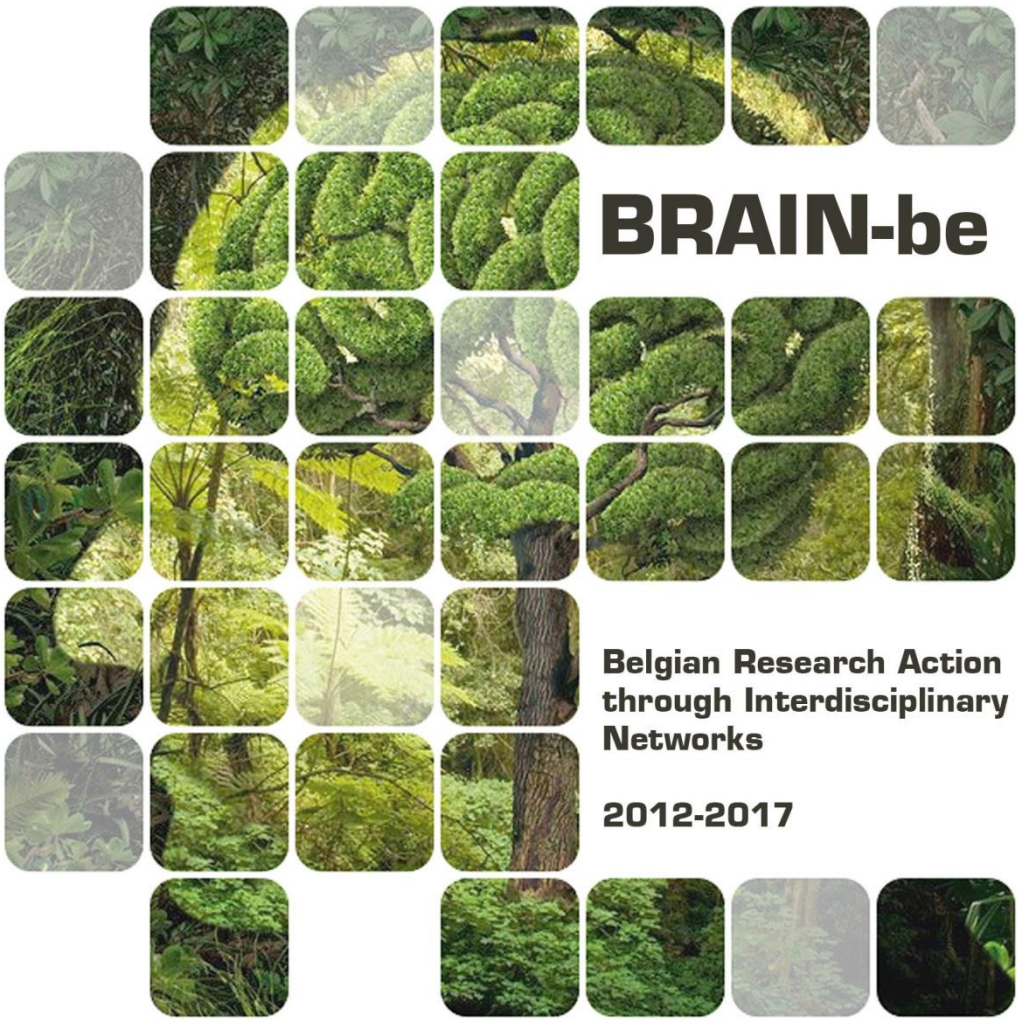


CAUSINEQ

Causes of health and mortality inequalities in Belgium: multiple dimensions, multiple causes.

KAREN VAN AERDEN (ed.) (VUB[2]) – REBEKA BALOGH (VUB[2]) – LUC DAL (UCL[1]) – JOAN DAMIENS (UCL[1]) – DEBORAH DE MOORTEL (VUB[2]) – THIERRY EGGERICKX (UCL[1]) – CATHERINE GOURBIN (UCL[1]) – PAULIEN HAEGEDOORN (VUB[2]) – KELLY HUEGAERTS (VUB[2]) – PAUL MAJERUS (UCL[1]) – BRUNO MASQUELIER (UCL[1]) – JEAN-PAUL SANDERSON (UCL[1]) – OCEANE VAN CLEEMPUT (UCL[1]) – CHRISTOPHE VANDESCHRICK (UCL[1]) – CHRISTOPHE VANROELEN (VUB[2]) – KATRIEN VANTHOMME (VUB[2]) – DIDIER WILLAERT (VUB[2]) – SYLVIE GADEYNE (VUB[2])

[1] Centre de recherche en démographie et sociétés, Place de l'Université 1, 1348 Louvain-la-Neuve

[2] Interface Demography, Pleinlaan 5, 1050 Brussel

Axis 5: Major societal challenges

VRIJE UNIVERSITEIT BRUSSEL
UCLouvain
belspo
.be

NETWORK PROJECT

CAUSINEQ

Causes of health and mortality inequalities in Belgium: multiple dimensions, multiple causes.

Contract - BR/121/A5

FINAL REPORT

PROMOTORS: SYLVIE GADEYNE (Vrije Universiteit Brussel)
THIERRY EGGERICKX (Université Catholique de Louvain)

AUTHORS: KAREN VAN AERDEN (ed.) (Vrije Universiteit Brussel)
REBEKA BALOGH (Vrije Universiteit Brussel)
LUC DAL (Université Catholique de Louvain)
JOAN DAMIENS (Université Catholique de Louvain)
DEBORAH DE MOORTEL (Vrije Universiteit Brussel)
THIERRY EGGERICKX (Université Catholique de Louvain)
CATHERINE GOURBIN (Université Catholique de Louvain)
PAULIEN HAEGEDOORN (Vrije Universiteit Brussel)
KELLY HUEGAERTS (Vrije Universiteit Brussel)
PAUL MAJERUS (Université Catholique de Louvain)
BRUNO MASQUELIER (Université Catholique de Louvain)
JEAN-PAUL SANDERSON (Université Catholique de Louvain)
OCEANE VAN CLEEMPUT (Université Catholique de Louvain)
CHRISTOPHE VANDESCHRICK (Université Catholique de Louvain)
CHRISTOPHE VANROELEN (Vrije Universiteit Brussel)
KATRIEN VANTHOMME (Vrije Universiteit Brussel)
DIDIER WILLAERT (Vrije Universiteit Brussel)
SYLVIE GADEYNE (Vrije Universiteit Brussel)

VUB VRIJE UNIVERSITEIT BRUSSEL UCLouvain belspo .be

Published in 2019 by the Belgian Science Policy Office
WTC III
Simon Bolivarlaan 30 Boulevard Simon Bolivar
B-1000 Brussels
Belgium
Tel: +32 (0)2 238 34 11
http://www.belspo.be
http://www.belspo.be/brain-be

Contact person: Emmanuèle Bourgeois
Tel: +32 (0)2 238 34 94

Van Aerden, K. (ed.), Dal, L., Damiens, J., De Moortel, D., Eggerickx, T., Gourbin, C., Haegedoorn, P., Huegaerts, K., Majérus, P., Masquelier, B., Sanderson, J-P., Van Cleemput, O., Vandeschrick, C., Vanroelen, C., Vanthomme, K., Willaert, D. & Gadeyne, S. ***CAUSINEQ. Causes of health and mortality inequalities in Belgium*: multiple dimensions, multiple causes.** Final Report. Brussels : Belgian Science Policy Office 2019 – 106 p. (BRAIN-be - Belgian Research Action through Interdisciplinary Networks)

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

Context

In Belgium, life expectancy is now twice what it was 170 years ago, due to improvements in public and private hygiene, nutrition, medical progress and health services. The average lifespan of a Belgian resident is over 80 years, but large inequalities according to socio-economic position persist.

Objectives

The CAUSINEQ project aimed to investigate the social inequalities in health and mortality in Belgium, their evolution in recent years and the role of de-standardised employment arrangements and family situations. The goal was to obtain information on the structural drivers of social differences in mortality and health and to generate policy-relevant findings.

Conclusions

The results of the CAUSINEQ project show that social inequalities in health and mortality are significant in Belgium and that they have been increasing both for men and women since at least the 1990s. Moreover, spatial disparities in mortality between regions, districts and municipalities persist and have been worsening for at least a quarter century. Concerning the role of employment, analyses show a clear excess mortality of the unemployed compared to the employed for practically all main causes of death. Furthermore, non-standard employment types appear to be only marginally better for the health of individuals than unemployment. With regard to marital status and family situation, a significant undermortality of (married) couples and an excess mortality for children under 5 years of age living in a single-parent family were observed.

Keywords

Inequality
Health
Mortality
Employment
Family

1. INTRODUCTION

In Belgium, like in other European countries, a negative relationship has been demonstrated between socio-economic position on the one hand and health and mortality on the other hand. The CAUSINEQ project aimed to investigate these social inequalities in health and mortality in Belgium, their evolution and the role of de-standardised employment arrangements and family situations. The goal was to obtain information about the mechanisms by which social differences in mortality and health are generated in Belgium, in order to provide insights in policy measures that could prove effective in countering these differences.

In first instance, the evolution of mortality inequalities in Belgium between 1991 and 2016 is studied using an indicator for socio-economic position combining information on education, housing and socio-professional group. In second instance, the relationship between instability in professional careers and (cause-specific) mortality is investigated. Mortality inequalities by employment status have been considered in detail, controlling for other dimensions of socio-economic position. The third part of the report considers mortality differentials by marital status, household situations and their transformation (again controlled for other dimensions of socio-economic position), in order to gain insight into the effect of the de-standardisation of family formation processes. In the final part, analyses have been performed that show how adverse health – as an important precursor of mortality – varies jointly by employment and living arrangements.

This report bundles all results stemming from the research efforts conducted within the framework of the CAUSINEQ project. In the next section, a state-of-the-art with regard to socio-economic inequalities in health and mortality is provided and the different objectives of the project are outlined. The data, measures and methods used to obtain the results are described in a methodological section. The presentation of the scientific results constitutes the main part of the report and is followed by a reflection on dissemination and valorisation of the results.

2. STATE OF THE ART AND OBJECTIVES

Thanks to advances in public and private hygiene, overall improvements in living conditions and medical innovations, life expectancy in Western countries has increased spectacularly during more than a century (Riley 2001; Adveev et al. 2011). In Belgium, the average life expectancy is now about 80 years, twice as long as 170 years ago. As in other Western countries, however, disparities persist and sometimes even widen.

2.1 Health and mortality inequalities in Belgium and Europe

The issue of social inequalities in health and mortality is an old one (Vedrennevilleneuve 1961; Lagasse et al. 1990; Valkonen 2002). In the 17th century, there was a 10-year gap in life expectancy between the privileged and disadvantaged classes in Geneva, while in Rouen the difference was only 3 years (Blum et al. 1989). Social differences in mortality could also be measured in the countryside of the Ancien Régime. From the second half of the 19th century onwards, social disparities in mortality have been the subject of numerous debates involving different "explanatory approaches". Literature has identified four types of factors to explain social differences in mortality (Macintyre 1997; Valkonen 2002):

- Artefactual explanations: measurement errors linked to the availability and quality of data;
- Selection effect explanations: linked to the assumption that it is health status that determines social status and not the other way around;
- Cultural and behavioural explanations: (lifestyle) factors specific to the different socio-economic positions in society such as alcohol consumption, smoking, dietary choices, etc.;
- Socio-economic explanations: structural or material characteristics of individuals (income, level of education, working and housing conditions, etc.).

While none of these explanatory mechanisms can be ruled out, most studies have considered individual socioeconomic factors to be at the root of inequalities in health and mortality (Herjean 2006; Link & Phelan 1995; Van Oyen et al. 2010). Over the years, a vast body of research has provided robust evidence for a negative association between (different indicators of) socio-economic position and mortality (Link et al. 1995; Phelan et al. 2004; Gadeyne 2006; Phelan et al. 2010). The reason is that the distribution of 'life chances' of all kinds is tightly linked with economic power mechanisms and their distribution in society (Muntaner et al. 2000). Many studies have also shown that differences in mortality and morbidity follow a definite socioeconomic *gradient* (Van Oyen et al. 2010): in other words, the further up the social ladder, the higher the life expectancy, and vice versa.

Besides social differences, also spatial differences in mortality are well established in the history of our societies (Antonovsky 1967; Caselli & Vallin 2002; Valkonen 2002). A significant proportion of these spatial differences in health/mortality can be explained by the socio-economic characteristics of the population: the most disadvantaged places are inhabited by the most disadvantaged people and therefore characterised by the highest

mortality rates (Caselli & Vallin 2002; Deboosere & Fizman 2009; Brown & Leyland 2010). Studies have however shown that statistical control for individual socio-economic factors does not fully explain or eradicate local and regional disparities in mortality (Deboosere & Gadeyne 2002; Rican et al. 2003; Reid & Van den Boomen 2015). Other factors such as the physical and social environment of the place of residence come into play as well (Diez Roux & Mair 2010; Meijer et al. 2012). Exposure to certain types of pollution, the proximity of a major road, the dangerousness of the road network for instance will affect health, even regardless of social class. Similarly, exogenous factors such as local social policies, service provisions (transport, health, etc.) and land use planning will influence the lifestyles and health of people, regardless of their socio-economic status (Lerch et al. 2017). The social environment will also affect health and mortality, through norm and behavioural imitation effects for instance. Several studies argue that more deprived persons are negatively affected by living in the same environment as wealthier families, given the psychological stress caused by social comparisons (Kawachi & Kennedy 1999). Other authors refer rather to the beneficial effect on health and mortality of the coexistence of different social groups in the same territory. On the part of the poorest, there would then be an integration, whether or not constrained, of social norms favourable to health (lower consumption of alcohol and tobacco, physical exercise, etc.) and a direct benefit derived from a generally greater supply of services (food, sports facilities, health, etc.) where the richest are in the majority (Meijer et al. 2012).

But what about the evolution of social differences in mortality? There was once a strong belief that the welfare state and the decrease in mortality would soften inequalities between social classes (Antonovsky 1967), but numerous empirical studies have shown this has not been the case (Cambois & Jusot 2007; Jasilionis et al. 2014). Social inequalities with regard to death have persisted and even widened. According to Mackenbach (2012), in high income countries there is an average disparity in life expectancy of 5 to 10 years between the two extremes of the social hierarchy. Many countries also witnessed an increase in social inequalities in mortality during recent decades (Marang-van de Mheen et al. 1998; Valkonen 1999; Martikainen et al. 2001; Cambois & Jusot 2007; Borrel et al. 2008). In Belgium too, the overall life expectancy of men and women (which was respectively 79.0 and 83.7 years in 2017) hides important differences between socio-economic groups. On top of this, these differences have increased considerably between the 1990s and 2000s (Deboosere et al. 2009; Van Oyen et al. 2010).

2.2 The measurement of social inequalities in mortality

Many factors are at play when it comes to the individual's socio-economic position: level of education, employment status, housing conditions and income (Kunst & Mackenbach 1994; Hummer et al. 1998; Cambois & Jusot 2007). Because of the complications involved in combining the various dimensions, most studies only focus on one of these dimensions. Many previous studies in Europe and Belgium have used education as a proxy-indicator for socio-economic position, looking at the association between educational attainment and health or mortality (Galobardes et al. 2007; Kunst & Mackenbach 1994; Van Oyen et al.

2010). This variable has the advantage that it is not very susceptible to changes over time and that it does not vary by proximity of death, which is the case for income and employment status, for instance (Valkonen 2002). However, a high level of education does not automatically guarantee favourable material or housing conditions or an overall favourable position on the social continuum (Cambois et al. 2007). The same holds for all other dimensions: what really determines individuals' social situation is their status in each of the various dimensions.

Therefore, in the CAUSINEQ project, multiple indicators representing these different dimensions of individuals' socio-economic position have been included – education, socio-professional status, housing conditions and income, besides an overall indicator combining all these dimensions. The main advantage of using multiple indicators for individuals' socio-economic position – compared with studies retaining only one dimension – is that it allows for a more comprehensive understanding of the relationship with health and mortality. The combined indicator for socio-economic position will reveal the most vulnerable groups with regard to health and mortality, while including the different separate dimensions will shed light on the specific pathways between socio-economic position and health/mortality.

Explaining socio-economic inequalities in health and mortality is a major concern from a policy point of view. The main objective of this project was therefore to investigate and provide new insights into the mechanisms that generate differential health-related life chances for different socio-economic groups in Belgium. The profound socio-economic and demographic changes over the last decades – in terms of the de-standardisation of life courses in Post-Fordist societies – have had a key impact on different aspects of individuals' life courses, especially on family situations and professional careers. Both have become more flexible and diversified in comparison with the standardised forms or trajectories that were dominant in the period immediately after the Second World War. Since fragile life courses in terms of family or employment situations are more often found among groups with a vulnerable socio-economic position, the association between both domains and health/mortality will be covered in detail in this report.

2.3 The de-standardisation of working life and the life course

Theoretically, three sequential historical periods can be distinguished: 1) a pre-industrial period where individuals had little power of their fates, 2) an institutionalised period (1870-1970) where individuals and governments tried to control life courses and 3) an individualised period from the 1970s onwards (Roussel et al. 1982; Yonnet 2006). The pre-industrial period, marked by omnipresent and unpredictable deaths, has been gradually replaced by a period of more predictable and longer life spans.

As the modernisation of Western societies coincided with a move towards the standardisation of family and employment trajectories, life courses became more and more structured around institutions and values (Boyer et al. 1993; Kohli 1989; Widmer et al. 2009). This process culminated in the 1960s, the period of Fordism, where the nuclear family model

and the standard employment model of the male breadwinner constituted a synchronised social model (Lipietz 1987). Both working careers and employment arrangements in industrialised countries were highly predictable (Paugam 2000). The Standard Employment Relationship (SER) entailed lifelong, stable, full-time, socially protected and collectively regulated employment (Bosch 2004). The SER-model was to be perceived in close relation with the dominant nuclear family model, characterised by stable, relatively early marriages and the start of reproduction, as well as a clear division of tasks between a male breadwinner and a female care-giver (Lesthaeghe et al. 1986; Lesthaeghe et al. 2006; Pierson 2007).

From the 1970s onwards, the Fordist period of institutionalisation and standardisation was succeeded by a period of de-standardisation and individualisation (Bessin 1999). Again, the employment and the family sphere moved hand in hand (Jessop 1994). As a consequence of macro-economic, social and demographic changes, the SER-model came under pressure (Boyer et al. 1993). Employment evolved away from the old standard in several ways, mainly through the growth of non-standard or contingent forms of employment (Facey et al. 2010) and through the erosion of mechanisms regulating standard forms of employment (Scott-Marshall 2005). Moving away from the SER-model often happened at the expense of employees' collective protection and security, putting the "least marketable groups" in the labour market in the most vulnerable position (Rittich 2004). Inherent to this evolution was the risk for an increasing dualisation in the quality of employment, with important consequences for health and mortality.

The same period was also characterised by drastic changes in the family sphere, more specifically by a multiplication of types of personal and family trajectories and a deregulation of social rhythms (Kolhi 1986; Widmer et al. 2009). Family arrangements became much less predictable and less stable, because of the retreat from formal marriage, the tendency to postpone marriage and parenthood and the increase in union dissolutions (Lesthaeghe et al. 2006; Eggerickx et al. 2009b). This combination of changes is described as the second demographic transition.

Several authors pointed at the clear relationship between the above described changes in the family and the employment sphere (Vosko 2011). From a social stratification perspective, it is clear that particularly women and individuals/families with fewer resources tended to be affected more often and more severely by these evolutions (Cranford et al. 2003; Rosanvallon 2000). This means that the de-standardisation of both the family and the employment sphere poses real problems for social cohesion and equity in society (Standing 2011). An integrated approach towards socio-economic health/mortality inequalities, including both the family and the employment sphere, is called for (Benach et al. 2012).

Therefore, this project aims to investigate whether or not de-standardised family situations and employment arrangements are related to health and mortality in Belgium. Do they cause an excess mortality and if so, for which causes of death?

2.4 Employment arrangements and health/mortality

Belgium witnessed, as many other Western-European countries, profound macro-economic changes during the past forty years, including the de-standardisation of the Fordist 'Standard Employment Model' for some fractions of the labour force. The first hypothesis at the basis of the CAUSINEQ project is that the major Post-Fordist transformations in the world of work have had far-reaching implications for social inequalities in health and mortality. Some of the changes in the professional domain have been quite positive for the health and well-being of workers, for instance the gradual disappearance of physically dangerous and mentally alienating industrial work (Reich 1991). However, the transition away from the Fordist model has also been accompanied by rising levels of (long-term) unemployment and stronger links between unemployment rates and economic conjuncture. At the same time, employment arrangements have become more flexible, uncertain and even precarious. This evolution is regarded as an important determinant of social health inequalities by many public health specialists (Ferrie 1999; Quinlan et al. 2001; Benach et al. 2002; Benach et al. 2010). At the individual level, the employment situation is a key factor determining both financial resources and psychological well-being. Research into the health and mortality effects of different forms of (un)employment is thus timelier than ever.

2.5 Family arrangements and health/mortality

The second hypothesis at the basis of this project is that the major transformations in family formation and dissolution processes – characteristics of the second demographic transition – are associated with social inequalities in health and mortality. Family arrangements and trajectories have become less predictable and less stable since the late 1960s. More specifically, the boundaries between official marital status have blurred and new types of family arrangements came into existence (Koskinen et al. 2007).

Reflections on inequalities in mortality according to marital status began in the early 19th century, when differences in life expectancy between married and unmarried individuals were observed (Brockmann & Klein 2004). From these early studies to the present day, the vast majority of research on the issue of marital inequalities in mortality has highlighted greater longevity among married individuals (Shurtleff 1955; Nizard & Vallin 1977; Goldman & Hu 1993; Martikainen et al. 2005) and, at the same time, an increase in unmarried mortality (Kraus & Lilienfeld 1959; Koskenvuo et al. 1980; Manzoli et al. 2007; Roelfs et al. 2011). Several explanations can be given. In particular, married life confers social and financial protection on spouses (Hemström 1996; Burgoa et al. 1998). Moreover, married life promotes the sharing of assets, income and expenses, thus allowing to achieve economies of scale (Hemström 1996; Burgoa et al. 1998). It is however important to mention that selection effects are at play as well. Educational attainment, socio-professional category and income influence general health status, which in turn promotes or hinders cohabitation and marriage (Hemström 1996). Over the years, mortality inequalities by marital status seem to have increased in several Western countries (Hu & Goldman 1990; Martikainen et al. 2005; Berntsen 2011), including Belgium (Murphy et al. 2007). The widening of the gap seems to

be mainly driven by a more rapid decrease in mortality among married people than among those who are not married.

Previous research also demonstrated that the nuclear family model generally has favourable consequences for health, while individuals living alone and single mothers are confronted with excess mortality (Hu & Goldman 1990; Martikainen 1995; Weitoft et al. 2000; Herttua et al. 2011). Thus, a more detailed study of mortality differentials by family forms and/or household compositions is necessary (Koskinen et al. 2007).

2.6 Research questions of the CAUSINEQ project

The following four research questions were central to the CAUSINEQ project:

RQ1: How have socio-economic inequalities in overall mortality evolved in Belgium and its regions between 1991 and 2016?

RQ2: To what extent are overall and cause-specific mortality related to employment status in Belgium, taking into account other aspects of individuals' socio-economic position?

RQ3: To what extent are overall and cause-specific mortality related to marital status and family arrangements in Belgium, considering other aspects of socio-economic position?

RQ4: How does individuals' general and mental health – as a precursor of mortality – vary by labour market position, living arrangements and broader social precariousness in Belgium?

3. METHODOLOGY

3.1 Data

The first three research questions were investigated using the National Mortality Database. This database consists of a linkage at the individual level between the Belgian censuses conducted in 1991, 2001 and 2011, data from the National Register on all-cause mortality and certificate data from the civil registry office on cause-specific mortality during follow-up. This record linkage has been effectuated by Statistics Belgium and is based on anonymised individual identification codes available since 1991. The database covers all persons officially residing in the country at baseline (i.e. at the time of the census) and includes a very rich set of information on socio-economic and demographic characteristics. The data are rich, exhaustive and unique, allowing for very detailed and robust analyses of overall and cause-specific mortality. Since all deaths are included on a nationwide scale for the period under observation, it can be ruled out that results are due to random variation. To our knowledge, only Nordic countries dispose of equally comprehensive data on a nationwide scale.

