that improving the quality of work will enhance the success of policies aiming to increase effective retirement ages.

12.5 Possibilities for further work

With only two time points, it was not possible in this thesis to isolate real changes in quality of life from measurement error. A third wave of CASP-19 scores was released in summer 2013 which, although too late for inclusion in this thesis, would enable modelling of a latent variable of linear change in quality of life. This approach would enable adjustment for measurement error, and enable real change in quality of life over the time period 2005–2013 to be estimated. In addition, a fourth wave of CASP-19 will be included in the 2017 questionnaire.

In 2009, when the last measurement of CASP-19 included in this thesis was taken, the GAZEL cohort still traversed the boundary between late mid-life and early old age. Previous research has highlighted how changes in quality of life accelerate in later old age (Jivraj et al., 2013). Therefore, following up the cohort as it ages will enable a better understanding of how ageing is experienced in terms of quality of life. This will be particularly interesting in the context of the detailed information that has been provided about cohort members' earlier physical and psychosocial working conditions.

As well as these results being used as a baseline for future studies using the GAZEL cohort, they could be compared in the future with other cohorts. The stable living and working conditions that the GAZEL respondents experienced over the course of their adult lives resulted from circumstances which are unlikely to be repeated. The workers benefited from secure employment in nationalized industries as well as 30 years of economic boom which took place during their childhood and early career. The GAZEL cohort members enjoyed a particularly privileged and stable passage into retirement and old age. Consequently, the results of this thesis provide a reference point for future studies based on younger cohorts who have faced greater insecurity of employment, which might have long-term consequences for their overall quality of life in old age as well as in the nature of inequalities.[2]

Future work could include a Franco-British comparison because the CASP-19 quality of life measure has been included in a British cohort of civil servants, Whitehall II, which has participants of a similar age to those in the GAZEL cohort who have also benefited from secure working conditions. It would be interesting to repeat in Whitehall II some of the analyses performed for this thesis, such as those examining associations between mid-life psychosocial working conditions and quality of life, as well as those examining career trajectories. Similar comparisons between the GAZEL and Whitehall II cohorts have been performed with health outcomes (Singh-Manoux et al., 2006; Stringhini et al., 2011).

Lastly, examination of quality of life as a predictor of other outcomes will be possible in the GAZEL cohort in the years to come. As the cohort ages, it will be possible to examine the relationship between CASP-19 and mortality (Netuveli et al., 2012; Steptoe and Wardle, 2012), in particular by cause of death, as well as the relationship between quality of life and consumption of prescription medication.

12.6 Conclusion

This thesis aimed to model how current circumstances and those from mid-life might influence quality of life in early old age in a French occupational cohort. It is original in examining current influences upon quality of life in a large single-country cohort beyond Britain and Ireland. For the first time, it has been possible to study how dangerous and strenuous working conditions over the course of individuals' working lives might influence their quality of life following retirement, using a measure of quality of life that does not reduce individuals' experiences to the nature of their health.

In addition, it has been possible in this large cohort to examine the pathways through which individuals' earlier employment characteristics, in particular, physical working conditions and occupational position, have influenced quality of life after retirement. Results reported in this thesis indicated that associations between mid-life employment characteristics and quality of life following retirement were largely accounted for by individuals' more recent states of health and finances.

[2] I thank David Blane for this insight.

To conclude, this thesis has found that it was older people's current circumstances that were most important for their quality of life. The role of mid-life circumstances was largely limited to shaping individuals' current circumstances in retirement. Consequently, individuals' previous histories did not, in themselves, restrict individuals from flourishing in old age, and it is probable that supporting people in maintaining their health, financial security and social networks as they age will help them to sustain their quality of life and enhance their agency in old age.

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Appendices

Appendix A

Original questions from the GAZEL questionnaires with English translations

A.1 Sources of non-questionnaire data

Information on posts and retirement is provided by the « Service de Gestion du Personnel Sur Ordinateur. » Information on deaths is provided by the « Service Des Pensions d'EDF et de GDF et le Centre d'épidémiologie sur les causes médicales de décès, INSERM ». Information on sickness absence is provided by the « Service Général de Médecine de Contrôle d'EDF et de GDF ».

A.2 Questionnaire items

A.2.1 Socio-demographic and household information

Table A.1: Marital status (2005 and 2009)

Q4	Quelle est votre situation de famille ? (Célibataire, marié(e), vivant maritalement, séparé(e), divorcé(e), veuf(ve))	What is your marital status? (Single, married, cohabiting, separated, divorced, widowed)

Table A.2: Household size (1989, 2002 and 2005)

Q5	Combien de personnes, VOUS COMPRIS, vivent actuellement à votre foyer ? dont combien d'enfants vivant au foyer ?	How many people, INCLUDING YOU, currently live in your home? of these, how many are children living at home?

Table A.3: Education (1989)

Q52	Quel est votre diplôme le plus élevé (ou le niveau d'études correspondant) ?	What is your highest educational qualification (or the equivalent level of studies)?
	(Certificat d'études primaires ; BEPC ; Baccalauréat ; CAP ; BEP, BP, BEC, BEI ; Enseignement supérieur technique de niveau BTS, DUT ; Autre enseignement supérieur ; Autre diplôme)	(Primary education certificate; Junior secondary education certificate; Secondary education leaving certificate; Vocational qualification; Vocational school-leaving qualifications; Two-year professional higher education qualification; Other higher education; Other qualification)

A.2.2 Retirement characteristics

Table A.4: Retirement 1996-2001

La raison de votre départ à la retraite était… départ anticipé pour cause de maladie	The reason for your retirement was… early retirement through ill health

Table A.5: Retirement 2000-2011

Avant votre date de retraite officielle, étiez-vous en longue maladie ou invalidité ? (oui/non)	Before your official retirement date, were you on long-term sick leave or disability leave? (yes/no)

A.2.3 Quality of life

The English-language original version of the CASP-19 scale has been provided in the right-hand column.

Table A.6: CASP-19 quality of life scale (2005 and 2009)

Q48	*Voici une liste d'expressions que les gens utilisent pour décrire leur vie en général et la façon dont ils se sentent. Pourriez-vous indiquer la fréquence avec laquelle chacune d'entre elles s'applique à vous-même ? (Souvent, parfois, rarement, jamais)*	*Here is a list of expression that people use to describe their life in general and the way that they feel. Could you indicate the frequency with which each one of these applies to you? (Often, sometimes, rarely, never)*
	1. Mon âge m'empêche de faire ce que je voudrais*	1. My age prevents me from doing the things I would like to*
	2. J'ai le sentiment de ne pas contrôler ce qui m'arrive*	2. I feel that what happens to me is out of my control*
	3. Je me sens libre de planifier mon avenir	3. I feel free to plan for the future
	4. Je me sens à l'écart*	4. I feel left out of things*
	5. J'arrive à faire ce que je veux	5. I can do the things that I want to do
	6. Mes responsabilités familiales m'empêchent de faire ce que je veux*	6. Family responsibilities prevent me from doing what I want to do*
	7. J'ai le sentiment de me faire plaisir avec ce que je fais	7. I feel that I can please myself what I can do
	8. Mon état de santé m'empêche de faire ce que je veux*	8. My health stops me from doing the things I want to do*
	9. Le manque d'argent m'empêche de faire ce que je veux*	9. Shortage of money stops me from doing the things I want to do*
	10. J'aborde chaque nouvelle journée avec plaisir	10. I look forward to each day
	11. Je trouve que ma vie a un sens	11. I feel that my life has meaning
	12. J'ai du plaisir à faire ce que je fais	12. I enjoy the things that I do
	13. J'ai plaisir à être en compagnie d'autres personnes	13. I enjoy being in the company of others
	14. Dans l'ensemble, je repense à mon passé avec bonheur	14. On balance, I look back on life with a sense of happiness
	15. Ces jours-ci, je me sens plein(e) d'énergie	15. I feel full of energy these days
	16. Je choisis de faire des choses que je n'ai jamais faites auparavant	16. I choose to do things that I have never done before
	17. Je suis satisfait(e) de la façon dont ma vie s'est déroulée	17. I feel satisfied with the way my life has turned out
	18. Je trouve que la vie offre plein d'opportunités	18. I feel that life is full of opportunities
	19. Je pense que l'avenir se présente bien pour moi	19. I feel that the future looks good for me

Items marked with a star (*) are reverse scored.

A.2.4 Health measures

Table A.7: Difficulties in hearing and vision (2002-2009)

Q.23	*Avez-vous des difficultés*	*Do you have difficulties*
	pour entendre ? (oui/non) pour voir, même avec des lunettes ? (oui/non)	with hearing? (yes/no) with seeing, even when using glasses? (yes/no)

Table A.8: Nottingham Health Scale (Physical limitations) (2006)

Q51	*La liste ci-dessous évoque quelques problèmes rencontrés par beaucoup de personnes dans leur vie quotidienne. Lisez attentivement cette liste et cochez la réponse «Oui» ou «Non» selon votre état actuel. Veuillez répondre à toutes les questions même si elles ne vous semblent pas très adaptées à votre cas. Si vous hésitez entre oui et non, cochez ce qui correspond le mieux à votre état aujourd'hui.*	*The list below describes several problems that many people encounter in daily life. Read this list carefully and tick "Yes" or "No" according to your current condition. Please respond to all of the questions even if they do not seem to correspond well in your case. If you are not sure whether to tick yes or no, select what corresponds best to your situation today.*
	10. Pour marcher, je suis limité(e) à l'intérieur (de mon domicile, du bâtiment . . .)	10. I can only walk about indoors (of my house, indoors. . .)
	11. J'ai des difficultés à me pencher en avant (pour lacer mes chaussures, ramasser un objet . . .)	11. I find it hard to bend
	14. Je suis totalement incapable de marcher	14. I'm unable to walk at all
	17. J'ai du mal à monter ou à descendre les escaliers ou les marches	17. I have trouble getting up and down stairs and steps
	18. J'ai du mal à tendre le bras (pour attraper les objets)	18. I find it hard to reach for things
	25. J'ai des difficultés à m'habiller ou à me déshabiller	25. I find it hard to dress myself
	27. J'ai des difficultés à rester longtemps debout	27. I find it hard to stand for long (e.g., at the kitchen sink, waiting for a bus)
	35. J'ai besoin d'aide pour marcher dehors (une canne, quelqu'un pour me soutenir)	35. I need help to walk about outside (e.g., a walking aid or someone to support me)

Table A.9: Self-assessed health (1989)

Q22	Comment jugez-vous votre état de santé général ?	How do you rate your general state of health?
	A ; B ; C ; D ; E ; F ; G ; H. (Polar labelling : A = très bon, H = très mauvais.)	A; B; C; D; E; F; G; H. (Polar labelling: A = very good, H = very bad.)

Table A.10: CES-D depression scale (2005)

Q37	*Les impressions suivantes sont ressenties par la plupart des gens. Pourriez-vous indiquer la fréquence avec laquelle vous avez éprouvé les sentiments ou eu les comportements décrits dans cette liste durant la semaine écoulée. Pour répondre, cochez la case correspondante à la réponse choisie : (jamais, très rarement ; occasionnellement ; assez souvent, fréquemment ; tout le temps)*	*The following impressions are felt by most people. Could you indicate how frequently last week you experienced these feelings or had the behaviours described in this list. To respond, tick the box corresponding to the chosen response: (rarely or none of the time ; some or little of the time; occasionally or a moderate amount of the time; most or all of the time)*
	1. J'ai été contrarié(e) par des choses qui d'habitude ne me dérangent pas	1. I was bothered by things that usually don't bother me
	2. Je n'ai pas eu envie de manger, j'ai manqué d'appétit	2. I did not feel like eating; my appetite was poor
	3. J'ai eu l'impression que je ne pouvais pas sortir du cafard, même avec l'aide de ma famille et de mes amis	3. I felt that I could not shake off the blues even with help from my family and friends
	4. J'ai eu le sentiment d'être aussi bien que les autres*	4. I felt that I was just as good as other people*
	5. J'ai eu du mal à me concentrer sur ce que je faisais	5. I had trouble keeping my mind on what I was doing
	6. Je me suis senti(e) déprimé(e)	6. I felt depressed
	7. J'ai eu l'impression que toute action me demandait un effort	7. I felt that everything I did was an effort
	8. J'ai été confiant(e) en l'avenir*	8. I felt hopeful about the future*
	9. J'ai pensé que ma vie était un échec	9. I thought my life had been a failure
	10. Je me suis senti(e) craintif(ve)	10. I felt fearful
	11. Mon sommeil n'a pas été bon	11. My sleep was restless
	12. J'ai été heureux(se)*	12. I was happy*
	13. J'ai parlé moins que d'habitude	13. I talked less than usual
	14. Je me suis senti(e) seul(e)	14. I felt lonely
	15. Les autres ont été hostiles envers moi	15. People were unfriendly
	16. J'ai profité de la vie*	16. I enjoyed life*
	17. J'ai eu des crises de larmes	17. I had crying spells
	18. Je me suis senti(e) triste	18. I felt sad
	19. J'ai eu l'impression que les gens ne m'aimaient pas	19. I felt that people disliked me
	20. J'ai manqué d'entrain	20. I could not get "going"

Items marked with a star (*) are reverse scored.

Table A.11: Risky health behaviours (1989)

Q39	Êtes-vous fumeur ? (fumeur [au moins de 1 cigarette par jour], non-fumeur, ex-fumeur [arrêt du tabagisme depuis au moins 1 an])	Are you a smoker? (smoker [at least 1 cigarette a day], non-smoker, ex-smoker [stopped smoking at least 1 year ago])
Q44	*Pour les boissons consommées quotidiennement, indiquez le nombre de verres (ou de tasses) par jour. (jamais, à l'occasion, tous les jours ; si « tous les jours » nombres de verres (tasses) par jour).*	*For drinks that are consumed every day, indicate the number of classes (or cups) per day (never, sometimes, every day; if "every day" number of glasses (cups) per day).*
	Jus de fruits, sodas ; café, thé ; vin ; bière ou cidre ; pastis ; whisky ; autres apéritifs ou digestifs	Fruit juces; sodas; coffee; tea; wine; beer or cider; pastis; whisky; other aperitifs or digestives

Table A.12: Short-form 36 health survey (2003 and 2007)

	Les questions qui suivent, portent sur votre santé telle que vous la ressentez. Ces informations nous permettront de mieux savoir comment vous vous sentez dans votre vie de tous les jours. Veillez répondre à toutes les questions en entourant le chiffre correspondant à la réponse choisie, comme il est indiqué. Si vous ne savez pas très bien comment répondre, choisissez la réponse la plus proche de votre situation.	*The following questions are about your health as you experience it. This information allows us to better understand how you feel in your daily life. Please respond to all the questions by circling the number corresponding to the chosen response, as is indicated. If you don't quite know how to respond, choose the response that is closest to your situation.*
Q48	Dans l'ensemble, pensez-vous que votre santé est : excellente, très bonne, bonne, médiocre, mauvaise	In general, would you say your health is: excellent, very good, good, fair, poor
Q49	Par rapport à l'année dernière à la même époque, comment trouvez-vous votre état de santé, en ce moment ? (Bien meilleur que l'an dernier, plutôt meilleur, à peu près pareil, plutôt moins bon, beaucoup moins bon)	Compared to one year ago, how would you rate your health in general now? (Much better now than one year ago, somewhat better now than one year ago, about the same as one year ago, somewhat worse than one year ago, much worse than one year ago)

Continued on next page

Table A.12 – *continued from previous page*

Q50	Voici une liste d'activités que vous pouvez avoir à faire dans votre vie de tous les jours. Pour chacune d'entre elles indiquez si vous êtes limité(e) en raison de votre état de santé actuel. (oui, très limité(e) ; oui, un peu limité(e) ; non, pas du tout limité(e) a. Efforts physiques importants, tels que courir, soulever un objet lourd, faire du sport b. Efforts physiques modérés tels que déplacer une table, passer l'aspirateur, jouer aux boules c. Soulever et porter des courses d. Monter plusieurs étages par l'escalier e. Monter un étage par l'escalier f. Se pencher en avant, se mettre à genoux, s'accroupir g. Marcher plus d'un kilomètre à pied h. Marcher plusieurs centaines de mètres i. Marcher une centaine de mètres j. Prendre un bain, une douche ou s'habiller	The following items are about activities you might do during a typical day. Does your health now limit you in these activities? If so, how much? (yes, limited a lot; yes, limited a little; no, not limited at all) a. Vigorous activities, such as running, lifting heavy objects, participating in strenuous sports b. Moderate activities, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf c. Lifting or carrying groceries d. Climbing several flights of stairs e. Climbing one flight of stairs f. Bending, kneeling, or stooping g. Walking more than a mile h. Walking several blocks i. Walking one block j. Bathing or dressing yourself
Q51	Au cours de ces 4 dernières semaines, et en raison de votre état physique, (Oui/non) a. Avez-vous réduit le temps passé à votre travail ou à vos activités habituelles ? b. Avez-vous accompli moins de choses que ce que vous auriez souhaité ? c. Avez-vous dû arrêter de faire certaines choses ? d. Avez-vous eu des difficultés à faire votre travail ou toute autre activité (par exemple, cela vous a demandé un effort supplémentaire) ?	During the past 4 weeks as a result of your physical health, (Yes/no) a. Have you cut down the amount of time you spent on work or other activities? b. Have you accomplished less than you would like? c. Have you had to stop doing certain activities? d. Have you had difficulty performing your work or other activities (for example, it took extra effort)?

Continued on next page

Table A.12 – ***continued from previous page***

Q52	Au cours de ces 4 dernières semaines, et en raison de votre état émotionnel (comme vous sentir triste, nerveux(se) ou déprimé(e)), (Oui/non) a. Avez-vous réduit le temps passé à votre travail ou à vos activités habituelles ? b. Avez-vous accompli moins de choses que ce que vous auriez souhaité ? c. Avez-vous eu des difficultés à faire ce que vous aviez à faire avec autant de soin et d'attention que d'habitude ?	During the past 4 weeks, and as a result of any emotional problems (such as feeling depressed or anxious), (Yes/no) a. Have you cut down the amount of time you spent on work or other activities? b. Have you accomplished less than you would like? c. Have you had difficulties to do work or other activities as carefully as usual?
Q53	Au cours de ces 4 dernières semaines, dans quelle mesure votre état de santé physique ou émotionnel, vous a-t-il gêné(e) dans votre vie sociale et vos relations avec les autres, votre famille, vos amis, vos connaissances ? (pas du tout, un petit peu, moyennement, beaucoup, énormément)	During the past 4 weeks, to what extent has your physical health or emotional problems interfered with your normal social activities with family, friends, neighbours, or groups? (not at all, slightly, moderately, quite a bit, extremely)
Q54	Au cours de ces 4 dernières semaines, quelle a été l'intensité de vos douleurs physiques ? (nulle, très faible, faible, moyenne, grande, très grande)	How much bodily pain have you had during the past 4 weeks? (none, very mild, mild, moderate, severe, very severe)
Q55	Au cours de ces 4 dernières semaines, dans quelle mesure vos douleurs physiques vous ont-elles limité(e) dans votre travail ou vos activités domestiques (pas du tout, un petit peu, moyennement, beaucoup, énormément)	During the past 4 weeks, how much did pain interfere with your normal work (including both work outside the home and housework)? (not at all, a little bit, moderately, quite a bit, extremely)

Continued on next page

Table A.12 – *continued from previous page*

Q56	Les questions qui suivent portent sur comment vous vous êtes senti(e) au cours de ces 4 dernières semaines. Pour chaque question, veuillez indiquer la réponse qui vous semble la plus appropriée. Au cours de ces 4 dernières semaines, y a-t-il eu des moments où : (en permanence, très souvent, souvent, quelquefois, rarement, jamais)	These questions are about how you feel and how things have been with you during the past 4 weeks. For each question, please give the one answer that comes closest to the way you have been feeling. How much of the time during the past 4 weeks: (all of the time, most of the time, a good bit of the time, some of the time, a little of the time, none of the time)
	a. Vous vous êtes senti(e) dynamique	a. Did you feel full of pep?
	b. Vous vous êtes senti(e) très nerveux(se)	b. Have you been a very nervous person?
	c. Vous vous êtes senti(e) si découragé(e) que rien ne pouvait vous remonter le moral	c. Have you felt so down in the dumps that nothing could cheer you up?
	d. Vous vous êtes senti(e) calme et détendu(e)	d. Have you felt calm and peaceful?
	e. Vous vous êtes senti(e) débordant(e) d'énergie	e. Did you have a lot or energy?
	f. Vous vous êtes senti(e) triste et abattu(e)	f. Have you felt downhearted and blue?
	g. Vous vous êtes senti(e) épuisé(e)	g. Did you feel worn out?
	h. Vous vous êtes senti(e) heureux(se)	h. Have you been a happy person?
	i. Vous vous êtes senti(e) fatigué(e)	i. Did you feel tired?
Q57	Au cours de ces 4 dernières semaines y a-t-il eu des moments où votre état de santé, physique ou émotionnel, vous a gêné(e) dans votre vie sociale et vos relations avec les autres, votre famille, vos amis, vos connaissances ? (en permanence, une bonne partie du temps, de temps en temps, rarement, jamais)	During the past 4 weeks, how much of the time has your physical health or emotional problems interfered with your social activities (like visiting with friends, relatives, etc.)? (all of the time, most of the time, some of the time, a little of the time, none of the time)
Q58	Indiquez, pour chacune des phrases suivants, dans quelle mesure elles sont vraies ou fausses dans votre cas : (totalement vraie, plutôt vraie, je ne sais pas, plutôt fausse, totalement fausse)	How true or false is each of the following statements for you? (definitely true, mostly true, don't know, mostly false, definitely false)
	a. Je tombe malade plus facilement que les autres	a. I seem to get sick a little easier than other people
	b. Je me porte aussi bien que n'importe qui	b. I am as healthy as anybody I know
	c. Je m'attends à ce que ma santé se dégrade	c. I expect my health to get worse
	d. Je suis en excellente santé	d. My health is excellent

A.2.5 Recent circumstances

Table A.13: Social activities (2005)

Q44	*La partie suivante porte sur vos activités sociales c'est-à-dire des activités qui vous conduisent à avoir des échanges, à être en contact avec d'autres personnes.*	*The next part is about your social activities, in other words, activities that lead you to be in contact with other people.*
	Voici une liste d'activités sociales que les gens peuvent avoir. *Pourriez-vous indiquer la fréquence avec laquelle vous avez eu chacune d'entre elles, au cours du dernier mois ? (presque tous les jours, presque toutes les semaines, moins fréquemment, jamais)*	*Here is a list of social activities that people might do.* *Could you indicate the frequency with which you did each of these over the last month? (almost every day, almost every week, less frequently, never)*
	1. Avoir des activités bénévoles ou caritatives 2. S'occuper d'un adulte malade ou handicapé 3. Rendre service à un membre de la famille, à des amis ou à des voisins 4. Participer à un club de sport, à une amicale ou un autre type de club (club du 3^{e} âge . . .) 5. Participer aux activités d'une communauté religieuse (église, synagogue, mosquée . . .) 6. Suivre des cours ou une formation 7. Participer aux activités d'une organisation politique ou syndicale 8. Autre : [please state]	1. Volunteering or charitable activities 2. Looking after an ill or disabled adult 3. Helping out a family member, friends or neighbours 4. Taking part in a sports club, a social club or another type of club (elderly association. . .) 5. Taking part in religious activities in a community (church, synagogue, mosque . . .) 6. Following a course or a training programme 7. Taking part in political or union activities 8. Other: [please state]