The construction of the database involved different steps. At the end of the nineties, Interface Demography created – in cooperation with Statistics Belgium – the National Mortality Database. This database initially consisted of a linkage – based on the anonymised registration number – between the Belgian census of 1991 and register data on emigration and mortality during the period 1991-1996. Cause-specific mortality data were then added for the years 1991-1995, using anonymous individual linkage with death certificates. The same linkage procedures were repeated for the 2001 and 2011 censuses, including information on overall and cause-specific mortality data during the period 2001-2016 and 2011-2016. For people present in two or even in all three censuses, information in both/all censuses can be combined.

To answer the fourth research question, data from the Gender and Generations Panel Survey (GGPS 2008-2010), the Belgian Health Interview Surveys (HIS 1997, 2001, 2004, 2008 and 2013) and the European Working Conditions Survey (EWCS 2005, 2010 and 2015) were used. The GGPS (https://www.ggp-i.org/data/) is a longitudinal survey launched by the United Nations in 2000 in order to gather information on the family dynamics and relationships of non-institutionalised individuals aged 18-79 at the time of the first wave. For Belgium, one wave of data collection has been carried out, in which 7,171 respondents participated. The GGPS has the important advantage that it allows for investigating cross-cutting relations between the employment situation and the wider social and family situation. The Health Interview Surveys (https://his.wiv-isp.be/SitePages/Home.aspx) are embedded in the European Health Interview Survey project and have been organised by the Scientific Direction Epidemiology and Public Health of Sciensano since 1997. The purpose of this periodically organised survey is to assess the health status of the Belgian population and to identify the determinants influencing the main health problems. In the analyses presented in this report, a sub-sample of employed and unemployed youth (18- to 29-year-olds) was

used. Finally, analyses were also based on a pooled dataset from the fourth (2005), fifth (2010) and sixth (2015) wave of the European Working Conditions Survey (https://www.eurofound.europa.eu/surveys/european-working-conditions-surveys). The EWCS is a cross-sectional survey organized every five years since 1990 by the European Foundation for the Improvement of Living and Working Conditions (Eurofound). The analyses presented in this report are based on all employees aged 18-64 with an employment contract and living in a EU27 member state (N=71,520).

3.2 Measures

Overall and cause-specific mortality

As there are large differences in the contribution of specific causes of death to inequalities in overall mortality, this report will focus on both all-cause mortality and cause-specific mortality. Given the fact that each disease/disorder or cause of death has its own set of risk factors and determinants, differentiating between different causes will enable a more complete understanding of how inequalities in mortality are generated and how this connects with the socio-economic position of individuals.

To study socio-economic inequalities in all-cause mortality, mortality rates have been calculated. In order to capture the entire spectrum of mortality inequalities, all causes of death are considered. The most important causes in terms of mortality toll are considered separately, while other causes were grouped together. Causes are classified according to the International Classification of Diseases (ICD-9 and ICD-10) using existing international classifications.

Socio-economic position

This report will adhere to a multidimensional conceptualisation and measurement of socio-economic position. An interesting contribution in this regard is the work of Bourdieu (1986). He distinguished three fundamental forms of capital: economic, cultural and social capital. Economic capital refers to one's material resources, cultural capital captures the knowledge- and status-related assets of a person and social capital relates to the benefits of social group membership. In the CAUSINEQ project, different measures of socio-economic position (capturing the different forms of capital) have been taken into account. The variable 'educational attainment' – measured by educational degree and number of years of schooling – is used to capture individuals' cultural capital. Economic capital has been operationalised by indicators for 'housing status', 'housing comfort', 'employment status' and 'type of employment contract'. Each of these indicators represents a different aspect of material circumstances. Finally, social capital will be (partially) operationalised by 'marital status' and 'household type', the former being the officially registered household situation, the latter the de facto household composition.

Besides these single indicators, this report also includes two combined indicators for socio-economic position. The first combined indicator is a product of the DESTINY-project, that was funded by the Federal Science Policy Office (Eggerickx et al. 2009). The idea is to use a

scoring method to divide the country's population into social groups. The indicator is based on three factors linked to social inequality, drawn from population censuses: level of education, employment category and housing characteristics. Each individual is assigned a score according to their position on each of the dimensions, their sum of scores varying between 0 and 10. "Children" who have not yet finished their studies, who still live with their parents and who do not have a dwelling of their own are assigned the score of the parent with the highest score. To make analysis easier and to avoid the issue of small cell counts (rarity or absence of deaths), individuals have been grouped into quartiles by score, representing four social groups: underprivileged, mid-low, mid-high, and privileged (Eggerickx et al., 2018b).

This method of grouping scores into quartiles allows for the monitoring, to a large degree, of the effects of change in our societies. With regard to education, for example, the educational level of the population has increased considerably: more and more people have a university degree; fewer and fewer have no diploma. Social differences in mortality based on this single variable and on the dichotomy of "no diploma versus a university degree" thus apply to an ever-smaller population at the bottom of the social scale. As a consequence, the social and political significance of the inequalities is reduced, since the highest mortality rates are observed in a population that is statistically shrinking. With score quartiles, on the other hand, the person-years associated with each social group are virtually identical, rendering the differences and changes all the more significant. In addition, with each census the least privileged quartile is composed of people who are more and more educated, while in the most privileged quartile the weight of those with university degrees also increases. The indicator thus takes into consideration overall changes in level of education, as housing characteristics and employment status also do. In the end, it is assumed that the multidimensional indicator maximises social differences in mortality. In other words, the differences that will be highlighted with this indicator will be more important than those suggested by considering each variable separately.

The second combined indicator was constructed as a part of this project. To answer the fourth research question, a typology of labour market positions was created, using Latent Class Cluster Analysis (Hagenaars et al. 2002). More specifically, survey information on the labour market position of respondents was enriched by information on the employment conditions and relations characterising the jobs of those respondents in waged employment. The final result is an empirical typology for labour market position which includes different types of waged employment, as well as three other categories: the self-employed, the unemployed and individuals in another type of activity status (Van Aerden et al. 2017). The use of a typological approach allows to include information from different indicators (in this case indicators on the employment situation) without adding too much complexity to the analyses with health (or other) outcomes.

Other stratifiers

The size of the association between employment status, living arrangements and cause-specific mortality differs between men and women and between different age groups. Analyses have therefore been stratified according to gender and age. Analyses have also paid attention to the interrelations between socio-economic position and various 'ascribed' positions such as age, gender, nationality and region.

3.3 Statistical procedures

Several methods have been applied to investigate socio-economic inequalities in all-cause and cause-specific mortality (cf. the first three research questions of the CAUSINEQ project). Age-standardised mortality rates by gender and different indicators of socio-economic position were established in order to calculate absolute inequalities. Life table methodology has been used in order to investigate absolute and relative differences in life expectancy by socio-economic position. To further control socio-economic inequalities for other covariates, Cox and Poisson regression analyses including a series of socio-economic indicators have been performed for men and women and for different age groups.

For the calculation of mortality tables, the methodology proposed in Preston et al. (2001, p.49) was followed. This choice was made in order to make comparisons with the tables calculated by STATBEL as straightforward as possible. In summary, the elaboration of the tables (calculated between exact ages) is initiated by the calculation of age-specific rates. These are then transformed into quotients that allow for the calculation of the various functions of the table, including life expectancy. As tables were calculated in five-year age groups, it was decided not to opt for the assumption of a uniform distribution of deaths between two ages. The coefficients necessary to take into account the non-uniform distribution were calculated using the observed ages at death. This approach (non-uniform distribution) has the advantage of preventing some tables from closing before the age of 105. In addition, a quotient substitution procedure was used to circumvent certain situations that do not allow for a harmonious development of the tables, such as ages without observed deaths or with quotients higher than unity or without cases (i.e. situations generally related to the presence of small numbers in highly disaggregated tables). Calculations also used the Arriaga method (Preston et al. 2001) to measure the contribution of different age groups to differences in life expectancy observed between two periods for each social group or between social groups for the same period.

The analysis of inequalities in health outcomes – as a precursor of mortality – requires other statistical techniques. As mentioned before, Latent Class Cluster Analysis (LCCA) was used to create a typology of labour market positions. LCCA uses the distribution of a selection of indicators over the sample to create an empirical typology. Respondents within the same category of the typology are homogeneous – from a probabilistic perspective – regarding the selected indicators, whereas respondents belonging to different categories have a dissimilar

profile with regard to the indicators included in the LCCA (Van Aerden 2018). In the context of the CAUSINEQ project, this means that respondents in waged employment were grouped into a limited number of categories, based on their degree of similarity regarding the selected indicators for the employment situation. In a next step, the groups of the self-employed and the unemployed were added to the labour market typology as separate categories. Finally, binary logistic regression analyses were used to relate the constructed labour market typology to health outcomes. The role of social precariousness was also taken into account.

4. SCIENTIFIC RESULTS AND RECOMMENDATIONS

This part of the report presents the most important research results of the CAUSINEQ project. First, the results regarding the social and spatial inequalities in mortality in Belgium and their evolution since 1991 are presented. Secondly, the report focuses on the association between mortality and employment status. This part of the report also contains a first exploration of the association between destandardised employment trajectories and mortality. In the third part, attention will be paid to another dimension of destandardisation, that of family (de)formation, and its association with mortality. Fourthly, results will be presented on the combined impact of both dimensions of destandardisation on health outcomes.

4.1 Social & spatial inequalities in mortality in Belgium since 1991 (RQ1)

As mentioned, this part will first focus on the social and spatial differences in mortality by age, gender and major causes of death in Belgium. Results are mainly based on the construction of mortality tables by social group. First, social mortality differences are considered in detail, next spatial differences are presented, taking into account of course the role of social dimensions.

4.1.1 Social mortality differences in Belgium

As mentioned, social inequalities in mortality were measured using the DESTINY-indicator. This multidimensional indicator is based on score quartiles for a summed scale including three factors linked to social inequality: level of education, employment category and housing features. Results were presented for the four identified social groups (i.e. quartiles) and for those persons whose score fell within the 5% most and 5% least privileged group, that is, for those who occupy the best and worst positions on the indicator.

A wide gap in all-cause mortality

In Belgium, the gap in life expectancy between social groups (score quartiles) at either extreme of the social pyramid amounts to 9 years among men and 6 years among women during the 2011-2015 period. A comparison of the 5% lowest scores and the 5% highest scores shows that differences climb to about 13 years among men and 10 years among women. A clear social gradient can be observed, for men as well as women and for all three observation periods. By gender, the mortality table for 2011–2015 shows a difference in life expectancy at birth of 5 years. The gender difference varies by social group. It is the largest in the least privileged group and shrinks across the social scale. The same patterns can be observed for earlier observation periods (see table 1).

How have social differences in mortality evolved over the past quarter century? The results show that there were improvements in life expectancy at birth between 1992-1995 and 2011-2015 for all social groups, but not at the same pace. Improvement was slower for the underprivileged (+4.3 years for men and +2.1 for women) and faster for the privileged (+5.1 years for men and +3.9 for women). In other words, social inequalities in mortality have increased and they have done so proportionally more for women than for men. In sum, social inequalities in mortality by social group are significant and growing in Belgium.

Table 1. Life expectancy at birth by social group (SG), men and women in Belgium, 1992-1996, 2002-2006 and 2011-2015

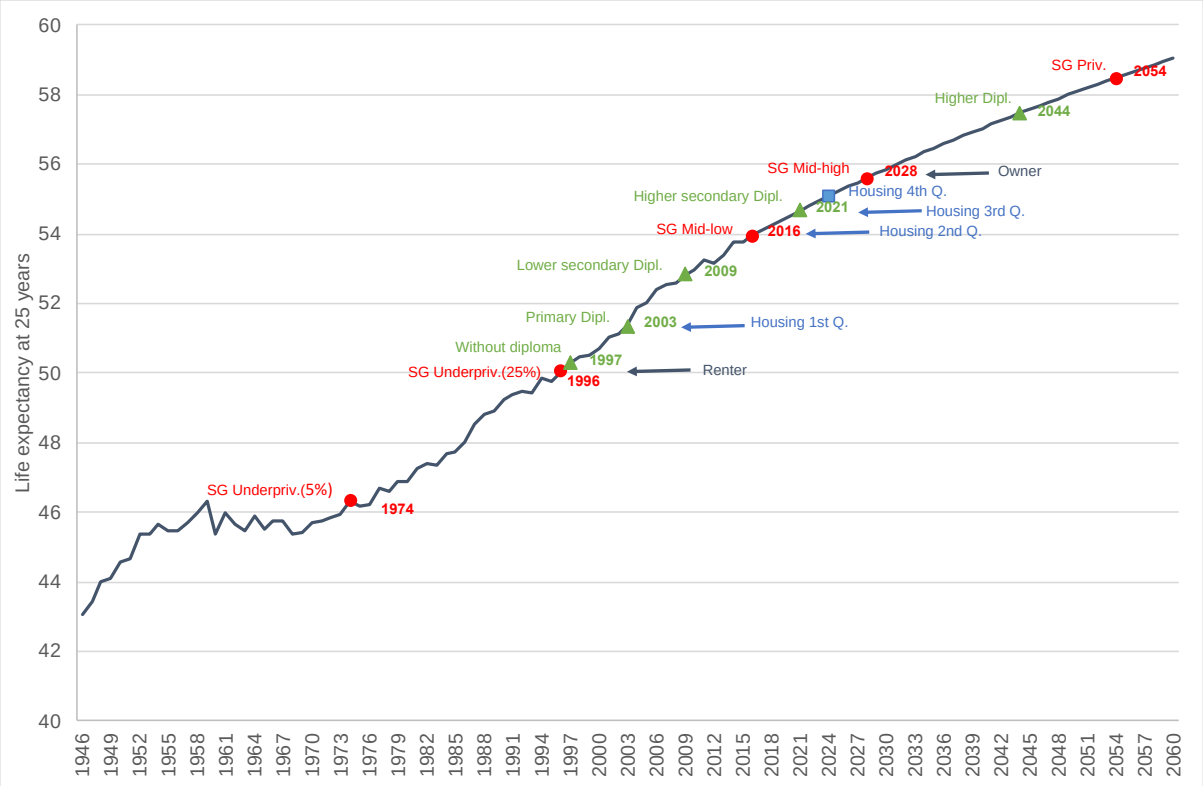
Social groups	1992–1996	2002–2006	2011–2015	Increases between 1992–1996 and 2011–2015
Men				
Underprivileged SG (5%)	65.6	68.3	70.2	4.6
Underprivileged SG (25%)	69.6	72.0	73.9	4.3
Mid-low SG	73.5	76.7	78.1	4.6
Mid-high SG	75.4	78.4	80.0	4.6
Privileged SG (5%)	78.3	81.9	82.8	4.5
Privileged SG (25%)	78.0	80.7	83.0	5.1
Total	73.3	75.8	78.1	4.8
Women				
Underprivileged SG (5%)	75.3	76.6	76.6	1.3
Underprivileged SG (25%)	78.3	79.6	80.4	2.1
Mid-low SG	81.1	83.3	84.1	3.0
Mid-high SG	82.2	84.3	84.8	2.6
Privileged SG (5%)	83.4	85.9	86.8	3.4
Privileged SG (25%)	83.1	85.6	87.0	3.9
Total	80.1	81.7	83.1	3.0
Differences women/men				
Underprivileged SG (5%)	9.7	8.3	6.4	

Source: Eggerickx et al. 2018b

Shifts in mortality rates are part of the epidemiological transition, a transition from a pathological environment dominated by infectious diseases to one where chronic and man-made (non-infectious) diseases prevail. Another feature of this transition is an increase in life expectancy due to societal and medical changes such as improvements in public and personal hygiene practices, diet, medical procedures and the public health system (Meslé & Vallin 2002). After a period of slower growth (1955-1970), life expectancy entered a new period of steady, marked growth, mainly attributable to a major drop in cardiovascular diseases and the adoption of individual behaviours conducive to better health. This evolution, characterised by a significant increase in life expectancy at birth, can be described as “the health transition” (Vallin & Meslé 2013).

Figure 1 considers inequalities in life expectancy from the temporal perspective of the health transition. Male life expectancy at age 25, observed in 2012-2016 for each of the categories of the different dimensions of socio-economic position (educational level, housing features, etcetera), has been positioned on a "timeline". This timeline corresponds to the annual evolution of the life expectancy at age 25 in the total Belgian population since the end of the Second World War until 2060, according to estimates calculated on the basis of population projections by the Federal Planning Bureau. This representation provides an approximation of the delay or advance made by the different categories on the road to health transition. The figure clearly shows that there is a significant gap between different social groups. In 2012-2016, men in the underprivileged social group have the life expectancy at 25 years that the Belgian male population had in 1996, whereas the privileged social group has the life expectancy at 25 years that Belgium will probably reach in 2054. This means that the underprivileged social group is almost half a century behind in the health transition.

Figure 1. Life expectancy at age 25 according to different social categories, Belgium, 1946-2060



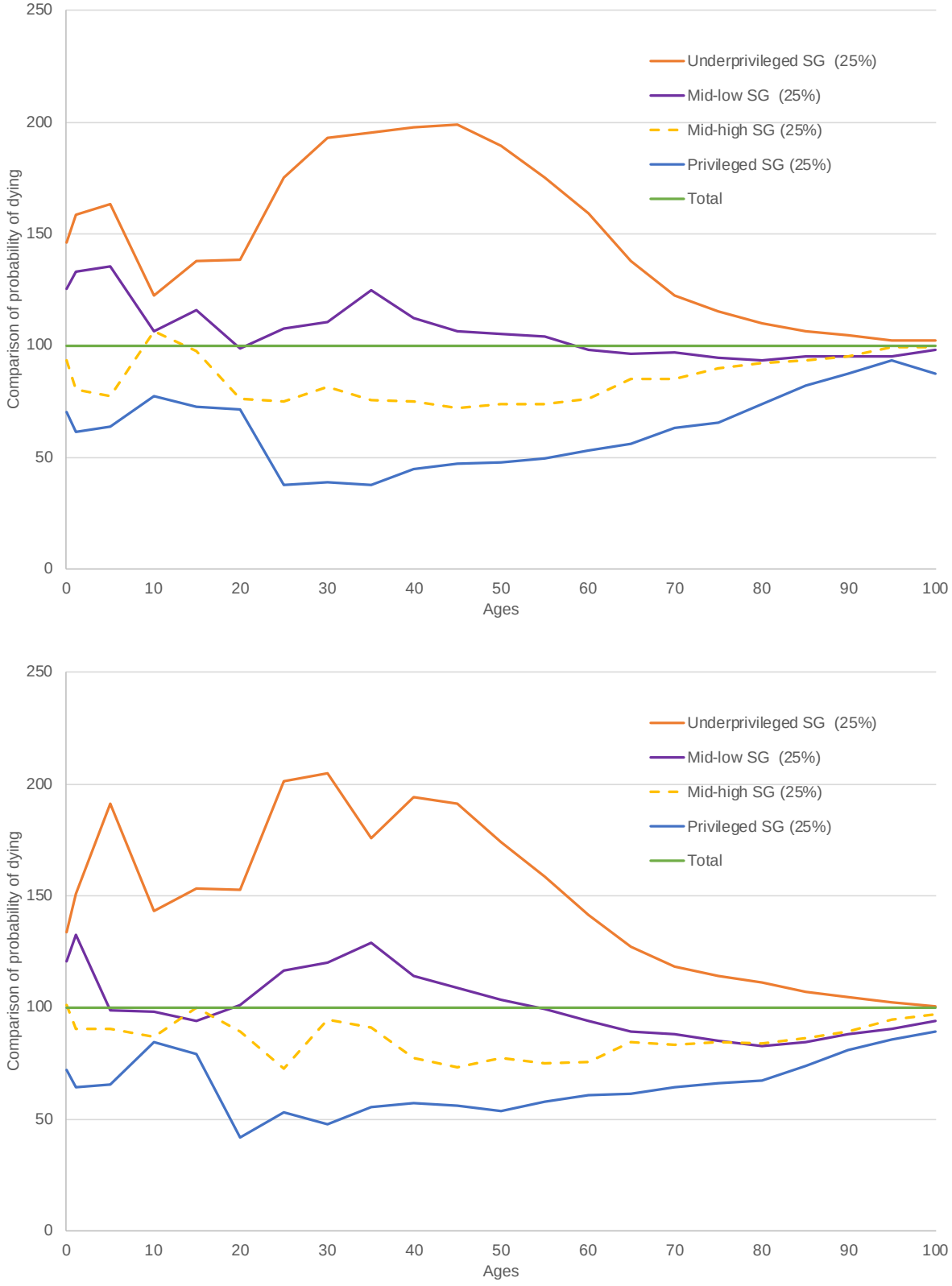
Source: Eggerickx et al. 2018a

The effect of age on changes in life expectancy by social group

There are two ways of measuring the effect of age. One way is to compare the probability of dying by age for the privileged and underprivileged groups, allowing to measure the relative gap by age. Another way is to calculate the contribution of each age class to changes in life expectancy between two observation periods or to differences in life expectancy between social groups (Pressat 1985).

Figure 2 shows the relative probability of dying by age according to social group, with the entire national population as a reference group. The underprivileged group is characterised by excess mortality at all ages and for both sexes, just as the privileged group is characterised by lower mortality. In addition, the gap varies by age. For men, excess mortality for the underprivileged group is most striking between 25 and 50 years of age, with a probability of dying twice as high compared to the total population and 4 to 5 times as high compared to the privileged group. There are also major differences between both social groups among children aged 0–5. The picture is similar for female social groups.

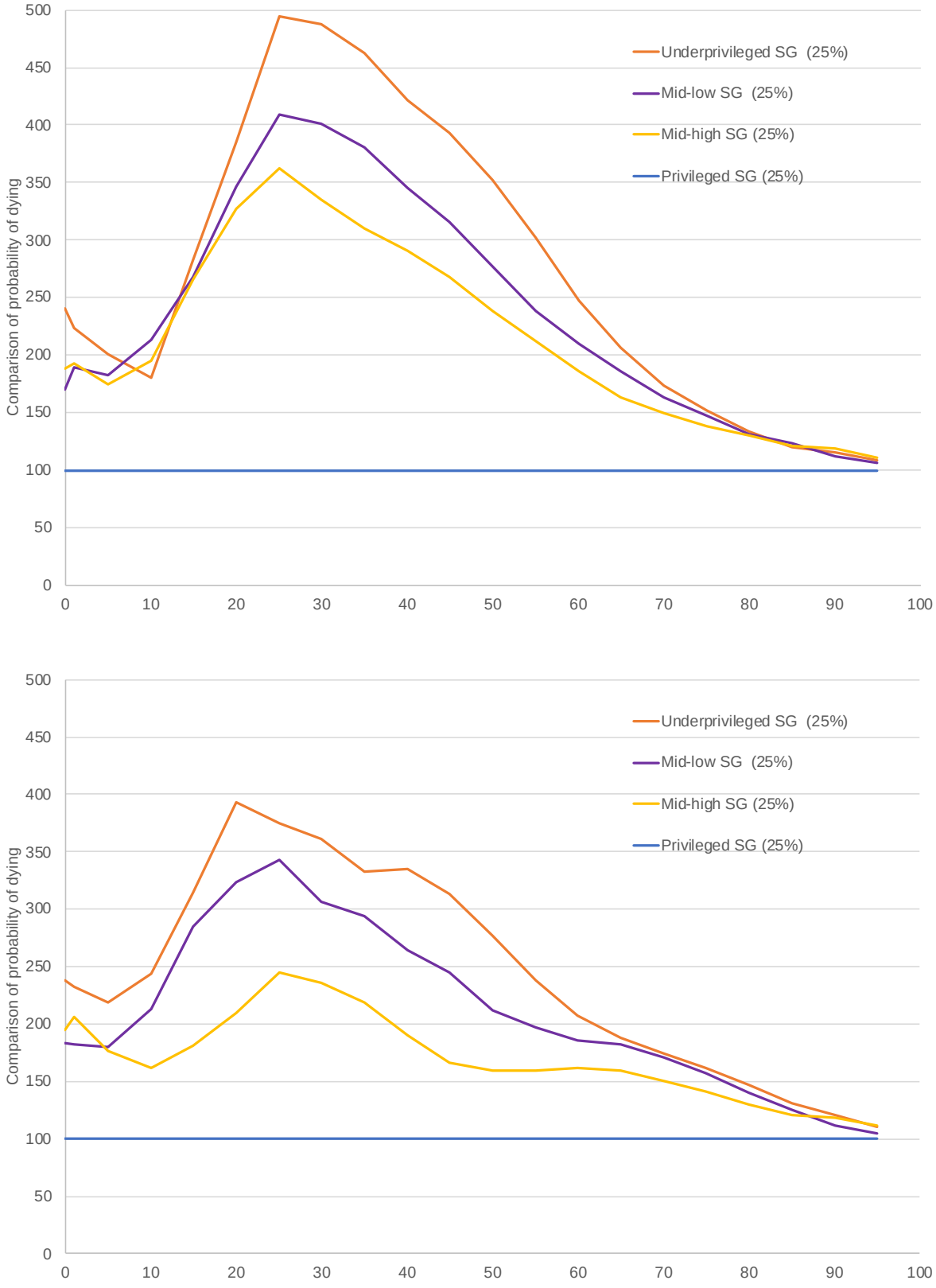
Figure 2. Relative probability of dying (%) by social group and age, men (above) and women (below) in Belgium, 2011-2015 (total population = index of 100)



Source: Eggerickx et al. 2018b

Figure 3 shows the ages that are most affected by increasing social inequalities in mortality. For each observation period, the probability of dying by age for the underprivileged group is compared with that of the privileged group. Over 100 indicates excess mortality. For men at all ages – apart from 10-19 years and over 85 years – social inequalities in death grow significantly with time. This trend is especially strong among men aged 25-50, when excess mortality for the underprivileged is highest. Among men aged 25-30 for instance, the risk of dying in the underprivileged group was 3.5 times higher than in the privileged group in 1992-1996, 4 times as high in 2002–2006 and 5 times as high in 2011-2015.