Table A.14: Emotional support (2004)

Q64	Y a-t-il quelqu'un sur qui vous pouvez compter pour discuter de choses personnelles ou pour prendre une décision difficile ? (Oui/non)	Is there somebody you can rely on to discuss personal things or to take a difficult decision? (Yes/no)
	Auriez-vous eu plus besoin de ce type d'aide que vous n'en avez reçu ? (Oui, beaucoup plus ; oui, plus ; oui, un peu plus ; non, c'était suffisant)	Did you need this more of this sort of help than you got? (Yes, a lot more; yes, more; yes, a little more; no, it was enough)

Table A.15: Confidence in finances (2002)

Q49	Quand vous pensez aux 10 prochaines années, quelle confiance avez-vous en votre situation financière ? (Très confiant, assez confiant, pas très confiant, pas confiant du tout)	If you think about the next 10 years, how confident are you about your finances? (Very confident, quite confident, not very confident, not confident at all)

Table A.16: Income (2002)

Q47	Quels sont les revenus mensuels nets de votre foyer (c'est-à-dire la somme de tous les revenus des personnes qui contribuent au revenu de votre foyer) ?	What is the monthly income of your household (i.e. the sum of all the revenues of the people who contribute to the income of your household)
	Moins de 991 euro (6500 F)	Less than 991 euro (6500 Fr.F)
	De 991 euro (6500 F) à moins de 1144 euro (7500 F)	From 991 euro (6500 Fr.F) to less than 1144 euro (7500 Fr.F)
	De 1141 euro (7500 F) à moins de 1372 euro (9000 F)	From 1141 euro (7500 Fr.F) to less than 1372 euro (9000 Fr.F)
	De 1372 euro (9000 F) à moins de 1601 euro (10 500 F)	From 1372 euro (9000 Fr.F) to less than 1601 euro (10 500 Fr.F)
	De 1601 euro (10 500 F) à moins de 1982 euro (13 000 F)	From 1601 euro (10 500 Fr.F) to less than 1982 euro (13 000 Fr.F)
	De 1982 euro (13 000 F) à moins de 2592 euro (17 000 F)	From 1982 euro (13 000 Fr.F) to less than 2592 euro (17 000 Fr.F)
	De 2592 euro (17 000 F) à moins de 3811 euro (25 000 F)	From 2592 euro (17 000 Fr.F) to less than 3811 euro (25 000 Fr.F)
	De 3811 euro (25 000 F) à moins de 4574 euro (30 000 F)	From 3811 euro (25 000 Fr.F) to less than 4574 euro (30 000 Fr.F)
	De 4574 euro (30 000 F) à moins de 6098 euro (40 000 F)	From 4574 euro (30 000 Fr.F) to less than 6098 euro (40 000 Fr.F)
	6098 euro (40 000 F) et plus	6098 euro (40 000 Fr.F) and more

Table A.17: Wealth (2002)

Q48	Si vous vendiez tous vos biens (résidence principale, résidence secondaire, mobilier, voiture, bijoux, etc., et après remboursement de vos éventuels crédits) à quelle somme pensez-vous que cela correspondrait ?	If you sold all of your assets (main residence, secondary residence, furniture, car, jewellery, etc, and after repaying any debts) what sum do you think it would correspond to?
	Moins de 1525 euro (10 000 F)	Less than 1525 euro (10 000 French francs)
	De 1525 euro (10 000 F) à moins de 4574 euro (30 000 F)	From 1525 euro (10 000 Fr.F) to less than 4574 euro (30 000 Fr.F)
	De 4574 euro (30 000 F) à moins de 7623 euro (50 000 F)	From 4574 euro (30 000 Fr.F) to less than 7623 euro (50 000 Fr.F)
	De 7623 euro (50 000 F) à moins de 15 245 euro (100 000 F)	From 7623 euro (50 000 Fr.F) to less than 15 245 euro (100 000 Fr.F)
	De 15 245 euro (100 000 F) à moins de 76 225 euro (500 000 F)	From 15 245 euro (100 000 Fr.F) to less than 76 225 euro (500 000 Fr.F)
	De 76 225 euro (500 000 F) à moins de 152 449 euro (1 million F)	From 76 225 euro (500 000 Fr.F) to less than 152 449 euro (1 million Fr.F)
	De 152 449 euro (1 million F) à moins de 304 898 euro (2 million F)	From 152 449 euro (1 million Fr.F) to less than 304 898 euro (2 million Fr.F)
	De 304 898 euro (2 million F) à moins de 457 347 euro (3 million F)	From 304 898 euro (2 million Fr.F) to less than 457 347 euro (3 million Fr.F)
	457 347 euro (3 million F) et plus	457 347 euro (3 million Fr.F) and more

Table A.18: Neighbourhood and social relations (2003)

	Voici quelques questions concernant votre cadre de vie. Nous vous demandons d'abord d'indiquer si la commune où vous habitez se trouve en milieu rural ou urbain. Les questions suivantes portent sur votre appréciation de votre quartier, tel que vous le définissez vous-même.	*Here are several questions concerning your living environment. We would like you firstly to indicate if the neighbourhood you are living in is in a rural or urban area. The next questions are about how you rate your neighbourhood, however you define your neighbourhood.*
Q39	Êtes-vous satisfait de la qualité de vie dans votre quartier ? (Très satisfait(e), plutôt satisfait(e), sans opinion, plutôt insatisfait(e), très insatisfait(e))	Are you satisfied with the quality of life in your neighbourhood? (Very satisifed, quite satisfied, no opinion, quite unsatisfied, very unsatisfied)
Q40	Au cours du 12 derniers mois, dans votre quartier vous est-il arrivé d'être gêné par : (non, jamais ; rarement ; parfois ; oui, assez souvent ; oui, très souvent) Le bruit ? La pollution ? La présence d'ordures ménagères ?	During the last 12 months, in your neighbourhood have you been bothered by: (no, never; rarely; sometimes; yes, quite often; yes, very often) Noise? Pollution? Rubbish?
Q41	Êtes-vous satisfait de l'accès aux commerces et aux services (magasins, écoles, médecins et équipements de santé, transports en commun.) dans votre quartier ? (Très satisfait(e), plutôt satisfait(e), sans opinion, plutôt insatisfait(e), très insatisfait(e))	Are you satisfied with access to shops and services (shops, schools, doctors and health centres, public transport) in your neighbourhood? (Very satisifed, quite satisfied, no opinion, quite unsatisfied, very unsatisfied)
Q42	Comment jugez-vous l'accès aux activités de loisirs (cinéma, spectacles de théâtre et de musique, restaurants, équipements sportifs, associations culturelles) dans votre quartier ? (Très satisfaisant, plutôt satisfaisant, plutôt insatisfaisant, très insatisfaisant, sans opinion)	How do you rate the access to leisure activities (cinema, theatre and concert halls, restaurants, sports facilities, cultural organizations) in your neighbourhood? (Very satisfactory, quite satisfactory, quite unsatisfactory, very unsatisfactory, no opinion)
Q43	Au cours des 12 derniers mois vous est-il arrivé d'avoir des conversations avec vos voisins ou de leur rendre de petits services (garder les clefs, garder les plantes, prêter des outils ou des produits de cuisine) ? (Très fréquemment, régulièrement, de temps en temps, rarement, jamais)	During the last 12 months have you had conversations with your neighbours or helped them out (looking after keys, taking care of plants, lending tools or ingredients)? (Very frequently, regularly, from time to time, rarely, never)
Q44	Parmi les membres de votre famille et vos amis proches, combien habitent dans votre quartier ? (Aucun, 1 ou 2, 3 à 5, 6 à 9, 10 ou plus)	Among your family members and close friends, how many live in your neighbourhood? (None, 1 or 2, 3 to 5, 6 to 9, 10 or more)
Q45	Avez-vous le sentiment qu'au cours des 12 derniers mois le vandalisme (par exemple la détérioration des parties communes d'immeubles ou des biens publics) a été un problème dans votre quartier ? (Oui, un problème très important ; oui, plutôt un problème ; non, plutôt pas un problème ; non, pas du tout un problème ; sans opinion)	Have you had the impression that during the last 12 months vandalism (for example the deterioration of shared parts of the building or public facilities) has been a problem in your neighbourhood? (Yes, a very important problem; yes, a bit of a problem; no, not really a problem; no, not at all)
Q46	Vous sentez-vous en sécurité dans votre quartier ? (Oui, toujours ; oui, la plupart du temps ; non, pas toujours ; non, jamais ; ni oui, ni non.)	Do you feel safe in your neighbourhood? (Yes, always; yes, most of the time; no, not always; no, never; undecided)

A.2.6 Physical and psychosocial working conditions

Table A.19: Retrospective ergonomic strain (2007)

Q46	*Au cours de votre vie professionnelle, avez-vous eu à : (oui/non)* *Si oui, précisez les périodes en indiquant les années : de . . . à . . . ; de . . . à . . . ; de . . . à . . . ; de . . . à . . .*	*During your working life, have you had to: (yes/no)* *If yes, indicate the periods by writing in the years: from . . . to . . . ; from . . . to . . . ; from . . . to . . . ; from . . . to . . .*
	porter or déplacer des charges lourdes de façon habituelle ?	regularly carrying or moving heavy loads?
	vous pencher en avant ou tordre le dos ou le tronc, de façon habituelle ?	regularly bending forward or twisting the back or trunk?
	conduire un véhicule (voiture, camionnette, camion,. . .) pendant deux heures ou plus par jour (y compris les allers et retours domicile-travail) ?	driving a vehicle (car, van, lorry,. . .) for two or more hours a day (including commuting between home and work)?
	travailler en position agenouillée ?	working in a kneeling position?
	monter et descendre des escaliers, au moins l'équivalent de 10 étages par jour ?	climbing up and down stairs, at least the equivalent of 10 floors per day?
	monter sur des escabeaux ou des échelles ?	climbing ladders and stepladders?
	travailler bras en l'air ?	working with arms in the air?
	porter des charges sur l'épaule ?	carrying loads on the shoulder?
	utiliser des outils à main vibrants ?	using vibrating hand tools?

Table A.20: Ergonomic strain (1989 and 1990)

Q9	*L'exécution de votre travail vous impose-t-elle ? (cochez autant de cases que nécessaire)*	*In carrying out your work do you have to? (tick as many boxes as necessary)*
	De rester longtemps debout	To stand for long periods
	De rester longtemps dans une autre posture pénible ou fatigante à la longue	To hold another posture that is eventually uncomfortable or tiring
	D'effectuer des déplacements longs, fréquents ou rapides	To carry out lengthy, frequent or rapid movements
	De porter ou déplacer des charges lourdes	To carry or move heavy loads
	De subir des secousses ou vibrations	To be exposed to shaking or vibrations
	De travailler sur écran	To work with a screen
	Aucune des contraintes précédentes	None of the previous constraints

Table A.21: Dangerous working conditions (1989 and 1990)

Q13	*Au cours de votre travail risquez-vous ? (cochez autant de cases que nécessaire)*	*During your work do you risk...? (tick as many boxes as necessary)*
	De respirer des émanations de gaz	Breathing in fumes
	De faire une chute grave	A serious fall
	De faire une chute peu grave	A minor fall
	Des blessures sur machine	Being injured by a machine
	Des brûlures thermiques	Heat burns
	Des brûlures chimiques	Chemical burns
	Des accidents de circulation (en cours de travail)	Vehicle accidents (while at work)
	Aucun des risques précédents	None of the previous risks

Table A.22: Karasek job strain scale (1997 and 1999)

	Votre travail (si vous êtes retraité, passez directement à la question 64)	*Your work (if you are retired, go directly to question 64)*
	Pour les questions suivantes, veuillez cocher la case qui correspond le mieux à votre réponse (cocher une seule case par question)	*For the following questions, please tick the box which corresponds best to your response (tick one single box per question)*
Q33	Dans mon travail, je dois apprendre des choses nouvelles (pas du tout d'accord, pas d'accord, d'accord, tout à fait d'accord)	My job requires that I learn new things
Q34	Dans mon travail, j'effectue des tâches répétitives (pas du tout d'accord, pas d'accord, d'accord, tout à fait d'accord)	My job involves a lot of repetitive work
Q35	Mon travail me demande d'être créatif (pas du tout d'accord, pas d'accord, d'accord, tout à fait d'accord)	My job requires me to be creative
Q36	Mon travail me permet souvent de prendre des décisions moi-même (pas du tout d'accord, pas d'accord, d'accord, tout à fait d'accord)	My job allows me to make a lot of decisions on my own
Q37	Mon travail demande un haut niveau de compétence (pas du tout d'accord, pas d'accord, d'accord, tout à fait d'accord)	My job requires a high level of skill
Q38	Dans ma tâche, j'ai très peu de liberté pour décider comment je fais mon travail (pas du tout d'accord, pas d'accord, d'accord, tout à fait d'accord)	On my job, I have very little freedom to decide how I do my work
Q39	Dans mon travail, j'ai des activité variées (pas du tout d'accord, pas d'accord, d'accord, tout à fait d'accord)	I get to do a variety of different things on my job
Q40	J'ai la possibilité d'influencer le déroulement de mon travail (pas du tout d'accord, pas d'accord, d'accord, tout à fait d'accord)	I have a lot of say about what happens on my job
Q41	J'ai l'occasion de développer mes compétences professionnelles (pas du tout d'accord, pas d'accord, d'accord, tout à fait d'accord)	I have an opportunity to develop my own special abilities
Q42	Mon travail demande de travailler très vite (pas du tout d'accord, pas d'accord, d'accord, tout à fait d'accord)	My job requires working very fast

Continued on next page

Table A.22 – ***continued from previous page***

Q43	Mon travail demande de travailler intensément (pas du tout d'accord, pas d'accord, d'accord, tout à fait d'accord)	My job requires working very hard
Q44	Mon travail demande beaucoup d'efforts physiques (pas du tout d'accord, pas d'accord, d'accord, tout à fait d'accord)	My job requires lots of physical effort
Q45	On ne me demande pas d'effectuer une quantité de travail excessive (pas du tout d'accord, pas d'accord, d'accord, tout à fait d'accord)	I am not required to perform excessive work
Q46	Je dispose du temps nécessaire pour exécuter mon travail (pas du tout d'accord, pas d'accord, d'accord, tout à fait d'accord)	I have enough time to get the job done
Q47	Dans mon travail, je dois souvent déplacer ou soulever des charges très lourdes (pas du tout d'accord, pas d'accord, d'accord, tout à fait d'accord)	I am often required to move or lift very heavy loads on my job
Q48	Mon travail exige des activités physiques rapides et continues (pas du tout d'accord, pas d'accord, d'accord, tout à fait d'accord)	My work requires rapid and continuous physical activity
Q49	Je reçois des ordres contradictoires de la part d'autres personnes (pas du tout d'accord, pas d'accord, d'accord, tout à fait d'accord)	I am free from conflicting demands that others make
Q50	Mon travail nécessite de longues périodes de concentration intense (pas du tout d'accord, pas d'accord, d'accord, tout à fait d'accord)	My job requires long periods of intense concentration on the task
Q51	Mes tâches sont souvent interrompues avant d'être achevées, nécessitant de les reprendre plus tard (pas du tout d'accord, pas d'accord, d'accord, tout à fait d'accord)	My tasks are often interrupted before they can be completed, requiring attention at a later time
Q52	Mon travail est très "bousculé" (pas du tout d'accord, pas d'accord, d'accord, tout à fait d'accord)	My job is very hectic
Q53	Je dois souvent effectuer des tâches avec le corps dans une position incommode pendant de longues périodes (pas du tout d'accord, pas d'accord, d'accord, tout à fait d'accord)	I often have to perform tasks in awkward body positions for lengthy periods

Continued on next page

Table A.22 – ***continued from previous page***

Q54	Je dois souvent effectuer des tâches avec la tête ou les bras dans une position incommode pendant de longues périodes (pas du tout d'accord, pas d'accord, d'accord, tout à fait d'accord)	I often have to perform tasks with my head or arms in awkward positions for lengthy periods
Q55	Attendre le travail de collègues ou d'autres départements ralentit souvent mon propre travail (pas du tout d'accord, pas d'accord, d'accord, tout à fait d'accord)	My work is slowed by having to wait for the work of others
Q56	Mon supérieur se sent concerné par le bien-être de ses subordonnés (pas du tout d'accord, pas d'accord, d'accord, tout à fait d'accord, je n'ai pas de supérieur)	My supervisor is concerned about the well-being of his/her subordinates
Q57	Mon supérieur prête attention à ce que je dis (pas du tout d'accord, pas d'accord, d'accord, tout à fait d'accord, je n'ai pas de supérieur)	My supervisor pays attention to what I say
Q58	Mon supérieur m'aide à mener ma tâche à bien (pas du tout d'accord, pas d'accord, d'accord, tout à fait d'accord, je n'ai pas de supérieur)	My supervisor is helpful
Q59	Mon supérieur réussit facilement à faire collaborer ses subordonnés (pas du tout d'accord, pas d'accord, d'accord, tout à fait d'accord, je n'ai pas de supérieur)	My supervisors is a good organizer
Q60	Les collègues avec qui je travaille sont des gens professionnellement compétents (pas du tout d'accord, pas d'accord, d'accord, tout à fait d'accord)	My co-workers are competent
Q61	Les collègues avec qui je travaille me manifestent de l'intérêt (pas du tout d'accord, pas d'accord, d'accord, tout à fait d'accord)	My co-workers are interested in me
Q62	Les collègues avec qui je travaille sont amicaux (pas du tout d'accord, pas d'accord, d'accord, tout à fait d'accord)	My co-workers are friendly
Q63	Les collègues avec qui je travaille m'aident à mener les tâches à bien (pas du tout d'accord, pas d'accord, d'accord, tout à fait d'accord)	My co-workers are helpful

Table A.23: Effort-reward imbalance scale (1998)

	Les questions des deux pages suivantes concernent votre travail. Si vous êtes en activité, répondez à ces questions en vous référant à votre situation de travail actuelle. Si vous êtes retraité(e), répondez en vous référant à votre dernière situation professionnelle.	*The questions on the next two pages concern your work. If you are working, respond to the questions in relation to your current job. If you are retired, respond in terms of your last job.*
Q47	*Pour cette première page, indiquez si vous êtes d'accord ou non avec chacune des phrases, en cochant la case correspondante. Si vous cochez la case en face de la flèche =>, alors indiquez aussi dans quelle mesure vous êtes en général perturbé(e) par cette situation, en entourant le chiffre qui correspond le mieux à votre réponse. Merci de répondre à toutes les questions. (pas d'accord; d'accord => Je ne suis pas du tout perturbé(e), Je suis un peu perturbé(e), Je suis perturbé(e), Je suis très perturbé(e))*	*For this first page, indicate if you agree or not with each of the phrases, by ticking the corresponding box. If you tick the box next to the arrow =>, then also indicate how much in general you are bothered by this situation, by circling the figure that corresponds best to your response. Please answer all the questions. (disagree; agree => I am not at all distressed, I am somewhat distressed, I am distressed, I am very distressed.)*
	Je suis constamment pressé(e) par le temps à cause d'une forte charge de travail	I have constant time pressure due to a heavy work load
	Je suis fréquemment interrompu(e) et dérangé(e) dans mon travail	I have many interruptions and disturbances while performing my job
	J'ai beaucoup de responsabilités à mon travail	I have a lot of responsibility in my job
	Je suis souvent contraint(e) à faire des heures supplémentaires	I am often pressured to work overtime
	Mon travail exige des efforts physiques	My job is physically demanding
	Au cours des dernières années, mon travail est devenu de plus en plus exigeant	Over the past few years, my job has become more and more demanding
	Je reçois le respect que je mérite de mes supérieurs	I receive the respect I deserve from my superior or a respective relevant person
	Je reçois le respect que je mérite de mes collègues	I experience adequate support in difficult situations
	Au travail, je bénéficie d'un soutien satisfaisant dans les situations difficiles	I am treated unfairly at work (reverse coded)
	On me traite injustement à mon travail	My job promotion prospects are poor (reverse coded)

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Table A.23 – ***continued from previous page***

Je suis en train de vivre ou je m'attends à vivre un changement indésirable dans ma situation de travail	I have experienced or I expect to experience an undesirable change in my work situation (reverse coded)
Mes perspectives de promotion sont faibles	My job promotion prospects are poor (reverse coded)
Ma sécurité d'emploi est menacée	My employment security is poor (reverse coded)
Ma position professionnelle actuelle correspond bien à ma formation	My current occupational position adequately reflects my education and training
Vu tous mes efforts, je reçois le respect et l'estime que je mérite à mon travail	Considering all my efforts and achievements, I receive the respect and prestige I deserve at work
Vu tous mes efforts, mes perspectives de promotion sont satisfaisantes	Considering all my efforts and achievements, my job promotion prospects are adequate
Vu tous mes efforts, mon salaire est satisfaisant	Considering all my efforts and achievements, my salary is adequate

Appendix B

PCS-ESE – ESeC conversion table

The transposition table B.1 between the French national 1982 and 2003 occupational classifications and the European Socio-economic Classification (ESeC) was created by Loretta G. Platts, following discussions with David Blane at Imperial College London, Eric Harrison at City University and Louis-André Vallet at INSEE. It is restricted to occupations contained in the GAZEL cohort personnel records to 2010.

The tables are based on the cross-walk between the four-digit French occupational classification in 2003 (PCS: *nomenclature des professions et catégories socio-professionnelles*) and ESeC (European Socio-economic Classification) which was created by Christel Colin and Louis-André Vallet at INSEE. The cross-walk can be found in Appendix D (introduction on p. 87, table on pp. 90–5) to Brousse et al. (2007).

Generally, it is recommended to convert from national classifications to ESeC via the International Standard Classification of Occupations (ISCO). However, this presents difficulties in the French case as the French occupational classification is substantially different to the ISCO as the French classification, in particular, retains a distinction between private and public organizations. Therefore, rather than converting via ISCO, the final version of Colin and Vallet's cross-walk was created by converting each occupation directly between the French PCS occupational classification and ESeC.

Colin and Vallet's cross-walk used the PCS 2003 classification; however, since EDF/GDF is a large organization, the PCS-ESE 2003 classification (*Employés salariés d'entreprises*) was used in the GAZEL dataset. Although very similar, these classifications are not identical. More problematically, some occupations in GAZEL are coded using the older PCS-ESE 1982, and these were transposed into the correct ESeC class using INSEE's correspondence table between the PCS-ESE 1982 and 2003 nomenclatures (Insee, 2004). The final version of the PCS-ESeC conversion table, produced during the course of this doctorate, was shared with the team running the GAZEL cohort for use by other researchers.

Table B.1: Transposition table between the French National Occupational Classifications (PCS-ESE) and the European Socio-economic Classification.

PCS-ESE 03	PCS-ESE 82	Insee label	ESeC
371A		Cadres d'état-major administratifs, financiers, commerciaux des grandes entreprises	1
372A		Cadres chargés d'études économiques, financières, commerciales	1
372B		Cadres de l'organisation ou du contrôle des services administratifs et financiers	1
372C		Cadres spécialistes des ressources humaines et du recrutement	1
372D		Cadres spécialistes de la formation	1
372E		Juristes	1
372F		Cadres de la documentation, de l'archivage (hors fonction publique)	1
373A		Cadres des services financiers ou comptables des grandes entreprises	1
373B		Cadres des autres services administratifs des grandes entreprises	1
374C		Cadres commerciaux des grandes entreprises (hors commerce de détail)	1
375A		Cadres de la publicité	1
375B		Cadres des relations publiques et de la communication	1
380A		Directeurs techniques des grandes entreprises	1
382A		Ingénieurs et cadres d'étude du bâtiment et des travaux publics	1
382C		Ingénieurs, cadres de chantier et conducteurs de travaux (cadres) du bâtiment et des travaux publics	1
383A		Ingénieurs et cadres d'étude, recherche et développement en électricité, électronique	1
383B		Ingénieurs et cadres de fabrication en matériel électrique, électronique	1
385A		Ingénieurs et cadres d'étude, recherche et développement des industries de transformation (agroalimentaire, chimie, métallurgie, matériaux lourds)	1
386B		Ingénieurs et cadres d'étude, recherche et développement de la distribution d'énergie, eau	1
386D		Ingénieurs et cadres de la production et de la distribution d'énergie, eau	1
387A		Ingénieurs et cadres des achats et approvisionnements industriels	1
387B		Ingénieurs et cadres de la logistique, du planning et de l'ordonnancement	1
387C		Ingénieurs et cadres des méthodes de production	1
387D		Ingénieurs et cadres du contrôle-qualité	1
387E		Ingénieurs et cadres de la maintenance, de l'entretien et des travaux neufs	1
388A		Ingénieurs et cadres d'étude, recherche et développement en informatique	1
388B		Ingénieurs et cadres d'administration, maintenance, support et services aux utilisateurs en informatique	1
388C		Chefs de projets informatiques, responsables informatiques	1

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Table B.1 – continued from previous page

PCS-ESE 03	PCS-ESE 82	Insee label	ESeC
389A		Ingénieurs et cadres techniques de l'exploitation des transports	1
422C		Maîtres auxiliaires et professeurs contractuels de l'enseignement secondaire	2
423B		Formateurs et animateurs de formation continue	2
425A		Sous-bibliothécaires, cadres intermédiaires du patrimoine	2
431F		Infirmiers en soins généraux	2
434B		Assistants de service social	2
461B		Secrétaires de direction, assistants de direction (non cadres)	2
461C		Secrétaires de niveau supérieur (non cadres, hors secrétaires de direction)	2
461D		Maîtrise et techniciens des services financiers ou comptables	2
461E		Maîtrise et techniciens administratifs des services juridiques ou du personnel	2
461F		Maîtrise et techniciens administratifs des autres services administratifs	2
462C		Acheteurs non classés cadres, aides-acheteurs	2
462E		Autres professions intermédiaires commerciales (sauf techniciens des forces de vente)	2
463B		Techniciens commerciaux et technico-commerciaux, représentants en biens d'équipement, en biens intermédiaires, commerce interindustriel (hors informatique)	3
463D		Techniciens commerciaux et technico-commerciaux, représentants en services auprès d'entreprises ou de professionnels (hors banque, assurance, informatique)	3
463E		Techniciens commerciaux et technico-commerciaux, représentants auprès de particuliers (hors banque, assurance, informatique)	3
464A		Assistants de la publicité, des relations publiques	2
465B		Assistants techniques de la réalisation des spectacles vivants et audiovisuels	6
466C		Responsables d'exploitation des transports de voyageurs et de marchandises (non cadres)	2
472C		Métreurs et techniciens divers du bâtiment et des travaux publics	2
473A		Dessinateurs en électricité, électromécanique et électronique	2
473B		Techniciens de recherche-développement et des méthodes de fabrication en électricité, électromécanique et électronique	2
473C		Techniciens de fabrication et de contrôle-qualité en électricité, électromécanique et électronique	6
475A		Techniciens de recherche-développement et des méthodes de production des industries de transformation	2

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Table B.1 – continued from previous page

PCS-ESE 03	PCS-ESE 82	Insee label	ESeC
475B		Techniciens de production et de contrôle-qualité des industries de transformation	6
476A		Assistants techniques, techniciens de l'imprimerie et de l'édition	6
477A		Techniciens de la logistique, du planning et de l'ordonnancement	6
477B		Techniciens d'installation et de maintenance des équipements industriels (électriques, électromécaniques, mécaniques, hors informatique)	6
477C		Techniciens d'installation et de maintenance des équipements non industriels (hors informatique et télécommunications)	6
477D		Techniciens de l'environnement et du traitement des pollutions	6
478A		Techniciens d'étude et de développement en informatique	2
478B		Techniciens de production, d'exploitation en informatique	6
478C		Techniciens d'installation, de maintenance, support et services aux utilisateurs en informatique	6
478D		Techniciens des télécommunications et de l'informatique des réseaux	6
479B		Experts de niveau technicien, techniciens divers	2
481A		Conducteurs de travaux (non cadres)	6
485A		Agents de maîtrise et techniciens en production et distribution d'énergie, eau, chauffage	6
486B		Agents de maîtrise en maintenance, installation en électricité et électronique	6
486D		Agents de maîtrise en maintenance, installation en mécanique	6
487A		Responsables d'entrepôt, de magasinage	6
487B		Responsables du tri, de l'emballage, de l'expédition et autres responsables de la manutention	6
534A		Agents civils de sécurité et de surveillance	7
541B		Agents d'accueil qualifiés, hôtesses d'accueil et d'information	7
541D		Standardistes, téléphonistes	7
542A		Secrétaires	3
542B		Dactylos, sténodactylos (sans secrétariat), opérateurs de traitement de texte	3
543B		Employés qualifiés des services comptables ou financiers	3
543C		Employés non qualifiés des services comptables ou financiers	3
543E		Employés qualifiés des services du personnel et des services juridiques	3
543F		Employés qualifiés des services commerciaux des entreprises (hors vente)	3
543G		Employés administratifs qualifiés des autres services des entreprises	3
543H		Employés administratifs non qualifiés	3
555A		Vendeurs par correspondance, télévendeurs	7
564A		Concierges, gardiens d'immeubles	9

Continued on next page

Table B.1 – continued from previous page

PCS-ESE 03	PCS-ESE 82	Insee label	ESeC
622C		Monteurs câbleurs qualifiés en électricité	8
623A		Chaudronniers-tôliers industriels, opérateurs qualifiés du travail en forge, conducteurs qualifiés d'équipement de formage, traceurs qualifiés	8
623E		Soudeurs manuels	8
625H		Ouvriers qualifiés des autres industries (eau, gaz, énergie, chauffage)	8
628A		Mécaniciens qualifiés de maintenance, entretien : équipements industriels	8
628B		Electromécaniciens, électriciens qualifiés d'entretien : équipements industriels	8
628G		Ouvriers qualifiés divers de type industriel	8
632F		Plombiers et chauffagistes qualifiés	8
632K		Ouvriers qualifiés d'entretien général des bâtiments	8
633A		Electriciens qualifiés de type artisanal (y c. bâtiment)	8
634B		Métalliers, serruriers qualifiés	8
634C		Mécaniciens qualifiés en maintenance, entretien, réparation : automobile	8
653A		Magasiniers qualifiés	9
655A		Autres agents et ouvriers qualifiés (sédentaires) des services d'exploitation des transports	8
	2310	Chefs de grande entreprise (500 salariés et plus)	1
	3413	Professeurs techniques de lycée	2
	3414	Directeurs d'établissement d'enseignement secondaire et inspecteurs	1
	3710	Cadres d'état-major administratifs, financiers, commerciaux des grandes entreprises	1
	3721	Cadres chargés d'études économiques, financières, commerciales	1
	3722	Cadres spécialistes du recrutement, de la formation	1
	3723	Cadres de l'organisation ou du contrôle des services administratifs et financiers	1
	3724	Cadres de gestion courante des services	1
	3725	Cadres de gestion courante des services du personnel des grandes entreprises	1
	3726	Cadres de gestion courante des autres services administratifs des grandes entreprises	1
	3728	Cadres de la documentation, de l'archivage (hors fonction publique)	1
	3733	Cadres des ventes des grandes entreprises (hors commerce de détail)	1
	3735	Cadres de la publicité, cadres des relations publiques	1
	3810	Directeurs techniques des grandes entreprises	1
	3821	Ingénieurs et cadres de recherches, études, essais en électricité, électronique	1
	3822	Ingénieurs et cadres de bureau d'études ou des méthodes en mécanique	1

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Table B.1 – continued from previous page

PCS-ESE 03	PCS-ESE 82	Insee label	ESeC
	3823	Ingénieurs et cadres d'études, méthodes, contrôles en btp	1
	3825	Ingénieurs et cadres de recherche, développement en chimie, biologie	1
	3828	Ingénieurs et cadres spécialistes de l'informatique (sauf technico-commercial)	1
	3829	Autres ingénieurs et cadres d'études	1
	3831	Ingénieurs et cadres de fabrication en matériel électrique, électronique	1
	3833	Ingénieurs et cadres de chantier du btp	1
	3839	Ingénieurs et cadres de la production et distribution d'électricité, gaz, eau,chauffage,énergie	1
	3841	Ingénieurs et cadres d'entretien, travaux neufs	1
	3842	Ingénieurs et cadres des achats et approvisionnements industriels	1
	3843	Ingénieurs et cadres de planning, ordonnancement	1
	3861	Cadres des transports et de la logistique	1
	4225	Enseignants du technique court pour les enseignements généraux et techniques théoriques	2
	4226	Enseignants du technique court pour les enseignements professionnels pratiques	2
	4231	Assistants techniques de la documentation, de l'archivage (hors fonction publique)	2
	4232	Formateurs et animateurs de formation continue	2
	4315	Infirmiers en soins généraux salariés	2
	4331	Assistantes sociales	2
	4333	Animateurs socio-culturels et de loisirs	3
	4611	Maîtrise et techniciens des services comptables ou financiers , comptables	2
	4612	Maîtrise et techniciens administratifs (autres que financiers et comptables)	2
	4613	Maîtrise et techniciens administratifs des services juridiques ou du personnel	2
	4614	Maîtrise et techniciens administratifs	2
	4615	Personnels de secrétariat de niveau supérieur, secrétaires de direction (non cadre)	2
	4624	Représentants en biens d'équipement, biens intermédiaires, commerce interindustriel	3
	4627	Représentants auprès de particuliers	3
	4628	Acheteurs non classés cadres, aide-acheteurs	2
	4629	Professions intermédiaires commerciales (sauf représentants et maîtrise de magasin)	2
	4631	Assistants techniques de la publicité, des relations publiques (salariés ou indépendants)	2

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Table B.1 – continued from previous page

PCS-ESE 03	PCS-ESE 82	Insee label	ESeC
	4633	Assistants techniques de la réalisation des spectacles vivants et audiovisuels (salariés ou indépendants)	6
	4642	Responsables d'exploitation des transports (non cadres)	2
	4662	Maîtrise du hall et des étages (hôtellerie)	6
	4711	Dessinateurs projeteurs en électricité, électronique	2
	4712	Dessinateurs d'études en électricité, électronique	2
	4715	Techniciens de recherche, études, essais, installation en électricité, électromécanique	2
	4716	Techniciens de contrôle de qualité en matériel électrique, électronique	6
	4717	Techniciens de maintenance, dépannage, en électricité, électronique, automatisme	6
	4718	Techniciens des télécommunications	6
	4723	Techniciens en mécanique et chaudronnerie	6
	4733	Géomètres, topographes	2
	4735	Métreurs et techniciens divers du bâtiment et des travaux publics	2
	4751	Techniciens chimistes, biologistes	6
	4761	Techniciens en métallurgie et matériaux	6
	4771	Assistants techniques de l'édition et de l'imprimerie	6
	4781	Préparateurs de méthodes	2
	4782	Techniciens de planning, ordonnancement, lancement	6
	4791	Pupitreurs, chefs de salle en informatique (hors fonction publique)	6
	4792	Programmeurs, préparateurs de travaux en informatique (hors fonction publique)	6
	4794	Techniciens divers	2
	4831	Conducteurs de travaux non cadres	6
	4871	Agents de maîtrise et techniciens de la production et distribution d'électricité, gaz, eau, chauffage, énergie	6
	4881	Agents de maîtrise 2^{e} niveau en entretien, installation	6
	4882	Agents de maîtrise 1er niveau en entretien, installation électromécanique ou électronique	6
	4883	Agents de maîtrise 1er niveau en entretien, installation mécanique	6
	4891	Responsables d'entrepôt, de magasinage	6
	4892	Responsables de manutention	6
	4893	Maîtrise de restauration et de cuisine	6
	5317	Agents de sécurité, de surveillance	7
	5411	Secrétaires	3
	5413	Dactylos, sténo-dactylos (sans secrétariat)	3
	5414	Opératrices sur machines spécialisées de bureau	3

Continued on next page

Table B.1 – continued from previous page

PCS-ESE 03	PCS-ESE 82	Insee label	ESeC
	5415	Opératrices de saisie en informatique	3
	5416	Opérateurs d'exploitation en informatique	3
	5417	Standardistes, téléphonistes	7
	5422	Employés qualifiés des services comptables ou financiers	3
	5423	Employés non qualifiés des services comptables ou financiers	3
	5424	Employés administratifs divers d'entreprise	3
	5425	Employés qualifiés des services du personnel et des services juridiques	3
	5426	Employés qualifiés des autres services administratifs	3
	5427	Employés administratifs non qualifiés	3
	5428	Dessinateurs d'exécution	3
	5444	Agents et hôtesses d'accueil et d'information	7
	5612	Serveurs qualifiés (restaurants, cafés)	7
	5613	Autres emplois des restaurants, café, bars	7
	5615	Employés qualifiés de l'hôtellerie	7
	5633	Concierges, gardiens d'immeubles	9
	6201	Mécaniciens qualifiés d'entretien d'équipements industriels	8
	6202	Electromécaniciens, électroniciens qualifiés d'entretien d'équipements industriels	8
	6215	Monteurs câbleurs en électricité (montage à l'unité ou en petite série, installation)	8
	6218	Plateformistes, contrôleurs qualifiés de matériel électrique ou électronique	8
	6221	Chaudronniers, tôliers industriels qualifiés	8
	6224	Soudeurs manuels qualifiés sur métaux	8
	6236	Ouvriers qualifiés de contrôles et d'essais en mécanique, métallurgie	8
	6244	Autres ouvriers qualifiés des travaux publics	8
	6246	Ouvriers qualifiés de l'extraction (carrières, pétrole, gaz, ...)	8
	6254	Ouvriers qualifiés de laboratoire (chimie)	8
	6281	Ouvriers de la photogravure et des laboratoires photographiques et cinématographiques	8
	6283	Ouvriers de l'impression	8
	6284	Ouvriers qualifiés de la brochure, de la reliure et du façonnage du papier-carton	8
	6293	Surveillants qualifies d'exploitation	8
	6294	Agents qualifiés de laboratoire (sauf chimie et santé)	8
	6299	Ouvriers qualifiés divers de type industriel et ouvriers qualifiés mal désignés	8
	6301	Jardiniers	8
	6311	Electriciens qualifiés du bâtiment	8

Continued on next page

Table B.1 – continued from previous page

PCS-ESE 03	PCS-ESE 82	Insee label	ESeC
	6322	Métalliers, serruriers, qualifiés	8
	6323	Mécaniciens qualifiés d'automobiles (entretien, réparation)	8
	6332	Menuisiers qualifiés du bâtiment	8
	6341	Maçons qualifiés	8
	6344	Plombiers et chauffagistes qualifiés	8
	6347	Ouvriers qualifiés d'entretien général des bâtiments	8
	6354	Cuisiniers qualifies	8
	6411	Conducteurs routiers et grands routiers (salariés)	9
	6414	Conducteurs de voiture particulière (salariés)	9
	6515	Magasiniers	9
	6521	Agents qualifiés des services d'exploitation des transports (personnels sédentaires)	8
	6792	Manutentionnaires, agents non qualifiés des services d'exploitation des transports	9
	6793	Ouvriers du tri, de l'emballage, de l'expédition	9
	6799	Ouvriers non qualifiés divers de type industriel et ouvriers mal désignés	9
	6891	Nettoyeurs	9

Appendix C

Missing data

C.1 Description of missing data

There is substantial missingness in the data as was displayed in the tables presented throughout Chapter 6. In order to examine whether the assumption that the data are missing completely at random (MCAR) is plausible, it is necessary to see whether the missingness is related to other covariates in the data. A range of variables drawn from the baseline questionnaire have been used because they had been shown to predict attrition in the GAZEL data (Goldberg et al., 2006).

Table C.1 describes the participants included and excluded from the complete case analyses presented in Chapter 7 in relation to both baseline covariates and administrative records. (Chapter 7 has been taken as an example; it is likely that similar patterns of missingness exist for other analyses using CASP-19 in 2005 or 2009.) Chi-squared tests and an independent samples t-test were used to test for significance of the differences between responders and non-responders. In the case of each variable, response rates between the groups differed significantly at $p<0.001$.

Participants were significantly and substantially less likely to be included in the complete case analyses reported in Chapter 7 if they were female, younger (which is likely related to the fact of being female), or held at a post at a lower employment grade. Cohort members reporting worse health behaviours in 1989, such as smoking or high consumption of alcohol were less likely to respond. Similarly, participants reporting lower self-rated health in 1989 or a lower education level were less likely to respond. These results are in accordance with an article published on attrition in GAZEL (Goldberg et al., 2006). Notably, participants lacking information from personnel records responded only slightly less than the average; here, the differences in responding were much smaller than for other characteristics.

The large variations in probability of responding to the later survey by baseline characteristics render the assumption that the data are missing completely at random (MCAR) rather implausible. For this reason, it is more probable that the data are missing at random (MAR). Consequently, sensitivity analyses using full information maximum

Table C.1: Resurvey responses by selected characteristics for 19716 participants alive in 2005

Characteristic	Complete cases	Incomplete cases	Percent responding (%)
Gender			
Male	5947	8296	41.8
Female	1765	3708	32.3
Age group in 2005			
36–40 years	682	1477	31.6
41–45 years	4080	6195	39.7
46–50 years	2950	4332	40.5
Education level in 1989			
University	1428	1794	44.3
High school	576	827	41.1
Less than high school	5460	8754	38.4
Other	195	253	43.5
No response	53	376	12.4
Self-assessed health in 1989			
Very good = 1	788	1244	38.8
2	2653	3507	43.1
3	2185	3213	40.5
4	1227	2176	36.1
5	565	1107	33.8
6	204	454	31.0
7	38	105	26.6
Very bad = 8	3	47	6.0
No response	49	151	24.5
Smoking status in 1989			
Smoker	1905	3519	35.1
Non-smoker	3360	5157	39.5
Ex-smoker	2408	3205	42.9
No response	39	123	24.1
Alcohol consumption in 1989			
Abstainers	180	359	33.4
Occasional	4449	7001	38.9
Moderate	1231	1604	43.4
Average	1240	1845	40.2
Heavy	575	1047	35.5
No response	37	148	20.0
Occupational grade in 1989			
Lower level employees	941	2533	27.1
Mid level employees	4510	6975	39.3
Higher level	2252	2483	47.6
Missing administrative record	9	13	40.9
All	7712	12004	39.1

likelihood estimation were included in Appendix G. Many of the baseline characteristics included in Table C.1 were included as auxiliary variables in the full information maximum likelihood procedure, as was outlined in section 5.3.1.3 on page 121.

One exception might apply: In the case of those participants lacking information from administrative records alone, the likely cause of the loss (bureaucratic error) and the small differences in later responses suggest that this sort of missing information could be treated as missing completely at random.

C.2 Discussion

The measures available in the GAZEL cohort originated in both administrative and questionnaire data. Relatively little administrative data was missing, and the processes governing the loss of data are most likely to be largely independent of those individual characteristics which are of primary interest in this study. In contrast, a substantial proportion of data from the questionnaire surveys was missing, and it seems implausible that the data are missing completely at random. Because a wide range of variables were available from the baseline survey which predict missingness, it is reasonably plausible that the missing at random assumption is fulfilled.

Appendix D

Using the difference score to measure change: Methodological discussion

D.1 Methodological complications in measuring change between two time points

There are a range of methodological complications in the use of the difference score to measure change. Although the consensus is that the difference score is a valid way to measure change (Clarke, 2004; Rogosa, 1995), certain important difficulties remain, concerning the consistency of the measures's meaning over time, ceiling and floor effects and, most seriously, measurement error. That these difficulties, particularly the last, can be dealt with only to a certain extent, has led to calls for great caution in interpreting the results of change analyses (Rogosa, 1995; Singer and Willett, 2003).

D.1.1 Consistent meaning of the measure

An initial concern is to be sure that the psychological variable being measured retains the same meaning over the measurement occasions (Plewis, 1985; Rogosa, 1995). I argue the measure of CASP-19 quality of life used in this study is likely to retain the same meaning for participants because the measurements are only four years apart and are taken from adults.

D.1.2 Ceiling and floor effects

While no participants attained the minimum score of zero for quality of life, some did attain the maximum score, which means that their change can only be in one direction. However, the ceiling problem is likely to not be too serious because few individuals attained the maximum score in either year (15 participants in 2005 and 28 individuals in 2009).

D.1.3 Measurement error

An extremely serious concern in the analysis of change stems from errors in measuring the outcome variable. Through random measurement error alone, relatively high or low observations at the first time point are likely to be followed by values that are nearer the participant's true mean at the second time point (Barnett et al., 2005). This means that the correlations between the initial status and the change as measured are possibly quite different to the true initial status and change (Rogosa, 1995). Much of the literature is in agreement up to this point; the next section will describe how views have diverged into two schools of thought about the best analytical strategy to pursue.

D.1.3.1 ANCOVA

One point of view finds that random measurement error will tend to produce negative correlations between the initial value and the change score as measured, which some call regression to the mean (Twisk, 2003), although others avoid the term (Plewis, 1985). Therefore analyses using change scores risk making natural variation look like change. In order to correct for regression to the mean, a modelling technique called the analysis of covariance (ANCOVA) has been recommended, in which baseline scores are included as a covariate when predicting change (Barnett et al., 2005; Plewis, 1985; Twisk, 2003). In this approach, the conditional effect of the predictor on change in the outcome is estimated, the condition being that the outcome at the first time point is similar in all the predictor groups (Dugravot et al., 2009).

Following this approach, absolute change would be calculated after correcting for the initial value at $t = 1$:

$$Y_{it_2} - Y_{it_1} = \beta_0 + \beta_1 Y_{it_1} + \beta_2 X_{it_1} + \ldots + \epsilon_i \tag{D.1}$$

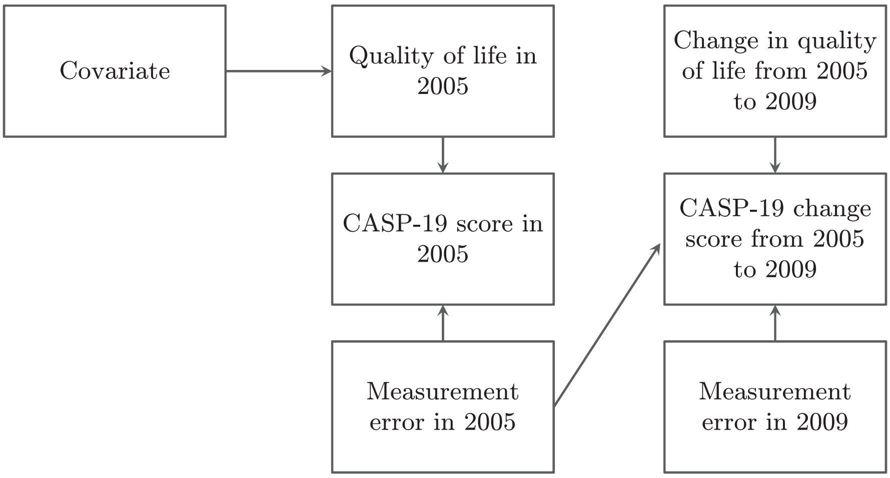
where Y_{it_2} are observations for individual i at time t_2, Y_{it_1} are observations for individual i at time t_1, X_{it_1} represents the exposure variable for individual i at time t_1, and ϵ_i is the error of individual i.