Figure 3. Changes in relative probability of dying (%) between underprivileged and privileged social groups, men (above) and women (below) in Belgium (privileged SG = index of 100)



Source: Eggerickx et al. 2018b

The pronounced social differences for young adults have but a moderate impact on the evolution of differences in life expectancy at birth, as the risk of dying is inherently very low among these young adults. It is indeed important to determine the weight of the different age groups in terms of changes in life expectancy at birth according to social group. The decline in mortality at old age and the increasing contribution of older people to the increase of life expectancy at birth are the main effects of the health gains in recent decades. Elderly are the main winners of the health transition, because of the decline in cardiovascular diseases (Meslé & Vallin 2002; Meslé 2005).

Table 2 shows that the privileged social group is undeniably at the forefront of the health transition, while the underprivileged group is far behind. Over two decades, declining mortality for privileged men aged 60 and over has been translated in a life expectancy gain of 3.2 years, while for those in the least privileged quartile the gain has only been 1.9 years. For the least privileged (5%), the weak gains in life expectancy for those aged 60 and over, and especially for those aged 80 and over, point to a delay in the health transition and to a high vulnerability for cardiovascular diseases and other pathologies particularly affecting older people. In sum, it is mainly the decline in mortality among the elderly that explains the gains in life expectancy at birth today, but especially for the most privileged social groups. Alongside this, gains at young ages – under the age of 40 – seem more pronounced for the lowest quartile (1.5 years) and for the 5% least privileged (2.3 years) than for the most privileged (0.9 years).

Table 2. Contribution of age groups to the increase of life expectancy (years gained) between 1992-1996 and 2011-2015 by social group, men and women in Belgium

Ages	Total	Underprivileged (5%)	Underprivileged (25%)	Mid-low	Mid-high	Privileged
Men						
0–19	0.6	0.8	0.7	0.4	0.4	0.5
20–39	0.5	1.5	0.8	0.6	0.6	0.4
40–59	0.9	1.3	0.8	0.8	0.9	0.9
60–79	2.2	0.9	1.5	2.1	2.0	2.4
80+	0.6	0.1	0.4	0.7	0.6	0.8
Gains 0-80+	4.8	4.6	4.3	4.6	4.6	5.1
Women						
0–19	0.4	0.4	0.4	0.2	0.2	0.3
20–39	0.2	0.2	0.2	0.2	0.2	0.3
40–59	0.4	0.3	-0.1	0.3	0.4	0.7
60–79	1.2	0.3	1.0	1.2	0.9	1.4
80+	0.8	0.0	0.6	1.1	0.9	1.3
Gains 0-80+	3.0	1.3	2.1	3.0	2.6	3.9

Source: Eggerickx et al. 2019

Social inequalities in cause-specific mortality

The most underprivileged social groups have higher mortality rates than the more privileged groups. Many factors have been proposed to explain these differences in mortality by social group (Mackenbach et al. 2008). First, certain high-risk behaviours are more prevalent among the least privileged groups, such as smoking, excessive consumption of alcohol, poor-quality diet and an excessively sedentary lifestyle (lack or insufficient levels of physical activity). Second, social disparities in mortality are also linked to diseases in which prevention plays an important role (e.g. bowel cancer, breast cancer, suicide), privileged social classes being generally more receptive to prevention campaigns (Cambois & Jusot 2007; Willems et al. 2007). Third, social inequalities in mortality are sustained by the physical and social environment, with a strong polarisation in terms of the environments and districts where people live. Independently of the individual features of their inhabitants, underprivileged districts are less conducive to the health of their inhabitants, for example having less green space, poorer health infrastructure and greater exposure to noise and air pollution (Willems et al. 2007). In European countries, social differences in risk of death are generally attributable to the same diseases: cardiovascular diseases, cancer and digestive and respiratory diseases (Cambois & Jusot 2007). In Belgium, social inequalities in mortality mostly involve alcohol-related mortality, lung cancer and cardiovascular diseases (Gadeyne 2006; Willems et al. 2007).

Table 3 shows – for the period 1992-1996, 2002-2006 and 2011-2015 and for the four social groups – the probability of dying and their ratios for the main causes of death: tumours, circulatory diseases, respiratory diseases, external causes and other causes. These categories were defined according to the Ninth Revision of the World Health Organization's International Classification of Diseases (ICD-9) for 1992–1996 and the Tenth Revision (ICD-10) for 1998 and later. For 2011-2015, the greatest probability of dying for men aged 40-64 and aged 65-79 was observed for tumours, across all social groups. For men aged 80-94 the greatest risk of dying is observed for circulatory diseases, again for all social groups. The results for women followed the same pattern (table 4).

Beyond this identical cause of death structure observed during all follow-up periods, there is considerable variation by social group. First, for each cause of death and for each age group, the probability of dying changes by social group: the higher up the social ladder, the lower the probability, among men and women and during all periods of observation. Secondly, the magnitude of the social differences varies according to age, sex and cause of death. Thus, for each cause of death, the probability ratio – comparing mortality in each social group with the levels observed for the most privileged group – generally decreases with age. Social inequalities in mortality, while not disappearing completely, thus weaken with age, at least partially confirming the hypothesis of a selection effect into old age (Oris & Lerch 2009). Respiratory diseases are the cause of death showing the largest social inequalities, in all age groups and for both sexes. This is followed by circulatory diseases and then by the other causes of death. Apart from circulatory diseases, disparities between social groups are wider among men than among women.

Table 3. Probability of dying by cause of death and social group (four quartiles: Q1 underprivileged, Q2 mid-low, Q3 mid-high and Q4 privileged), men in Belgium, 1992-1996, 2002-2006 and 2011-2015

Cause of death	Ages	1992-1996				2002-2006				2011-2015			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Tumour	20-39	3	3	2	2	3	2	2	1	3	2	2	1
	40-64	96	74	61	48	89	60	49	38	80	53	40	29
Probabilities	65-79	230	208	188	161	200	167	154	129	181	154	141	108
(‰)	80-94	447	423	394	342	416	384	356	318	375	345	328	309
	20-39	1.76	1.29	1.21	1.00	2.56	1.60	1.38	1.00	2.42	1.69	1.40	1.00
	40-64	2.02	1.56	1.27	1.00	2.33	1.57	1.29	1.00	2.78	1.84	1.40	1.00
probability	65-79	1.43	1.29	1.17	1.00	1.55	1.30	1.19	1.00	1.67	1.43	1.30	1.00
ratio	80-94	1.31	1.24	1.15	1.00	1.31	1.21	1.12	1.00	1.21	1.12	1.06	1.00
Circulatory	20-39	4	2	2	1	3	2	1	1	2	1	1	1
	40-64	73	48	39	30	62	35	29	21	47	27	19	12
Probabilities	65-79	241	214	192	158	189	140	128	104	130	104	93	60
(‰)	80-94	705	676	662	587	669	618	587	554	568	510	503	439
	20-39	3.69	2.09	1.56	1.00	3.91	2.28	1.60	1.00	3.77	1.96	1.61	1.00
	40-64	2.43	1.61	1.32	1.00	2.94	1.68	1.38	1.00	3.84	2.21	1.59	1.00
probability	65-79	1.53	1.35	1.21	1.00	1.82	1.35	1.24	1.00	2.18	1.74	1.55	1.00
ratio	80-94	1.20	1.15	1.13	1.00	1.21	1.12	1.06	1.00	1.30	1.16	1.15	1.00
Respiratory	20-39	1	0	0	0	1	0	0	0	0	0	0	4
	40-64	22	10	6	3	19	7	4	3	18	7	4	2
Probabilities	65-79	108	75	56	36	93	55	43	31	67	41	35	21
(‰)	80-94	394	299	271	184	420	326	300	249	323	246	251	195
	20-39	5.50	2.65	2.22	1.00	12.73	4.98	2.81	1.00	0.11	0.06	0.03	1.00
	40-64	7.21	3.13	1.84	1.00	6.42	2.50	1.42	1.00	8.22	3.12	1.85	1.00
probability	65-79	3.02	2.10	1.55	1.00	3.03	1.80	1.39	1.00	3.22	1.95	1.70	1.00
ratio	80-94	2.14	1.63	1.48	1.00	1.69	1.31	1.20	1.00	1.66	1.26	1.29	1.00
External	20-39	28	19	16	9	22	16	12	7	17	12	8	5
	40-64	29	20	17	13	25	18	15	11	27	19	14	10
Probabilities	65-79	24	19	17	14	19	13	11	10	17	15	13	9
(‰)	80-94	91	91	59	53	72	65	49	49	69	62	60	52
	20-39	3.06	2.12	1.75	1.00	3.10	2.31	1.74	1.00	3.71	2.60	1.72	1.00
	40-64	2.21	1.54	1.30	1.00	2.22	1.64	1.35	1.00	2.72	1.93	1.41	1.00
probability	65-79	1.73	1.39	1.21	1.00	1.89	1.32	1.11	1.00	1.98	1.67	1.50	1.00
ratio	80-94	1.72	1.71	1.11	1.00	1.48	1.34	1.00	1.00	1.32	1.19	1.15	1.00
Other	20-39	9	4	3	2	9	4	2	1	7	3	2	1
	40-64	48	26	20	15	54	25	22	15	67	34	25	15
Probabilities	65-79	103	82	75	63	101	70	67	55	116	85	81	61
(‰)	80-94	459	426	407	358	454	388	395	348	505	442	451	394
	20-39	4.99	2.12	1.47	1.00	9.65	3.84	1.80	1.00	6.75	3.10	2.10	1.00
	40-64	3.19	1.70	1.31	1.00	3.67	1.70	1.47	1.00	4.41	2.27	1.62	1.00
probability	65-79	1.63	1.30	1.18	1.00	1.82	1.27	1.21	1.00	1.91	1.39	1.34	1.00
ratio	80-94	1.28	1.19	1.14	1.00	1.31	1.11	1.14	1.00	1.28	1.12	1.14	1.00

The mortality level of the most privileged group is taken as reference in the probability ratio

Source: Eggerickx et al. 2019

Table 4. Probability of dying by cause of death and social group (four quartiles: Q1 underprivileged, Q2 mid-low, Q3 mid-high and Q4 privileged), women in Belgium

Cause of death	Ages	1992-1996				2002-2006				2011-2015			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Tumour	20-39	3	3	3	2	4	2	2	2	3	2	2	2
	40-64	50	46	42	44	51	40	36	34	53	40	32	28
Probabilities	65-79	101	90	90	88	94	82	82	75	94	82	81	73
(‰)	80-94	233	212	200	205	215	201	209	210	210	195	197	184
	20-39	1.39	1.21	1.01	1.00	1.90	1.30	1.25	1.00	1.71	1.26	1.08	1.00
	40-64	1.14	1.05	0.95	1.00	1.52	1.19	1.08	1.00	1.89	1.41	1.15	1.00
probability	65-79	1.15	1.02	1.02	1.00	1.27	1.10	1.10	1.00	1.30	1.13	1.12	1.00
ratio	80-94	1.14	1.03	0.97	1.00	1.02	0.96	1.00	1.00	1.14	1.06	1.07	1.00
Circulatory	20-39	2	1	1	1	2	1	1	0	1	1	1	0
	40-64	26	15	11	9	25	13	10	6	21	10	7	4
Probabilities	65-79	150	114	91	77	108	71	58	47	73	49	46	30
(‰)	80-94	653	595	567	510	598	518	486	443	507	410	417	354
	20-39	3.88	2.42	1.67	1.00	4.28	2.48	1.67	1.00	6.20	4.24	3.26	1.00
	40-64	3.03	1.78	1.33	1.00	3.87	2.08	1.57	1.00	5.14	2.46	1.77	1.00
probability	65-79	1.94	1.48	1.17	1.00	2.31	1.52	1.24	1.00	2.46	1.66	1.56	1.00
ratio	80-94	1.28	1.17	1.11	1.00	1.35	1.17	1.10	1.00	1.43	1.16	1.18	1.00
Respiratory	20-39	1	0	0	0	1	0	0	0	0	0	2	1
	40-64	7	3	2	1	9	3	2	2	11	4	2	1
Probabilities	65-79	28	18	16	14	32	18	15	13	29	18	14	10
(‰)	80-94	177	145	131	119	219	158	160	140	178	131	125	98
	20-39	13.99	5.47	5.40	1.00	10.65	3.88	1.95	1.00	0.38	0.16	1.69	1.00
	40-64	5.47	2.68	1.86	1.00	5.75	2.07	1.48	1.00	9.90	4.06	2.07	1.00
probability	65-79	2.00	1.32	1.12	1.00	2.44	1.39	1.19	1.00	2.83	1.73	1.42	1.00
ratio	80-94	1.49	1.22	1.10	1.00	1.56	1.13	1.14	1.00	1.83	1.34	1.28	1.00
External	20-39	7	5	4	4	6	4	3	2	5	3	3	1
	40-64	10	8	7	8	9	7	7	6	11	8	6	5
Probabilities	65-79	12	10	8	8	9	8	7	5	9	7	7	5
(‰)	80-94	58	52	51	47	46	42	44	38	48	39	41	36
	20-39	1.95	1.41	1.14	1.00	2.55	1.84	1.53	1.00	3.93	2.74	2.03	1.00
	40-64	1.36	1.03	0.96	1.00	1.65	1.17	1.14	1.00	2.13	1.53	1.25	1.00
probability	65-79	1.52	1.29	1.05	1.00	1.73	1.50	1.43	1.00	1.64	1.29	1.34	1.00
ratio	80-94	1.23	1.11	1.09	1.00	1.19	1.09	1.15	1.00	1.33	1.09	1.13	1.00
Other	20-39	4	2	1	1	5	2	1	1	4	2	2	1
	40-64	23	13	11	8	26	14	11	7	33	18	12	8
Probabilities	65-79	77	56	49	43	74	47	40	35	79	52	51	36
(‰)	80-94	443	382	360	340	432	338	306	289	492	371	388	340
	20-39	3.89	2.34	1.40	1.00	9.06	3.28	1.88	1.00	6.83	3.85	2.43	1.00
	40-64	2.97	1.68	1.45	1.00	3.50	1.87	1.50	1.00	3.99	2.21	1.51	1.00
probability	65-79	1.81	1.32	1.15	1.00	2.11	1.34	1.15	1.00	2.18	1.45	1.42	1.00
ratio	80-94	1.30	1.12	1.06	1.00	1.49	1.17	1.06	1.00	1.45	1.09	1.14	1.00

The mortality level of the most privileged group is taken as reference in the probability ratio

Source: Eggerickx et al. 2019

A focus on social inequalities in mortality after age 65

Social differences in mortality among older people are poorly studied. Given the increasing contribution of older people to life expectancy gains, this issue will increasingly gain importance in the context of population ageing (Huisman et al. 2013; Spini & Widmer 2009) and current policies aiming to increase the legal retirement age. Over time, mortality has become more and more concentrated in the higher ages of life. In 1841-1844, 10% of deaths in Belgium occurred after the age of 80, while this proportion was equal to 12% in 1900-1904, 32% in 1960-1964 and 62% in 2010-2014 (Eggerickx et al. 2017). Life expectancy at age 65 remained virtually unchanged between 1841 and 1945, rose rapidly after the Second World War and sharply and steadily from the 1970s onwards. Relative to life expectancy at birth, there has been a net acceleration in life expectancy gains at age 65 and 80 since the late 1970s. Thus, between 1950 and 2015, life expectancy at birth increased by about 20%, while life expectancy at age 65 and 80 increased by 50% and more than 60% respectively. These rapid gains at older ages result from a significant decline in the mortality rate beyond age 65 for more than half a century, which is now a major contribution to the increase of life expectancy at birth. Until 1954, the contribution of people aged 60 and over to the increase in life expectancy was marginal, about 10%. Between 1954 and 1984, they contributed 26% to the increase and between 1984 and 2014 60% (Eggerickx et al. 2017).

An important question is whether there are differences by social group at older ages and how they evolved since the early 1990s. Table 5 shows that in 2011-2015, there is a gap of more than 4 years in life expectancy at age 65 between men in the most disadvantaged and those in the most favoured quartile. If we compare the 5% most favoured and 5% most disadvantaged, the gap amounts to 7 years. For women, the difference is equal to 3.7 years and to 7 years respectively. These patterns are also observed for the periods 1992-1996 and 2002-2006.

Between 1992-1996 and 2011-2015, life expectancy at age 65 increased for all social groups, but at a faster rate among the privileged than among the underprivileged. In other words, over the past few decades, social inequalities in mortality beyond the age of 65 have increased. The same conclusions apply to the life expectancy at age 80.

Table 5. Life expectancy at age 65 by social group, men and women in Belgium, 1992-1996, 2002-2006 and 2011-2015

Social groups	1992–1996	2002–2006	2011–2015	Evolution
Men				
Underprivileged SG (5%)	12.46	13.37	13.69	1.23
Underprivileged SG (25%)	13.90	15.24	16.46	2.56
Mid-low SG (25%)	15.11	17.29	18.26	3.15
Mid-high SG (25%)	15.92	17.98	18.73	2.82
Privileged SG (5%)	17.67	19.64	20.65	2.98
Privileged SG (25%)	17.44	19.24	20.73	3.29
Total	**14.72**	**16.34**	**17.82**	**3.10**
Differences Priv./Underpriv. (25%)	3.54	3.99	4.27	
Differences Priv./Underpriv. (5%)	5.21	6.27	6.96	
Women				
Underprivileged SG (5%)	16.61	17.48	17.03	0.42
Underprivileged SG (25%)	18.36	19.50	20.25	1.89
Mid-low SG (25%)	19.92	21.62	22.45	2.53
Mid-high SG (25%)	20.61	22.25	22.44	1.83
Privileged SG (5%)	21.32	23.03	23.99	2.68
Privileged SG (25%)	21.47	23.25	23.92	2.45
Total	**19.03**	**20.10**	**21.19**	**2.17**
Differences Priv./Underpriv. (25%)	2.96	3.53	3.74	
Differences Priv./Underpriv. (5%)	4.86	5.77	6.89	

Source: Eggerickx et al. 2020 (forthcoming)

These bivariate analyses are complemented by multivariate analyses of the probability of dying during the 5 years after the 1991 and 2011 population censuses, using a series of explanatory variables (table 6). The probability of dying varies greatly depending on the household situation and the marital status at old age. The results confirm the protective effect of marriage, with people living in married couples having a significantly lower mortality compared to other marital status situations (Murphy et al. 2007; Valkonen et al. 2004). Single individuals have the highest risk of death for both age groups and among men and women. Even when controlled for the effect of other variables, the social group has a significant impact on the probability of dying and more so for men than for women.

Table 6. Relative mortality (odds ratios) by social group, household situation, men and women in thr elderly population (aged 65 and over, 65-79 and 80 and over) in Belgium, 2011-2015 and 1992-1996

2011-2015	**65 years and over**		**65-79 years**		**80 years and over**	
	Men	Women	Men	Women	Men	Women
Age in 2011	1.13	1.15	1.11	1.12	1.16	1.17
Privileged SG (25%)	***Ref***	***Ref***	***Ref***	***Ref***	***Ref***	***Ref***
Underprivileged SG (25%)	1.63	1.48	1.79	1.66	1.41	1.35
Mid-low SG (25%)	1.40	1.26	1.51	1.36	1.25	1.18
Mid-high SG (25%)	1.30	1.22	1.35	1.27	1.20	1.17
Married couple	***Ref***	***Ref***	***Ref***	***Ref***	***Ref***	***Ref***
Other	1.17	1.40	1.15	1.42	1.17	1.27
Cohabitant	1.14	1.22	1.18	1.26	1.03	1.10
Isolated single	1.48	1.29	1.59	1.48	1.20	1.08
Isolated (widowed, divorced)	1.32	1.14	1.47	1.27	1.10	0.98
Single-parent	1.33	1.40	1.46	1.49	1.12	1.24
Foreigners	***Ref***	***Ref***	***Ref***	***Ref***	***Ref***	***Ref***
Belgians	1.10	1.14	1.12	1.17	1.07	1.12
1992-1996	**65 years and over**		**65-79 years**		**80 years and over**	
	Men	Women	Men	Women	Men	Women
Age in 1991	1.12	1.15	1.12	1.13	1.15	1.16
Privileged SG (25%)	***Ref***	***Ref***	***Ref***	***Ref***	***Ref***	***Ref***
Underprivileged SG (25%)	1.65	1.47	1.66	1.53	1.63	1.39
Mid-low SG (25%)	1.42	1.21	1.42	1.22	1.46	1.20
Mid-high SG (25%)	1.26	1.09	1.25	1.08	1.29	1.11
Married couple	***Ref***	***Ref***	***Ref***	***Ref***	***Ref***	***Ref***
Other	1.17	1.31	1.14	1.27	1.19	1.25
Cohabitant	1.22	1.17	1.26	1.21	1.04	1.05
Isolated single	1.25	1.07	1.28	1.15	1.09	0.91
Isolated (widowed, divorced)	1.23	1.05	1.28	1.11	1.07	0.92
Single-parent	1.22	1.19	1.29	1.20	1.01	1.08
Foreigners	***Ref***	***Ref***	***Ref***	***Ref***	***Ref***	***Ref***
Belgians	1.00	1.08	0.98	1.06	1.11	1.17

Source: Eggerickx et al. 2020 (forthcoming)

The role of health status?

Poorer health status being associated with a higher risk of death (in particular among the older age groups), it is important to consider the role of health status. As for mortality, the most disadvantaged are worse off (all other things being equal) for health status. The question is thus whether there still are, for a given health condition, mortality differences between social groups among the elderly.

In the 2001 census, 38% of the people aged 65-79 in the underprivileged social group report good health, compared to 67% in the privileged group. This difference in subjective health status is observed for people aged 80 and over as well. It can legitimately be assumed that social inequalities in mortality at older ages essentially result from inequalities in health status between social groups. In this case, there should be no mortality differences according to social group among sub-populations with a similar health status.

Health status indeed has a strong influence on life expectancy, poor health erasing social differences in life expectancy between men and women aged 65 to 80. However, social inequalities persist among those who declare themselves in good or average health, with the gradient following the health status. In other words, the better the health status, the larger the mortality inequalities between social groups. This is true both for men and women, aged over 65 and over 80.