D.1.3.2 ANOVA

A second school of thought is sceptical of ANCOVA, preferring variants of ANOVA (analysis of variance) in which the unconditional effect of the predictor is regressed on the change score (Clarke, 2004). Here, it is argued that conditioning on the baseline would introduce "more bias than it eliminates" in the common scenario where an exposure predicts the outcome at the first time point and there is measurement error in the outcome (Glymour et al., 2005). In such a case, including the baseline score as a covariate in a change analysis might introduce a spurious association between the exposure and the change score resulting in sizable bias (Dugravot et al., 2009; Glymour et al., 2005; Yanez et al., 1998).

Figure D.1 depicts a Directed Acyclic Graph, or DAG, of the relationship between quality of life in 2005 and its measurement with CASP-19 in 2005 on the one hand, and real change in quality of life 2005–2009 and its measurement with the CASP-19 change score 2005–2009. It is important to note that this figure, adapted from Glymour (2006), depicts the null hypothesis of no relationship between the covariate and change in quality of life from 2005 to 2009, as there is no direct arrow linking these two boxes.

Figure D.1: A Directed Acyclic Graph of an analysis of change in quality of life between 2005 and 2009



This figure is adapted from Glymour (2006). It depicts the relations corresponding to the null hypothesis of no relationship between the covariate and the change score.

The measurement error at time 1 in 2005 affects both the CASP-19 score in 2005 and the CASP-19 change score. As would be expected from the idea of regression to the mean, if the baseline error was positive, the change in the CASP-19 score 2005–2009 would tend to be negative.

The CASP-19 score in 2005 can be described, in the DAG terminology, as a collider on the path between the covariate and the CASP-19 change score, for there is no other path connecting them. Therefore, according to the DAG, analyses that are not adjusted for CASP-19 in 2005 would provide unbiased estimates of the overall effect of the covariate on change. However, adjusting for CASP-19 in 2005 would "unblock" the path and introduce a spurious correlation between the covariate and CASP-19 change, as a result of the correlated measurement error at time 1 in 2005.

The intuition is as follows: a person with a high CASP-19 score in 2005 either has high quality of life in 2005, or large positive measurement error in 2005, or both. This means that within levels of CASP-19 in 2005, quality of life and measurement error are negatively correlated. Therefore, conditional on CASP-19 in 2005, the covariate and the change score will be positively correlated, even when the covariate is not associated with actual change in quality of life 2005–2009.

Without conditioning on the baseline, in ANOVA, difference scores are calculated as follows,

$$Y_{it_2} - Y_{it_1} = \beta_0 + \beta_1 X_{it_1} + \ldots + \epsilon_i \tag{D.2}$$

where Y_{it_2} are observations for individual i at time t_2 and Y_{it_1} are observations for individual i at time t_1, X_{it_1} represents the exposure variable for individual i at time t_1, and ϵ_i is the error of individual i.

In summary, when examining changes in a variable it is necessary to know when to condition on the baseline. It seems that adjusting for baseline ameliorates certain biases, it can introduce others, and that it is not easy to know when to adjust for baseline scores (Dugravot et al., 2009). It is crucial to observe the data to see whether covariates are associated with baseline quality of life, at which point controlling for baseline scores would likely introduce spurious associations between the covariates and change in quality of life. In the analyses reported in this thesis, the covariates included in the change analysis are those which have been reported in the literature as having cross-sectional associations with quality of life. In addition, Chapter 7 reports associations between the covariates included at baseline and quality of life in 2005. Because the covariates are associated with baseline quality of life, ANOVA will be performed, and the results presented without conditioning on the baseline.

Although this is the most appropriate approach for these data, in any case, results from these analyses need to be interpreted with caution, because it is impossible to distinguish true change from measurement error (Singer and Willett, 2003). With three waves, it would be possible to apply a latent variable modeling approach in order to account for measurement error in modelling straight-line relationships, but the third wave of CASP-19 quality of life scores was due for release in late summer 2013, which was not early enough for timely completion of this thesis.

Appendix E

Supplementary tables for the cross-sectional analyses

This appendix chapter presents supplementary tables for Chapter 7 *Current influences upon quality of life*, in which the analyses are stratified by gender.

E.1 Description of the sample, stratified by gender

Table E.1 presents descriptive statistics for men and women. These can be compared with the tables presented in Chapter 6 *Introduction to the sample and measures*.

Table E.1: Descriptive results for 5941 men and 1754 women from the GAZEL cohort (complete cases only)

Variable	Men freq/$\bar{x}$	Men %/std dev.	Women freq/$\bar{x}$	Women %/std dev.
CASP-19 (2005)	43.9	7.3	41.3	9.1
Demographics				
Age (2005)	61.0	2.8	58.3	4.2
Family situation				
Children ever recorded at home (1989, 2002, 2005)				
No children	718	12.1%	303	17.3%
One or more children	5223	87.9%	1451	82.7%

Continued on next page

Table E.1 – ***continued from previous page***

Variable	Men freq/$\bar{x}$	Men %/std dev.	Women freq/$\bar{x}$	Women %/std dev.
Marital status in 2005				
Single	86	1.5%	101	5.8%
Married or cohabiting	5454	91.8%	1287	73.4%
Divorced or separated	299	5.0%	270	15.4%
Widowed	102	1.7%	96	5.5%
Household size in 2005				
Living alone	382	6.4%	340	19.4%
Two people	4485	75.5%	1072	61.1%
Three or more people	1074	18.1%	342	19.5%
Financial adequacy				
Net monthly household revenue (2002)				
<1372 euro	148	2.5%	91	5.2%
1372 – <1601 euro	131	2.2%	37	2.1%
1601 – <1982 euro	1087	18.3%	268	15.3%
1982 – <2592 euro	998	16.8%	161	9.2%
2592 – <3811 euro	2207	37.2%	763	43.5%
3811 – <4574 euro	604	10.2%	156	8.9%
≥4574 euro	766	12.9%	278	15.9%
Confidence in financial situation for next ten years (2002)				
Very confident	966	16.3%	194	11.1%
Quite confident	4058	68.3%	1186	67.6%
Not very confident	837	14.1%	328	18.7%
Not confident at all	80	1.4%	46	2.6%
Activity (2005)				
Working	419	7.1%	585	33.4%
Retired	5522	93.0%	1169	66.7%
Community & social relationships				
Participation in clubs and societies (2005)				
None	1208	20.3%	474	27.0%
Low–medium level of participation	2325	39.1%	713	40.7%
High level of participation	2408	40.5%	567	32.3%

Continued on next page

Table E.1 – ***continued from previous page***

Variable	Men freq/$\bar{x}$	Men %/std dev.	Women freq/$\bar{x}$	Women %/std dev.
Frequent annoyances in the neighbourhood (2003)				
No	5135	86.4%	1432	81.6%
Yes	806	13.6%	322	18.4%
Dissatisfaction with access to local amenities (2003)				
No	4628	77.9%	1351	77.0%
Yes	1313	22.1%	403	23.0%
Feel insecure or think vandalism is a problem (2003)				
No	4419	74.4%	1272	72.5%
Yes	1522	25.6%	482	27.5%
No family or close friends living nearby (2003)				
No	3136	52.8%	839	47.8%
Yes	2805	47.2%	915	52.2%
Rarely or never exchange goods/services with neighbours (2003)				
No	5001	84.2%	1352	77.1%
Yes	940	15.8%	402	22.9%
Close, confiding relationship (2004)				
No	856	14.4%	224	12.8%
Yes	5085	85.6%	1530	87.2%
Sufficient social support (2004)				
No, a lot more support needed	132	2.2%	116	6.6%
No, more support needed	496	8.4%	224	12.8%
No, a little more support needed	988	16.6%	344	19.6%
Yes	4325	72.8%	1070	61.0%
Caring for an adult (2005)				
Nearly every day	218	3.7%	116	6.6%
Nearly every week	370	6.2%	146	8.3%
Less frequently	877	14.8%	240	13.7%
Never	4476	75.3%	1252	71.4%

Continued on next page

Table E.1 – *continued from previous page*

Variable	Men freq/$\bar{x}$	Men %/std dev.	Women freq/$\bar{x}$	Women %/std dev.
Health				
Depression (2005)				
No depression	4905	82.6%	1055	60.2%
Symptoms of mild depression	869	14.6%	490	27.9%
Symptoms of more severe depression	167	2.8 %	209	11.9%
SF-36 Mental component score (MCS) (2003)	49.3	8.9	44.5	11.4
SF-36 Physical component score (PCS) (2003)	50.8	6.8	50.0	8.1
Limitations to physical activities (2006)				
No limitations	3927	66.1%	979	55.8%
One limitation	1046	17.6%	370	21.1%
Two or more limitations	833	14.0%	358	20.4%
Missing	135	2.3%	47	2.7%
Total	5941	100.0%	1754	100.0%

E.2 Cross-sectional bivariate associations between quality of life and individuals' recent circumstances, stratified by gender

Table E.2 displays the associations between current and recent circumstances and quality of life for men; Table E.3 for women.

Table E.2: Bivariate relationships between contemporaneous predictors and CASP-19 quality of life for 5941 male GAZEL participants

Variable	Coefficient	SE	p-value	95% CI
Demographics				
Age and age-squared				
Age	0.15	0.03	<0.001	0.08 to 0.21
Age^2	−0.03	0.01	0.001	−0.05 to −0.01

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Table E.2 – ***continued from previous page***

Variable	Coefficient	SE	p-value	95% CI
Family				
Children				
No children	*Reference*	*Reference*	*Reference*	*Reference*
One or more children	0.78	0.29	0.007	0.21 to 1.35
Marital status (2005)				
Single	−3.37	0.79	<0.001	−4.92 to −1.81
Married or cohabiting	*Reference*	*Reference*	*Reference*	*Reference*
Divorced or separated	−2.27	0.43	<0.001	−3.11 to −1.42
Widowed	−0.79	0.73	0.281	−2.22 to 0.64
Household size (2005)				
Living alone	−2.62	0.39	<0.001	−3.38 to −1.86
Two people	*Reference*	*Reference*	*Reference*	*Reference*
Three or more people	−1.07	0.25	<0.001	−1.56 to −0.59
Financial adequacy & activity				
Net monthly household revenue (2002)				
<1372 euro	−2.59	0.62	<0.001	−3.80 to −1.38
1372 – <1601 euro	−2.12	0.65	0.001	−3.40 to −0.84
1601 – <1982 euro	−1.54	0.27	<0.001	−2.06 to −1.01
1982 – <2592 euro	−0.91	0.28	0.001	−1.46 to −0.37
2592 – <3811 euro	*Reference*	*Reference*	*Reference*	*Reference*
3811 – <4574 euro	0.87	0.33	0.009	0.21 to 1.52
≥4574 euro	1.20	0.30	<0.001	0.60 to 1.79
Confidence in finances (2002)				
Very confident about finances	*Reference*	*Reference*	*Reference*	*Reference*
Quite confident about finances	−2.71	0.25	<0.001	−3.20 to −2.22
Not very confident about finances	−6.99	0.33	<0.001	−7.63 to −6.34
Not confident at all about finances	−10.73	0.81	<0.001	−12.33 to −9.14
Labour market status (2005)				
Working	*Reference*	*Reference*	*Reference*	*Reference*
Retired	0.84	0.37	0.023	0.11 to 1.57
Community & social relationships				
Social participation (2005)				
No participation in clubs	*Reference*	*Reference*	*Reference*	*Reference*
Low–medium participation in clubs	1.19	0.26	<0.001	0.68 to 1.69
High participation in clubs	2.59	0.26	<0.001	2.09 to 3.09

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Table E.2 – ***continued from previous page***

Variable	Coefficient	SE	p-value	95% CI
Frequent annoyances in the neighbourhood (2003)				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	−2.18	0.28	<0.001	−2.72 to −1.64
Dissatisfaction with access to local amenities (2003)				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	−2.30	0.23	<0.001	−2.75 to −1.86
Feel insecure or think vandalism is a problem (2003)				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	−2.04	0.22	<0.001	−2.47 to −1.62
No family or close friends living nearby (2003)				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	−0.59	0.19	0.002	−0.96 to −0.22
Rarely or never exchange goods/services with neighbours (2003)				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	−2.29	0.26	<0.001	−2.80 to −1.78
Close, confiding relationship (2004)				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	4.14	0.27	<0.001	3.62 to 4.66
Perceived adequacy of social support (2004)				
Much more social support needed	−10.45	0.61	<0.001	−11.64 to −9.25
More social support needed	−5.69	0.33	<0.001	−6.33 to −5.05
A little more social support needed	−4.04	0.24	<0.001	−4.51 to −3.56
Enough social support	*Reference*	*Reference*	*Reference*	*Reference*
Caring for an adult (2005)				
Nearly every day	−1.70	0.51	0.001	−2.70 to −0.71
Nearly every week	−0.42	0.40	0.290	−1.19 to 0.36
Less frequently	0.11	0.27	0.676	−0.42 to 0.64
Never	*Reference*	*Reference*	*Reference*	*Reference*

Continued on next page

Table E.2 – ***continued from previous page***

Variable	Coefficient	SE	p-value	95% CI
Health				
Depression symptoms (CES-D) (2005)				
Absence of depression	*Reference*	*Reference*	*Reference*	*Reference*
Symptoms of mild depression	−8.83	0.21	<0.001	−9.25 to −8.41
Symptoms of moderate/severe depression	−20.27	0.46	<0.001	−21.17 to −19.37
Short-form 36 mental health (2003)				
SF-36 mental component summary	0.40	0.01	<0.001	0.38 to 0.42
Short-form 36 physical health (2003)				
SF-36 physical component summary	0.29	0.01	<0.001	0.26 to 0.31
Limitations to physical activities (NHP) (2006)				
No limitations to physical activities	*Reference*	*Reference*	*Reference*	*Reference*
One limitation to physical activities	−3.19	0.24	<0.001	−3.66 to −2.72
Two or more limitations to physical activities	−6.48	0.26	<0.001	−7.00 to −5.96
Missing	−2.67	0.61	<0.001	−3.86 to −1.48

Table E.3: Bivariate relationships between contemporaneous predictors and CASP-19 quality of life for 1754 female GAZEL participants

Variable	Coefficient	SE	p-value	95% CI
Demographics				
Age and age-squared				
Age	−0.08	0.05	0.149	−0.18 to 0.03
Age^2	−0.02	0.01	0.051	−0.04 to 0.00
Family				
Children				
No children	*Reference*	*Reference*	*Reference*	*Reference*
One or more children	0.72	0.58	0.211	−0.41 to 1.85
Marital status (2005)				
Single	−2.57	0.93	0.006	−4.40 to −0.75
Married or cohabiting	*Reference*	*Reference*	*Reference*	*Reference*
Divorced or separated	−3.81	0.60	<0.001	−4.99 to −2.63
Widowed	−1.15	0.95	0.229	−3.01 to 0.72

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Table E.3 – ***continued from previous page***

Variable	Coefficient	SE	p-value	95% CI
Household size (2005)				
Living alone	−2.50	0.56	<0.001	−3.60 to −1.39
Two people	*Reference*	*Reference*	*Reference*	*Reference*
Three or more people	−1.41	0.56	0.012	−2.52 to −0.31
Financial adequacy & activity				
Net monthly household revenue (2002)				
<1372 euro	−5.45	0.98	<0.001	−7.38 to −3.52
1372 – <1601 euro	−4.30	1.49	0.004	−7.23 to −1.38
1601 – <1982 euro	−2.03	0.63	0.001	−3.26 to −0.79
1982 – <2592 euro	−2.24	0.77	0.004	−3.75 to −0.74
2592 – <3811 euro	*Reference*	*Reference*	*Reference*	*Reference*
3811 – <4574 euro	1.63	0.78	0.036	0.11 to 3.16
≥4574 euro	3.16	0.62	<0.001	1.94 to 4.38
Confidence in finances (2002)				
Very confident about finances	*Reference*	*Reference*	*Reference*	*Reference*
Quite confident about finances	−3.70	0.67	<0.001	−5.02 to −2.39
Not very confident about finances	−9.25	0.78	<0.001	−10.79 to −7.71
Not confident at all about finances	−10.94	1.42	<0.001	−13.72 to −8.15
Labour market status (2005)				
Working	*Reference*	*Reference*	*Reference*	*Reference*
Retired	1.92	0.46	<0.001	1.02 to 2.82
Community				
Social participation (2005)				
No participation in clubs	*Reference*	*Reference*	*Reference*	*Reference*
Low–medium participation in clubs	1.39	0.53	0.009	0.34 to 2.43
High participation in clubs	3.84	0.56	<0.001	2.74 to 4.94
Frequent annoyances in the neighbourhood (2003)				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	−2.52	0.56	<0.001	−3.62 to −1.43
Dissatisfaction with access to local amenities (2003)				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	−3.04	0.51	<0.001	−4.05 to −2.04

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Table E.3 – ***continued from previous page***

Variable	Coefficient	SE	p-value	95% CI
Feel insecure or think vandalism is a problem (2003)				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	−2.15	0.48	<0.001	−3.10 to −1.20
No family or close friends living nearby (2003)				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	−0.89	0.43	0.041	−1.74 to −0.04
Rarely or never exchange goods/services with neighbours (2003)				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	−2.84	0.51	<0.001	−3.85 to −1.83
Close, confiding relationship (2004)				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	7.43	0.63	<0.001	6.20 to 8.66
Perceived adequacy of social support (2004)				
Much more social support needed	−12.55	0.80	<0.001	−14.12 to −10.97
More social support needed	−7.85	0.60	<0.001	−9.03 to −6.66
A little more social support needed	−5.35	0.51	<0.001	−6.35 to −4.35
Enough social support	*Reference*	*Reference*	*Reference*	*Reference*
Caring for an adult (2005)				
Nearly every day	−3.03	0.88	0.001	−4.76 to −1.30
Nearly every week	−1.28	0.79	0.107	−2.84 to 0.28
Less frequently	−0.72	0.64	0.260	−1.98 to 0.53
Never	*Reference*	*Reference*	*Reference*	*Reference*
Health				
Depression symptoms (CES-D) (2005)				
Absence of depression	*Reference*	*Reference*	*Reference*	*Reference*
Symptoms of mild depression	−8.81	0.35	<0.001	−9.51 to −8.12
Symptoms of moderate/severe depression	−18.60	0.49	<0.001	−19.57 to −17.64
Short-form 36 mental health (2003)				
SF-36 mental component summary	0.39	0.02	<0.001	0.36 to 0.42
Short-form 36 physical health (2003)				
SF-36 physical component summary	0.34	0.03	<0.001	0.29 to 0.39

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Table E.3 – *continued from previous page*

Variable	Coefficient	SE	p-value	95% CI
Limitations to physical activities (NHP) (2006)				
No limitations to physical activities	*Reference*	*Reference*	*Reference*	*Reference*
One limitation to physical activities	−4.67	0.51	<0.001	−5.67 to −3.66
Two or more limitations to physical activities	−8.73	0.52	<0.001	−9.74 to −7.71
Missing	−5.23	1.26	<0.001	−7.70 to −2.77

E.3 Cross-sectional multivariate relationships between quality of life and individuals' recent circumstances, stratified by gender

Table E.4: Nested models of the current factors predicting 2005 CASP-19 scores in the GAZEL cohort study (unstandardized β coefficients; men only, n=5941)

Variable	Demographics	Family	Finances	Community	Health
Demographics					
Age and age-squared					
Age	0.13**	0.17***	0.21***	0.23***	0.14***
Age^2	−0.01	0.00	0.00	0.00	0.00
Family					
Children					
No children		*Reference*	*Reference*	*Reference*	*Reference*
One or more children		0.33	0.27	0.08	0.10
Marital status					
Single		−2.10*	−2.10*	−1.58	−0.72
Married or cohabiting		*Reference*	*Reference*	*Reference*	*Reference*
Divorced or separated		−1.38*	−1.05	−0.30	0.30
Widowed		0.28	0.09	0.14	1.62*
Household size					
Living alone		−1.46*	−1.01	−0.94	−0.42
Two people		*Reference*	*Reference*	*Reference*	*Reference*
Three or more people		−1.33***	−1.07***	−0.65**	−0.73***

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Table E.4 – ***continued from previous page***

Variable	Demographics	Family	Finances	Community	Health
Financial adequacy & activity					
Monthly household income					
<1372 euro			−0.19	0.22	−0.20
1372 – <1601 euro			−0.55	−0.26	−0.44
1601 – <1982 euro			−0.55*	−0.38	−0.45*
1982 – <2592 euro			−0.63*	−0.57*	−0.72***
2592 – <3811 euro			*Reference*	*Reference*	*Reference*
3811 – <4574 euro			0.64*	0.81**	0.51*
≥4574 euro			0.94**	0.87**	0.67**
Confidence in finances over the next 10 years					
Very confident			2.48***	2.13***	1.35***
Quite confident			*Reference*	*Reference*	*Reference*
Not very confident			−4.02***	−3.02***	−1.52***
Not confident at all			−7.67***	−5.45***	−3.04***
Labour market status					
In work			*Reference*	*Reference*	*Reference*
Retired			1.72***	1.39***	0.77**
Community & social relationships					
Social participation					
No participation in clubs				*Reference*	*Reference*
Low–medium participation in clubs				1.08***	0.54**
High participation in clubs				2.05***	1.14***
Frequent annoyances in the neighbourhood					
No				*Reference*	*Reference*
Yes				−0.86***	0.03
Dissatisfaction with access to local amenities					
No				*Reference*	*Reference*
Yes				−1.25***	−0.50**
Feel insecure or think vandalism is a problem					
No				*Reference*	*Reference*
Yes				−0.89***	0.01
No family or close friends living nearby					
No				*Reference*	*Reference*
Yes				−0.13	−0.11

Continued on next page

Table E.4 – *continued from previous page*

Variable	Demographics	Family	Finances	Community	Health
Rarely or never exchange goods/services with neighbours					
No				*Reference*	*Reference*
Yes				−1.27***	−0.99***
Close, confiding relationship					
No				*Reference*	*Reference*
Yes				2.09***	1.03***
Perceived adequacy of social support					
Much more support needed				−7.65***	−2.03***
More social support needed				−4.11***	−1.21***
A little more social support needed				−3.12***	−1.36***
Enough social support				*Reference*	*Reference*
Caring for an adult					
Less than daily				−1.40**	−0.89*
Less than weekly				−0.24	0.10
Less than monthly				−0.15	0.28
Not caring for an adult				*Reference*	*Reference*
Health					
Depression symptoms (CES-D)					
Few or no depression symptoms					*Reference*
Symptoms of mild depression					−5.74***
Symptoms of moderate/severe depression					−14.01***
SF-36 mental component summary					0.18***
SF-36 physical component summary					0.19***
Constant	44.03***	44.16***	42.84***	41.98***	24.84***
R^2	0.00	0.01	0.10	0.22	0.50
Log likelihood	−20246	−20208	−19927	−19490	−18169
AIC	40497	40433	39892	39046	36413

* p<0.05; ** p<0.01; *** p<0.001.

Table E.5: Nested models of the current factors predicting 2005 CASP-19 scores in the GAZEL cohort study (unstandardized β coefficients; women only, n=1754)

Variable	Demographics	Family	Finances	Community	Health
Demographics					
Age and age-squared					
Age	−0.02	0.00	0.06	0.03	0.02
Age^2	−0.02	−0.01	0.00	0.00	−0.01
Family					
Children					
No children		*Reference*	*Reference*	*Reference*	*Reference*
One or more children		0.81	0.28	0.51	0.50
Marital status					
Single		−3.22**	−1.49	−1.19	−1.23
Married or cohabiting		*Reference*	*Reference*	*Reference*	*Reference*
Divorced or separated		−4.84***	−1.58	−1.34	−1.66**
Widowed		−2.14	−0.73	−0.53	−0.30
Household size					
Living alone		1.06	0.87	0.85	0.95
Two people		*Reference*	*Reference*	*Reference*	*Reference*
Three or more people		−1.49*	−1.34*	−1.07*	−1.27***
Financial adequacy & activity					
Monthly household income					
<1372 euro			−2.60*	−0.77	−0.26
1372 – <1601 euro			−3.18*	−2.29	−1.51
1601 – <1982 euro			−0.89	−0.75	−0.34
1982 – <2592 euro			−1.22	−1.33	−0.66
2592 – <3811 euro			*Reference*	*Reference*	*Reference*
3811 – <4574 euro			0.99	0.48	−0.01
≥4574 euro			2.54***	2.04***	1.36**
Confidence in finances over the next 10 years					
Very confident			2.99***	2.65***	1.25**
Quite confident			*Reference*	*Reference*	*Reference*
Not very confident			−4.49***	−3.07***	−1.58***
Not confident at all			−5.05***	−3.37**	−1.52

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Table E.5 – *continued from previous page*

Variable	Demographics	Family	Finances	Community	Health
Labour market status					
In work			*Reference*	*Reference*	*Reference*
Retired			1.59**	0.81	−0.16
Community & social relationships					
Social participation					
No participation in clubs				*Reference*	*Reference*
Low–medium participation in clubs				1.00*	0.53
High participation in clubs				2.72***	1.63***
Frequent annoyances in the neighbourhood					
No				*Reference*	*Reference*
Yes				−0.92	−0.23
Dissatisfaction with access to local amenities					
No				*Reference*	*Reference*
Yes				−1.54***	−0.20
Feel insecure or think vandalism is a problem					
No				*Reference*	*Reference*
Yes				−0.58	0.41
No family or close friends living nearby					
No				*Reference*	*Reference*
Yes				0.03	−0.20
Rarely or never exchange goods/services with neighbours					
No				*Reference*	*Reference*
Yes				−1.77***	−1.03**
Close, confiding relationship					
No				*Reference*	*Reference*
Yes				2.81***	1.34**
Perceived adequacy of social support					
Much more support needed				−8.84***	−2.57***
More social support needed				−5.99***	−2.30***
A little more social support needed				−4.77***	−1.69***
Enough social support				*Reference*	*Reference*

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Table E.5 – ***continued from previous page***

Variable	Demographics	Family	Finances	Community	Health
Caring for an adult					
Less than daily				−2.51***	−1.13*
Less than weekly				−1.21	−0.32
Less than monthly				−0.96	−0.47
Not caring for an adult				*Reference*	*Reference*
Health					
Depression symptoms (CES-D)					
Few or no depression symptoms					*Reference*
Symptoms of mild depression					−5.86***
Symptoms of moderate/severe depression					−12.83***
SF-36 mental component summary					0.14***
SF-36 physical component summary					0.19***
Constant	41.75***	42.04***	40.95***	40.99***	28.41***
R^2	0.00	0.03	0.12	0.30	0.60
Log likelihood	−6361	−6335	−6242	−6030	−5541
AIC	12729	12688	12522	12127	11156

* p<0.05; ** p<0.01; *** p<0.001.

Appendix F

Sensitivity analyses with CASP-15

This appendix chapter presents supplementary tables for sensitivity analyses using CASP-15 instead of CASP-19. Four items which were related to individuals' objective circumstances were excluded: (Item 1) *My age prevents me from doing the things I would like to*, (Item 6) *Family responsibilities prevent me from doing what I want to do*, (Item 8) *My health stops me from doing the things I want to do*, and (Item 9) *Shortage of money stops me from doing the things I want to do*.

As described in section 12.3.3.2, the exclusion of these four items avoids the criticism that the CASP-19 measure conflates subjective quality of life with its objective influences. This is potentially a problem for analyses examining the relative strength of associations of various individual circumstances upon quality of life. The selected supplementary analyses presented in this appendix present results for the remaining 15 CASP items.

F.1 Cross-sectional analyses

The first set of supplementary analyses concerns the cross-sectional associations between quality of life and its possible determinants.

F.1.1 Cross-sectional bivariate associations between quality of life and individuals' recent circumstances

Table F.1 presents bivariate relationships between recent or current factors and CASP-15 quality of life in 2005. Compared to the results presented in Table 7.2 on page 174, the sample size is larger, which will tend reduce the sizes of standard errors and confidence intervals. In addition, CASP-15 has a maximum of 45 points, compared to CASP-19 which has a maximum of 57 points. This will tend to reduce the size of the bivariate associations presented in Table F.1. These two factors make the analyses difficult to compare. Many of the results appear to be similar. However, it is possible to discern reductions in the sizes of the associations between both measures of financial adequacy and quality of life and substantial reductions in the associations between the SF-36 measures of physical and mental health and quality of life.

Table F.1: Bivariate relationships between contemporaneous predictors and CASP-15 quality of life for 7775 GAZEL participants

Term	Coefficient	SE	p-value	95% CI
Demographics				
Gender				
Male	*Reference*	*Reference*	*Reference*	*Reference*
Female	−2.57	0.18	<0.001	−2.92 to −2.23
Age and age-squared				
Age	−0.09	0.02	<0.001	−0.13 to 0.05
Age^2	−0.05	0.01	<0.001	−0.06 to −0.04
Family				
Children				
No children	*Reference*	*Reference*	*Reference*	*Reference*
One or more children	1.14	0.22	<0.001	0.71 to 1.57
Marital status (2005)				
Single	−3.92	0.47	<0.001	−4.84 to −3.00
Married or cohabiting	*Reference*	*Reference*	*Reference*	*Reference*
Divorced or separated	−3.30	0.28	<0.001	−3.85 to −2.75
Widowed	−1.98	0.47	<0.001	−2.90 to −1.08
Household size (2005)				
Living alone	-3.18	0.25	<0.001	−3.67 to −2.68
Two people	*Reference*	*Reference*	*Reference*	*Reference*
Three or more people	−0.81	0.19	<0.001	−1.19 to −0.43
Financial adequacy & activity				
Net monthly household revenue (2002)				
<1372 euro	−3.21	0.44	<0.001	−4.06 to −2.35
1372 – <1601 euro	−2.13	0.51	<0.001	−3.13 to −1.14
1601 – <1982 euro	−1.00	0.21	<0.001	−1.42 to −0.59
1982 – <2592 euro	−0.45	0.23	0.046	−0.89 to −0.01
2592 – <3811 euro	*Reference*	*Reference*	*Reference*	*Reference*
3811 – <4574 euro	0.70	0.26	0.008	0.18 to 1.22
≥4574 euro	1.07	0.23	<0.001	0.61 to 1.53

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Table F.1 – ***continued from previous page***

Term	Coefficient	SE	p-value	95% CI
Confidence in finances (2002)				
Very confident about finances	*Reference*	*Reference*	*Reference*	*Reference*
Quite confident about finances	−2.10	0.20	<0.001	−2.50 to −1.70
Not very confident about finances	−5.62	0.26	<0.001	−6.14 to −5.11
Not confident at all about finances	−8.78	0.59	<0.001	−9.94 to −7.63
Labour market status (2005)				
Working	*Reference*	*Reference*	*Reference*	*Reference*
Retired	2.40	0.22	<0.001	1.97 to 2.83
Community & social relations				
Social participation (2005)				
No participation	*Reference*	*Reference*	*Reference*	*Reference*
Low–medium participation	1.33	0.20	<0.001	0.95 to 1.71
High participation	2.92	0.20	<0.001	2.54 to 3.31
Frequent annoyances in the neighbourhood (2003)				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	−1.78	0.21	<0.001	−2.19 to −1.36
Dissatisfaction with access to local amenities (2003)				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	−1.88	0.18	<0.001	−2.23 to −1.53
Feel insecure or think vandalism is a problem (2003)				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	−1.52	0.17	<0.001	−1.86 to −1.19
No family or close friends living nearby (2003)				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	−0.78	0.15	<0.001	−1.07 to −0.48
Rarely or never exchange goods/services with neighbours (2003)				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	−2.50	0.19	<0.001	−2.89 to −2.12
Close, confiding relationship (2004)				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	4.28	0.21	<0.001	3.87 to 4.69

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Table F.1 – ***continued from previous page***

Term	Coefficient	SE	p-value	95% CI
Perceived adequacy of social support (2004)				
Much more social support needed	−9.88	0.39	<0.001	−10.65 to −9.11
More social support needed	−5.42	0.24	<0.001	−5.90 to −4.95
A little more social support needed	−3.55	0.19	<0.001	−3.91 to −3.18
Enough social support	*Reference*	*Reference*	*Reference*	*Reference*
Caring for an adult (2005)				
Nearly every day	−1.92	0.37	<0.001	−2.64 to −1.20
Nearly every week	−0.29	0.30	0.338	−0.88 to 0.30
Less frequently	0.39	0.21	0.070	−0.03 to 0.81
Never	*Reference*	*Reference*	*Reference*	*Reference*
Health				
Depression symptoms (CES-D) (2005)				
Absence of depression	*Reference*	*Reference*	*Reference*	*Reference*
Symptoms of mild depression	−7.32	0.15	<0.001	−7.61 to −7.03
Symptoms of moderate/severe depression	−16.79	0.26	<0.001	−17.31 to −16.28
Short-form 36 mental health (2003)				
SF-36 mental component summary	0.34	0.01	<0.001	0.32 to 0.35
Short-form 36 physical health (2003)				
SF-36 physical component summary	0.20	0.01	<0.001	0.18 to 0.22

F.1.2 Cross-sectional multivariate relationships between quality of life and individuals' current circumstances

Table F.2 presents the multivariate relationships between CASP-15 quality of life and participants' current or recent circumstances. The corresponding table in the main body of the thesis is Table 7.3 on page 178. As in that table, the variables were introduced into a series of nested models in blocks, in the following order: demographic variables, family, finances, community and health circumstances. The proportion of explained variability (R^2) in the outcome variable CASP-15 is provided for each model, as well as the log-likelihood and AIC.

Table F.2: Nested models of the current factors predicting 2005 CASP-15 scores in the GAZEL cohort study (unstandardized β coefficients; n=7775)

Variable	Demographics	Family	Finances	Community	Health
Demographics					
Gender					
Male	*Reference*	*Reference*	*Reference*	*Reference*	*Reference*
Female	−2.32***	−1.86***	−1.66***	−1.08***	0.48**
Age					
Age	0.01	0.02	0.09***	0.09***	0.06**
Age^2	−0.02***	−0.02***	−0.01	−0.01*	−0.01
Family					
Children					
No children		*Reference*	*Reference*	*Reference*	*Reference*
One or more children		0.52*	0.43	0.29	0.34*
Marital status					
Single		−2.66***	−2.07***	−1.80**	−1.29**
Married or cohabiting		*Reference*	*Reference*	*Reference*	*Reference*
Divorced or separated		−2.57***	−1.56***	−1.03 **	−0.59
Widowed		−1.15*	−0.91	−0.73	0.23
Household size					
Living alone		−0.36	−0.40	−0.33	−0.02
Two people		*Reference*	*Reference*	*Reference*	*Reference*
Three or more people		−0.79***	−0.61**	−0.27	−0.36*
Financial adequacy & activity					
Monthly household income					
<1372 euro			−0.50	0.19	0.02
1372 − <1601 euro			−0.75	−0.44	−0.49
1601 − <1982 euro			−0.20	−0.08	−0.17
1982 − <2592 euro			−0.41	−0.39	−0.44**
2592 − <3811 euro			*Reference*	*Reference*	*Reference*
3811 − <4574 euro			0.33	0.38	0.13
≥4574 euro			0.87***	0.73***	0.42*

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Table F.2 – *continued from previous page*

Variable	Demographics	Family	Finances	Community	Health
Confidence in finances over the next 10 years					
Very confident			1.78***	1.50***	0.84***
Quite confident			*Reference*	*Reference*	*Reference*
Not very confident			−3.08***	−2.17***	−1.00***
Not confident at all			−5.60 * **	−3.81***	−2.02***
Labour market status					
In work			*Reference*	*Reference*	*Reference*
Retired			1.64***	1.21***	0.48*
Community & social relationships					
Social participation					
No participation				*Reference*	*Reference*
Low–medium participation				1.03***	0.63***
High participation				2.10***	1.35***
Frequent annoyances in the neighbourhood					
No				*Reference*	*Reference*
Yes				−0.52**	0.09
Dissatisfaction with access to local amenities					
No				*Reference*	*Reference*
Yes				−0.94***	−0.24
Feel insecure or think vandalism is a problem					
No				*Reference*	*Reference*
Yes				−0.55***	0.15
No family or close friends living nearby					
No				*Reference*	*Reference*
Yes				−0.12	−0.11
Rarely or never exchange goods/services with neighbours					
No				*Reference*	*Reference*
Yes				−1.27***	−0.95***
Close, confiding relationship					
No				*Reference*	*Reference*
Yes				2.20***	1.19***

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Table F.2 – *continued from previous page*

Variable	Demographics	Family	Finances	Community	Health
Perceived adequacy of social support					
Much more support needed				−6.81***	−1.72***
More social support needed				−3.83***	−1.14***
A little more social support needed				−2.80***	−1.09***
Enough social support				*Reference*	*Reference*
Caring for an adult					
Less than daily				−1.30***	−0.62*
Less than weekly				−0.07	0.32
Less than monthly				0.08	0.41**
Not caring for an adult				*Reference*	*Reference*
Health					
Depression symptoms (CES-D)					
Few or no depression symptoms					*Reference*
Symptoms of mild depression					−5.06***
Symptoms of moderate/severe depression					−12.20***
SF-36 mental component summary					0.13***
SF-36 physical component summary					0.10***
Constant	36.88***	36.77***	35.41***	34.22***	24.56***
R^2	0.03	0.05	0.11	0.25	0.53
Log likelihood	−25573	−25497	−25214	−24539	−22760
AIC	51154	51013	50467	49146	45596

* p<0.05; ** p<0.01; *** p<0.001.

Table F.3 displays the standardized beta coefficients of the associations between the CASP-15 measure of quality of life and a range of individuals' current and recent circumstances.

Table F.3: Nested models of the current factors predicting 2005 CASP-15 scores in the GAZEL cohort study (standardized β coefficients; n=7775)

Variable	Demographics	Family	Finances	Community	Health
Demographics					
Gender					
Male	*Reference*	*Reference*	*Reference*	*Reference*	*Reference*
Female	−0.148***	−0.118***	−0.106***	−0.069***	0.031**
Age					
Age	0.005	0.009	0.047***	0.048***	0.031**
Age^2	−0.048***	−0.045***	−0.019	−0.023*	−0.012
Family					
Children					
No children		*Reference*	*Reference*	*Reference*	*Reference*
One or more children		0.027*	0.022	0.015	0.018*
Marital status					
Single		−0.063***	−0.049***	−0.043**	−0.031**
Married or cohabiting		*Reference*	*Reference*	*Reference*	*Reference*
Divorced or separated		−0.102***	−0.062***	−0.041**	−0.023
Widowed		−0.027*	−0.022	−0.017	0.006
Household size					
Living alone		−0.016	−0.018	−0.015	−0.001
Two people		*Reference*	*Reference*	*Reference*	*Reference*
Three or more people		−0.046***	−0.036**	−0.016	−0.021*
Financial adequacy & activity					
Monthly household income					
<1372 euro			−0.013	0.005	0.000
1372 – <1601 euro			−0.017	−0.010	−0.011
1601 – <1982 euro			−0.012	−0.005	−0.010
1982 – <2592 euro			−0.023	−0.021	−0.024**
2592 – <3811 euro			*Reference*	*Reference*	*Reference*
3811 – <4574 euro			0.015	0.017	0.006
≥4574 euro			0.045***	0.038***	0.022*

Continued on next page

Table F.3 – *continued from previous page*

Variable	Demographics	Family	Finances	Community	Health
Confidence in finances over the next 10 years					
Very confident			0.097***	0.082***	0.046***
Quite confident			*Reference*	*Reference*	*Reference*
Not very confident			−0.168***	−0.118***	−0.054***
Not confident at all			−0.109***	−0.074***	−0.039***
Labour market status					
In work			*Reference*	*Reference*	*Reference*
Retired			0.084***	0.062***	0.025*
Community & social relationships					
Social participation					
No participation				*Reference*	*Reference*
Low–medium participation				0.077***	0.047***
High participation				0.155***	0.100***
Frequent annoyances in the neighbourhood					
No				*Reference*	*Reference*
Yes				−0.028**	0.005
Dissatisfaction with access to local amenities					
No				*Reference*	*Reference*
Yes				−0.060***	−0.015
Feel insecure or think vandalism is a problem					
No				*Reference*	*Reference*
Yes				−0.037***	−0.010
No family or close friends living nearby					
No				*Reference*	*Reference*
Yes				−0.009	−0.008
Rarely or never exchange goods/services with neighbours					
No				*Reference*	*Reference*
Yes				−0.073***	−0.055***
Close, confiding relationship					
No				*Reference*	*Reference*
Yes				0.116***	0.063***

Continued on next page

Table F.3 – *continued from previous page*

Variable	Demographics	Family	Finances	Community	Health
Perceived adequacy of social support					
Much more support needed				−0.184***	−0.046***
More social support needed				−0.169***	−0.050***
A little more social support needed				−0.161***	−0.062***
Enough social support				*Reference*	*Reference*
Caring for an adult					
Less than daily				−0.040***	−0.019*
Less than weekly				−0.003	0.012
Less than monthly				0.004	0.022**
Not caring for an adult				*Reference*	*Reference*
Health					
Depression symptoms (CES-D)					
Few or no depression symptoms					*Reference*
Symptoms of mild depression					−0.293***
Symptoms of moderate/severe depression					−0.401***
SF-36 mental component summary					0.197***
SF-36 physical component summary					0.102***

* $p<0.05$; ** $p<0.01$; *** $p<0.001$.

The use of standardized coefficients allows for the effect sizes to be compared to each other, despite variables being measured with greatly varying metrics. In a similar manner to the results reported in the main body of the thesis (see Table 7.4 on page 182), in the full model, the variables relating to health are most strongly associated with quality of life. Variables from the domain corresponding to community and social relationships also have relatively large standardized coefficients, particularly social participation and social support.

F.1.3 Contribution of separate domains to quality of life

Table F.4 displays the variance explained by each domain, after excluding the variance explained by any of the other domains.

The results are, overall, similar to those reported in Table 7.5 on page 185, with the health domain contributing about half of the independent variation to quality of life. After exclusion of the four items of CASP-19 which refer to limitations due to family, financial and health circumstances as well as due to ageing, the percent change in R^2 is smaller in the corresponding demographic, financial and health domains. In contrast, it is larger in

Table F.4: Explained variance after backward extraction of each domain from the fully adjusted model of cross-sectional influences upon quality of life in 2005 measured by CASP-15

Block	R^2 after extraction	Change in R^2	% change
Demographic domain	0.525	0.002	0.4%
Family situation domain	0.525	0.002	0.4%
Financial adequacy & activity domain	0.518	0.009	1.7%
Community & social relationships domain	0.503	0.024	4.6%
Physical & mental health domain	0.253	0.274	52.0%

The R^2 before extraction of any domains was 0.527.

the community and social relationships domain. However, in general, the overall picture remains the same.

F.2 Multivariate change analyses

This section presents the sensitivity analyses, performed with CASP-19, for the three models presented in the final part of Chapter 8 *Predicting change in quality of life*.

The sample contained 5499 cohort members, an increase of 68 participants compared to the original sample used in the analysis presented in Chapter 8. The larger sample size resulted from the use in both years of the shortened 15-item CASP scale for which fewer individuals had missing values.

In this sample, overall change in CASP-15 quality of life between 2005 and 2009 was –0.19 with a standard deviation of 4.82 (95% confidence intervals: –0.31 to –0.06). The confidence intervals for this estimate encompass the smaller decline of –0.11 points reported in section 8.3.1 on page 189.

F.2.1 Model 1: Demographics and change in CASP-15 quality of life, 2005–2009

This model displays associations between demographic characteristics (age, age-squared and gender) and average change in CASP-15 quality of life scores between the years 2005 and 2009.

The results reported in this table are close to those to those given in Table 8.5 on page 200 in the main body of the thesis.

F.2.2 Model 2: Demographics, covariates at baseline and change in CASP-15 quality of life, 2005–2009

This model additionally includes values for the covariates at baseline in order to predict change in CASP-15 quality of life between 2005 and 2009. This table corresponds to Table 8.6 on page 201 in the main body of the thesis. The results presented in Table F.6

Table F.5: Multiple linear regression model of change in CASP-15 scores between 2005 and 2009 in 5499 GAZEL cohort participants: demographics

Variable	β coefficient	p-value	95% CI	Standardized β
Demographics				
Gender				
Male	*Reference*	*Reference*	*Reference*	*Reference*
Female	0.72	<0.001	0.37 to 1.06	0.063
Age (2005)				
Age	−0.07	0.001	−0.11 to −0.03	−0.047
Age-squared	0.01	0.010	0.00 to 0.02	0.037
Constant	−0.49	<0.001	−0.66 to −0.32	

The R^2 for this model is 0.01.

are similar to those reported in Chapter 8: in each case the point estimates from this sensitivity analysis fall within the 95% confidence intervals presented in Table 8.6 on page 201 of the original analysis.

Table F.6: Multiple linear regression model of change in CASP-15 scores between 2005 and 2009 in 5499 GAZEL cohort participants: demographics and baseline covariates.