Table 7. Life expectancy at age 65 by social group and health status, men and women in Belgium, 2002-2006

Social groups	**Men**				**Women**			
	Good	Medium	Bad	Total	Good	Medium	Bad	Total
Underprivileged SG	19.1	15.5	10.2	15.2	23.5	20.2	14.1	19.5
Mid-low SG	20.9	16.9	10.6	17.3	25.2	21.7	14.8	21.6
Mid-high SG	21.5	17.0	10.1	18.0	25.6	21.7	14.4	22.3
Privileged SG	22.6	17.4	9.8	19.2	25.9	22.3	13.8	23.0
Total	**20.4**	**16.2**	**10.2**	**16.3**	**24.3**	**20.7**	**14.2**	**20.1**
Differences Priv./Underpriv.	3.5	1.9	-0.4	4.0	2.4	2.1	-0.3	3.5

Source: Eggerickx et al. 2020 (forthcoming)

Logistic regression models were developed to determine the net effect of health status on mortality for different social groups (table 8). The comparison of model 2 and model 1 reveals that in addition to other explanatory variables such as gender, marital status and nationality, the control for health status leads to a decrease of the odds ratio among all social groups, particularly among the underprivileged group. The individual's health status thus partly explains the effect of social group on the probability of dying, but it does not eliminate it. After controlling for health status, the underprivileged, mid-low and mid-high social groups still have respectively a 36%, 15% and 10% higher mortality than the privileged social group.

In conclusion, social inequalities in the face of death persist beyond the age of 65 and even increased over the past 25 years both for women and men. Health status captures some of the social effect on mortality, but does not eliminate it among people aged 65 to 79 and aged 80 and over. The poorer the health status, the lower the social inequalities in mortality.

Table 8. Relative mortality (odds ratios) by sex, social group household situation, elderly population (aged 65 and over, 65-79 and 80 and over) in Belgium, 2002-2006

Variables	65 years and over		65 - 79 years	80 years and over
	Model 1	Model 2	Model 3	Model 4
Age	1.14	1.14	1.11	1.16
Women	***Ref***	***Ref***	***Ref***	***Ref***
Men	2.12	2.24	2.30	2.01
Privileged SG	***Ref***	***Ref***	***Ref***	***Ref***
Underprivileged SG	1.73	1.36	1.37	1.32
Mid-low SG	1.33	1.15	1.14	1.16
Mid-high SG	1.18	1.10	1.10	1.11
Married couple	***Ref***	***Ref***	***Ref***	***Ref***
Other	1.31	1.28	1.21	1.25
Cohabitant	1.16	1.12	1.14	1.00
Isolated single	1.28	1.32	1.38	1.09
Isolated (widowed, divorced)	1.14	1.17	1.23	1.02
Single-parent	1.32	1.31	1.32	1.18
Foreigners	***Ref***	***Ref***	***Ref***	***Ref***
Belgians	1.07	1.21	1.23	1.17
Good/very good health status		***Ref***	***Ref***	***Ref***
Poor/very poor health status		4.66	5.17	3.76
Medium health status		1.81	1.87	1.71

Source: Eggerickx et al. 2020 (forthcoming)

A focus on mortality by educational level

In Belgium, social inequalities in mortality have often been investigated using educational level as a socio-economic indicator (Deboosere et al. 2009; Renard et al. 2017; Van Oyen et al. 2010). Table 9 presents male and female life expectancy at age 25 by educational level in 1992-1996 and 2011-2015. The results are clear: the higher the educational level, the higher the life expectancy. The gaps between the extreme categories - without a degree and with a diploma of tertiary education - are larger for men than for women. In 2012-2016, men with higher education benefit from a 7.3 years longer life expectancy at age 25 compared to men without a diploma. This difference amounts to 6.4 years for women. Another striking result is that over the past 20 years, gaps have widened significantly, revealing greater gains in life expectancy among the better educated than among the less educated.

Table 9. Evolution of life expectancy at age 25 by education, housing comfort, housing tenure and social group, men and women in Belgium, 1992-1996 and 2011-2015*

Dimensions	Modalities	Male			Female		
		1992-1996	2011-2015	Gains	1992-1996	2011-2015	Gains
Level of education	No diploma	48.1	50.2	2.1	55.0	54.8	-0.2
	Primary	48.3	51.3	3.0	55.7	56.9	1.3
	Lower Secondary	50.3	52.9	2.6	57.2	58.3	1.1
	Higher secondary	51.3	54.6	3.3	57.7	59.5	1.7
	Higher/Tertiary	53.6	57.5	3.9	58.4	61.2	2.8
	Gaps between extremes	*5.5*	*7.3*		*3.4*	*6.4*	
Housing comfort	1st quartile	46.5	51.3	4.8	53.8	56.8	3.0
	2nd quartile	49.5	54.1	4.6	55.9	58.7	2.8
	3rd quartile	51.3	54.6	3.2	57.2	59.5	2.4
	4th quartile	51.8	55.0	3.2	57.8	60.1	2.3
	Gaps between extremes	*5.3*	*3.7*		*4.0*	*3.3*	
Housing tenure	Renter	47.0	50.0	2.9	54.6	56.6	2.1
	Owner	51.0	55.6	4.6	57.0	60.2	3.2
	Gaps between extremes	*4.0*	*5.6*		*2.4*	*3.6*	
Social groups	Underprivileged SG (5%)	42.8	46.3	3.5	51.5	52.3	0.9
	Underprivileged SG (25%)	46.4	49.9	3.5	54.4	56.1	1.7
	Mid-low SG (25%)	49.9	54.0	4.1	56.9	59.6	2.7
	Mid-high SG (25%)	51.6	55.6	4.0	58.0	60.3	2.3
	Privileged SG (25%)	54.1	58.6	4.5	58.8	62.3	3.5
	Gaps between extremes (5 %)	*11.3*	*12.3*		*7.3*	*10.0*	
	Gaps between extremes (25 %)	*7.7*	*8.7*		*4.4*	*6.2*	

Source: Eggerickx et al. 2018a

** Controlled for age*

A focus on mortality by housing conditions

Depending on their income, educational attainment and professional activity, individuals have a differential access to housing quality (Chatelard et al. 2012). Housing is a complex and multidimensional social construction involving different dimensions, including facilities, construction, community, environment, etcetera (Bonnefoy 2007). On top of this, being owner or tenant plays a very important role (Bujega-Bloch 2013). Several studies have shown that homeowners have a better health status and a higher life expectancy than renters (Hiscock et al., 2003). Poor housing conditions are believed to be the result of poorer social conditions and the cause of various health problems. The hypothesis tested here

states that living in poor housing conditions and renting are associated with higher mortality, regardless of the socio-demographic characteristics of individuals.
In order to assess the overall quality of housing conditions, a composite variable was created (Eggerickx et al. 2018a). It gives each individual a score out of 4, relating to different elements such as housing tenure, presence of a bathroom, central heating, separate kitchen, double glazing, garage, but also the type of dwelling and density of occupation of the accommodation. This score was divided according to two methods: into quartiles, to maintain identical population numbers for each group over time and into three comfort levels (which makes it possible to isolate two distinct groups: the least well housed and the best housed).

First, mortality tables by housing tenure and housing quality quartile were calculated. This allows to compare life expectancies according to housing conditions. On average, owners live longer than tenants, both for men and women (see table 9). In 2011-2015, male homeowners can expect to live 55.6 years at age 25, compared to 50.0 years for tenants. For women, life expectancy at age 25 is equal to 60.2 years for homeowners and 56.6 years for tenants. There is thus a gap of 5.6 years in life expectancy at age 25 between homeowners and tenants for men and 3.6 years for women. In 1992-1996, gaps were lower, 4.0 and 2.4 years respectively. Life expectancy gaps by dwelling tenure have thus increased in recent decades. Regarding housing quality, results in table 9 show that during 2011-2015, men belonging to the first housing quality quartile could expect to live on average 51.3 years at age 25, compared to 55 years for men belonging to the last quartile (a difference of 3.7 years). For women, the least well housed have a life expectancy at 25 that is 3.3 years shorter than the best housed (56.8 years compared to 60.1 years). Compared to 1992-1996, these gaps between housing comfort extremes are decreasing. How to explain this paradoxical situation? Of course, housing quality is generally better in 2011 than twenty years earlier. Differences in housing quality scores, measured by items such as a bathroom or central heating, are less discriminating in 2011 than earlier. Moreover, poor quality housing is increasingly less and less the monopoly of the poorest populations, modern lives being plagued by uncertainty, separation, job loss and mobility, sometimes meaning a downgrading in terms of housing quality or tenure (Mulder & Lauster 2010; Painter & Lee 2009). In other words, housing quality may no longer be a good proxy for socio-economic status in general.

Second, logistic regression analyses were performed to estimate the net effect of housing conditions on dying within five years following the census. The purpose is to neutralise the effects of some other characteristics: age, sex, family and marital status, nationality, region of residence, socio-professional category and level of education. Results show that the quartile with the highest housing quality scores is associated with a mortality that is 53% higher compared to the quartile with the lowest housing quality (step 1). This paradox can be explained by the older population structure – and therefore the higher mortality – of the privileged housing classes. The integration of demographic (steps 2 and 5) and socio-economic variables (steps 3 and 6) into the model highlights the impact of individual characteristics in the relationship. Education and occupational category reduce the higher

mortality among the least well housed and the tenants, but do not eliminate the differences. Table 10 shows that the least well housed (1st quartile) are subject to a 29% higher mortality compared to the best housed (last quartile) during the period 2011-2015, even after controlling for all these variables. With regard to the tenure of a dwelling, being a tenant is associated with a 31% higher risk of death than owning a house. The absence of certain elements, such as a bathroom and central heating, is also associated with a 23% and 21% higher mortality risk after control (step 6). The results for 1991-1996 and 2001-2006 show comparable patterns.

In sum, the mortality tables and regression models reveal that the socio-economically disadvantaged people are the most poorly housed. The mortality tables confirm a possible link between housing conditions and mortality inequalities. On the one hand, homeowners live longer than tenants, a gap that has widened in recent decades. On the other hand, the top quarter of the population living in better housing is living longer than the bottom quarter, but gaps are narrowing. Finally, taking into account the various socio-demographic characteristics for the period 2011-2016, mortality among tenants still is 31% higher than among homeowners and 29% higher among those who are less well housed than those who are better housed.

Table 10. Odds ratios by housing condition-related variables and by socio-demographic variables, 2011-2016

	Step 1	Step 2	Step 3	Step 4	Step 5	Step 6
Housing quality score (ref: under 2,2/4)						
Between 2.2 and 3	1.862 ***	0.857 ***	0.914 ***			
Between 3 and 4	1.535 ***	0.632 ***	0.710 ***			
Unknown	1.736 ***	0.927 ***	0.973 ***			
Housing tenure (ref: Owner)						
Renter				1.062 ***	1.383 ***	1.309***
Unknown				1.153 ***	1.184 ***	1.218***
Presence of a bathroom						
No bathroom				1.955 ***	1.272 ***	1.23 ***
Unknown				0.917 ***	1.029 **	1.027 **
Presence of central heating						
No central heating				1.512 ***	1.301 ***	1.209***
Unknown				1.301 ***	0.254 ***	1.171***
Occupancy density (ref: Under 1 room/inhabitant)						
1 to 1.25 room/inhabitant				1.137 ***	1.067 ***	1.117***
1.25 to 1.5 room/inhabitant				0.993	1.061 ***	1.113***
1.5 to 2 rooms/inhabitant				1.479 ***	1.074 ***	1.168***
2 to 2.5 rooms/inhabitant				3.568 ***	1.114 ***	1.211***
2.5 to 3 rooms/inhabitant				6.049 ***	1.022	1.113***
3 rooms/inhabitant and more				9.490 ***	0.959 ***	1.079***
Unknown				4.221 ***	0.956 **	1.077***
Type of household (ref: married with child)						
Married without child		1.289 ***	1.178 ***		1.331 ***	1.200***
Cohabitant with child		0.819 ***	0.856 ***		0.832 ***	0.871***
Cohabitant without child		1.122 ***	1.079 ***		1.145 ***	1.093***
Collective		4.172 ***	3.887 ***		4.521 ***	3.979***
One-person		1.320 ***	1.234 ***		1.386 ***	1.275***
Single-parent		1.390 ***	1.307 ***		1.403 ***	1.314***
Others and unknown		1.430 ***	1.317 ***		1.469 ***	1.364***
Sex (ref: man)						
Woman		0.519 ***	0.492 ***		0.520 ***	0.493***
Age group (ref: 50-59)						
Under 20		0.032 ***	0.017 ***		0.329 ***	0.018***
20-29		0.101 ***	0.068 ***		0.103 ***	0.071***
30-39		0.156 ***	0.164 ***		0.156 ***	0.165***
40-49		0.380 ***	0.395 ***		0.383 ***	0.398***
60-69		2.425 ***	1.985 ***		2.425 ***	1.982***
70-79		5.744 ***	3.938 ***		5.736 ***	3.943***
80-89		17.557 ***	11.593 ***		17.400 ***	11.569***
90 and more, Unknown		60.022 ***	39.904 ***		59.469 ***	39.774***
Nationality (ref: Belgian)						
European (non-Belgian)		0.807 ***	0.723 ***		0.809 ***	0.729 ***
Non-European		0.621 ***	0.498 ***		0.627 ***	0.514 ***
Marital status (ref: never married)						
Married		0.792 ***	0.793 ***			
Divorced		1.075 ***	1.057 ***		0.801 ***	0.806 ***
Widow, widower		1.041 ***	1.052 ***		1.089 ***	1.074 ***
Region of residence (ref: Flanders)						
Walloon Region		1.276 ***	1.265 ***		1.266 ***	1.257***
Brussels		1.030 ***	1.061 ***		1.034 ***	1.065***
Unknown		1.061 ***	1.127 ***		1.084 ***	1.139***
Level of education (ref: no diploma, primary)						
Lower Secondary			0.867 ***			0.879***
Higher Secondary			0.811 ***			0.831***
Higher/Tertiary			0.638 ***			0.662***
Unknown			0.956 ***			0.964***
Socio-professional category (ref: unemployed)						
Retired			0.898 ***			0.897***
Worker			0.545 ***			0.545***
Self-employed, liberal			0.514 ***			0.517***
Employed (public sector)			0.471 ***			0.471***
Employed (private sector)			0.446 ***			0.447***

Source: Damiens 2020 (forthcoming)

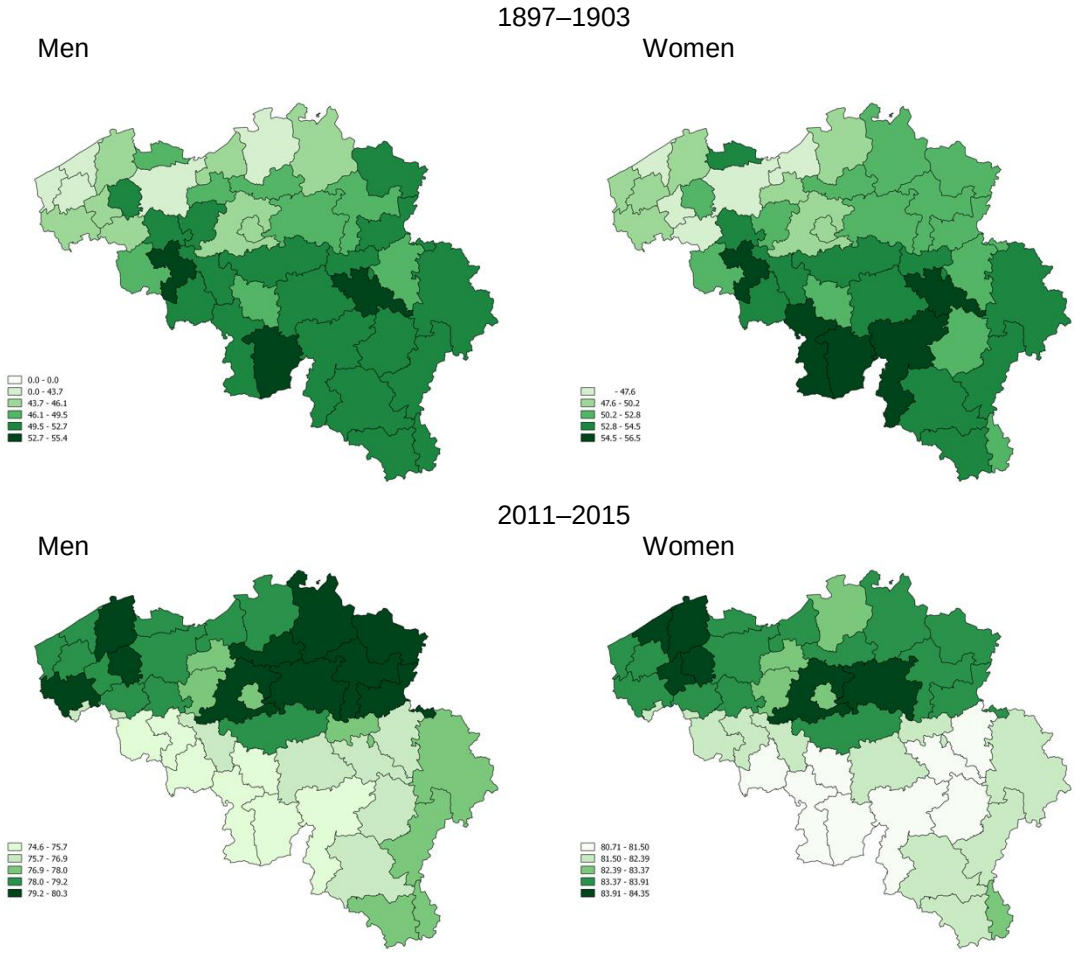
4.1.2 Spatial mortality differences in Belgium

The objective of this section is to analyse the evolution of spatial inequalities (at the district level) in mortality in Belgium from 1991 to the present day. How large are spatial inequalities in mortality in Belgium and how have they changed in recent decades?

In Belgium, the history of mortality is marked by the contrast between Flanders and the Walloon region for at least two centuries. In the 19th century, mortality in Flanders was decidedly higher for both women and men. These differences in mortality between the two regions reflected profound inequalities in terms of standard of living between the Walloon region (were the industrial development took place earlier) and Flanders. From that period onwards, life expectancy at birth between Flanders and the Walloon region began to undergo a progressive reversal, first for men and then for women. Since the 1960s, excess mortality in the Walloon region became generalised. The most affected groups by this regional disparity in mortality are men and adults aged 30-65 and young people aged 10-19. Mortality tables for 2011-2015 show that male life expectancy at birth was equal to 79.1 years in Flanders and 76.2 years in the Walloon region; for women these figures were equal to 83.8 years and 81.8 years respectively. While for men the difference of somewhat less than 3 years has been stable for two decades, for women it has widened from 1.2 years in 1992-1996 to 2 years in 2011-2015. The most common explanations for the regional inequalities in mortality refer to socio-economic differences between the 'rich' Flanders and the 'impoverished' Walloon Region and sociocultural differences in nutritional practices, tobacco and alcohol consumption, etc. (Deboosere & Gadeyne 2002).

At a smaller geographic scale – that of administrative districts – differences in mortality were particularly pronounced in the nineteenth and early twentieth century (Eggerickx et al. 2012). In about a century, the spatial pattern of mortality has completely reversed, with under-mortality in the Flemish districts and excess mortality in the Walloon districts, except for the suburban district of Nivelles (see figure 4). Disparities between districts are less significant nowadays than at the beginning of the twentieth century. In 2011-2015, the difference is just under 6 years for men and almost 4 years for women. Nevertheless, like social inequalities, spatial differences in mortality have increased since the early 1990s (from 4.7 years in 1992-1996 to 5.7 years in 2011-2015 for men and from 2.7 to 3.6 years for women).

Figure 4. Life expectancy at birth, men and women in Belgium, 1897-1903 and 2011-2015



Source: Eggerickx et al. 2019

There is no doubt about the relationship between life expectancy at birth and the socio-economic characteristics at the district level (Duchene & Thiltgès 1993; Deboosere & Gadeyne 2002; Van Hemelrijck et al. 2016). Overall, districts characterised by low median declared income (2015) are also characterised by low male life expectancy at birth and vice versa (Eggerickx et al. 2018b). Nevertheless, the coefficient of determination between these two variables is equal to 0.42, which means that their relationship is not that pronounced. Two districts deviate from the expected pattern: on the one hand, the Brussels-Capital district, characterised by the lowest median income but a higher life expectancy than most Walloon districts and, on the other hand, the Arlon district, characterised by the highest median income but a significantly lower life expectancy than other high-income districts. These paradoxes could be explained, at least in part, by specific migratory phenomena.

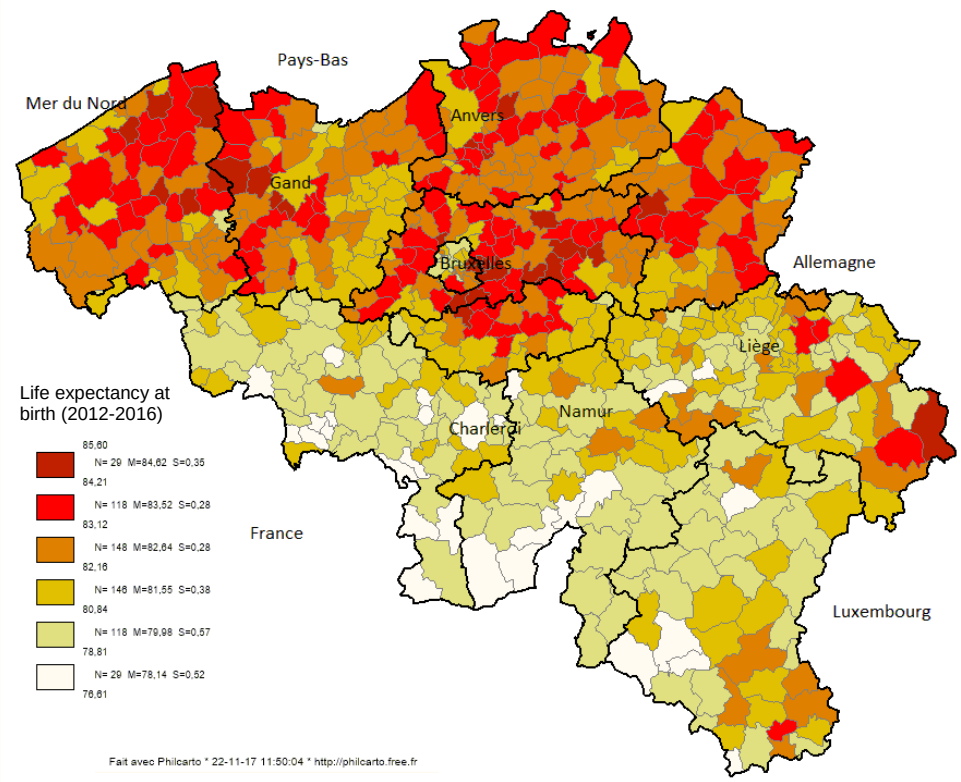
Mapping the causes of death at the district level nuances the regional duality of mortality and prompts to consider other factors than the socio-economic composition of populations to explain the mortality differentials (Grimmeau et al. 2015). In 1991-1995, cardiovascular disease was the leading cause of death for both men and women and accounted for a large

part of the differences between Flanders and the Walloon Region. There is a high correlation between cardiovascular disease and socio-economic status, but other elements are at play as well: genetic factors and behaviours associated with tobacco and alcohol consumption, physical exercise and eating habits. Strong regional contrasts are found for 'other causes of death' (e.g. alcohol-related deaths, male suicide and road accidents), with a higher prevalence in the Walloon Region. The higher prevalence of road accidents might be correlated with the configuration and quality of the road network on the one hand and the density and proximity of emergency medical services on the other hand. Finally, while there is an east-west divide for lung cancer mortality, no regional pattern can be discerned in breast cancer mortality for women or prostate cancer mortality for men. These results are largely confirmed by Renard et al. (2017) in their study conducted on premature mortality by cause of death at the district level during 2003-2009.