Variable	β coefficient	p-value	95% CI	Standardized β
Demographics				
Gender				
Male	*Reference*	*Reference*	*Reference*	*Reference*
Female	0.15	0.403	−0.20 to 0.51	0.013
Age (2005)				
Age	0.03	0.233	−0.02 to 0.07	0.019
Age-squared	0.00	0.710	−0.01 to 0.01	−0.006
Family situation				
Children				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	0.06	0.740	−0.32 to 0.45	0.005
Married or cohabiting (2005)				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	0.26	0.473	−0.44 to 0.95	0.017

Continued on next page

Table F.6 – ***continued from previous page***

Variable	β coefficient	p-value	95% CI	Standardized β
Household size (2005)				
Living alone	1.13	0.004	0.35 to 1.91	0.068
Two people	*Reference*	*Reference*	*Reference*	*Reference*
Three or more people	0.16	0.363	−0.18 to 0.49	0.012
Financial adequacy & activity				
Net revenue (2002)				
<1372 euro	−0.49	0.224	−1.28 to 0.30	−0.017
1372 – <1601 euro	−0.66	0.138	−1.52 to 0.21	−0.020
1601 – <1982 euro	−0.23	0.217	−0.61 to 0.14	−0.018
1982 – <2592 euro	−0.18	0.355	−0.55 to 0.20	−0.013
2592 – <3811 euro	*Reference*	*Reference*	*Reference*	*Reference*
3811 – <4574 euro	−0.17	0.450	−0.60 to 0.27	−0.011
≥4574 euro	0.07	0.726	−0.33 to 0.47	0.005
Confidence in finances (2002)				
Very confident	−0.04	0.827	−0.32 to 0.39	0.003
Quite confident	*Reference*	*Reference*	*Reference*	*Reference*
Not very confident	0.19	0.308	−0.18 to 0.56	0.014
Not confident at all	0.70	0.180	−0.32 to 1.73	0.018
Labour market status (2005)				
Working	*Reference*	*Reference*	*Reference*	*Reference*
Retired	−1.71	<0.001	−2.18 to −1.24	−0.119
Community				
Social participation (2005)				
No participation at all	*Reference*	*Reference*	*Reference*	*Reference*
Low–medium level of participation	−0.15	0.354	−0.48 to 0.17	−0.016
High level of participation	−0.23	0.176	−0.56 to 0.10	−0.023
Frequent local annoyances (2003)				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	−0.16	0.385	−0.52 to 0.20	−0.012
Dissatisfaction with access to local amenities (2003)				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	−0.19	0.207	−0.49 to 0.11	−0.017

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Table F.6 – ***continued from previous page***

Variable	β coefficient	p-value	95% CI	Standardized β
Feel insecure or think vandalism is a problem (2003)				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	−0.16	0.292	−0.45 to 0.14	−0.014
No family or close friends living locally (2003)				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	−0.19	0.128	−0.44 to 0.06	−0.020
Rarely or never exchange goods/services with neighbours (2003)				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	0.04	0.832	−0.30 to 0.37	0.003
Close, confiding relationship (2004)				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	0.36	0.064	−0.02 to 0.73	0.026
Perceived adequacy of social support (2004)				
Much more social support needed	−0.07	0.857	−0.87 to 0.73	−0.003
More social support needed	0.01	0.967	−0.44 to 0.46	0.001
A little more social support needed	0.08	0.964	−0.33 to 0.35	0.001
Enough social support	*Reference*	*Reference*	*Reference*	*Reference*
Caring for an adult every day (2005)				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	0.33	0.276	−0.27 to 0.93	0.014
Health				
Depression symptoms (CES-D) (2005)				
No depression	*Reference*	*Reference*	*Reference*	*Reference*
Symptoms of mild depression	1.22	<0.001	0.87 to 1.57	0.095
Symptoms of more serious depression	5.09	<0.001	4.45 to 5.73	0.225
Hearing impairment reported (2005)				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	−0.25	0.101	−0.55 to 0.05	−0.022
Visual impairment reported (2005)				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	−0.71	0.001	−1.15 to −0.27	−0.043

Continued on next page

Table F.6 – *continued from previous page*

Variable	β coefficient	p-value	95% CI	Standardized β
Two or more physical functioning limitations (2003)				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	−0.50	0.001	−0.80 to −0.20	−0.045
Participant hospitalized (2004)				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	−0.32	0.132	−0.73 to 0.10	−0.020
Constant	0.79	0.131	−0.23 to 1.81	

The R^2 for this model is 0.08.

F.2.3 Model 3: Demographics, covariates at baseline, changing covariates and change in CASP-15 quality of life, 2005–2009

This model additionally includes information on covariates that change over the period of follow-up in order to predict changes in CASP-15 quality of life over the period 2005–2009. Partial results from the model are displayed in Table F.7; only the results for the changing covariates are shown.

The results presented here contrast with those presented in Table 8.7 in the main body of the thesis. Despite the slightly larger sample, retiring, decreasing participation in social activities and changes to the health variables concerning visual impairment, physical limitations and hospitalization were no longer significantly associated with change in quality of life.

Table F.7: Multiple linear regression model of change in CASP-15 scores between 2005 and 2009 in 5499 GAZEL cohort participants: change covariates.

Variable	β coefficient	p-value	95% CI	Standardized β
Marital status				
Divorced/separated/became single 2005–2009				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	−1.34	0.017	−2.44 to −0.24	−0.031

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Table F.7 – *continued from previous page*

Variable	β coefficient	p-value	95% CI	Standardized β
Widowed 2005–2009				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	−0.27	0.656	−1.45 to 0.92	−0.006
Married or began cohabiting 2005–2009				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	−0.47	0.446	−1.67 to 0.74	−0.010
Activity				
Retired 2005–2009				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	0.60	0.150	−0.22 to 1.42	0.035
Community and social relationships				
Change in social participation 2005–2009				
No change in social activities	*Reference*	*Reference*	*Reference*	*Reference*
Increase in social activities	0.22	0.256	−0.16 to 0.60	0.016
Decrease in social activities	−0.28	0.083	−0.60 to 0.04	−0.023
Change in caring responsibilities 2005–2009				
No change in daily caring responsibilities	*Reference*	*Reference*	*Reference*	*Reference*
Ceasing daily caring responsibilities	2.03	0.001	0.80 to 3.25	0.072
Gain of daily caring responsibilities	−1.10	0.002	−1.79 to −0.40	−0.040
Health				
Change in depression symptoms 2005–2008				
Depression symptoms improve	*Reference*	*Reference*	*Reference*	*Reference*
Depression symptoms stay the same	−1.28	<0.001	−1.82 to −0.75	−0.105
Depression symptoms worsen	−3.37	<0.001	−4.03 to −2.71	−0.200
Hearing loss 2005–2009				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	−0.37	0.060	−0.76 to 0.02	−0.025
Vision impaired 2005–2009				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	−0.23	0.224	−0.60 to 0.14	−0.016
Development of two or more physical limitations 2003–2007				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	−0.39	0.059	−0.80 to 0.01	−0.025

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Table F.7 – *continued from previous page*

Variable	β coefficient	p-value	95% CI	Standardized β
Cessation of two or more physical limitations 2003–2007				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	0.50	0.068	−0.04 to 1.04	0.027
Any hospitalization 2005–2009				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	−0.21	0.118	−0.47 to 0.05	−0.020
Constant	1.89	0.006	0.55 to 3.24	

The R^2 for this model is 0.11.
In the cases of both marital status variables, the reference category is *remained married or in a cohabitation.*
All effects shown are of the change in covariates over the follow-up period. Baseline covariates are included in the model but their effects are not shown.

F.3 Discussion

Although inclusion of items in the CASP-19 scale that correspond to certain objective circumstances, in the analysis of current influences upon quality of life, does lead to greater correlation with those circumstances than seen in the CASP-15 scale with these removed, this does not make a large difference and the overall conclusions presented in Chapter 7 do not change.

In the multivariate change analysis, the relationships between the demographic and baseline covariates and change in quality of life 2005–2009 altered little. However, the impact on the results obtained from model 3 with changing covariates was larger. Several domains of changes became insignificant at the 95% level suggesting that inclusion of items referring to limitations due to family, financial and health circumstances as well as due to ageing in CASP-19 may have affected the results obtained in Chapter 8. Therefore, researchers using CASP-19 should be aware of the possibility of conflation of subjective quality of life with its determinants in interpreting results.

Appendix G

Full information maximum likelihood analyses: supplementary tables

In this thesis, results have been presented after listwise exclusion of individuals with missing data. Performing analyses on complete cases only requires that the information is missing completely at random, an unverifiable assumption. Therefore chapter presents supplementary tables generated using full information maximum likelihood (FIML) estimation for a range of models appearing in the thesis. As explained more fully in section 5.3.1.3 in Chapter 5, FIML uses all of the available information in the data and, as long as information is missing at random, will yield unbiased parameter estimates where data are missing. This is a less restrictive assumption, which is more likely to be the case.

The results in this chapter are presented in the same order as they appear in the thesis and are cross-referenced to the corresponding tables in the main body of the thesis.

G.1 Cross-sectional multivariate relationships between individuals' current circumstances & their quality of life: FIML estimation

Table G.1 presents results obtained using FIML estimation. These can be compared with the final model "Health" presented in Chapter 7 *Current influences upon quality of life* Tables 7.3 and 7.4.

Table G.1: Final model of the current factors predicting 2005 CASP-19 scores in the GAZEL cohort study (FIML estimation, n=19741)

Variable	β	SE	p-value	95% CI	Standardized β
Demographics					
Age and age-squared					
Age	0.09	0.02	<0.001	0.07 to 0.13	0.042
Age^2	−0.01	0.00	0.169	−0.02 to 0.00	−0.015
Gender					
Male	*Reference*	*Reference*	*Reference*	*Reference*	*Reference*
Female	1.07	0.13	<0.001	0.51 to 0.97	0.041
Family					
Children					
No children	*Reference*	*Reference*	*Reference*	*Reference*	*Reference*
One or more children	0.02	0.15	0.877	−0.41 to 0.13	−0.006
Marital status					
Single	−0.96	0.39	0.014	−2.16 to −0.77	−0.030
Married or cohabiting	*Reference*	*Reference*	*Reference*	*Reference*	*Reference*
Divorced or separated	−0.53	0.28	0.064	−1.15 to −0.13	−0.022
Widowed	1.12	0.36	0.002	0.37 to 1.66	0.022
Household size					
Living alone	0.43	0.29	0.142	−0.12 to 0.91	0.016
Two people	*Reference*	*Reference*	*Reference*	*Reference*	*Reference*
Three or more people	−0.74	0.13	<0.001	−1.01 to −0.54	−0.037

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Table G.1 – ***continued from previous page***

Variable	β	SE	p-value	95% CI	Standardized β
Financial adequacy & activity					
Monthly household income					
<1372 euro	0.09	0.29	0.765	−0.24 to 0.79	0.007
1372 – <1601 euro	−0.64	0.35	0.071	−1.14 to 0.11	−0.010
1601 – <1982 euro	−0.30	0.15	0.046	−0.45 to 0.08	−0.009
1982 – <2592 euro	−0.68	0.16	<0.001	−0.84 to −0.29	−0.025
2592 – <3811 euro	*Reference*	*Reference*	*Reference*	*Reference*	*Reference*
3811 – <4574 euro	0.20	0.18	0.276	0.00 to 0.65	0.012
≥4574 euro	0.77	0.16	<0.001	0.63 to 1.20	0.039
Confidence in finances over the next 10 years					
Very confident	1.51	0.15	<0.001	1.21 to 1.73	0.063
Quite confident	*Reference*	*Reference*	*Reference*	*Reference*	*Reference*
Not very confident	−1.55	0.14	<0.001	−1.70 to −1.19	−0.068
Not confident at all	−2.49	0.38	<0.001	−2.70 to −1.34	−0.036
Labour market status					
In work	*Reference*	*Reference*	*Reference*	*Reference*	*Reference*
Retired	0.51	0.17	0.003	0.42 to 1.04	0.033
Community & social relationships					
Social participation					
No participation in clubs	*Reference*	*Reference*	*Reference*	*Reference*	*Reference*
Low–medium participation in clubs	0.50	0.13	<0.001	0.38 to 0.85	0.038
High participation in clubs	1.34	0.14	<0.001	1.35 to 1.84	0.096
Frequent annoyances in the neighbourhood					
No	*Reference*	*Reference*	*Reference*	*Reference*	*Reference*
Yes	−0.02	0.15	0.872	−0.29 to 0.24	−0.001
Dissatisfaction with access to local amenities					
No	*Reference*	*Reference*	*Reference*	*Reference*	*Reference*
Yes	−0.51	0.13	<0.001	−0.87 to −0.42	−0.033
Feel insecure or think vandalism is a problem					
No	*Reference*	*Reference*	*Reference*	*Reference*	*Reference*
Yes	0.03	0.12	0.802	−0.29 to 0.14	−0.004
No family or close friends living nearby					
No	*Reference*	*Reference*	*Reference*	*Reference*	*Reference*
Yes	−0.13	0.10	0.210	−0.38 to −0.01	−0.012

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Table G.1 – ***continued from previous page***

Variable	β	SE	p-value	95% CI	Standardized β
Rarely or never exchange goods/services with neighbours					
No	*Reference*	*Reference*	*Reference*	*Reference*	*Reference*
Yes	−0.94	0.14	<0.001	−1.22 to −0.73	−0.047
Close, confiding relationship					
No	*Reference*	*Reference*	*Reference*	*Reference*	*Reference*
Yes	0.98	0.15	<0.001	1.11 to 1.63	0.061
Perceived adequacy of social support					
Much more support needed	−2.33	0.29	<0.001	−4.06 to −3.03	−0.085
More social support needed	−1.38	0.18	<0.001	−2.17 to −1.55	−0.071
A little more social support needed	−1.55	0.14	<0.001	−2.15 to −1.67	−0.090
Enough social support	*Reference*	*Reference*	*Reference*	*Reference*	*Reference*
Caring for an adult					
Less than daily	−0.86	0.24	<0.001	−1.65 to −0.81	−0.033
Less than weekly	0.06	0.19	0.770	−0.35 to 0.34	0.000
Less than monthly	0.13	0.14	0.372	−0.14 to 0.37	0.005
Not caring for an adult	*Reference*	*Reference*	*Reference*	*Reference*	*Reference*
Health					
Depression symptoms (CES-D)					
Few or no depression symptoms	*Reference*	*Reference*	*Reference*	*Reference*	*Reference*
Symptoms of mild depression	−5.56	0.14	<0.001	−3.33 to −2.81	−0.153
Symptoms of moderate/severe depression	−12.41	0.25	<0.001	−6.84 to −5.95	−0.201
SF-36 mental component summary	0.18	0.01	<0.001	0.22 to 0.24	0.291
SF-36 physical component summary	0.20	0.01	<0.001	0.23 to 0.25	0.215
Constant	19.81	0.63	0.000	–	–
R^2	0.47	–	–	–	–

G.2 Change analysis: FIML estimation

Comparison of the full information maximum likelihood estimates presented in this section (Table G.2 on the next page) with the estimates presented in Table 8.7 on page 204 show quite minor change to effect sizes and levels of significance. Of most note, divorce, separation and becaming single over the 2005 to 2009 period were no longer significantly associated with reduced CASP-19 quality of life. This means that none of the changes in marital status were significantly associated with changes in quality of life at the 95% level in the FIML analysis.

In contrast, the results presented in this Appendix present more convincing evidence than in the results displayed in the complete case analyses that changes in social activities were associated with quality of life. As in the complete case analyses, most of the changes in health status were associated with quality of life, with the exception of developing a hearing impairment, results which correspond to those presented in Table 8.7 on page 204.

Table G.2: Multiple linear regression model with full information maximum likelihood estimation of change in CASP-19 scores between 2005 and 2009 in 18930 GAZEL cohort participants: change covariates.

Variable	β coefficient	p-value	95% CI	Standardized β
Marital status				
Divorced/separated/became single 2005–2009				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	−0.62	0.139	−1.31 to 0.07	−0.013
Widowed 2005–2009				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	0.01	0.978	−0.77 to 0.80	0.000
Married or began cohabiting 2005–2009				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	−0.13	0.784	−0.87 to 0.63	−0.003
Activity				
Retired 2005–2009				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	1.42	<0.001	0.88 to 1.97	0.077
Community and social relationships				
Change in social participation 2005–2009				
No change in social activities	*Reference*	*Reference*	*Reference*	*Reference*
Increase in social activities	0.31	0.072	0.03 to 0.59	0.019
Decrease in social activities	−0.52	<0.001	−0.77 to −0.28	−0.037
Change in caring responsibilities 2005–2009				
No change in daily caring responsibilities	*Reference*	*Reference*	*Reference*	*Reference*
Ceasing daily caring responsibilities	1.78	0.001	0.92 to 2.65	0.055
Gain of daily caring responsibilities	−1.33	<0.001	−1.83 to −0.83	−0.042
Health				
Change in depression symptoms 2005–2008				
Depression symptoms improve	1.84	<0.001	1.45 to 2.22	0.101
Depression symptoms stay the same	*Reference*	*Reference*	*Reference*	*Reference*
Depression symptoms worsen	−2.10	<0.001	−2.42 to −1.79	−0.108
Hearing loss 2005–2009				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	−0.23	0.169	−0.51 to 0.05	−0.013

Continued on next page

Table G.2 – ***continued from previous page***

Variable	β coefficient	p-value	95% CI	Standardized β
Vision impaired 2005–2009				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	−0.41	0.011	−0.68 to −0.15	−0.025
Development of two or more physical limitations 2003–2007				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	−0.68	<0.001	−0.97 to −0.39	−0.039
Cessation of two or more physical limitations 2003–2007				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	0.98	<0.001	0.61 to 1.36	0.048
Any hospitalization 2005–2009				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	−0.60	<0.001	−0.78 to −0.42	−0.053
Constant	0.70	0.513	−0.15 to 1.54	

The R^2 for this model is 0.11.
In the cases of both marital status variables, the reference category is *remained married or in a cohabitation*.
All effects shown are of the change in covariates over the follow-up period. Baseline covariates and demographic characteristics are included in the model but their effects are not shown.

G.3 Mid-life working conditions and quality of life following retirement: FIML estimation

This section presents the sensitivity analyses for certain of the results presented in Chapter 9 *Social position and occupational conditions in mid-life*. Estimation using full information maximum likelihood was carried out in order to include cases providing some but not full information.

G.3.1 Psychosocial occupational exposures

The results for male participants presented in Table G.3 are similar to those from the complete case analyses presented in Table 9.7 on page 221. The FIML models for women did not converge, and are therefore not displayed here.

Table G.3: Associations between psychosocial occupational exposures and quality of life in 2009: Results of multivariate linear models

	Model 1			Model 2		
	Coefficient	SE	R^2	Coefficient	SE	R^2
Job strain, n=8330			0.038			0.042
No exposure (reference)	–	–		–	–	
Exposed	−3.02***	0.37		−2.91***	0.37	
Effort-reward imbalance, n=9938			0.039			0.044
No exposure (reference)	–	–		–	–	
High exposure	−3.54***	0.46		−3.43***	0.46	

Note. * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.
Model 1: Associations between each psychosocial occupational exposure and quality of life, controlled for age, age-squared, occupational grade (1998) & social class (1998).
Model 2: Model 1 + adjustments for five physical occupational exposures.

G.3.2 Physical occupational exposures

The results displayed in Table G.4 in this chapter correspond to those presented for the complete case analyses using the male participants in Table 9.13 on page 229. The FIML estimation procedure for the female participants did not converge and the results for women are consequently not presented here.

G.4 Retirement and quality of life: FIML estimation

G.4.1 Modelling changing quality of life during the retirement in relation to mid-life working conditions

Table G.5 displays results corresponding to those displayed in Table 10.7 on page 245. As in results reported in the main body of the thesis using only complete cases, improvement

Table G.4: Associations between physical occupational exposures and quality of life: Results of multivariate linear models for 13785 retired men from the GAZEL cohort

	Model 1			Model 2		
	Coefficient	Std error	R^2	Coefficient	Std error	R^2
Ergonomic strain						
Retrospective ergonomic strain			0.029			0.040
No exposure	*Reference*	*Reference*		*Reference*	*Reference*	
Moderate exposure	0.33	0.18		0.27	0.18	
High exposure	−0.06	0.19		−0.04	0.19	
Ergonomic strain	−0.41***	0.08	0.032	−0.38**	0.08	0.043
Physical danger						
Physical hazards	−0.18***	0.05	0.030	−0.18**	0.05	0.041
Accident episodes			0.032			0.043
None	*Reference*	*Reference*		*Reference*	*Reference*	
One	−0.98***	0.23		−0.90***	0.23	
Two or more	−1.20***	0.33		−1.17***	0.33	
Exposure to harmful chemicals						
Chemical exposures			0.012			0.041
No exposure	*Reference*	*Reference*		*Reference*	*Reference*	
Moderate exposure	−0.01	0.01		0.09	0.18	
High exposure	0.01	0.01		−0.20	0.21	

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$
Model 1: Associations between each physical occupational exposure and quality of life, controlled for age, age-squared, occupational grade and ESeC social class.
Model 2: All adjustments as for model 1 + psychosocial strain (Karasek job strain scale).

in quality of life upon retiring was greater for participants who had earlier reported job strain but not for those who had previously reported effort-reward imbalance.

Table G.5: Moderation of the association between retirement and change in quality of life (2005–2009) by earlier psychosocial working conditions for 2067 GAZEL cohort participants

Variable	Coefficient	Standard error	95% confidence intervals
Effort-reward imbalance			
No	*Reference*	*Reference*	*Reference*
Yes	0.81	1.17	−1.11 to 2.74
Constant	2.28***	0.00	1.93 to 2.63
Job strain			
No	*Reference*	*Reference*	*Reference*
Yes	2.18***	0.64	1.12 to 3.23
Constant	2.07***	0.21	1.72 to 2.42

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$.

G.4.2 Age at retirement and quality of life

Table G.6 displays results corresponding to those displayed in Table 10.10 on page 248. For both genders, use of full information maximum likelihood estimation generated results which were very similar to those presented in the complete case analyses in the main body of the thesis.

Table G.6: Age at retirement and quality of life in 2009 for 10871 men and 2438 women in the GAZEL cohort

Variable	Coefficient	Standard error	95% confidence intervals
Men			
Age at retirement	0.15***	0.03	0.09 to 0.20
Constant	42.78***	0.09	42.64 to 42.92
Women			
Age at retirement	−0.11	0.07	−0.22 to 0.01
Constant	41.30***	0.22	40.94 to 41.74

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$.

G.4.3 Modelling quality of life in relation to whether participants experienced a retirement transition marked by ill health or disability

The results obtained using full information maximum likelihood estimation displayed in Table G.7 are close to those reported in Table 10.11 on page 249. In both cases, continuing professional activities in some form following retirement was associated with about one-point higher CASP-19 quality of life scores on average.

Table G.7: Post-retirement professional activities and quality of life in 2009 for 11 906 GAZEL cohort participants, using FIML estimation

Post-retirement professional activities	Coefficient	Standard error	95% confidence intervals
No	*Reference*	*Reference*	*Reference*
Yes	0.99**	0.35	0.41 to 1.57
Constant	42.66***	0.08	42.53 to 42.80

The R^2 for this model is 0.1%.
*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$.

G.4.4 Modelling quality of life in relation to whether participants experienced a retirement transition marked by ill health or disability

The results obtained using full information maximum likelihood estimation displayed in Table G.8 are close to those reported in Table 10.12 on page 250. In both cases, experiencing a retirement transition marked by ill health or a disability was associated with about 4.5-point lower CASP-19 quality of life scores following retirement.

Table G.8: Retirement related to illness and quality of life in 2009 for 19 149 GAZEL cohort participants, using FIML estimation

Retired in ill health	Coefficient	Standard error	95% confidence intervals
No	*Reference*	*Reference*	*Reference*
Yes	−4.51***	0.33	−5.05 to −3.96
Constant	42.99***	0.07	42.88 to 43.10

The R^2 for this model is 1%.
*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$.