The full extent of spatial inequalities in mortality becomes clear at the lower scale of the municipalities. In 2012-2016, there is a 10-year difference in life expectancy at birth (total population) between the extremes of the communal distribution. Within each region, areas of excess and relative under-mortality can be identified, beyond a marked North-South divide (figure 5). In Flanders, a group of municipalities located between Antwerp, Ghent and Brussels are characterised by a higher level of mortality than the regional average. It essentially concerns a former industrial zone centred on textiles with a relative excess mortality observed already half a century ago (Eggerickx & Sanderson 2010). The agglomerations of Ghent and Antwerp are also characterised by a lower life expectancy at birth than the regional average. In the South, Walloon Brabant (the vast peri-urban area located in the south of the Brussels conurbation) has a life expectancy well above the regional average, similar to the Flemish level. Moreover, all municipalities identified as peri-urban and located around the agglomerations of Charleroi, Namur and Liège are distinguished by a relative under-mortality, just as the more rural municipalities in the south of the province of Luxembourg 'benefiting' from the peri-urbanisation of the city of Luxembourg. These municipalities have been characterised in recent decades by a strong migratory attractiveness, whose actors – households aged 30-49 with their children – are increasingly socially selected under ever-increasing land and property pressure (Eggerickx & Sanderson 2019).

The extent of social inequalities in mortality within regions and sub-regions, as well as the growth in spatial inequalities in mortality over recent decades, raises questions about changes in the socio-demographic composition of migrants and by extension the role of migration (Ghosn et al. 2012). Today as in the past, sub-regional spaces and residential environments (urban, peri-urban, rural, etc.) are strongly structured by migration. On the one hand, internal and international migration are the main components of population movement and renewal at a fine spatial scale. On the other hand, migrants differ from non-migrants in a number of characteristics (age, sex, family situation, educational level, income, etc.) and can thus influence the demographic and socio-economic composition of populations at point of origin and point of arrival. Growing spatial inequalities in mortality can thus be partially explained by the selective effect of migration.

Figure 5. Life expectancy at birth by municipalities, Belgium, in 2011-2015



Source: Eggerickx et al. 2018b

As noted above, socio-economic features largely account for spatial disparities in mortality. Nonetheless, after controlling for socio-economic variables, disparities remain at the regional and sub-regional scales (table 11). This can also be observed for the social groups defined earlier. Within the same social group, regional differences in mortality remain, confirming that spatial inequalities in mortality do not only result from a different socio-economic composition. In 2011-2015, there is a gap of 3.4 years in life expectancy at birth between Brussels and the Walloon Region in the underprivileged social group. For the privileged social group, the difference between Flanders and the Walloon region is equal to 1.9 years for men. In general, the higher in the social hierarchy, the less significant the regional differences.

Finally, between 1992-1996 and 2011-2015, for equal social groups, regional differences in mortality have increased. Between Flanders and the Walloon Region, there was a difference in life expectancy of 3 years in 1992-1996 compared to 3.4 years 20 years later for underprivileged men; for privileged men the differential in life expectancy increased from 1.4 to 1.9 years between both periods. These trends also apply for women, although gaps are less pronounced.

Table 11. Life expectancy at birth by social group, men and women in Flanders, the Walloon Region and Brussels, 1992-1996 and 2011-2015

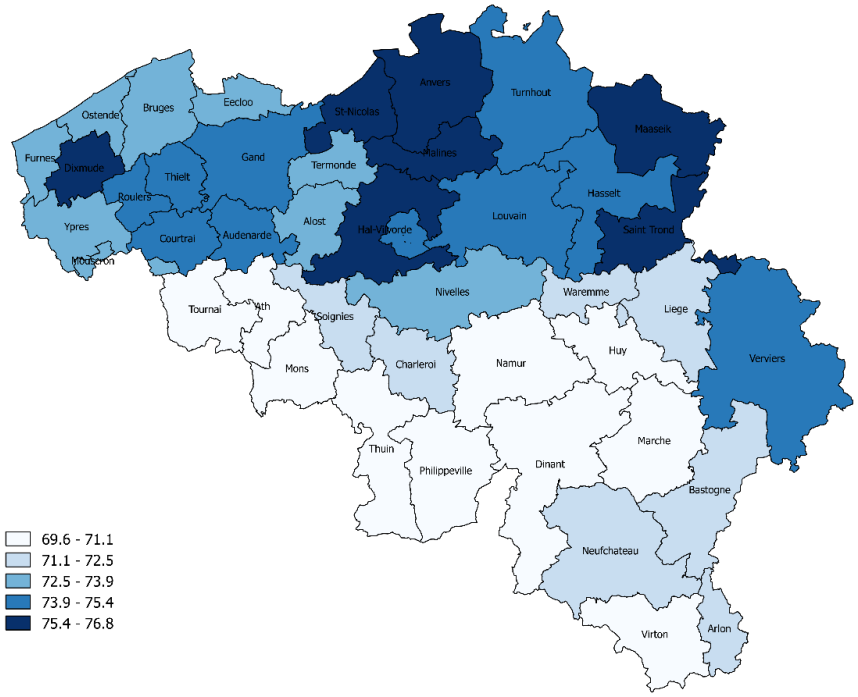
Social Groups	Men				Women			
	Belgium	Brussels	Flanders	Walloon Region	Belgium	Brussels	Flanders	Walloon Region
1992–1996								
Underprivileged (5%)	65.6	68.1	66.1	63.9	75.3	76.9	75.5	74.3
Underprivileged (25%)	69.6	70.4	70.6	67.6	78.3	78.6	78.8	77.2
Mid-low	73.5	72.6	74.6	71.9	81.1	80.5	81.6	80.3
Mid-high	75.4	74.8	76.1	74.3	82.2	81.9	82.6	81.6
Privileged	78.0	78.1	78.4	77.0	83.1	83.4	83.5	82.3
Total	**73.3**	**73.1**	**74.3**	**71.7**	**80.1**	**80.0**	**80.5**	**79.3**
Differences Priv./Underpriv.	8.4	7.7	7.8	9.4	4.8	4.8	4.7	5.1
2011–2015								
Underprivileged (5%)	70.2	73.1	71.0	68.4	76.6	78.1	76.6	75.6
Underprivileged (25%)	73.9	75.2	75.0	71.7	80.4	80.8	81.1	78.9
Mid-low	78.2	77.6	79.1	76.5	84.1	83.6	84.8	82.7
Mid-high	79.9	79.7	80.7	78.5	84.8	84.3	85.4	83.9
Privileged	83.0	82.4	83.8	81.9	87.0	86.6	87.7	86.1
Total	**78.1**	**77.9**	**79.1**	**76.2**	**83.1**	**82.8**	**83.8**	**81.8**
Differences Priv./Underpriv.	9.1	7.3	8.8	10.1	6.6	5.8	6.6	7.3

Source: Eggerickx et al. 2018b

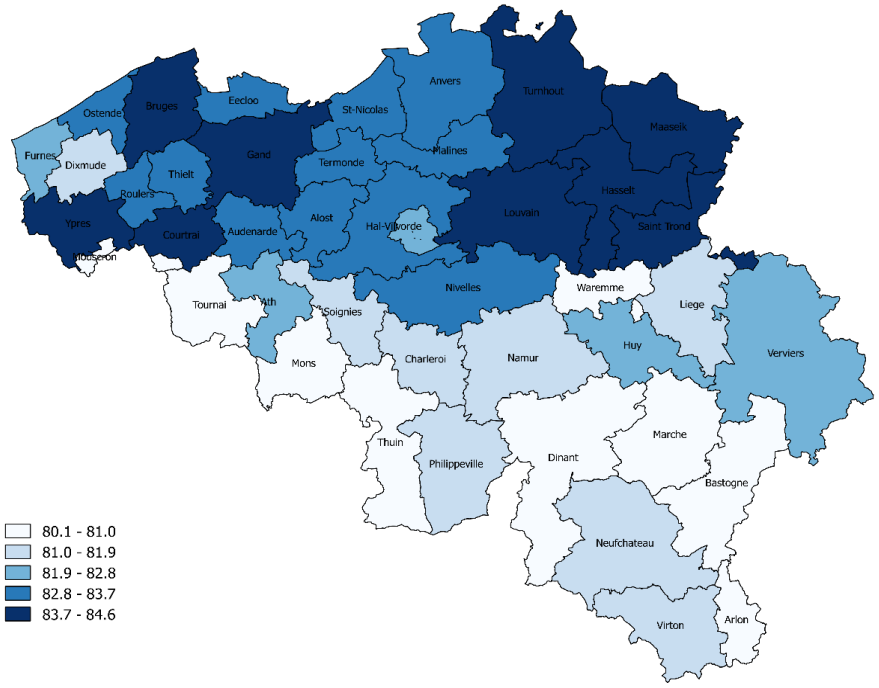
The contrasts become more obvious at the district level. Among underprivileged men, there is a gap of more than 7 years, while for privileged men it is equal to 4.5 years. For women, the differences fluctuate between 4.4 and 5 years depending on social group. In districts where life expectancy is high for the privileged social group, it is also higher for the underprivileged group (figure 6). This becomes clear in the Walloon districts of Nivelles and Mons. For Nivelles (located within Brussels' wealthy peri-urban area), male life expectancy for privileged and underprivileged social classes is much higher than the averages for the Walloon Region. For Mons, (formerly the industrial centre of the Borinage area and today socially disenfranchised), both social groups score below the regional average. In other words, the social environment has a positive effect on health and mortality where the privileged groups are better represented and a negative effect where they are in the minority. This means that the socio-economic composition of district populations is insufficient to explain mortality differences. Other factors are at play (e.g. environmental, cultural, behavioural) and affect the mortality of all groups in the same way. An additional factor is high spatial differentiation in the availability and quality of health services (Bourguignon et al. 2017).

Figure 6. Life expectancy at birth by district, men in the underprivileged and the privileged social group in Belgium, 2011-2015

Underprivileged social group



Privileged social group



Source: Eggerickx et al. 2018b

Simple regression models (2011-2015) for the 25-54, 55-79 and 80+ age groups were calculated to measure the "net effect" of district on mortality controlling for a series of other variables that potentially impact the risk of death: age, sex, social group, nationality and household status.

Table 12. Relative mortality (odds ratio) by district of residence, population aged 25-54, 55-79 and 80 and over, Belgium, 2011-2015

	25-54	**55-79**	**> 80**
Bruxelles	**1**	**1**	**1**
Aalst	1.197*	0.952*	1.085*
Antwerpen	0.987	0.901*	0.993
Brugge	0.988	0.814*	0.949*
Dendermonde	1.121*	0.909*	1.058*
Diksmuide	1.136	0.779*	0.807*
Eekloo	0.909	0.834*	0.997
Gent	1.052	0.861*	0.944*
Halle-Vilvoorde	1.119*	0.893*	0.983
Hasselt	1.007	0.849*	1.002
Ieper	1.158*	0.795*	0.892*
Kortrijk	1.21*	0.85*	0.961
Leuven	1.092*	0.845*	1.009
Maaseik	0.904*	0.816*	0.961
Mechelen	0.995	0.869*	1.012
Oostende	1.18*	0.863*	0.897*
Oudenaarde	1.1	0.846*	0.979
Roeselare	1.165*	0.803*	0.895*
Sint-Niklaas	0.909*	0.82*	0.97
Sint-Truiden	0.924	0.871*	1.103*
Tielt	1.034	0.783*	0.903*
Turnhout	0.924*	0.829*	1.032
Veurne	1.154	0.873*	0.878*
Arlon	1.32*	0.996	0.998
Ath	1.524*	1.181*	1.118*
Bastogne	1.332*	1.015	1.143*
Charleroi	1.447*	1.254*	1.232*
Dinant	1.515*	1.221*	1.192*
Huy	1.411*	1.136*	1.283*
Liège	1.315*	1.156*	1.19*
Marche	1.41*	1.055	1.201*
Mons	1.473*	1.241*	1.21*
Mouscron	1.359*	1.014	1.056
Namur	1.409*	1.096*	1.15*
Neufchâteau	1.564*	1.041	1.153*
Nivelles	1.162*	0.984	1.068*
Philippeville	1.543*	1.185*	1.238*
Soignies	1.451*	1.152*	1.107*
Thuin	1.529*	1.183*	1.144*
Tournai	1.53*	1.1*	1.109*
Verviers	1.076	0.984	1.127*
Virton	1.592*	0.964	1.081
Waremme	1.351*	1.1*	1.264*

Controlling by age, sex, social group, nationality and household status

The results show that taking into account the other explanatory variables does not cancel out the differences in mortality by district.

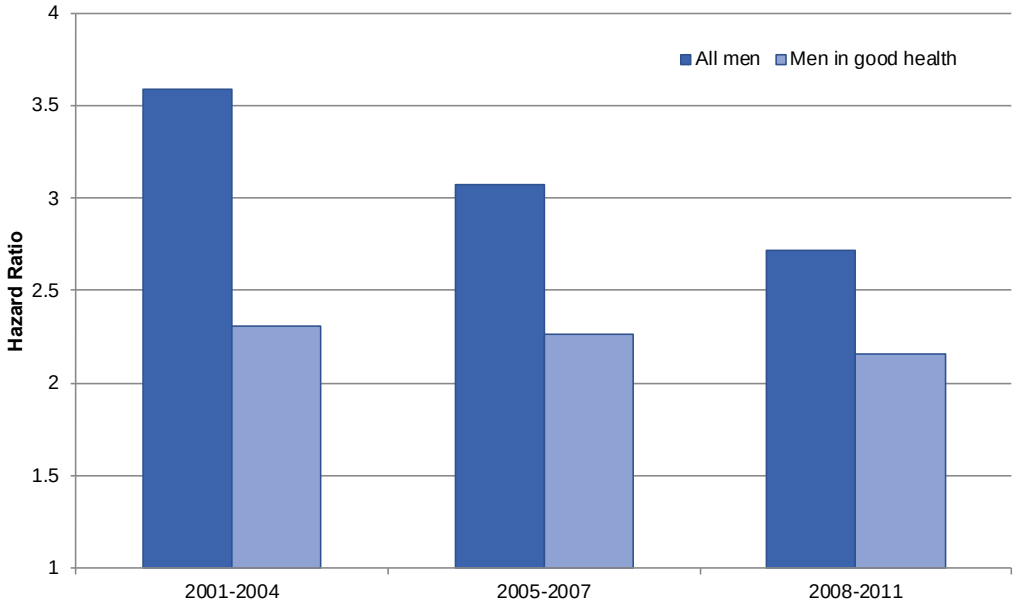
4.2 Mortality and (un)employment in Belgium (RQ2)

The second research question concerns the association between all-cause and cause-specific mortality and employment status, the first dimension of the de-standardisation of the life course considered in the CAUSINEQ project. To understand the relationship between all-cause and cause-specific mortality on the one hand and (un)employment on the other hand, several individual and multilevel models were constructed, controlling for different socio-economic and socio-demographic characteristics and studying (where possible) variations through time and space.

4.2.1 Differences in all-cause mortality (2001 & 2011 Census data)

The first step was to calculate mortality differences by activity status, comparing mortality rates of employed men and women with mortality rates of different non-working categories in the population. These estimates revealed that specific non-working categories suffered very high mortality rates. Controlling for individuals' health at baseline (which was only feasible with the 2001 census data) showed that the mortality excess of these groups was due to a selection effect (i.e. unhealthy people having a higher risk to be or become unemployed). Selection effects and reverse causation are of great concern in studies on the health impact of unemployment. Controlling for health status at baseline (2001) and excluding particular categories from the analyses (i.e. those who never worked, those who did not work because of social, family or health issues and the retired) resulted in relatively stable mortality rates among the unemployed. This stability is indicative of the fact that selection effects have generally been ruled out (figure 7).

Figure 7. Hazard ratio by activity status (employed versus unemployed and looking for a job), all men and men in good health aged 30-59 (at baseline), Belgium, 2001-2011



Source: Census 2001 linked to mortality data 2001-2011

It was therefore decided to restrict most analyses in this part of the report to the population in good health at baseline (2001) and, for the unemployed, to those actively looking for a job (conform the WHO-definition of unemployment).

Survival regression models of all-cause mortality in this study population were used to investigate the association between unemployment and mortality in detail at the individual level, controlling for factors such as gender, age, education, housing quality, ethnicity (Belgian, Turks and Moroccans) and living arrangements (see table 13).

Table 13. Hazard ratio by activity status (employed versus unemployed and looking for a job), controlling for education, housing, ethnicity and living arrangement, men in good health aged 30-59 (at baseline), Belgium, 2001-2011

	Men in good health aged 30-59, 2001-2011					
	M1	M2	M3	M4	M5	M6
Age	1.09	1.08	1.09	1.08	1.09	1.09
Activity status						
Working	1.00	1.00	1.00	1.00	1.00	1.00
Not working	2.22	2.03	2.00	2.34	1.94	1.82
Education						
No/primary education		1.76				1.61
Lower secondary education		1.59				1.48
Higher secondary education		1.37				1.31
Higher education		1.00				1.00
Housing quality						
Insufficient quality			2.12			1.58
Basic quality			1.70			1.37
Good quality			1.34			1.14
Good and spacious			1.20			1.10
Very good and spacious			1.00			1.00
Origin						
Belgian origin				2.01		2.18
European and Western origin				1.75		1.84
Non-Western origin				1.41		1.57
Turkish origin				1.11 n.s.		1.19 n.s.
Moroccan origin				1.00		1.00
Living arrangement						
Child					1.64	1.49
Single					1.81	1.69
Single with child					1.40	1.37
Other					1.71	1.55
Couple					1.00	1.00

n.s.: not significant

Source: Census 2001 linked to mortality data 2001-2011

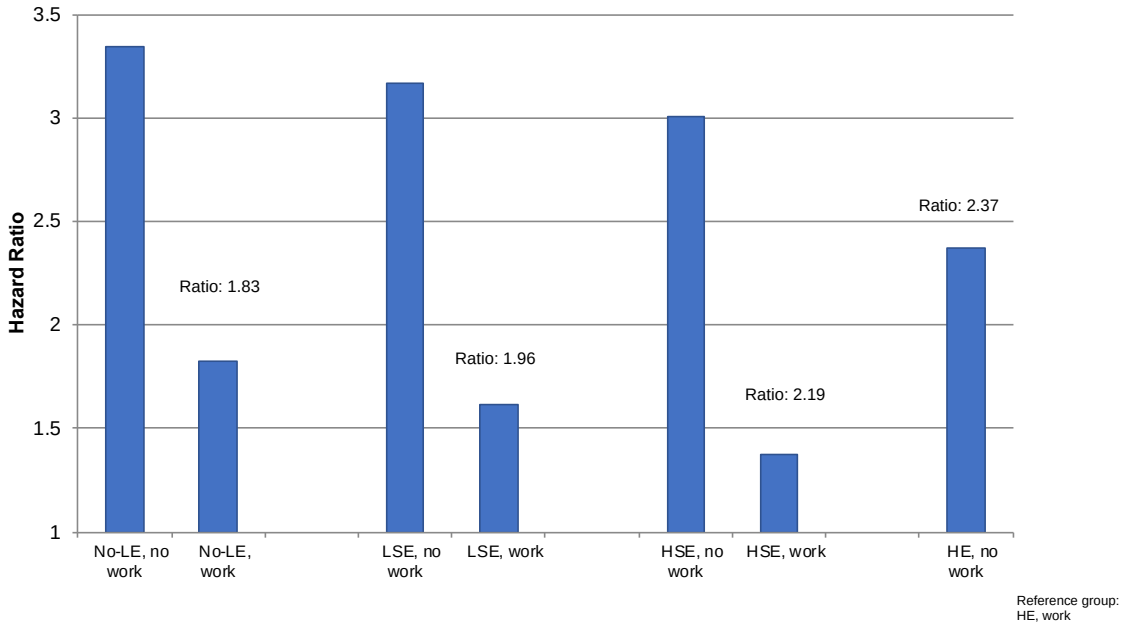
The results reveal that the unemployed have a two times higher mortality risk than the employed. Even when they report a high educational level, excellent housing conditions and healthy living arrangements, unemployed men still have a higher mortality risk than their employed counterparts. The results for women are comparable, although inequalities are smaller than for men. Stratification of the analyses by age showed that inequalities are higher in the middle-aged population (30-39 and 40-49, hazard ratios of about 2.5) than in the population aged 20-29 and 50-59 (hazard ratios of about 2).

The protective effect of education vis-à-vis the detrimental health impact of unemployment was also studied, by cross-classifying educational attainment and employment status. Our analysis shows a slight protective effect of education against the detrimental health impact of

unemployment (figure 8). Among the unemployed, men with lower degrees have higher mortality risks than those with a tertiary education degree. More striking is that unemployed men have higher mortality rates than working men, irrespective of their educational degree. Unemployed men with a tertiary degree, for instance, show higher mortality risks than employed men without or with a primary degree, even after statistical control for housing, living arrangement and ethnicity. Stratification by ethnicity furthermore reveals that this pattern occurred within the Belgian population only, not in ethnic minority groups such as Turkish and Moroccan men.

It is also observed in our analysis that mortality differences by employment status are largest among the highest educated, confirming the disappointment-paradox hypothesis: individuals with greater potential and expectations experience higher levels of stress and a more negative impact on health when they encounter economic adversity. An individual who simultaneously holds positions of unequal rank, such as having a high level of education but being unemployed is referred to as status inconsistent. This inconsistency of social status can be a structural source of stress in itself and thus trigger higher mortality risks. However, it should be kept in mind that higher educated employed usually have healthier jobs, explaining the larger differences in this group as well.

Figure 8. Hazard ratio by activity status (employed versus unemployed and looking for a job) and education (No-LE = no or low education, LSE = lower secondary education, HSE = higher secondary education, HE = higher education) combined, with control for confounding factors, men in good health aged 30-59 (at baseline)



Source: Census 2001 linked to mortality data 2001-2011

Part of these analyses was repeated using the most recent 2011 administrative census data, linked to mortality data for the follow-up period 2011-2013 (see table 14). When focussed on the role of unemployment on mortality differentials after controlling for educational level, income, housing and living arrangement, it becomes clear that the more recent data confirm the earlier conclusions (De Vestel 2018). Unemployed men and women show higher mortality rates, compared to the employed. For men (but not for women), the association remains significant when controlling for other socio-economic and socio-demographic characteristics. The relationship between unemployment and mortality was most pronounced in the Flemish Region and in the Brussels Capital Region and among the highest educated (De Vestel 2018).

Table 14. Relative all-cause mortality risks (hazard ratios) by activity status and socio-economic and socio-demographic control variables, Belgian men between 30-59, 2011-2013

Men	Model 1	Model 2	Model 3	Model 4	Model 5
Activity status (ref. employed)					
Unemployed	2.55 (2.43 – 2.67)***	2.40 (2.29 – 2.51)***	2.16 (2.05 – 2.26)***	1.74 (1.66 – 1.83)***	1.16 (1.10 – 1.23)***
Age (centred 30 years)		1.10 (1.09 – 1.10)***	1,09 (1.09 – 1.10)***	1.09 (1.09 – 1.10)***	1.10 (1.09 – 1.10)***
Education (ref. tertiary education)					
No degree or primary education			1.85 (1.74 – 1.96)***	1.77 (1.66 – 1.88)***	1.30 (1.22 – 1.39)***
Lower secondary education			1.85 (1.76 – 1.95)***	1.78 (1.70 – 1.87)***	1.44 (1.36 – 1.52)***
Higher secondary education			1.59 (1.52 – 1.67)***	1.55 (1.48 – 1.63)***	1.35 (1.29 – 1.42)***
Household composition (ref. couple with children)					
Couple without children				1.33 (1.27 – 1.39)***	1.28 (1.22 – 1.34)***
Single with children				1.84 (1.72 – 1.97)***	1.70 (1.59 – 1.82)***
Single without children				2.34 (2.24 – 2.44)***	1.96 (1.87 – 2.05)***
Other				1.93 (1.71 – 2.18)***	1.67 (1.48 – 1.89)***
Income decile (ref. 10th decile)					
Decile 1-6					1.97 (1.86 – 2.09)***
Decile 7-8					1.50 (1.42 – 1.58)***
Decile 9					1.22 (1.15 – 1.29)***
Owner (ref.)					
Tenant					1.38 (1.32 – 1.43)***
Housing quality (ref. medium comfort)					
Little comfort					1.19 (1.14 – 1.24)***
No comfort					1.41 (1.24 – 1.61)***
Deviance (-2 Log Likelihood)	376110.93	369678.65	368955.10	367484.32	366464.38
Chi-square: difference with previous model	1213.81***	6432.28***	723.55***	1470.78***	1019.95***

Hazard ratios for all-cause mortality (95% confidence intervals between brackets)
Model 1: relationship between activity status and all-cause mortality; Model 2: M1 + age; Model 3: M2 + education; Model 4: M3 + household composition; Model 5: M4 + income decile, owner/tenant and housing quality.
** p<0.05, ** p<0.01, *** p<0.001*

Source: De Vestel 2018

4.2.2 Differences in cause-specific mortality (2001 Census data)

In a next step, the individual survival models were elaborated by focussing on specific causes of death. Using the 2001 census data and information from the death certificates during the follow-up period, the inequalities in main cause groups were studied (see table 15). The analyses clearly show that the mortality excess of the unemployed results from an excess mortality in practically all main cause groups (Vanthomme & Gadeyne 2019). Mortality differences between the employed and unemployed are largest for endocrine, nutritional and metabolic diseases; for mental and behavioural disorders and diseases of the digestive and respiratory system. Concentrating on specific causes within each main group, large inequalities are observed for alcohol-related mortality such as alcohol psychosis, dependency and abuse; cirrhosis of the liver; alcohol poisoning and furthermore for diabetes; accidental falls; cancer of the lip, oral cavity and pharynx; and lung cancer (Vanthomme & Gadeyne 2019).

Table 15. Age-adjusted all-cause and cause-specific mortality rate ratios (MRR) with 95% confidence intervals (CI) of being unemployed but looking for a job versus being employed, with and without adjustment for educational attainment, Belgian men and women aged 25-59 years, 2001-2011

	Men		**Women**	
	Model 1	Model 2	Model 1	Model 2
Reference category is employed	MRR (95% CI)	MRR (95% CI)	MRR (95% CI)	MRR (95% CI)
All deaths	**2.32 (2.24-2.40)**	**1.80 (1.74-1.87)**	**1.64 (1.57-1.72)**	**1.48 (1.41-1.56)**
Infectious diseases	**3.50 (2.73-4.50)**	**2.52 (1.89-3.35)**	**2.10 (1.46-3.01)**	**1.77 (1.21-2.59)**
Cancers	**1.86 (1.75-1.98)**	**1.55 (1.45-1.66)**	**1.30 (1.21-1.39)**	**1.21 (1.14-1.31)**
Endocrine diseases	**3.60 (2.75-4.70)**	**2.56 (1.89-3.46)**	**2.77 (1.83-4.19)**	**2.44 (1.57-3.80)**
Diabetes	3.12 (2.12-4.59)	2.07 (1.35-3.18)	3.56 (1.96-6.45)	3.07 (1.64-5.74)
Mental and behavioural disorders	**6.90 (5.74-8.29)**	**3.80 (3.06-4.73)**	**3.53 (2.50-4.99)**	**2.70 (1.84-3.96)**
Mental disorder due to alcohol	7.60 (6.17-9.37)	4.11 (3.19-5.29)	4.26 (2.84-6.38)	3.22 (2.10-4.95)
Diseases of the nervous system	**2.59 (2.02-3.33)**	**2.00 (1.50-2.67)**	**1.14 (0.77-1.68)**	**1.17 (0.77-1.78)**
Diseases of the circulatory system	**2.20 (2.03-2.37)**	**1.70 (1.56-1.85)**	**1.78 (1.58-2.02)**	**1.52 (1.33-1.73)**
Hypertensive diseases	1.86 (1.01-3.43)	1.55 (0.82-2.93)	2.37 (1.10-5.12)	1.91 (0.86-4.24)
Ischaemic Heart Disease	1.99 (1.77-2.24)	1.60 (1.41-1.82)	1.81 (1.43-2.28)	1.55 (1.21-1.99)
Pulmonary Heart Disease	2.09 (1.35-3.24)	1.84 (1.13-3.00)	2.47 (1.54-3.95)	2.42 (1.46-4.00)
Diseases of the respiratory system	**3.14 (2.62-3.76)**	**2.10 (1.70-2.59)**	**2.75 (2.11-3.57)**	**2.23 (1.68-2.94)**
Pneumonia	3.44 (2.46-4.81)	2.53 (1.72-3.73)	3.15 (1.96-5.08)	2.44 (1.46-4.08)
Chronic lower respiratory infections	3.43 (2.64-4.45)	2.22 (1.63-3.02)	3.13 (2.18-4.51)	2.41 (1.63-3.56)
Diseases of the digestive system	**3.83 (3.40-4.32)**	**2.74 (2.39-3.15)**	**3.15 (2.66-3.72)**	**2.71 (2.26-3.25)**
Alcoholic liver disease	4.20 (3.54-4.97)	3.18 (2.62-3.86)	3.44 (2.72-4.35)	3.10 (2.41-4.00)
Fibrosis and cirrhosis of the liver	3.78 (2.89-4.95)	2.93 (2.15-3.98)	3.20 (2.19-4.69)	2.70 (1.80-4.06)
Injury- poisoning and certain other consequences of external causes	**1.55 (1.40-1.71)**	**1.28 (1.14-1.43)**	**1.58 (1.37-1.82)**	**1.45 (1.24-1.69)**
External causes of morbidity and mortality	**3.06 (2.78-3.37)**	**2.36 (2.11-2.63)**	**2.64 (2.26-3.08)**	**2.13 (1.80-2.53)**
Transport accidents	2.29 (1.88-2.79)	1.79 (1.43-2.23)	2.13 (1.54-2.94)	1.60 (1.10-2.33)
Falls	4.77 (3.50-6.49)	3.12 (2.20-4.43)	3.68 (2.24-6.06)	2.70 (1.52-4.77)
Intentional self-harm	2.83 (2.46-3.27)	2.35 (2.00-2.76°	2.61 (2.09-3.27)	2.30 (1.80-2.94)

Mortality rate ratio of being unemployed and looking for a job versus being employed. Model 1: baseline model adjusted for attained age; Model 2: baseline model adjusted for attained age, educational attainment, home ownership, living situation and migrant background. Number of men = 1,693,799; number of women: 1,390,338.

Source: Vanthomme & Gadeyne, 2019

Specific attention was paid to the association between cancer mortality and activity status, because cancer has become during past decades the most important cause of death in the working age population. The analyses focussed on overall and site-specific cancer mortality during 2001-2011, related to activity status in 1991 (given the incubation time of cancer). Results (presented in table 16) illustrate that in the economically active age group (25-65), unemployed men and women have higher cancer mortality rates for preventable cancers (head and neck cancer, cancer of the oesophagus, colorectal, lung, breast, cervix, uterus, bladder and malignant melanoma) as well as non-preventable cancers (cancer of the stomach, liver, pancreas, ovary, kidney, eye, nervous system, non-Hodgkin, multiple

myeloma and leukaemia). These inequalities are manifest for most cancer sites and especially for preventable cancers with alcohol- and smoking-related cancers being the main contributors of these inequalities (Vanthomme et al. 2017).

Table 16. Net relative site-specific cancer mortality inequality (mortality rate ratios and 95% CI), Belgian men within the economically active age range, by employment group in 1991, 2001-2011

Men	**Employed**	**Unemployed and looking for a job**	**Unemployed and not looking for a job**	**Disabled**
All cancers	1.00	1.60 (1.55-1.65)	2.74 (2.69-2.80)	2.28 (2.19-2.37)
Preventable cancers				
Head and neck	1.00	2.33 (2.10-2.59)	2.73 (2.46-3.02)	2.18 (1.8-2.65)
Oesophagus	1.00	2.09 (1.83-2.38)	2.36 (2.12-2.62)	1.98 (1.59-2.48)
Stomach	1.00	1.35 (1.13-1.61)	2.97 (2.68-3.30)	2.65 (2.15-3.28)
Colorectal	1.00	1.26 (1.14-1.41)	2.61 (2.45-2.77)	1.71 (1.48-1.99)
Liver	1.00	1.49 (1.25-1.76)	2.31 (2.06-2.60)	2.29 (1.80-2.88)
Lung	1.00	1.71 (1.63-1.79)	2.86 (2.77-2.95)	2.52 (2.37-2.69)
Prostate	1.00	1.17 (1.01-1.35)	2.78 (2.59-2.99)	2.30 (1.96-2.70)
Bladder	1.00	1.91 (1.62-2.25)	3.37 (3.05-3.73)	2.65 (2.13-3.29)
Malignant melanoma	1.00	1.30 (0.97-1.73)	1.90 (1.57-2.31)	1.05 (0.59-1.88)
Non-preventable cancers				
Pancreas	1.00	1.38 (1.21-1.58)	2.44 (2.24-2.66)	1.85 (1.53-2.25)
Kidney	1.00	1.18 (0.97-1.45)	2.39 (2.14-2.68)	2.52 (2.01-3.16)
Eye, nervous system	1.00	0.94 (0.75-1.17)	2.14 (1.88-2.44)	2.15 (1.64-2.82)
Non-Hodgkin	1.00	1.35 (1.09-1.66)	2.42 (2.13-2.75)	1.79 (1.33-2.43)
Multiple myeloma	1.00	1.25 (0.93-1.68)	2.86 (2.46-3.32)	1.48 (0.97-2.25)
Leukemia	1.00	1.05 (0.84-1.31)	2.73 (2.44-3.06)	1.72 (1.30-2.28)

Source: Vanthomme et al., 2017

A related study analysed the role of parental socio-economic characteristics in 1991, among which activity status, in relation to overall and site-specific cancer mortality among children and young adults in the period 2001-2011. Parental characteristics (education, housing and area deprivation) as well as personal education were associated with higher all-cancer mortality in young adulthood, but parental activity status did not seem to be a relevant variable. In the full models, parental socio-economic position was no longer associated with cancer mortality, but deprived living conditions still were (Vanthomme et al. 2017).

4.2.3 The role of aggregated levels of unemployment (2001 Census data)

Unemployment was not only included as a characteristic of individuals. Previous studies show that the relation between employment status and mortality at the individual level is influenced by the aggregated level of unemployment of the place of residence. Literature suggests that the association between individual-level unemployment and mortality tends to be weaker when the aggregated level of unemployment is higher. A first explanation for this phenomenon refers to a compositional effect: unemployment becomes less health-selective when unemployment rates are high. An alternative explanation – the 'social norm of unemployment' hypothesis – refers to the reduced level of stigmatisation when unemployment is widespread, because one's own unemployment represents a smaller deviation from the social norm. This results in lower levels of stress and depression, partially moderating the damaging health effects of individual unemployment.

To study this, multilevel survival regression models for all-cause mortality among men and women aged 30-59 were used, in which unemployment rates at the (sub)district level were included alongside individual unemployment, educational level and housing conditions (table 17). The research results are in line with the 'social norm hypothesis', showing that the mortality excess for unemployed men and women is smaller in regions with high aggregate unemployment levels. This 'social norm' effect is most obvious among the unemployed with low educational levels. On top of this, results are also in line with the disappointment paradox and status inconsistency hypotheses mentioned before, since the largest mortality excess is seen for the unemployed with tertiary education (De Moortel et al. 2018).

Table 17. Mortality rate ratios (MRR) and their 95% confidence intervals (CI) for all-cause mortality, men and women in good health aged 30-59 years, Belgium, 2001-2011

	Men MRR (CI)	**Relative diff.**[a] MRR (CI)	**Women** MRR (CI)	**Relative diff.**[a] MRR (CI)
Model 1 interaction model employment status and employment-level quartiles				
Unemployed				
x unemployment rate Q1	1.36 (1.19-1.55)	1.87 (1.69-2.06)	1.36 (1.21-1.54)	1.63 (1.45-1.82)
x unemployment rate Q2	1.21 (1.07-1.38)	1.66 (1.51-1.83)	1.13 (1.00-1.26)	1.32 (1.18-1.47)
x unemployment rate Q3	1.61 (1.44-1.80)	1.76 (1.64-1.89)	1.45 (1.31-1.60)	1.50 (1.37-1.65)
x unemployment rate Q4	1.62 (1.53-1.72)	1.62 (1.53-1.72)	1.40 (1.29-1.52)	1.40 (1.29-1.52)
Employed				
x unemployment rate Q1	0.73 (0.66-0.80)		0.84 (0.79-0.89)	
x unemployment rate Q2	0.73 (0.67-0.80)		0.85 (0.80-0.91)	
x unemployment rate Q3	0.91 (0.84-1.00)		0.96 (0.90-1.03)	
x unemployment rate Q4	1.00		1.00	
p-values of LR-test comparing model with and without interaction		*0.064*		*0.046*
Model 2 interaction model employment status and education				
Unemployed				
x (pre-)primary education	2.52 (2.34-2.72)	1.55 (1.43-1.67)	1.79 (1.60-1.99)	1.32 (1.17-1.48)
x Low secondary education	2.36 (2.20-2.52)	1.59 (1.49-1.70)	1.79 (1.65-1.94)	1.49 (1.37-1.61)
x High Secondary education	2.43 (2.26-2.60)	1.84 (1.71-1.97)	1.70 (1.56-1.86)	1.44 (1.32-1.56)
x Tertiary education	1.97 (1.80-2.15)	1.97 (1.80-2.15)	1.63 (1.44-1.83)	1.63 (1.44-1.83)
Employed				
x (pre-)primary education	1.63 (1.57-1.69)		1.36 (1.27-1.45)	
x Low secondary education	1.48 (1.44-1.53)		1.20 (1.14-1.26)	
x High secondary education	1.32 (1.28-1.36)		1.19 (1.14-1.24)	
x Tertiary education (ref.)	1.00		1.00	
p-values of LR-test comparing model with and without interaction		*0.000*		*0.092*
Model 3 interaction model employment status. education and unemployment level				
Unemployed (pre-)primary education				
x Q1	2.04 (1.64-2.54)	1.71 (1.39-2.09)	1.61 (1.24-2.08)	1.52 (1.16-1.99)
x Q2	1.63 (1.30-2.05)	1.39 (1.12-1.72)	1.35 (1.05-1.73)	1.18 (0.91-1.53)
x Q3	2.50 (2.11-2.95)	1.73 (1.49-2.01)	1.85 (1.49-2.30)	1.40 (1.11-1.77)
x Q4	2.34 (2.10-2.61)	1.47 (1.31-1.65)	1.67 (1.40-1.99)	1.19 (0.98-1.45)
Unemployed low secondary education				
x Q1	1.82 (1.49-2.23)	1.71 (1.42-2.05)	1.66 (1.37-2.01)	1.68 (1.38-2.04)
x Q2	1.69 (1.39-2.05)	1.59 (1.34-1.90)	1.21 (1.00-1.47)	1.19 (0.98-1.45)
x Q3	2.38 (2.05-2.77)	1.76 (1.56-1.99)	1.87 (1.60-2.18)	1.58 (1.36-1.84)
x Q4	2.13 (1.92-2.35)	1.45 (1.32-1.61)	1.70 (1.49-1.94)	1.48 (1.29-1.70)
Unemployed high secondary education				
x Q1	1.79 (1.46-2.21)	1.91 (1.58-2.31)	1.64 (1.35-2.01)	1.65 (1.35-2.00)
x Q2	1.63 (1.33-2.00)	1.70 (1.42-2.04)	1.33 (1.09-1.62)	1.34 (1.11-1.62)
x Q3	2.07 (1.76-2.43)	1.73 (1.50-1.98)	1.57 (1.32-1.86)	1.39 (1.18-1.65)
x Q4	2.48 (2.23-2.76)	1.91 (1.72-2.13)	1.64 (1.42-1.90)	1.40 (1.21-1.63)
Unemployed tertiary education				
x Q1	1.71 (1.33-2.20)	2.39 (1.89-3.03)	1.39 (1.00-1.93)	1.67 (1.20-2.33)
x Q2	1.51 (1.20-1.88)	2.10 (1.70-2.58)	1.57 (1.21-2.04)	1.86 (1.44-2.41)
x Q3	1.63 (1.34-1.99)	1.83 (1.53-2.19)	1.44 (1.14-1.81)	1.56 (1.24-1.95)
x Q4	1.87 (1.63-2.14)	1.87 (1.63-2.14)	1.53 (1.26-1.86)	1.53 (1.26-1.86)
Employed (pre-)primary education				
x Q1	1.20 (1.07-1.33)		1.06 (0.93-1.20)	
x Q2	1.17 (1.05-1.31)		1.14 (1.01-1.30)	
x Q3	1.44 (1.29-1.61)		1.32 (1.16-1.51)	
x Q4	1.59 (1.49-1.70)		1.41 (1.24-1.59)	
Employed lower secondary education				
x Q1	1.06 (0.96-1.18)		0.99 (0.89-1.09)	
x Q2	1.06 (0.95-1.17)		1.02 (0.92-1.13)	
x Q3	1.35 (1.22-1.49)		1.18 (1.07-1.30)	
x Q4	1.46 (1.38-1.55)		1.15 (1.05-1.26)	
Employed higher secondary education				
x Q1	0.94 (0.85-1.04)		1.00 (0.91-1.10)	
x Q2	0.96 (0.87-1.06)		0.99 (0.90-1.09)	
x Q3	1.20 (1.08-1.33)		1.12 (1.02-1.24)	
x Q4	1.30 (1.22-1.37)		1.17 (1.07-1.28)	
Employed tertiary education				
x Q1	0.71 (0.64-0.79)		0.83 (0.75-0.91)	
x Q2	0.72 (0.65-0.80)		0.84 (0.77-0.93)	
x Q3	0.89 (0.80-0.99)		0.92 (0.84-1.01)	
x Q4 (ref.)	1.00		1.00	
p-values of LR-test comparing model with and without interaction		*0.244*		*0.656*

**All models are controlled for age, living arrangements, housing conditions and nationality of origin.*

[a]*Model 1: employed in unemployment rate Q_x (ref.); Model 2: employed with educational level$_x$ (ref.); Model 3: employed in unemployment rate Q_x with educational level$_x$ (ref.).*

Source: De Moortel et al. 2018

Again, specific attention was paid to cancer mortality, investigating the role of aggregate levels of unemployment. A first study probed into the contribution of individual characteristics – education, housing status and home ownership – and area-level characteristics – unemployment rate, urbanicity, the percentage employed in mining and the share of employed in other high-risk industries – to lung cancer mortality (see table 18). Individuals with a low socio-economic position (measured as pre-primary/primary educational level, low or basic quality comfort level and tenants) experience a higher lung cancer mortality risk. The analyses show significant sub-district variations in lung cancer mortality as well. Among women, an association with lung cancer mortality is found for two sub-district characteristics: urbanicity and unemployment rate. For men, lung cancer mortality is associated with the percentage employed in mining (Hagedoorn et al. 2016a).

Table 18. Age-adjusted lung cancer mortality rate ratios (MRR) with 95% confidence intervals (CI) by individual and sub-district characteristics, men aged 65+ in Belgium, 2001-2011

	Model 1[a] MRR 95%CI	**Model 2**[b] MRR 95%CI	**Model 3**[c] MRR 95%CI	**Model 4**[d] MRR 95%CI
Individual characteristics				
Educational level				
Pre-primary/primary	1.00 (Ref.)	1.00 (Ref.)	1.00 (Ref.)	1.00 (Ref.)
Lower secondary	0.84 (0.81-0.87)	0.84 (0.81-0.87)	0.84 (0.81-0.87)	0.84 (0.81-0.87)
Upper and post-secondary	0.72 (0.69-0.76)	0.72 (0.69-0.76)	0.72 (0.69-0.76)	0.72 (0.69-0.76)
Tertiary	0.55 (0.53-0.58)	0.55 (0.53-0.58)	0.55 (0.53-0.58)	0.55 (0.53-0.58)
Comfort level				
Low quality	1.00 (Ref.)	1.00 (Ref.)	1.00 (Ref.)	1.00 (Ref.)
Basic quality	1.02 (0.97-1.07)	1.02 (0.97-1.07)	1.02 (0.97-1.07)	1.02 (0.97-1.07)
Good quality	0.90 (0.86-0.94)	0.90 (0.86-0.94)	0.90 (0.86-0.94)	0.90 (0.86-0.94)
High quality	0.93 (0.89-0.98)	0.93 (0.89-0.98)	0.93 (0.89-0.98)	0.93 (0.88-0.98)
Very high quality	0.84 (0.79-0.89)	0.84 (0.78-0.89)	0.84 (0.79-0.89)	0.83 (0.78-0.89)
Home ownership				
Tenant	1.00 (Ref.)	1.00 (Ref.)	1.00 (Ref.)	1.00 (Ref.)
Owner	0.76 (0.74-0.79)	0.76 (0.74-0.79)	0.76 (0.74-0.79)	0.76 (0.74-0.79)
Marital status				
Non-married	1.00 (Ref.)	1.00 (Ref.)	1.00 (Ref.)	1.00 (Ref.)
Married	0.99 (0.96-1.02)	0.99 (0.96-1.02)	0.99 (0.96-1.02)	0.99 (0.96-1.02)
Sub-district characteristics				
Urbanicity				
Non-urban		1.00 (Ref.)	1.00 (Ref.)	1.00 (Ref.)
Urban		0.97 (0.91-1.04)	1.00 (0.95-1.06)	1.03 (0.97-1.10)
Unemployment rate				
Q1 (lowest)		1.00 (Ref.)		1.00 (Ref.)
Q2		1.10 (1.01-1.20)		1.01 (0.93-1.09)
Q3		1.13 (1.05-1.23)		0.94 (0.85-1.03)
Q4 (highest)		1.06 (0.97-1.16)		0.89 (0.81-0.99)
% Employed in mining				
Q1 (lowest)			1.00 (Ref.)	1.00 (Ref.)
Q2			1.09 (1.01-1.17)	1.08 (1.01-1.15)
Q3			1.13 (1.05-1.21)	1.19 (1.10-1.30)
Q4 (highest)			1.22 (1.13-1.31)	1.30 (1.18-1.43)
% Employed in other high-risk industries				
Q1 (lowest)			1.00 (Ref.)	1.00 (Ref.)
Q2			0.94 (0.88-1.02)	0.94 (0.87-1.00)
Q3			0.97 (0.90-1.04)	0.97 (0.91-1.04)
Q4 (highest)			0.97 (0.90-1.04)	0.96 (0.89-1.03)

[a]*Model 1: includes individual SES, adjusted for age and marital status*
[b]*Model 2: includes individual SES, urbanicity and unemployment rate, adjusted for age and marital status*
[c]*Model 3: includes individual SES, urbanicity and environmental pollution, adjusted for age and marital status*
[d]*Model 4: includes individual SES, urbanicity and unemployment rate and industrial pollution, adjusted for age and marital status*

Source: Hagedoorn et al. 2016a

A comparable analysis looked into head and neck cancer and more specifically investigated to which extent individual characteristics – employment status, education and housing conditions – and the area-level deprivation index are associated to head and neck cancer mortality among men aged 40-64 in Belgium (Hagedoorn et al. 2016b). This study reveals that head and neck cancer mortality is significantly higher for non-working men and tenants living in low-quality housing compared to employed men and homeowners living in high-quality housing respectively (see table 19). The share of unemployed among men 18-64 at

the municipality level is an important dimension of the deprivation index (besides the percentage of households without a car and the percentage of inhabitants aged 25-64 with low educational attainment). This deprivation index appears to be an important variable as well. Men living in municipalities in the 4th and 5th deprivation quintiles experience a significantly higher head and neck cancer mortality risk compared to those living in the least deprived municipalities (Hagedoorn et al. 2016b).