Appendix H

Tables of covariances for the path analyses

Table H.1: Covariance matrix and standard deviations used in the path analyses presented in Chapter 11 for 13 783 GAZEL cohort participants: Retrospective ergonomic strain and quality of life in 2009

	1.CASP	2.MCS	3.PCS	4.Ret. erg strain	5.Age	6.Age^2	7.Grade	8.ESeC 2	9.ESeC 3	10.ESeC 6	11.ESeC 7	12.ESeC 8	13.ESeC 9
Quality of life													
1. CASP-19 quality of life (2009)	55.899												
Mediating variables													
2. Mental health SF-36 MCS (2007)	34.838	81.256											
3. Physical health SF-36 PCS (2007)	16.731	4.420	47.818										
Physical occupational exposure													
4. Retrospective ergonomic strain	−0.382	−0.298	−0.505	0.377									
Control variables													
5. Age (1989)	−1.558	−0.550	−2.005	−0.077	8.118								
6. Age^2	−1.491	−0.198	−1.562	−0.077	6.360	56.557							
7. Occupational grade (1989)	3.698	2.206	2.385	−0.822	1.147	0.251	12.438						
8. ESeC class 2 (1989)	−0.046	−0.025	0.008	−0.030	0.016	0.019	−0.084	0.125					
9. ESeC class 3 (1989)	−0.069	−0.098	−0.087	−0.003	0.006	0.019	−0.187	−0.007	0.045				
10. ESeC class 6 (1989)	−0.060	0.049	−0.029	0.043	−0.076	−0.098	−0.429	−0.057	−0.018	0.237			
11. ESeC class 7 (1989)	−0.019	−0.016	−0.006	−0.002	−0.003	0.003	−0.034	−0.001	0.000	−0.003	0.008		
12. ESeC class 8 (1989)	−0.176	−0.086	−0.125	0.082	−0.053	0.014	−0.502	−0.016	−0.005	−0.042	−0.001	0.098	
13. ESeC class 9 (1989)	−0.012	−0.011	−0.008	0.000	−0.002	0.001	−0.015	0.000	0.000	−0.001	0.000	0.000	0.003

Variances are displayed on the horizontal diagonal.

Table H.2: Covariance matrix and standard deviations for the variables used in the path analyses presented in Chapter 11 for 13 783 GAZEL cohort participants: Ergonomic strain in 1989/90 and quality of life in 2009

	1.CASP	2.MCS	3.PCS	4.Erg. strain	5.Age	6.Age^2	7.Grade	8.ESeC 2	9.ESeC 3	10.ESeC 6	11.ESeC 7	12.ESeC 8	13.ESeC 9
Quality of life													
1. CASP-19 quality of life (2009)	55.922												
Mediating variables													
2. Mental health SF-36 MCS (2007)	16.797	81.307											
3. Physical health SF-36 PCS (2007)	34.879	4.484	47.888										
Physical occupational exposure													
4. Ergonomic strain (1989/90)	−0.795	−0.636	−0.796	1.158									
Controls													
5. Age (1989)	−1.559	−0.551	−2.011	−0.190	8.118								
6. Age^2	−1.486	−0.195	−1.563	−0.062	6.360	56.557							
7. Occupational grade (1989)	3.707	2.226	2.419	−1.351	1.147	0.251	12.438						
8. ESeC class 2 (1989)	−0.045	−0.024	0.010	−0.053	0.016	0.019	−0.084	0.125					
9. ESeC class 3 (1989)	−0.069	−0.098	−0.088	−0.002	0.006	0.019	−0.187	−0.007	0.045				
10. ESeC class 6 (1989)	−0.061	0.047	−0.031	0.078	−0.076	−0.098	−0.429	−0.057	−0.018	0.237			
11. ESeC class 7 (1989)	−0.019	−0.016	−0.006	−0.005	−0.003	0.003	−0.034	−0.001	0.000	−0.003	0.008		
12. ESeC class 8 (1989)	−0.177	−0.088	−0.128	0.120	−0.053	0.014	−0.502	−0.016	−0.005	−0.042	−0.001	0.098	
13. ESeC class 9 (1989)	−0.012	−0.011	−0.008	0.003	−0.002	0.001	−0.015	0.000	0.000	−0.001	0.000	0.000	0.003

Variances are displayed on the horizontal diagonal.

Table H.3: Covariance matrix and standard deviations for the variables used in the path analyses presented in Chapter 11 for 13 783 GAZEL cohort participants: Perceived hazards in 1989/90 and quality of life in 2009

	1.CASP	2.MCS	3.PCS	4.Hazards	5.Age	6.Age^2	7.Grade	8.ESeC 2	9.ESeC 3	10.ESeC 6	11.ESeC 7	12.ESeC 8	13.ESeC 9
Quality of life													
1. CASP-19 quality of life (2009)	55.888												
Mediating variables													
2. Mental health SF-36 MCS (2007)	34.840	81.265											
3. Physical health SF-36 PCS (2007)	16.744	4.437	47.839										
Physical occupational exposure													
4. Perceived hazards (1989/90)	−0.742	−0.392	−0.721	2.413									
Controls													
5. Age (1989)	−1.558	−0.552	−2.010	−0.363	8.118								
6. Age^2	−1.493	−0.205	−1.575	−0.202	6.360	56.557							
7. Occupational grade (1989)	3.693	2.209	2.393	−1.575	1.147	0.251	12.438						
8. ESeC class 2 (1989)	−0.045	−0.025	0.010	−0.102	0.016	0.019	−0.084	0.125					
9. ESeC class 3 (1989)	−0.069	−0.098	−0.087	−0.031	0.006	0.019	−0.187	−0.007	0.045				
10. ESeC class 6 (1989)	−0.061	0.048	−0.030	0.192	−0.076	−0.098	−0.429	−0.057	−0.018	0.237			
11. ESeC class 7 (1989)	−0.019	−0.016	−0.006	−0.011	−0.003	0.003	−0.034	−0.001	0.000	−0.003	0.008		
12. ESeC class 8 (1989)	−0.175	−0.086	−0.126	0.131	−0.053	0.014	−0.502	−0.016	−0.005	−0.042	−0.001	0.098	
13. ESeC class 9 (1989)	−0.012	−0.011	−0.008	0.000	−0.002	0.001	−0.015	0.000	0.000	−0.001	0.000	0.000	0.003

Variances are displayed on the horizontal diagonal.

Table H.4: Covariance matrix and standard deviations for the variables used in the path analyses presented in Chapter 11 for 13 783 GAZEL cohort participants: Accumulated accidents and quality of life in 2009

	1.CASP	2.MCS	3.PCS	4.Accidents	5.Age	6.Age^2	7.Grade	8.ESeC 2	9.ESeC 3	10.ESeC 6	11.ESeC 7	12.ESeC 8	13.ESeC 9
Quality of life													
1. CASP-19 quality of life (2009)	55.908												
Mediating variables													
2. Mental health SF-36 MCS (2007)	34.856	81.278											
3. Physical health SF-36 PCS (2007)	16.770	4.455	47.868										
Physical occupational exposure													
4. Accumulated accidents	−0.271	−0.200	−0.276	0.158									
Controls													
5. Age (1989)	−1.555	−0.550	−2.011	−0.059	8.118								
6. Age^2	−1.488	−0.203	−1.575	−0.028	6.360	56.557							
7. Occupational grade (1989)	3.707	2.220	2.416	−0.383	1.147	0.250	12.437						
8. ESeC class 2 (1989)	−0.045	−0.025	0.009	−0.009	0.016	0.019	−0.084	0.125					
9. ESeC class 3 (1989)	−0.069	−0.097	−0.087	0.003	0.006	0.019	−0.187	−0.007	0.045				
10. ESeC class 6 (1989)	−0.061	0.048	−0.031	0.017	−0.076	−0.098	−0.429	−0.057	−0.018	0.237			
11. ESeC class 7 (1989)	−0.019	−0.016	−0.006	0.000	−0.003	0.003	−0.034	−0.001	0.000	−0.003	0.008		
12. ESeC class 8 (1989)	−0.177	−0.088	−0.129	0.028	−0.053	0.014	−0.502	−0.016	−0.005	−0.042	−0.001	0.098	
13. ESeC class 9 (1989)	−0.012	−0.011	−0.008	0.000	−0.002	0.001	−0.015	0.000	0.000	−0.001	0.000	0.000	0.003

Variances are displayed on the horizontal diagonal.

Table H.5: Covariance matrix and standard deviations for the variables used in the path analyses presented in Chapter 11 for 13 783 GAZEL cohort participants: Accumulated chemical exposure and quality of life in 2009

	1.CASP	2.MCS	3.PCS	4.Chem. exp.	5.Age	6.Age^2	7.Grade	8.ESeC 2	9.ESeC 3	10.ESeC 6	11.ESeC 7	12.ESeC 8	13.ESeC 9
Quality of life													
1. CASP-19 quality of life (2009)	55.906												
Mediating variables													
2. Mental health SF-36 MCS (2007)	34.846	81.265											
3. Physical health SF-36 PCS (2007)	16.766	4.445	47.851										
Physical occupational exposure													
4. Acc. chemical exposures	−0.400	−0.096	−0.371	0.572									
Controls													
5. Age (1989)	−1.560	−0.554	−2.013	−0.034	8.118								
6. Age^2	−1.489	−0.208	−1.572	−0.195	6.360	56.557							
7. Occupational grade (1989)	3.699	2.213	2.401	−1.031	1.147	0.251	12.438						
8. ESeC class 2 (1989)	−0.045	−0.025	0.010	−0.048	0.016	0.019	−0.084	0.125					
9. ESeC class 3 (1989)	−0.069	−0.098	−0.087	−0.011	0.006	0.019	−0.187	−0.007	0.045				
10. ESeC class 6 (1989)	−0.061	0.050	−0.031	0.092	−0.076	−0.098	−0.429	−0.057	−0.018	0.237			
11. ESeC class 7 (1989)	−0.019	−0.016	−0.006	−0.003	−0.003	0.003	−0.034	−0.001	0.000	−0.003	0.008		
12. ESeC class 8 (1989)	−0.176	−0.088	−0.127	0.089	−0.053	0.014	−0.502	−0.016	−0.005	−0.042	−0.001	0.098	
13. ESeC class 9 (1989)	−0.012	−0.011	−0.008	0.000	−0.002	0.001	−0.015	0.000	0.000	−0.001	0.000	0.000	0.003

Variances are displayed on the horizontal diagonal.

Table H.6: Covariance matrix for the variables used in the analysis examining pathways from social position to subsequent quality of life for 16 623 participants from the GAZEL cohort

	1. CASP	2. MCS	3. PCS	4. Support	5. Wealth	6. Gender	7. Age	8. Grade
Quality of life								
1. CASP-19 quality of life (2005)	59.402							
Mediating variables								
2. Mental health SF-36 MCS (2003)	36.987	94.121						
3. Physical health SF-36 PCS (2003)	16.938	2.752	50.704					
4. Social support (2004)	0.515	0.481	0.061	0.123				
5. Wealth (2002)	1.725	1.394	0.773	0.019	1.726			
Controls								
6. Gender	−0.296	−0.663	−0.229	0.003	−0.029	0.166		
7. Age (1989)	−1.030	0.658	−1.917	−0.023	0.149	−0.183	9.377	
Social position								
8. Occupational grade (1989)	3.697	3.497	2.421	0.007	1.311	−0.331	1.669	11.014

Variances are displayed on the horizontal diagonal.

Appendix I

Research output

Academic publications

Platts, L.G., Netuveli, G., Webb, E., Zins, M., Goldberg, M., Blane, D., & Wahrendorf, M. (2013) Physical occupational exposures during working life and quality of life after labour market exit: Results from the GAZEL study. *Aging & Mental Health*, 17(6):697–706.

Platts, L.G., Webb, E., Zins, M., Goldberg, M., & Netuveli, G. Mid-life occupational grade and quality of life after retirement: A 16-year follow-up of the French GAZEL study. *Aging & Mental Health*, in press.

Non-peer-reviewed publications

Platts, L.G. (2012) Do physical working conditions influence quality of life after retirement? *ICLS Occasional Paper 9.3*. International Centre for Lifecourse Studies in Society and Health, London.

Platts, L.G. (2012) Influence des conditions de travail sur la qualité de vie après le départ en retraite [Influence of working conditions on quality of life after retirement]. *Journal d'information de la cohorte GAZEL*, 45:2.

Pikhartova, J., Platts, L. & Cable, N. A period of crucial changes: Adolescence (2012) *Life Gets Under Your Skin*. Bartley, M. (ed.) UCL Research Department of Epidemiology and Public Health, London.

Conferences

Platts, L.G., Netuveli, G., Webb, E., Wahrendorf, M., Zins, M., & Goldberg, M. Does health account for the relationship between mid-life occupational grade and quality of life after retirement? A 16-year follow-up of the French GAZEL study. *Second Special Interest Meeting on Comparative Health Sociology and Social Epidemiology*, Ghent, 20th–21st June 2013.

Platts, L.G., Netuveli, G., Webb, E., Zins, M., Goldberg, M., Blane, D., & Wahrendorf, M. Occupational exposures in mid-life and quality of life after labour market exit. *European Child Cohort Network and Society for Longitudinal and Life Course Studies International Conference*, Paris, 29th–31st October 2012.

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Platts, L.G., Netuveli, G., Zins, M., Goldberg, M., & Blane, D. Accumulation de risques au travail et qualité de vie après le départ à la retraite : une étude de « life course » avec la cohorte GAZEL [Accumulation of occupational hazards and quality of life after retirement: A life course study using the GAZEL cohort]. *3e Colloque thématique de l'ADELF 2012 : Épidémiologie sociale et inégalités de santé*, Toulouse, 15th–16th May 2012. Abstract published in *Revue d'Épidémiologie et de Santé Publique* 61, S114.

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Additional impact

A cross-walk between the French national occupational classifications used in the GAZEL cohort to the European Socio-economic Classification was generated during the course of this project. This creates possibilites for comparing social class inequalities in GAZEL with those in other European cohorts. To this end, the final cross-walk was transferred to the GAZEL team for other researchers to use.

Appendix J

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Physical occupational exposures during working life and quality of life after labour market exit: results from the GAZEL study

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Objective: To investigate variations in quality of life at older ages, we take a life course perspective to analyse long-term effects of physical working conditions upon quality of life after retirement. In doing so, we study to what extent these associations are explained by individuals' health at older ages.
Method: We use administrative data and self-administered questionnaire responses from the French GAZEL cohort. Quality of life was assessed with CASP-19 in 2009 and related to three types of physical working conditions during previous working life: (1) ergonomic strain, (2) physical danger and (3) exposures to chemicals. Health was assessed in 2007 with the SF-36 Health Survey. Multiple regressions were calculated in retired men only, controlling for important confounders including social position.
Results: In contrast to men, few women were exposed to strenuous and dangerous working conditions in this cohort and were not included in subsequent analyses. Negative effects on retired men's quality of life were found for the physical occupational exposures of ergonomic strain and physical danger, but not for chemical exposures. Effects were attenuated after the introduction of physical and mental health to the models, indicating an indirect effect of physical working conditions upon quality of life via health.
Conclusion: Adverse physical working conditions have long-term consequences for health and quality of life at older ages. Improvements to physical working conditions may improve individuals' quality of life over the long term.

Keywords: quality of life; life course; physical work environment; health; CASP-19

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Introduction

The period following labour market exit has been associated with an improvement in well-being as individuals are freed from the demands of working life (Westerlund et al., 2010). However, while a period of personal flourishing, which can accompany retirement, has been described as the Third Age (Laslett, 1991), retirement can also bring risks of social marginalization and impoverishment (Townsend, 1981). It is possible that exposures to hazards at earlier stages of the life course, such as social, financial and health hazards during working life, may increase individuals' chances of experiencing dependency rather than agency in later life. While the importance of life course circumstances for health in later life has been demonstrated (for reviews, see Blane, Netuveli, & Stone, 2007; Kuh & Shlomo, 2004), only a minority of studies have investigated life course influences on quality of life in early old age by explicitly focusing on a measure of quality of life that is not reducible to physical and mental health alone (Hyde, Wiggins, Higgs, & Blane, 2003; Netuveli, Wiggins, Hildon, Montgomery, & Blane, 2006).

In this vein, a small but growing literature highlights the importance of early adulthood and mid-life stages in explaining quality of life at older ages. Findings within the life course tradition suggest that previous conditions influence quality of life at older ages indirectly by influencing an individual's current situation; in this way, conditions during working life shape an individual's circumstances in later life as suggested by the pathway model in life course epidemiology (Blane, 2006; Blane et al., 2007). For instance, among older men in the Boyd-Orr cohort, socio-economic disadvantage during working life was associated with worse quality of life via current health and material circumstances, suggesting that earlier disadvantage tended to set men on a path to difficult current circumstances (Blane, Higgs, Hyde, & Wiggins, 2004). Similarly, in a study using the British Household Panel Survey, having had children at younger ages was

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related to lower quality of life among participants aged over 51 years, a relationship again largely accounted for by current socio-economic and health disadvantages (Read & Grundy, 2011). A small retrospective survey in the British county of Northamptonshire indicated that aspects of previous employment might influence retirees' quality of life via their effects on the quality of retirement (Lowis, Edwards, & Singlehurst, 2010). These results indicate the importance of taking a life course perspective in order to understand quality of life at older ages and suggest the importance of earlier working conditions.

Dangerous and strenuous working conditions influence health through a variety of pathways. Safety hazards may influence subsequent health through the long-term impact of injuries while health hazards may result in occupational illness (Levy, Wegman, Baron, & Sokas, 2011, p. 5). Biomechanical health hazards or ergonomic strain cause long-term and painful musculoskeletal disorders (Descatha et al., 2011; Leclerc, Tubach, Landre, & Ozguler, 2003; Plouvier, Leclerc, Chastang, Bonenfant, & Goldberg, 2009; Plouvier, Renahy, Chastang, Bonenfant, & Leclerc, 2008), while chemical health hazards are likely to influence later health as a result of causing cancer or disabling and often irreversible respiratory illness (Ahasic & Christiani, 2011, p. 398; Berr et al., 2010; Imbernon et al., 1995; Lundberg, Hemmingsson, & Hogstedt, 2007, p. 13; Martin, Imbernon, Goldberg, Chevalier, & Bonenfant, 2000). However, it is not known to what extent the health effects of earlier working conditions affect individuals' chances of enjoying good quality of life following retirement.

In this contribution, we focus on the long-term effects of physical working conditions upon quality of life at older ages, using prospective and retrospective data from the French GAZEL study. In addition, we study how far these conditions exert long-term effects on quality of life via their influences on health in later life. In doing so, two well-evidenced associations are considered and studied in a life course framework: first, studies showing that health is an important determinant of quality of life at older ages (Netuveli et al., 2006; Wiggins, Higgs, Hyde, & Blane, 2004); second, studies in which physical working conditions have been associated with health (for reviews, see Bambra, 2011, chap. 3; Clougherty, Souza, & Cullen, 2010).

Two further aspects must be considered here. First, we use the CASP-19 scale of quality of life, which is specifically designed to measure quality of life in early old age. As older people live longer and healthier lives, it is no longer appropriate to reduce quality of life in older people to their experience of their health. In this way, the CASP-19 measure of quality of life has been developed by drawing on the literature of ageing and the Third Age (Gilleard, 1996; Laslett, 1991), identifying human needs (Doyal & Gough, 1991) particularly relevant in early old age (control, autonomy, self-realization and pleasure (Hyde et al., 2003; see Methods for conceptual details). Consequently, this study with its measure of quality of life relates to the literature of the Third Age. Second, the GAZEL cohort provides detailed information on physical working conditions throughout working life, which have been obtained from administrative sources and annually self-administered questionnaires (see measurement for details), enabling a prospective study design to be used. In addition, information on employees' career histories is available for the GAZEL participants, enabling appropriate adjustment for social position, which otherwise might confound the effects of physical working conditions upon quality of life (e.g. lower social position in jobs with high physical demands).

Two research questions will be examined: (1) Can variations in quality of life in early old age be predicted from physical occupational exposures during working life? We predict that more strenuous and dangerous working conditions over the life course will be associated with lower quality of life following labour market exit. (2) How much is the decline in quality of life related to strenuous and dangerous earlier working conditions due to a decline in health? Since exposure to higher levels of physical occupational exposures has been associated with worse health after retirement and poorer health is a predictor of worse quality of life, we predict that health will mediate the relationships between physical working conditions and subsequent quality of life.

Methods

Data

The research questions were explored using the GAZEL occupational cohort of persons employed by the French national gas and electricity company (EDF-GDF). GAZEL participants tended to be hired in their 20s and work for the company until they retired between the ages of 50 and 60 years. Although the GAZEL cohort represents a specific employment sector, the study population was recruited from urban and rural areas throughout France, represents a wide range of occupations and has a socio-economic structure that compares well to the French population (for a detailed cohort profile, see Goldberg et al., 2007). Annual questionnaires and administrative records were used to measure physical occupational exposures. At study onset, in 1989, 20,625 employees were recruited. By January 2009, 1318 people had died. In our analyses, we were interested in physical occupational exposures and their long-term effects on quality of life after labour market exit. Therefore, we restricted the sample to men and women who were retired in 2009 (excluding a further 985 individuals). We further excluded 81 employees who had worked fewer than 15 years at EDF-GDF by the start of 2009 because they might have received substantial and unrecorded physical occupational exposures from employment elsewhere. Finally, individuals with

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missing data on quality of life, health or retrospective ergonomic strain (7400 people) were excluded to result in a complete case sample of 10,841 participants (8498 men and 2343 women). Attrition rates were higher among those who were in poorer health in 1989, reported more ergonomic constraints in 1989 and 1990 and had experienced workplace accidents.

Measures

Quality of life

Quality of life was assessed in the self-completion questionnaires with the CASP-19 instrument. It has been specifically designed for early old age and is widely used in international ageing surveys (Hyde et al., 2003; Netuveli et al., 2006). The CASP-19 measure is intended to be distinct of individual or contextual factors that influence quality of life, such as health or material circumstances, and does not focus on respondents' self-evaluation of quality of life. Rather, a theoretically informed approach based on the satisfaction of certain human needs has been taken (Doyal & Gough, 1991), emphasizing the more active and reflective dimensions of human nature (Wiggins et al., 2004). Each of the 19 four-point Likert-scaled items in the CASP-19 measure draws from one of the four domains: control (C), autonomy (A), self-realization (S) and pleasure (P). A summary measure of the 19 items is used to assess quality of life in this study; the total sum score ranges from 0 to 57, with higher scores indicating a higher overall quality of life. In our sample, the value for the internal consistency of the CASP-19 scale (Cronbach's alpha) was 0.88, the mean CASP-19 score was 43.22 and the standard deviation 7.69. Technical details about the CASP-19 scale and results of validation procedures are provided elsewhere (Blane et al., 2004; Hyde et al., 2003; Wiggins, Netuveli, Hyde, Higgs, & Blane, 2008).

Physical working conditions

In the analyses, we distinguished three different types of physical working conditions: (1) ergonomic strain, (2) physical danger and (3) exposures to chemicals.

(1) Ergonomic strain: Ergonomic strain was measured with two indicators: (i) a retrospective ergonomic strain score from the 2007 self-completion questionnaire and (ii) a prospective score of ergonomic strain measured in 1989 and 1990.