Table 19. Age-standardised mortality rates (ASMR) and their 95% confidence intervals (CI) by individual socioeconomic position (SEP) and municipal deprivation index for head and neck cancer, men aged 40-64 years, Belgium, 2001-2011

	ASMR* and 95% CI (per 100 000 person years)		Model 1		Model 2	
			MRR	95% CI	MRR	95% CI
Education						
Tertiary	7.7	(6.8-8.5)	1.00	(Ref.)	1.00	(Ref.)
Upper secondary	12.9	(11.8-14.0)	1.35	(1.17-1.55)	1.34	(1.17-1.55)
Lower secondary	17.9	(16.7-19.1)	1.55	(1.36-1.78)	1.54	(1.35-1.76)
Primary	21.4	(19.5-23.2)	1.33	(1.15-1.53)	1.31	(1.13-1.51)
Employment status						
Employed	9.0	(8.4-9.5)	1.00	(Ref.)	1.00	(Ref.)
Unemployed	37.7	(33.2-42.3)	3.04	(2.64-3.49)	2.96	(2.57-3.40)
Retired	35.3	(24.3-46.4)	2.18	(1.90-2.50)	2.16	(1.88-2.48)
Nonworking	53.9	(49.0-58.8)	3.99	(3.58-4.45)	3.95	(3.54-4.40)
Housing conditions						
Owner-high quality	7.3	(6.6-7.9)	1.00	(Ref.)	1.00	(Ref.)
Owner-mid quality	9.1	(8.0-10.2)	1.09	(0.94-1.27)	1.08	(0.93-1.26)
Owner-low quality	16.5	(15.2-17.8)	1.72	(1.51-1.95)	1.70	(1.50-1.93)
Tenant-high quality	16.1	(13.3-19.0)	1.85	(1.52-2.26)	1.83	(1.50-2.23)
Tenant-mid quality	25.4	(22.1-28.8)	2.52	(2.14-2.98)	2.47	(2.09-2.92)
Tenant-low quality	40.2	(37.0-43.4)	3.32	(2.91-3.79)	3.22	(2.82-3.68)
Municipality Deprivation Index						
Q1 (least deprived)	9.9	(8.9-11.0)			1.00	(Ref.)
Q2	12.0	(10.8-13.1)			1.06	(0.88-1.26)
Q3	13.4	(12.1-14.6)			1.10	(0.93-1.31)
Q4	16.2	(14.8-17.7)			1.27	(1.05-1.53)
Q5 (most deprived)	21.9	(20.1-23.6)			1.41	(1.17-1.71)

Ref: reference category.
Head and neck cancer: ICD-10 C01-C06; C09-C10; C12-C14; C32.
** Directly standardised using the male Belgian population of 2001 as the standard population.*
Model 1: Age + individual SEP.
Model 2: Age + individual SEP + municipal SEP.

Source: Hagedoorn et al. 2016b

Multilevel models were also used to study the role of individual and area socio-economic features in explaining regional mortality differences in Belgium among men aged 45-64 during the period 2001-2011. The highest levels of mortality are found in the inner city of the Brussels Capital Region and in several Walloon cities. Their disadvantage can be partially explained by the lower individual socio-economic position of their residents (see table 20). Among the area-level characteristics, both the percentage of employed men and the percentage of labourers had a protective effect, regardless of individual socio-economic position (Van Hemelrijck et al. 2016).

Table 20. Mortality Rate Ratios (MRRs) for all-cause mortality and 95% confidence intervals (CIs) in a random intercepts model with predictors at the individual and sub-district level, controlled for age and household position, Belgium, 2001-2011

Variable	MRR (95% CI)
Individual SEP	
Educational level	
No/Lower education	Ref.
Lower secondary education	0.94 (0.92-0.96)***
Higher secondary education	0.91 (0.89-0.93)***
Higher education	0.75 (0.73-0.77)***
Employment status	
Active	Ref.
Job-seeking	1.66 (1.61-1.71)***
Retired	1.38 (1.35-1.41)***
Unemployed (specific reason)	2.67 (2.60-2.73)***
Never active/not capable of answer/other	2.28 (1.80-2.88)***
Job category	
Civil servant/other employee	Ref.
Manager	1.00 (0.96-1.05)
Self-employed/liberal profession	1.03 (1.01-1.06)*
Labourer	1.04 (1.02-1.07)***
Other	1.11 (1.06-1.15)***
Activity sector	
Primary	Ref.
Secondary	1.11 (1.06-1.17)***
Tertiary	1.18 (1.12-1.24)***
Quaternary	1.25 (1.19-1.32)***
Other	1.23 (1.16-1.30)***
Home ownership	
Owner/Usufructuary	Ref.
Tenant	1.37 (1.34-1.40)***
Tenant at a public institution	1.48 (1.44-1.53)***
Comfort level dwelling	
Insufficient comfort	Ref.
Basic comfort	0.93 (0.90-0.95)***
Good comfort	0.80 (0.77-0.82)***
Good comfort and spacious	0.79 (0.76-0.81)***
Very good comfort	0.72 (0.70-0.75)***
Area-level SE characteristics	
% employed	0.98 (0.97-0.99)***
% labourers	0.99 (0.98-0.99)***
Variability intercept	**0.01 (0.01-0.02)**
BIC	**547122.70**

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

Source: Van Hemelrijck et al. 2016

4.2.4 Standard versus non-standard employment and mortality

Apart from types of status outside paid employment, the 2001 census provides information on the type of contract for those in employment (full-time, part-time, seasonal work, interim work, …) as well. Analyses with these variables show a clear association between excess mortality and non-standard employment (when compared to 'permanent employment') in the years following exposure.

The relative all-cause and cause-specific mortality risk of those on various non-standard contracts in 2001 in relation to permanent employees is shown in table 21. It is observed that (taking into account socio-economic and work-related characteristics) apart from those undertaking casual work, all categories of male workers in non-standard contracts in 2001 experience excess all-cause mortality in the subsequent 15 years compared to permanent workers. Male temporary agency workers and seasonal workers face a seriously increased risk of death due to respectively external causes/suicide and transport accidents (but note the wide confidence interval in some places). Female non-standard workers' relative mortality risks are less pronounced than those of their male counterparts (Balogh et al. 2019a).

Table 21. Hazard ratios and 95% confidence intervals by employment type in 2001, men and women in Belgium, 2001-2016

Men	**All-cause**	**CD**	**Cancer**	**External**	**Transport accidents**	**Suicide**
Permanent employment	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Temporary agency work	**1.54 (1.39,1.70)**	**1.53 (1.18,1.97)**	**1.38 (1.13,1.68)**	**2.06 (1.66,2.56)**	**1.85 (1.17,2.93)**	**2.17 (1.61,2.91)**
Seasonal work	**1.48 (1.12,1.95)**	1.44 (0.72,2.89)	**1.67 (1.03,2.69)**	1.75 (0.87,3.52)	**5.05 (2.07,12.31**)	0.83 (0.21,3.33)
Fixed-term employment	**1.23 (1.15,1.32)**	1.07 (0.89,1.28)	**1.22 (1.08,1.37)**	1.10 (0.91,1.32)	1.04 (0.70,1.54)	1.15 (0.90,1.48)
Work program	**1.32 (1.19,1.45)**	1.29 (1.01,1.64)	1.21 (1.00,1.45)	1.12 (0.84,1.49)	1.15 (0.61,2.15)	1.12 (0.76,1.66)
Casual work (without a formal contract) or other	0.87 (0.64,1.20)	0.81 (0.36,1.80)	0.93 (0.54,1.60)	0.88 (0.36,2.11)	N/A	1.02 (0.33,3.17)
Observations	*810,981*	*810,981*	*810,981*	*810,981*	*810,981*	*810,981*
Women	**All-cause**	**CD**	**Cancer**	**External**	**Transport accidents**	**Suicide**
Permanent employment	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Temporary agency work	**1.32 (1.14,1.51)**	**1.57 (1.03,2.38)**	0.99 (0.78,1.26)	**1.92 (1.30,2.82)**	**2.51 (1.22,5.16)**	1.45 (0.79,2.65)
Seasonal work	0.71 (0.45,1.11)	1.06 (0.34,3.33)	0.50 (0.23,1.13)	1.92 (0.71,5.19)	N/A	0.99 (0.14,7.12)
Fixed-term employment	**1.10 (1.02,1.19)**	1.17 (0.91,1.49)	1.03 (0.91,1.16)	1.05 (0.81,1.35)	0.87 (0.48,1.58)	1.02 (0.72,1.45)
Work program	1.04 (0.94,1.15)	1.27 (0.95,1.69)	1.14 (0.99,1.32)	0.73 (0.50,1.06)	0.80 (0.37,1.74)	0.81 (0.50,1.32)
Casual work (without a formal contract) or other	1.25 (0.99,1.59)	1.34 (0.63,2.85)	0.98 (0.66,1.44)	1.00 (0.37,2.68)	1.19 (0.16,8.61)	0.96 (0.24,3.88)
Observations	*643,052*	*643,052*	*643,052*	*643,052*	*643,052*	*643,052*

Note: reported associations are controlled for age in 5-year categories, educational attainment based on ISCED-classification (5), living in urban agglomeration, partner in household, migration background, economic sector, housing tenure, weekly working hours, work schedule and holding multiple jobs. CD = diseases of the circulatory system.

Source: Balogh et al. 2019a

4.2.5 A first exploration of employment trajectories and mortality (1991 & 2001 Census data)

The previous analysis was extended by cross-classifying the different 2001 employment types with the employment status (employed versus unemployed) in 1991. This was done in order to gain a first insight into the relationship between employment trajectories and mortality risk. Among men aged 30-59 (in good health at baseline 2001), there was a large mortality excess during 2001-2011 for those being unemployed at both moments, compared to those being employed at both censuses. A somewhat smaller mortality excess was found for those who were unemployed in 1991 but not in 2001 and still a smaller but significant mortality excess was noted for those unemployed in 2001 but not in 1991. Overall, the results (presented in table 22) show that nearly all categories of male workers whose employment trajectory deviated from the most stable one (employed in 1991 to permanent employment in 2001) have elevated all-cause mortality, after controlling for confounders. Many of them also exhibit excess mortality due to circulatory diseases and cancer. Among women, a distinctly different pattern can be observed. It are mainly those who experienced unemployment or had transitioned into inactivity by 2001 that have raised all-cause, CD and cancer mortality compared to stable permanent workers (Balogh et al. 2019b).

This final study highlights the importance of the quality of employment for the health of the population. Different mortality patterns are associated with different forms or trajectories of employment, supporting the idea that not only getting people into work is important for reducing health inequalities, but also the quality of jobs and employment matter.

Table 22. Hazard ratios and 95% confidence intervals for all-cause and cause-specific mortality by employment trajectory 1991-2001, men and women in Belgium, 2001-2016

Men	**All-cause**	**CD**	**Cancer**	**External**	**Transport accidents**	**Suicide**
From employed to permanent employment	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
From unemployed to permanent employment	**1.42 (1.33,1.51)**	**1.26 (1.07,1.48)**	**1.38 (1.24,1.54)**	**1.50 (1.22,1.83)**	1.31 (0.79,2.15)	**1.50 (1.12,2.00)**
From employed to temporary agency work	**1.45 (1.30,1.63)**	**1.60 (1.24,2.07)**	**1.29 (1.05,1.59)**	**1.82 (1.29,2.57)**	1.43 (0.59,3.44)	1.46 (0.85,2.53)
From unemployed to temporary agency work	**1.48 (1.12,1.98)**	1.25 (0.60,2.63)	**2.14 (1.40,3.29)**	1.35 (0.51,3.61)	3.57 (0.89,14.33)	1.42 (0.35,5.68)
From employed to seasonal/casual work	1.07 (0.88,1.31)	1.48 (0.98,2.22)	0.99 (0.69,1.41)	0.60 (0.22,1.59)	N/A	0.92 (0.30,2.86)
From unemployed to seasonal/casual work	0.70 (0.38,1.30)	1.60 (0.60,4.26)	0.45 (0.11,1.78)	0.89 (0.12,6.29)	N/A	1.93 (0.27,13.69)
From employed to fixed-term work	**1.25 (1.17,1.34)**	1.16 (0.99,1.37)	**1.28 (1.15,1.43)**	1.09 (0.85,1.40)	0.73 (0.36,1.46)	1.16 (0.82,1.64)
From unemployed to fixed-term work	**1.41 (1.16,1.70)**	1.22 (0.74,1.99)	1.14 (0.78,1.66)	**2.24 (1.35,3.72)**	**4.10 (1.70,9.92)**	**2.17 (1.03,4.56)**
From employed to work program	**1.35 (1.24,1.46)**	**1.46 (1.20,1.77)**	**1.29 (1.11,1.50)**	1.01 (0.72,1.42)	1.24 (0.62,2.50)	0.98 (0.60,1.60)
From unemployed to work program	**1.58 (1.35,1.85)**	1.32 (0.89,1.97)	**1.40 (1.04,1.88)**	**1.94 (1.21,3.13)**	1.26 (0.31,5.06)	1.69 (0.80,3.55)
From employed to unemployed	**1.70 (1.65,1.75)**	**1.64 (1.52,1.75)**	**1.52 (1.44,1.60)**	**2.04 (1.85,2.26)**	1.28 (0.96,1.70)	**1.99 (1.72,2.30)**
From unemployed to unemployed	**1.82 (1.75,1.89)**	**1.74 (1.58,1.92)**	**1.71 (1.59,1.84)**	**1.76 (1.52,2.03)**	**1.48 (1.02,2.13)**	**1.55 (1.24,1.94)**
From unemployed to inactive	**2.06 (2.00,2.13)**	**2.22 (2.07,2.37)**	**1.81 (1.72,1.91)**	**2.16 (1.92,2.43)**	**1.48 (1.06,2.06)**	**1.73 (1.42,2.10)**
From employed to inactive	**1.55 (1.52,1.58)**	**1.66 (1.60,1.73)**	**1.45 (1.41,1.49)**	**1.74 (1.61,1.88)**	**1.25 (1.02,1.53)**	**1.87 (1.67,2.10)**
Observations	*776,096*	*776,096*	*776,096*	*776,096*	*776,096*	*776,096*

Women	**All-cause**	**CD**	**Cancer**	**External**	**Transport accidents**	**Suicide**
From employed to permanent employment	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
From employed to temporary agency work	1.08 (1.00,1.16)	1.18 (0.95,1.46)	0.99 (0.88,1.10)	**1.42 (1.11,1.82)**	1.54 (0.85,2.80)	1.27 (0.90,1.81)
From unemployed to temporary agency work	1.18 (0.98,1.42)	1.56 (0.94,2.60)	0.92 (0.68,1.25)	**1.98 (1.12,3.51)**	2.10 (0.52,8.49)	2.11 (1.00,4.46)
From employed to seasonal/casual work	1.15 (0.84,1.59)	1.23 (0.46,3.27)	0.88 (0.51,1.52)	1.93 (0.72,5.15)	**5.85 (1.44,23.7)**	0.86 (0.12,6.14)
From unemployed to seasonal/casual work	1.10 (0.83,1.46)	1.53 (0.73,3.22)	0.75 (0.46,1.23)	3.35 (1.67,6.72)	N/A	2.35 (0.76,7.33)
From employed to fixed-term work	0.80 (0.48,1.33)	1.59 (0.51,4.94)	0.34 (0.11,1.07)	1.85 (0.46,7.40)	N/A	1.69 (0.24,12.01)
From unemployed to fixed-term work	1.08 (0.99,1.19)	1.06 (0.79,1.41)	0.98 (0.86,1.13)	1.29 (0.92,1.81)	1.62 (0.75,3.46)	1.01 (0.60,1.69)
From employed to work program	1.00 (0.83,1.21)	0.81 (0.42,1.57)	0.87 (0.64,1.17)	1.35 (0.72,2.51)	1.71 (0.42,6.93)	0.48 (0.12,1.93)
From unemployed to work program	1.04 (0.94,1.14)	1.13 (0.84,1.53)	0.97 (0.84,1.12)	1.04 (0.70,1.53)	1.19 (0.48,2.90)	1.08 (0.64,1.81)
From employed to unemployed	0.97 (0.84,1.13)	0.98 (0.62,1.54)	1.09 (0.88,1.34)	0.80 (0.43,1.50)	N/A	0.87 (0.39,1.95)
From unemployed to unemployed	**1.25 (1.19,1.31)**	**1.32 (1.15,1.52)**	1.04 (0.96,1.11)	1.59 (1.34,1.89)	1.21 (0.74,1.98)	**1.31 (1.01,1.69)**
From unemployed to inactive	**1.34 (1.28,1.41)**	**1.59 (1.38,1.83)**	1.10 (1.01,1.19)	1.88 (1.57,2.25)	1.38 (0.82,2.32)	**1.45 (1.10,1.90)**
From employed to inactive	**1.56 (1.51,1.61)**	**1.95 (1.77,2.14)**	**1.24 (1.18,1.31)**	**1.99 (1.73,2.28)**	1.29 (0.87,1.92)	1.83 (1.50,2.23)
Observations	*630,785*	*630,785*	*630,785*	*630,785*	*630,785*	*630,785*

Note: reported associations are controlled for age in 5-year categories, educational attainment based on ISCED-classification (5), living in urban agglomeration, partner in HH, migration background and self-rated health status at the start of follow-up. CD = diseases of the circulatory system.

Source: Balogh et al. 2019b

4.3 Mortality and living arrangements in Belgium (RQ3)

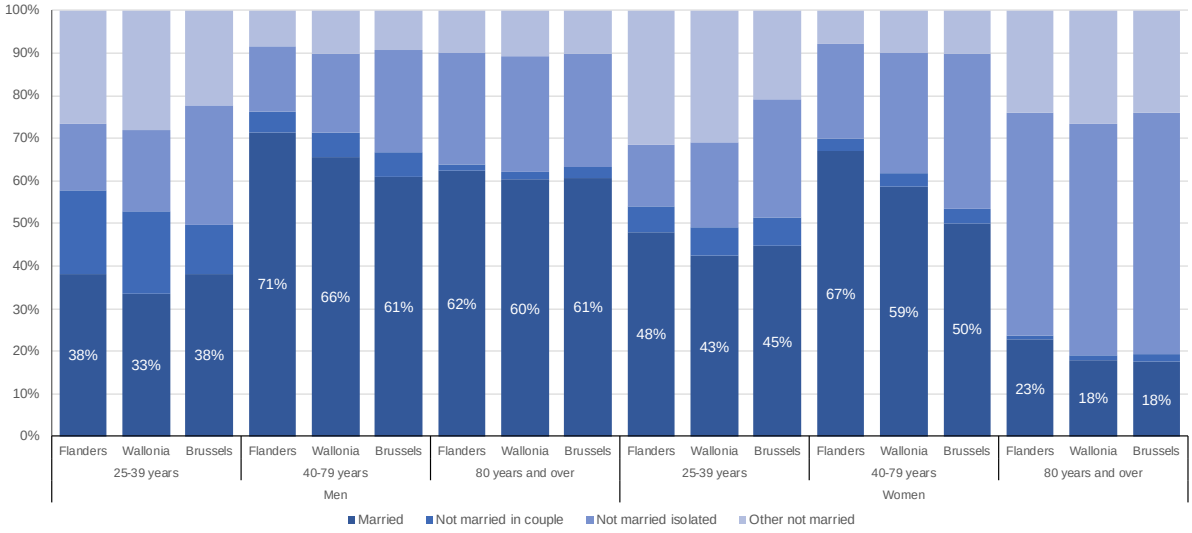
In this section, differences in (cause-specific) mortality by marital status and household/family situation will be studied, as a second dimension of de-standardised life courses. The analyses presented here go into more detail than the models including marital status or household situation that were presented earlier in the report. Two themes will be dealt with: first, the evolution of mortality according to marital status in Belgium and its regions from 1991 onwards and secondly, the excess mortality of children living in single-parent families in Belgium.

4.3.1 Regional and matrimonial inequalities in Belgium

High spatial inequalities in health and mortality persist in Belgium, in favour of Flanders (Deboosere et al. 2009). The contribution of marital status to these regional inequalities in mortality has not yet been studied in Belgium in detail, although we know that matrimonial and family behaviour differ from one Belgian region to the other. This is the case, among other things because the Walloon region has long been less religious and closer to French influences, while Flanders was/is more Catholic. In 2002, the number of divorces per capita was higher in the Walloon Region and Brussels than in Flanders. A marriage on average lasts longer in Flanders than in the Walloon Region (Mortelmans et al. 2009). The question that will be answered here is whether the overrepresentation of married residents in the Flemish region could, at least in part, explain the pattern of lower mortality in Flanders, compared to the rest of the country.

The analysis of the average distribution of individuals by region and marital status (2008-2012) confirms that the proportion of unmarried and isolated people is higher in the Walloon region and Brussels than in Flanders (figure 9). On one hand, the proportion of married people and couples is highest in Flanders. Among individuals aged 25 to 39, the proportion of married couples is lowest in the Walloon Region (limited to 33% of the female population and 43% of the male population). Differences in the distribution of the population by marital status are much more pronounced among individuals aged 40 to 79. In Flanders, 71% of men and 67% of women are married, 66% and 58% in the Walloon Region and 61% and 50% in Brussels. On the other hand, single and divorced people are less prevalent in Flanders than in the Walloon Region and Brussels. After the age of 80, the differences in distribution decrease, although the proportion of married men and women remains higher in Flanders than elsewhere in the country. Even within unmarried populations, there is an overrepresentation of isolated individuals in the south of the country among both men and women. These different matrimonial behaviours between the Belgian regions could explain, in part, spatial mortality differentials.

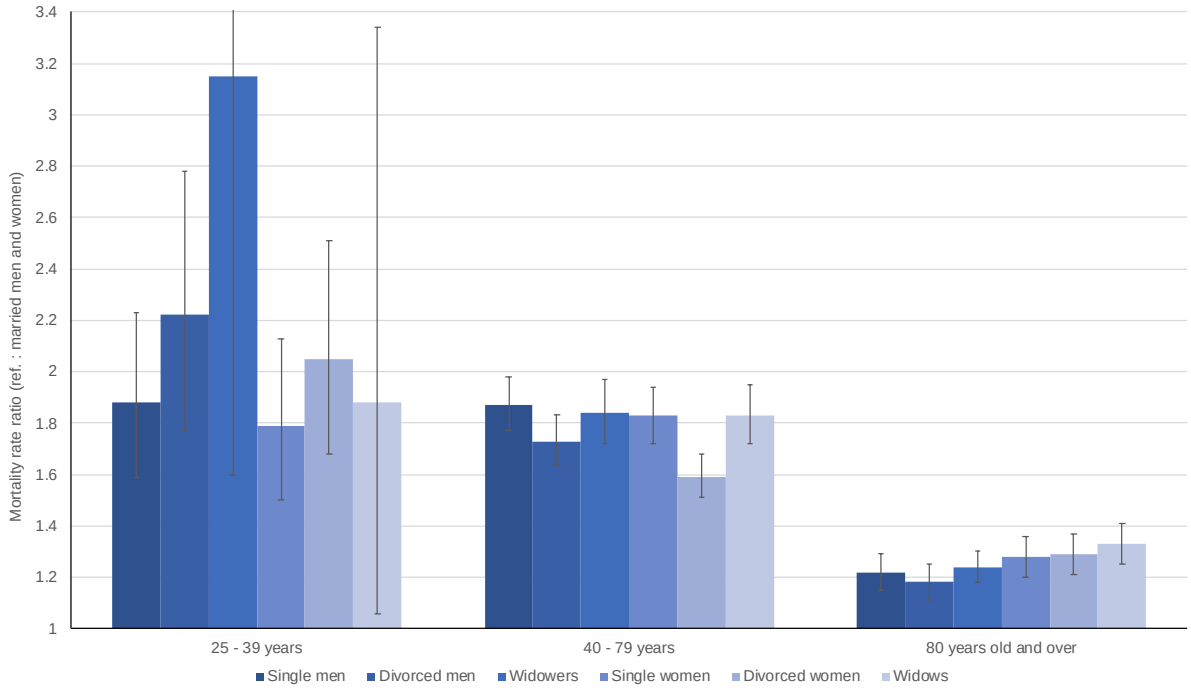
Figure 9. Distribution of the population by household situation, sex, age group and region, 2008-2012



Source: Majérus et al. 2019 (forthcoming)

Figure 10 shows the matrimonial inequalities in mortality for the period 2008-2012. The results confirm the lower mortality of married couples that has previously been documented in literature. This is true for all three age groups, although differences decrease as age progresses. Arriaga's method of decomposing differences in life expectancy between two populations by age shows that the ages between 40 and 79 are the most significant contributors to inequalities in life expectancy between married and unmarried individuals.

Figure 10. Mortality rate ratios by marital status, men and women aged 25-39, 40-79 and 80 and over in Belgium, 2008-2012



Source: Majérus et al. 2019 (forthcoming)

In a next step, the excess mortality of residents of the Walloon and Brussels regions is linked to the differential matrimonial behaviour between the three regions. The comparison of four regression models allows for observing the variation in mortality rate ratios between regions and for understanding the influence of marital status, housing quality and health status.