   (i) Retrospective ergonomic strain score: In the 2007 questionnaire participants were asked to indicate the start and end years of periods in which they were exposed to any of the following constraints at work: regularly carrying or moving heavy loads, regularly bending forward or twisting the back or trunk, driving a vehicle for two or more hours a day (including commuting to and from work), working on their knees, going up or down more than 10 flights of stairs a day, climbing onto ladders or step-ladders, working with the hands above the head, carrying loads on the shoulder and using vibrating tools. We created a summed score of career-long exposure by adding the number of different constraints participants were subjected to in each year, and adding together these annual totals to create a summed score of career-long ergonomic exposures. Individuals were grouped into three categories ('no exposure': unexposed; 'moderate exposure': exposure level at or below the median for those exposed; 'high exposure': exposure level above the median for those exposed).

   (ii) Ergonomic strain score (1989/1990): In the 1989 and 1990 questionnaires, participants were asked whether their current work included any of the following five types of activities: spending a long time on their feet; spending a long time in another tiring posture; long, frequent or rapid journeys in a vehicle; carrying or moving heavy loads; or being subjected to shaking or vibrations. Following Melchior et al. (2005), affirmative responses to each item were summed into a score of total ergonomic strain for each year ranging from 0 to 5. To minimize the influence of temporary activities and thereby reduce measurement error, the scores for 1989 and 1990 were averaged to produce a 1989/1990 score of ergonomic strain.

(2) Physical danger: Physical danger was measured with two indicators: perception of physical hazards in 1989 and 1990 and accident records.

   Perception of physical hazards: In the 1989 and 1990 questionnaires, participants indicated whether they thought they were exposed to any of a range of the following seven physical risks in the course of their work: breathing in gas, serious falls, minor falls, being injured by a machine, heat burns, chemical burns or having a road accident. Affirmative responses to each item were summed to produce total scores of physical hazards in 1989 and 1990. To reduce the influence of short-term risks, as well as fluctuations in risk assessments, the scores for 1989 and 1990 were averaged to produce a 0–7 score indicating exposure to physical hazards for the period 1989/1990.

   Accident records: Medically certified sickness absence data from administrative records were used

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to calculate total numbers of episodes of absences for each participant due to accidents at work (recorded as: *accident de travail*) between 1978 and 2009. The distribution of accidents was non-normal so a three-group categorical variable was created: a first group containing participants who did not have any accident episodes recorded (no exposure); the remainder were divided into two groups according to whether they had one accident (moderate exposure), or more than one accident (high exposure).

(3) Exposure to chemicals: To measure exposure to chemicals we used information from the MATEX job-exposure matrix, which indicated, for each employee, their estimated annual exposures to harmful chemicals (Imbernon, Goldberg, & Guénel, 1991; Imbernon et al., 1996). Company occupational physicians regrouped jobs into 403 different occupations and indicated likely exposure levels to each of 30 potential carcinogens. Details about individuals' occupational histories from company records were used to attribute exposures to each employee. Information from the job-exposure matrix is available from 1956 until 1998, when levels of chemical exposure fell to low levels among participants in the GAZEL cohort. We added together the number of different chemicals to which individuals were exposed in each year and then added these annual totals together to create an index of accumulated chemical exposures over the whole career. Next, individuals were regrouped into three categories ('no exposure': unexposed, 'moderate exposure': exposure level at or below the median for those exposed, 'high exposure': exposure level above the median for those exposed).

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Health functioning

Mental and physical component summary scores from the French standard version of the Short Form 36 Health Survey (SF-36) were used to measure health functioning in 2007 (Leplège, Ecosse, Coste, Pouchot, & Perneger, 2001; Ware Jr & Sherbourne, 1992). The SF-36 questionnaire is an internationally validated measure of health functioning composed of 36 questions about physical and mental functioning, which are grouped into eight subscales depicting different health domains. The internal consistency of the single domains proved satisfactory in our sample (Cronbach's alphas vary between 0.80 and 0.84) and two summary scores were derived, a mental component summary score (SF-36 MCS) and a physical component summary score (SF-36 PCS), both ranging from 0 to 100 with higher scores indicating better health. The psychometric properties of the French SF-36 and the construction of the two scores are fully described elsewhere (Leplège et al., 2001).

Additional variables

We included a number of socio-demographic variables as controls in the multivariate analyses. Age and age-squared were included because quality of life is known to have a nonlinear relationship with age (Zaninotto, Falaschetti, & Sacker, 2009). To minimize the risk that any observed association between physical working conditions and quality of life was due to respondents' social position, two complementary measures of social position have been used in the multiple analyses: social class and occupational grade (both measured in 1989).

Social class was measured using the European Socio-economic Classification (ESeC) (Rose & Harrison, 2007). It categorizes individuals according to particular aspects of the work setting and the labour market situation. More specifically, occupations are grouped according to the degree of specificity of human assets they require and of the difficulty managers face in monitoring the quality and quantity of work produced (Rose, Harrison, & Pevalin, 2009, pp. 10–14). To classify respondents into ESeC, we used the four-digit French national social class classification available in GAZEL and the conversion table developed by Louis-André Vallet and Christel Colin at the French National Institute of Statistics and Economic Studies (Brousse, Monso, & Wolff, 2007, pp. 87–95). Because all the GAZEL participants were employed, only seven of the existing 10 ESeC classes were available for our study. These are ESeC1 (large employers, higher grade professionals, administrative and managerial occupations); ESeC2 (lower grade professional, administrative and managerial occupations and higher grade technicians and supervisory occupations); ESeC3 (intermediate occupations); ESeC6 (lower supervisory and lower technician occupations); ESeC7 (lower sales, services and clerical occupations); ESeC8 (lower technical occupations) and ESeC9 (routine occupations).

The second measure, occupational grade, is an internal company classification. It classifies all occupations on a continuous scale, ranging from 1 to 52 in this sample, with higher values being associated with higher salary and higher status within the company. These complementary measures, social class and occupational grade, have been used as controls because each focuses on different aspects of social position: social class on the nature of employment relationships and occupational grade on an occupation's salary, position with the company hierarchy and prestige within the organization.

Statistical analysis

The analyses were carried out in Stata 12.1 (StataCorp, 2011a); men and women were analysed separately. First,

Table 1. Description of measures and sample ($N = 10{,}841$).

Variable (year)	Categories or range	Male ($N = 8498$) % or mean	Male ($N = 8498$) N or s.d.	Female ($N = 2343$) % or mean	Female ($N = 2343$) N or s.d.
Age (2009)	56–70 years (women), 61–70 years (men)	64.9	2.8	63.1	3.8
Occupational grade (1989)	1–52	9.5	3.5	7.2	2.6
ESeC social class (1989)	ESeC 1: Higher salariat	34.0	2885	9.0	211
	ESeC 2: Lower salariat	14.7	1252	60.4	1415
	ESeC 3: Higher grade white-collar workers	3.8	325	16.7	393
	ESeC 6: Higher grade blue-collar workers	38.1	3236	6.7	158
	ESeC 7: Lower grade white-collar workers	0.6	48	6.8	159
	ESeC 8: Skilled workers	8.6	734	0.3	7
	ESeC 9: Semi- & non-skilled workers	0.2	18	0.0	0
Ergonomic strain					
Retrospective ergonomic constraints (2007)	No exposure	35.0	2978	77.6	1817
	Moderate exposure	30.0	2546	20.2	482
	High exposure	35.0	2974	2.3	54
Ergonomic strain score (1989/1990)	0–5	0.9	1.0	0.3	0.5
Physical danger					
Physical hazards score (1989/1990)	0–7	1.6	1.5	0.2	0.5
Accumulated accidents (1978–2009)	No exposure	83.2	7071	87.6	2053
	Moderate exposure	11.6	988	9.1	213
	High exposure	5.2	439	3.3	77
Exposure to harmful chemicals					
Accumulated chemical exposures (1956–1998)	No exposure	39.4	3346	99.0	2319
	Moderate exposure	31.9	2709	1.0	23
	High exposure	28.8	2443	0.0	1
SF-36 MCS (2007)	0.3–71.3	49.4	8.9	45.7	10.9
SF-36 PCS (2007)	13.6–68.9	50.3	6.8	49.4	7.9
CASP-19 score (2009)	7–57	43.5	7.4	42.3	8.8

descriptive analyses were used to explore sample characteristics (Table 1). Second, we studied correlations between all variables under study for men only, given the low frequencies of strenuous and dangerous physical working conditions among women (Table 2).

We examined mean quality of life scores for each of the three categorical indicators of occupational exposures (retrospective ergonomic constraints, accumulated accidents and accumulated chemical exposures) in order to illustrate the crude associations between

Table 2. Intercorrelations between the main variables: all correlation coefficients are significant at $p < 0.05$ apart from the value marked[a] ($N = 8498$ men).

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
1. Age	–										
2. Occupational grade	0.14	–									
3. ESeC social class	−0.12	−0.71	–								
Ergonomic strain											
4. Accumulated ergonomic strain	−0.05	−0.37	0.42	–							
5. Ergonomic strain score	−0.08	−0.34	0.40	0.36	–						
Physical danger											
6. Physical hazards score	−0.10	−0.30	0.41	0.36	0.60	–					
7. Accumulated accidents	−0.07	−0.26	0.27	0.19	0.27	0.22	–				
Exposures to harmful chemicals											
8. Accumulated chemical exposures	−0.06	−0.43	0.53	0.46	0.33	0.43	0.22	–			
9. SF-36 MCS	−0.03	0.06	−0.02	−0.04	−0.05	−0.03	−0.05	0.00[a]	–		
10. SF-36 PCS	−0.10	0.08	−0.06	−0.12	−0.09	−0.06	−0.09	−0.07	0.04	–	
11. CASP-19	−0.07	0.12	−0.09	−0.06	−0.08	−0.06	−0.08	−0.05	0.51	0.30	–

[a] = not significant at the 5% level.

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physical working conditions and quality of life in men (Figure 1).

Next, to test our two research questions, we estimated ordinary least squares (OLS) linear regression models to predict quality of life in 2009 for men (Table 3). In Table 3, we present unstandardized regression coefficients together with standard errors and levels of significance, as well as one measure of model fit (coefficient of determination 'R^2' as a measure of 'explained variance'). Two nested models were estimated for each of the five occupational exposures. First, the effects of adverse physical working conditions were calculated, adjusted for age and the two measures of occupational position (Model 1). These models allow the effect of each occupational exposure to be tested separately (research question 1). Next, in Model 2, mental and physical health functioning was added to the models. By comparing the coefficients of the models, we examined the degree to which associations between physical working conditions and quality of life were mediated by health (research question 2).

To address a possible bias due to sample attrition and item non-response, multiple imputations were carried out as a test of robustness (Allison, 2002). The imputations were performed in Stata 12.1 using chained equations with augmentation where necessary (StataCorp, 2011b). To create the multiply imputed datasets, in addition to the covariates, variables were included that have previously been shown to predict attrition (Goldberg, Chastang, Zins, Niedhammer, & Leclerc, 2006) and that predict likely values for missing variables. For each model, 10 imputations were carried out each preceded by 10 iterations. The multiply imputed results are not presented in detail.

Results

Descriptive findings

Before examining the main research questions, we will briefly describe the sample as presented in Table 1. In 2009, when quality of life was measured, men's mean age was two years older than women's. Mean employment grade was higher for men than women and men were more likely to hold management and professional positions and supervisory blue-collar roles. In contrast, women tended to occupy white-collar posts; very few women held blue-collar roles. Regarding our exposures of interest, men had been exposed to more strenuous and dangerous working conditions than women, particularly for exposure to ergonomic strain and harmful chemicals where high levels of exposures were nearly non-existent for women. Male participants had better physical and mental health and reported better quality of life.

Bivariate associations

Table 2 displays all the correlation coefficients between the main variables. These analyses are restricted to men, because very few women had been exposed to adverse physical working conditions. In summary, the occupational exposures were positively correlated with each other, including the retrospective and prospective indicators of ergonomic strain, which provides some support for the reliability of the self-reported measures. Turning to the associations between social position and physical working conditions, higher grade and higher social class (the highest ESeC classes 1, 2 and 3 are non-manual) are associated with lower levels of exposures in men. Physical working conditions were weakly negatively correlated with physical and mental health functioning in men. There were positive correlations between physical and mental health functioning and quality of life. All types of physical working conditions were weakly negatively correlated with quality of life at older ages.

Figure 1 displays mean CASP-19 scores and 95% confidence intervals for the three categorical indicators of working conditions under study (retrospective ergonomic constraints, accumulated accidents and accumulated chemical exposure). In each case, the most exposed men reported lowest levels of quality of life, while quality of life was highest among those with no exposure. The differences are statistically significant at $p < 0.001$ (ANOVA). For the accumulated accidents measure of physical danger the difference in mean scores between the no exposure and high exposure groups is almost two CASP-19 points.

Do these associations persist after adjustment for important confounders? And how far does physical and mental health mediate these associations? These questions were answered in the two sets of models presented in Table 3, in which Model 1 controls for important confounders and Model 2 additionally includes health.

Multivariate findings

The findings of the multivariate analyses support the relationship between CASP-19 and occupational exposures, which was suggested by the bivariate analyses. With the exception of chemical exposures, the associations between the physical occupational exposures and quality of life are statistically significant after controlling for social position in Model 1 (Table 3). In Model 2, after inclusion of physical and mental health measures, model fit improves and the associations between each physical occupational exposure and quality of life attenuate or reverse. This suggests that the associations between physical occupational exposures and quality of life are accounted for once physical and mental health measures are included in the model.

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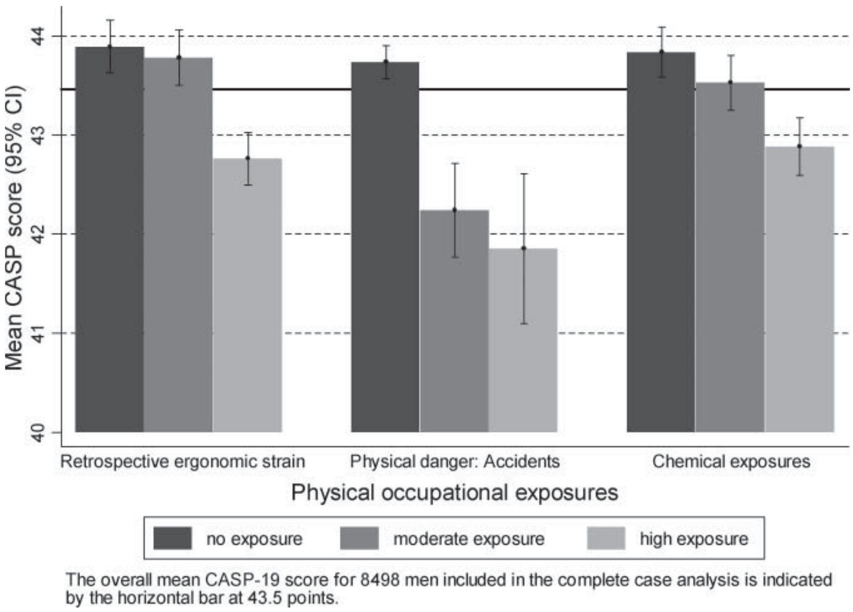

Figure 1. Quality of life after labour market exit by physical working conditions among 8498 men in the GAZEL cohort.

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The results of additional analyses using the multiply imputed data sets described in the methods section did not differ substantially from those displayed in Table 3 (results not shown). The magnitude and statistical significance of coefficients were similar for each measure of occupational exposure, as well as the findings suggesting a mediating role for health.

Discussion

This paper uses data from the GAZEL cohort to study the long-term effects of physical working conditions on quality of life after labour market exit and finds that exposure to negative physical working conditions across the working life course is associated with worse quality of

Table 3. Associations between physical occupational exposures and quality of life for men: Results of multivariate linear models ($N = 8498$).

	Model 1			Model 2		
	Coefficient	Standard error	R^2	Coefficient	Standard error	R^2
Ergonomic strain						
Retrospective ergonomic strain 2007			0.026			0.345
No exposure (reference)	–			–		
Moderate exposure	0.12	0.20		0.40*	0.16	
High exposure	−0.42*	0.21		0.40*	0.17	
Ergonomic strain 1989/1990	−0.36***	0.09	0.027	−0.04	0.07	0.344
Physical danger						
Physical hazards 1989/1990	−0.19**	0.06	0.026	−0.06	0.05	0.345
Accident episodes 1978–2009			0.028			0.345
No exposure (reference)	–			–		
Moderate exposure	−1.09***	0.25		−0.47*	0.21	
High exposure	−1.16**	0.37		−0.10	0.30	
Exposure to harmful chemicals						
Chemical exposures 1956–1998			0.025			0.344
No exposure (reference)	–			–		
Moderate exposure	0.03	0.20		0.01	0.16	
High exposure	0.02	0.23		0.08	0.19	

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.
Note: Model 1: Associations between each physical occupational exposure and quality of life, controlled for age, age-squared, occupational grade and ESeC social class.
Model 2: Model 1 + SF-36 mental and physical component scores.

life in early old age. We study to what extent health in later life accounts for the observed association, since working conditions are known to influence health in later life (Bodin et al., 2012; Descatha et al., 2011; Niedhammer, Chastang, David, & Kelleher, 2008), and health in turn is associated with quality of life (Farquhar, 1995; Webb, Blane, McMunn, & Netuveli, 2011; Zaninotto et al., 2009). To assess physical working conditions, we used administrative data combined with information from self-completion questionnaires and divided the exposure into three types: (1) ergonomic strain, (2) physical danger and (3) exposures to harmful chemicals. The CASP-19 questionnaire was used to indicate quality of life. To measure health in early old age we used mental and physical component scores from the SF-36 questionnaire.

The main findings can be summarized as follows: First, few women were exposed to adverse working conditions and those who were generally received low levels of exposure. In contrast, levels of physical occupational exposures were higher for men and consistent associations with quality of life were found for both measures of ergonomic strain and of physical danger, but not for chemical exposures. The associations of ergonomic strain and physical danger with quality of life remained statistically significant after adjustments for possible confounders including employment grade, social class and age of the study participants. It is possible that negative results for chemical exposures might be due to loss to follow-up due to death (Martin et al., 2000). Previous work in the GAZEL cohort has shown long-term effects of solvents on cognition at high levels of exposure (Berr et al., 2010; Sabbath et al., 2012); perhaps a lack of association with quality of life in the current study was a result of using a non-specific measure of lifetime chemical exposure. In summary, these results underline the importance of previous physical working conditions for quality of life in early old age.

Our second main finding draws attention to the mediating effect of health functioning in later life upon the relationship between physical working conditions and quality of life. For men, the associations of exposure to physical danger and ergonomic strain in the workplace with quality of life were attenuated after introduction of measures of physical and mental health functioning into the models. Corresponding to previous studies finding adverse effects of physical working conditions on later health (e.g., National Institute for Occupational Safety and Health, 1997; Punnett and Wegman 2004), this result suggests that the association between working conditions and quality of life is partially mediated by health.

The additional aspects of working conditions and further mechanisms may help explain the associations with mental health. For instance, poorer mental health functioning in later life could have resulted from poorer physical health or from other characteristics of the working environment such as high levels of work stress (Wahrendorf et al., 2012).

We found negative impacts of physical occupational exposures regardless of whether a measure of ergonomic strain from a two-year period in 1989/1990 or a retrospective measure of career exposures to ergonomic strain was used. This could be because the level of exposure to ergonomic strain in 1989/1990 is a good indicator of career-long ergonomic strain, perhaps because employees tended to have similar sorts of career trajectories.

To our knowledge, this is the first prospective study examining long-term influences of physical working conditions upon quality of life in early old age. Our findings add to the existing literature of the determinants of quality of life in older ages, first, by pointing to the importance of previous physical working conditions for later quality of life, and second, by highlighting the possible mediating role of health. These results extend earlier findings of long-term effects of conditions in previous life stages on quality of life (Blane et al., 2004) by studying the interrelations between previous working conditions, health in later life and quality of life after labour exit within a life course framework.

Strengths and limitations

The study design of the GAZEL cohort, in particular its large study sample and low attrition rates, is a particular strength of the study (Zins, Leclerc, & Goldberg, 2009). Uniquely, the GAZEL cohort provides detailed information on three different types of physical occupational exposures, based on administrative data and on self-reports and covering a long timeframe. Similarly, quality of life and health were measured by the full original versions of two theoretically grounded and internationally established questionnaires (Hyde et al., 2003; Leplège et al., 2001) and two complementary measures of social position were included as important confounders. However, several limitations of this study must be discussed.

First, despite a population that is socially and geographically diverse (Goldberg et al., 2007), conclusions from analyses of the GAZEL cohort data must be drawn carefully, since important segments of the population (e.g. unemployed people and self-employed workers) are absent. Furthermore, working conditions of the GAZEL cohort are considered to be generally better than those in the French population, given that participants held stable posts in a nationalized company. These might lead the impact of physical working conditions upon quality of life to be underestimated in this study. The influences of dangerous and strenuous working conditions could be greater in a less well-protected population.

Second, only one quarter of the respondents in our study were female, and the majority of women employed at GDF/EDF held white-collar posts. Consequently, few

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women were exposed to strenuous and dangerous working conditions and the relationship between physical occupational exposures during working life and quality of life following retirement could therefore not be explored amongst women here.

Third, by restricting the sample to people who had already left the labour market in 2009, some selection bias could have affected our findings, given that poor health might be one reason for labour market exit, and thus respondents in poor health may be over-represented. However, sensitivity analyses, which included men who were still working in 2009, gave similar results.

Fourth, although most data on occupational exposures were obtained from administrative records or from baseline in 1989, sample attrition had occurred by the time quality of life was recorded in 2009 and it may be possible that a systematic non-response bias occurred because people with more health problems were more likely to stop participating in the study (Goldberg et al., 2006). Similarly, people in good health may be more likely to give information on their quality of life. However, the robustness of these results has been tested by carrying out multiple imputations in which variables known to predict attrition were included and the findings were replicated.

Lastly, some readers may be concerned that the measures of health (SF-36) and quality of life (CASP-19) used in this analysis overlap, because SF-36 is sometimes used to measure health-related quality of life. We would argue that the measures are conceptually distinct, as CASP-19 explicitly focuses on aspects of quality of life that are not reducible to physical and mental health. Further research could use other health measures to confirm the results.

In this contribution, we focussed on associations between physical working conditions and quality of life after labour market exit and the explanation of this association by health. In doing so, other important potential determinants of quality of life were not included in the analyses. For instance, our findings clearly indicate that social position is associated with quality of life after labour market exit. Although our multivariate analyses control for social position and independent effect of physical working conditions could be observed in our final model, other factors associated with low social position (e.g. psychosocial work stress, health behaviours) could be investigated in subsequent studies. Similarly, analyses could examine whether the impact of physical occupational exposures varies according to the individual's social position or the timing of the exposure, or whether effects of chemical exposures can be found by differentiating exposures by type of chemicals or duration of exposure.

Conclusion

In conclusion, this study has shown that long-term exposure to ergonomic strain and physical hazards influence quality of life after labour market exit through their impact upon mental and physical health. After taking account of the effects of social class and occupational grade, findings suggest that physical work exposures during the life course have long-range effects upon subsequent quality of life. Improvements to working conditions to reduce exposure to strenuous and dangerous activities could increase quality of life as well as health over the long term.

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