The first model confirms the existence of a significant excess mortality in the Walloon region compared to Flanders at all ages. For Brussels, an excess mortality for the 40-79 age group exists. Including marital status in the model (M2) results in a decrease in mortality rate ratios observed in the first model (table 23). This decrease is larger among women and for the age group 40-79 years, where population structures diverge most by region. Among men and women aged 40-79, the excess mortality rate among Walloons decreases by 11% and 19% respectively. Older individuals are not affected by these structural effects and mortality rate ratios remain stable in the second model. The inhabitants of the Brussels-Capital Region also see their level of excess mortality decrease when controlled for marital status. Between ages 40 and 79, 29% of regional inequalities in male mortality are explained by differences in the distribution of the population by marital status. This number rises to 50% among Brussels women aged 40-79.

Table 23. Mortality rate ratios by region (M1) and marital status (M2), men and women aged 25-39, 40-79 and 80 and over in Belgium, 2008-2012

	M1 : Region (2008 – 2012)						**M2 : Region + Marital status (2008 – 2012)**					
	25 - 39 years		40 -79 years		80 year and above		25 - 39 years		40 -79 years		80 year and above	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Age	1.03**	1.09***	1.10***	1.10***	1.11***	1.12***	1.05**	1.10***	1.10***	1.10***	1.09***	1.11***
Flanders + (married)	1.00 (Ref.)	1.00 (Ref.)	1.00 (Ref.)	1.00 (Ref.)	1.00 (Ref.)	1.00 (Ref.)	1.00 (Ref.)	1.00 (Ref.)	1.00 (Ref.)	1.00 (Ref.)	1.00 (Ref.)	1.00 (Ref.)
Walloon region	1.43***	1.40***	1.36***	1.31***	1.09**	1.06**	1.39***	1.35***	1.32***	1.25***	1.09**	1.05*
Brussels	0.79$^{n.s.}$	0.86$^{n.s.}$	1.21***	1.20***	0.99$^{n.s.}$	0.98$^{n.s.}$	0.78$^{n.s.}$	0.84$^{n.s.}$	1.15***	1.10***	1.00$^{n.s.}$	0.97$^{n.s.}$
Single							1.84***	1.76***	1.86***	1.81***	1.22***	1.28***
Divorced							2.22***	2.02***	1.68***	1.56***	1.17***	1.29***
Widow							3.08***	1.83***	1.82***	1.80***	1.24***	1.33***

*n.s. p > 0.10; . P < 0.10; * p < 0.05; ** p < 0.01; *** p < 0.001*

Source: Majérus et al. 2019 (forthcoming)

Beyond the administrative status of marriage, the de facto household status gives a more precise idea about living arrangements (M3 in table 24). Indeed, the status of unmarried persons covers a wide range of realities: single isolated, divorced isolated, widowed isolated, but also single/divorced/widowed in a couple. It is mainly among young people that controlling the isolated status of unmarried individuals significantly reduces regional inequalities in mortality, by 16% for men and 20% for women. In the Brussels region, men aged 25 to 39 years have a significantly lower mortality rate than Flemish residents after controlling for the couple situation. In the middle age group, the level of excess mortality of men and women in the south of the country is virtually unchanged compared to the second model. In addition, the third model highlights the mortality disadvantage faced by unmarried women living alone compared to married or partnered women under 80 years of age.

In the fourth model, controlling for the type of housing and health status of individuals confirms that, beyond marital status, socio-economic and health factors are involved in the construction of regional inequalities in mortality.

Table 24. Mortality rate ratios by region, marital and cohabitation status (M3) and housing quality and level of health (M4), men and women aged 25-39, 40-79 and 80 and over in Belgium, 2008-2012

	M3 : Region + cohabitation status (2008-2012)						**M4 : Region + cohabitation status (2008-2012)**					
	25 - 39 years		40 -79 years		80 year and above		25 - 39 years		40 -79 years		80 year and above	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Age	1,05**	1,09***	1,10***	1,10***	1,09***	1,09***	1,04**	1,08***	1,09***	1,09***	1,08***	1,09***
Flanders + (married)	1.00 (Ref.)	1.00 (Ref.)	1.00 (Ref.)	1.00 (Ref.)	1.00 (Ref.)	1.00 (Ref.)	1.00 (Ref.)	1.00 (Ref.)	1.00 (Ref.)	1.00 (Ref.)	1.00 (Ref.)	1.00 (Ref.)
Walloon region	1,36***	1,32***	1,32***	1,24***	1,09**	1,04*	1,28***	1,23***	1,19***	1,10***	1,04$^{n.s.}$	1,01$^{n.s.}$
Brussels	0,71*	0,79$^{n.s.}$	1,14***	1,08**	1,00$^{n.s.}$	1,00$^{n.s.}$	0,66**	0,87$^{n.s.}$	1,00$^{n.s.}$	0,99$^{n.s.}$	0,99$^{n.s.}$	1,01$^{n.s.}$
Single in couple	0,96$^{n.s.}$	1,21$^{n.s.}$	0,99$^{n.s..}$	1,19**	0,95$^{n.s.}$	1,00$^{n.s.}$	0,95$^{n.s.}$	1,11$^{n.s.}$	0,88**	1,11$^{n.s.}$	0,90$^{n.s.}$	1,00$^{n.s.}$
Isolated single	2,59***	2,35***	1,83***	1,54***	0,99$^{n.s.}$	1,03$^{n.s..}$	2,32***	2,03***	1,45***	1,33***	0,92*	1,00$^{n.s.}$
Divorced in couple	1,31$^{n.s.}$	1,50*	1,08*	1,24***	0,97$^{n.s.}$	0,94$^{n.s..}$	1,26$^{n.s.}$	1,37$^{n.s.}$	0,97$^{n.s.}$	1,11***	0,93$^{n.s.}$	0,91$^{n.s.}$
Isolated divorced	2,82***	2,53***	1,79***	1,46***	0,98$^{n.s..}$	0,94$^{n.s.}$	2,57***	2,15***	1,45***	1,18*	0,91**	0,87***
Widow in couple	N/A	7,02***	1,17***	1,24***	0,98$^{n.s.}$	1,22***	N/A	6,57***	1,12*	1,14**	0,97$^{n.s.}$	1,17***
Widow isolated	3,80***	1,21$^{n.s.}$	1,66***	1,43***	1,04$^{n.s.}$	1,01$^{n.s.}$	3,58***	1,07$^{n.s.}$	1,54***	1,30***	1,02$^{n.s.}$	0,97$^{n.s.}$
Other	2,03***	1,53***	2,18***	2,93***	1,77***	2,10***	1,90***	1,39***	2,79***	2,48***	1,65***	1,93***

*n.s. p > 0.10; . P < 0.10; * p < 0.05; ** p < 0.01; *** p < 0.001*

Source: Majérus et al. 2019 (forthcoming)

People in Flanders seem to benefit from better quality housing and/or more general access to home ownership and also appear to have better overall health status. At an equivalent level of health and housing quality, the mortality rates of the Brussels residents aged 40-79 are similar to those of Flemish individuals. Similarly, the excess mortality rate among Walloons decreases by 41% among men and 58% among women after controlling for housing and health conditions. Like the Brussels population aged 80 and over, the Walloon population is no longer subject to a significantly higher level of mortality compared to Flemish residents. Finally, under equivalent housing and health conditions, mortality of single couples and divorced men living in couples is not significantly different from that of married couples. In contrast, single or divorced single men and women, as well as single widowers aged 25 to 79 remain exposed to a situation of excess mortality compared to married people. After the age of 80, living single, divorced or widowed without a spouse no longer induces a higher level of mortality and even seems to be a protective factor among divorced or single men. The model thus confirms the protective effect of marriage and couple life. However, although marital status reduces excess mortality in the Walloon Region compared to Flanders, economic factors account for a larger part of the differences between the regions.

4.3.2 Excess mortality in children living in one-parent families in Belgium

Belgium has one of the lowest levels of child mortality in the world, estimated in 2018 at 4.4 deaths before the 5th birthday per 1000 live births. However, there are inequalities between socio-economic groups (Devlieger et al. 2005). Literature on inequalities in child survival in Belgium remains scarce, especially when it comes to the effect of family composition on child health outcomes. In other high-income countries, family factors seem to play a crucial role in shaping health disparities in childhood (Östberg 1997; Weitoft et al. 2003; Remes et al. 2011). More generally, parental separation and other situations leading to a transition out of a two-parent family emerge as strong risk factors of health vulnerability and behavioural problems among children (Dawson 1991, Mauldon 1990).

Several categories of explanatory mechanisms have been identified. First, socio-economic deprivation of children living in one-parent families seems to play a role. The existing literature consistently shows that single-parent families have fewer resources than married or cohabiting couples, for which higher household income provides better nutrition, housing and protection against the hazards of life (Lerman 2002; Weitoft et al. 2003; Deboosere et al. 2009b). The second category of explanations relates to contextual effects. Lone mothers could live in more deprived areas or poorer environments, posing excess risks to their children beyond individual characteristics. Research on neighbourhoods' effect on child mortality is scarce however and studies that explored contextual effects on adult mortality are not all consistent. Some studies found a significant effect of area characteristics (Kendrick et al. 2005; Laing and Logan 1999; Haynes et al. 2003), others did not after controlling for individual characteristics (Laflamme and Diderichsen 2000; Reading et al. 2008). A final explanation refers to difficulties in parenting that could contribute to excess mortality. Literature highlights that childhood injuries, accidents and risky behaviours are far more common among single and reconstituted families, possibly reflecting differences in parental supervision and parenting behaviours in these family structures (Siegel et al. 1996; Thomson et al. 1994).

Even though unmarried couples, single parenthood and other unconventional household forms have become increasingly common in recent years, the associations between family type and child mortality have not yet been studied in Belgium. Therefore, this study aims to investigate the potential mechanisms involved in the relation between family type and excess child mortality. To take into account socio-economic deprivation, educational attainment and occupational status of the head of household will be included in these analyses. Parenting behaviours will be considered by comparing excess mortality in all-cause and violent-specific mortality and by including the type of death and day of death.

When considering all-cause mortality, children aged 0 to 4 in single-parent families show an excess mortality of 1.6 compared to children whose parents live in the same household and are married (model 1 in table 25). The differences between the mortality of children of married couples and children of cohabiting couples are not statistically significant. This excess mortality of children in single-parent families is reduced after the introduction of

control variables (education, parental activity, region of residence), but the rate ratio remains statistically significant and still relatively high, estimated at 1.4.

Table 25. Rate ratios for all-cause mortality by family type, region, education and occupation of the head of household, children aged 0-4 in Belgium

	(1)	(2)	(3)	(4)
Age	-0.507***	-0.508***	-0.506***	-0.509***
	(0.040)	(0.040)	(0.040)	(0.040)
Family type *(ref: married couple with children)*				
Other	0.440***	0.462***	0.248	0.132
	(0.168)	(0.168)	(0.180)	(0.182)
Cohabiting couple with children	-0.029	-0.0001	-0.039	-0.073
	(0.155)	(0.156)	(0.157)	(0.157)
Single-parent family	0.486***	0.551***	0.315*	0.334*
	(0.153)	(0.155)	(0.172)	(0.172)
Region *(ref: Flanders)*				
Brussels Capital Region		-0.343*	-0.463**	-0.478***
		(0.181)	(0.184)	(0.185)
Walloon Region		-0.240**	-0.301**	-0.300**
		(0.116)	(0.118)	(0.118)
Education of the HH head *(ref: university degree)*				
No education/Primary				0.887***
				(0.180)
Lower secondary				0.454***
				(0.169)
Higher secondary				0.501***
				(0.145)
Occupation of the HH head *(ref: full time)*				
Others			0.690***	0.280
			(0.159)	(0.186)
Unemployed			0.329**	0.130
			(0.165)	(0.171)
Part time			-0.161	-0.202
			(0.271)	(0.272)
Intercepts	-7.118***	-7.016***	-7.057***	-7.391***
	(0.106)	(0.113)	(0.114)	(0.146)
Observations	13,259	13,259	13,259	13,259
Log Likelihood	-1,019.414	-1,016.158	-1,006.341	-993.417
Akaike Inf. Crit.	2,048.828	2,046.315	2,032.682	2,012.835

Note: *$p < 0.1$; **$p < 0.05$; ***$p < 0.01$

Source: Van Cleemput et al. 2020 (forthcoming)

Variations according to the level of education of the head of household are however larger. Children with a secondary educated head of household have a 1.6 higher mortality compared to those where the head of household holds a university degree; those with a primary educated head of household have a 2.4 higher mortality. Interactions between family type and other control variables (level of education, etc.) were tested, but none of them were statistically significant.

The excess mortality of children in single-parent families increases substantially when only violent deaths (road accidents, falls, drownings) are considered (table 26). The excess mortality amounts to 2.6 in the unadjusted model and 1.6 after the introduction of the control variables. Remarkable is that the survival advantage of children in the Brussels Capital Region is larger when considering external deaths, the rate ratio declining from 0.62 to 0.50. In contrast, disparities in violent mortality by level of education of the head of household are reduced and only significant when comparing heads holding a university degree and those without a degree or primary education. Again, interactions between control variables and family types (single-parent and two-parent) are not statistically significant, suggesting that socio-economic variables have the same effect on child mortality in both groups, although lower levels of education or lack of employment is more common in single-parent families.

Table 26. Rate ratios for external mortality by family type, region, education and occupation of the head of household, children aged 0-4 in Belgium

	(1)	(2)	(3)	(4)
Age	-0.383***	-0.384***	-0.381***	-0.382***
	(0.053)	(0.053)	(0.053)	(0.053)
Family type *(ref: married couple with children)*				
Other	0.629**	0.649**	0.186	0.120
	(0.260)	(0.260)	(0.278)	(0.281)
Cohabiting couple with children	0.271	0.285	0.155	0.148
	(0.232)	(0.233)	(0.236)	(0.236)
Single-parent family	0.941***	0.993***	0.447*	0.480**
	(0.211)	(0.214)	(0.239)	(0.240)
Region *(ref: Flanders)*				
Brussels Capital Region		-0.419	-0.677**	-0.691**
		(0.290)	(0.294)	(0.295)
Walloon Region		-0.126	-0.269	-0.256
		(0.175)	(0.178)	(0.178)
Education of the HH head *(ref: university degree)*				
No education/Primary				0.496*
				(0.277)
Lower secondary				0.106
				(0.266)
Higher secondary				0.199
				(0.227)
Occupation of the HH head *(ref: full time)*				
Others			1.331***	1.060***
			(0.221)	(0.270)
Unemployed			0.751***	0.641**
			(0.243)	(0.253)
Part time			0.379	0.353
			(0.360)	(0.361)
Intercepts	-8.540***	-8.463***	-8.603***	-8.730***
	(0.177)	(0.187)	(0.192)	(0.230)
Observations	18,769	18,769	18,769	18,769
Log Likelihood	-637.270	-636.071	-619.638	-617.867
Akaike Inf. Crit.	1,284.540	1,286.141	1,259.276	1,261.733

Note: $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$

Source: Van Cleemput et al. 2020 (forthcoming)

4.4 Employment quality, living arrangements and health in Belgium (RQ4)

To examine the relationships between labour market positions, living arrangements, social precariousness and health – as a precursor of mortality – in Belgium, several studies have been performed. In the first two studies, a typology of labour market positions is constructed, using information about respondents' labour market status from the Generations & Gender Survey (GGS) and the European Working Conditions Survey (EWCS). For those respondents in waged employment, additional information from proxies representing the quality of employment (e.g. type of employment contract, income level, number of working hours, training opportunities, …) is used to discern different types of jobs. A third study uses data from the Health Interview Survey (HIS) to examine (the evolution in) prevalence ratios of mental distress and possible mental disorders in unemployed versus employed youth in Belgium.

4.4.1 Employment types, unemployment and subjective health in Belgium

In the first study, the Belgian GGPS-data are used to construct a labour market typology and to relate this typology to individuals' health, controlling for their household situation and broader social situation (Van Aerden et al. 2017). Results from a Latent Class Cluster Analysis show that four ideal-typical categories of waged employment can be distinguished in Belgium. Standard jobs are characterised by overall beneficial employment conditions. Instrumental jobs are relatively stable, have good working time arrangements and provide a sustainable income, but they lack extra advantages such as non-wage benefits and training opportunities. Precarious jobs are characterised by overall adverse employment conditions. The final category, portfolio jobs, is associated with overall very beneficial employment conditions, except for a high probability of irregular, exceptional and long working hours. The overall indicator for labour market position includes these four types of waged employment, the self-employed, the unemployed and the other activity statuses (conceived as a residual category).

Descriptive analyses show clear differences in the socio-economic and socio-demographic background characteristics associated with the different labour market positions (Van Aerden et al. 2017). The main conclusion is that standard jobs and portfolio jobs (and to a lesser extent self-employment) tend to be associated with favourable individual background characteristics and that they are consequently more prevalent among more privileged groups of people (men, middle-aged and highly educated individuals, …). In contrast, unemployment, instrumental jobs and precarious jobs are shown to be associated with a less beneficial socio-demographic profile and are more often found among vulnerable groups (the low educated, individuals originating from a low- or middle-income country, …).

Table 27. Relations between labour market position and poor general health

	Basic model	**Model 1**	**Model 2**	**Model 3**
Standard jobs	Ref.	Ref.	Ref.	Ref.
Instrumental jobs	1.15 n.s.	1.27 n.s.	1.07 n.s.	0.98 n.s.
	(0.78-1.69)	*(0.86-1.88)*	*(0.72-1.60)*	*(0.65-1.47)*
Precarious jobs	2.07 ***	2.43 ***	1.70 **	1.53 *
	(1.44-2.95)	*(1.67-3.52)*	*(1.15-2.49)*	*(1.04-2.26)*
Portfolio jobs	0.70 n.s.	0.72 n.s.	0.79 n.s.	0.82 n.s.
	(0.44-1.13)	*(0.44-1.17)*	*(0.48-1.29)*	*(0.50-1.33)*
Self-employment	1.41 *	1.37 n.s.	1.35 n.s.	1.29 n.s.
	(1.00-1.98)	*(0.97-1.93)*	*(0.96-1.91)*	*(0.91-1.84)*
Unemployment	3.15 ***	3.54 ***	2.09 ***	1.85 **
	(2.28-4.34)	*(2.54-4.92)*	*(1.47-2.97)*	*(1.29-2.65)*
Women (men = ref.)		1.09 n.s.	1.14 n.s.	1.16 n.s.
		(0.90-1.32)	*(0.93-1.38)*	*(0.95-1.42)*
Age (50-64 = ref.)		***	***	***
18-29		0.25 ***	0.24 ***	0.26 ***
		(0.18-0.34)	*(0.17-0.33)*	*(0.18-0.36)*
30-49		0.63 ***	0.60 ***	0.60 ***
		(0.52-0.77)	*(0.49-0.74)*	*(0.49-0.75)*
HC (working partner = ref.)			n.s.	n.s.
Non-working partner			1.22 n.s.	1.20 n.s.
			(0.94-1.57)	*(0.93-1.55)*
No partner			1.19 n.s.	1.08 n.s.
			(0.93-1.52)	*(0.84-1.39)*
Renter (owner = ref.)			1.30 *	1.26 *
			(1.05-1.61)	*(1.01-1.56)*
FS (able to make ends meet and save = ref.)			***	***
Able to make ends meet, unable to save			1.23 n.s.	1.13 n.s.
			(0.89-1.71)	*(0.81-1.58)*
Difficult to make ends meet			2.21 ***	1.89 ***
			(1.78-2.74)	*(1.51-2.36)*
Low social support (high = ref.)				2.49 ***
				(2.03-3.05)
Constant	0.11 ***	0.16 ***	0.12 ***	0.11 ***
Nagelkerke R Square	0.034	0.071	0.104	0.134

95% Confidence intervals are shown in parentheses.
Model 1: controlled for sex and age
Model 2: controlled for sex, age and household situation (HC: household composition, home ownership and FS: financial situation)
Model 3: final model controlled for sex, age, household situation and social support
*n.s. p>0.05, *p<0.05, **p<0.01,***p<0.001*

Source: Van Aerden et al. 2017

Results from binary logistic regression analyses show that unemployment is associated with the highest risk to report poor general health, followed by the precarious job type (see table 27). The results for mental health follow the same pattern, although also the instrumental job type is associated with a higher risk to report poor mental health (table 28). Controlling for the broader socio-economic situation (i.e. household situation, home ownership, material deprivation and social support) leads to a strong reduction in the associations between labour market position and general/mental health, but the odds remain statistically significant. Taking the social context into account seems to be particularly important for the unemployed and to a lesser extent for the workers holding a job resembling the precarious type (Van Aerden et al. 2017).

Table 28. Relations between labour market position and poor mental health

	Basic model	**Model 1**	**Model 2**	**Model 3**
Standard jobs	Ref.	Ref.	Ref.	Ref.
Instrumental jobs	2.34 ***	2.56 ***	2.07 **	1.76 *
	(1.49-3.65)	*(1.62-4.03)*	*(1.30-3.31)*	*(1.08-2.88)*
Precarious jobs	4.06 ***	3.50 ***	2.15 ***	1.74 *
	(2.72-6.07)	*(2.32-5.29)*	*(1.40-3.31)*	*(1.10-2.75)*
Portfolio jobs	0.75 n.s.	1.00 n.s.	1.26 n.s.	1.46 n.s.
	(0.41-1.39)	*(0.54-1.87)*	*(0.66-2.39)*	*(0.75-2.83)*
Self-employment	1.16 n.s.	1.32 n.s.	1.25 n.s.	1.14 n.s.
	(0.73-1.83)	*(0.83-2.10)*	*(0.78-2.01)*	*(0.69-1.88)*
Unemployment	6.70 ***	6.89 ***	3.29 ***	2.70 ***
	(4.66-9.63)	*(4.75-9.99)*	*(2.21-4.89)*	*(1.77-4.13)*
Women (men = ref.)		1.93 ***	2.04 ***	2.42 ***
		(1.55-2.41)	*(1.62-2.56)*	*(1.89-3.09)*
Age (50-64 = ref.)		n.s.	n.s.	n.s.
18-29		0.77 n.s.	0.72 *	0.92 n.s.
		(0.57-1.05)	*(0.53-1.00)*	*(0.65-1.30)*
30-49		0.92 n.s.	0.86 n.s.	0.89 n.s.
		(0.72-1.18)	*(0.66-1.12)*	*(0.67-1.17)*
HC (working partner = ref.)			***	***
Non-working partner			1.07 n.s.	1.05 n.s.
			(0.78-1.46)	*(0.75-1.46)*
No partner			2.13 ***	1.98 ***
			(1.66-2.74)	*(1.51-2.58)*
Renter (owner = ref.)			1.21 n.s.	1.11 n.s.
			(0.96-1.53)	*(0.86-1.42)*
FS (able to make ends meet and save = ref.)			***	***
Able to make ends meet, unable to save			2.17 ***	1.89 ***
			(1.51-3.11)	*(1.29-2.77)*
Difficult to make ends meet			3.45 ***	2.62 ***
			(2.69-4.43)	*(2.01-3.42)*
Low social support (high = ref.)				7.44 ***
				(5.92-9.36)
Constant	0.06 ***	0.04 ***	0.02 ***	0.01 ***
Nagelkerke R Square	0.081	0.099	0.181	0.311

95% Confidence intervals are shown in parentheses.
Model 1: controlled for sex and age
Model 2: controlled for sex, age and household situation (HC: household composition, home ownership and FS: financial situation)
Model 3: final model controlled for sex, age, household situation and social support
*n.s. p>0.05, *p<0.05, **p<0.01,***p<0.001*

Source: Van Aerden et al. 2017

The fact that controlling for social precarity indicators causes a (sometimes spectacular) reduction in the odds for poor health clearly shows how the broader socio-economic situation of individuals “interacts” with their labour market position in creating health inequalities and how the accumulation of health-damaging positions in different life spheres is a worrisome reality for part of the Belgian population. However, two important remarks have to be made. First, initially significant differences in self-perceived health between labour market positions retain their significance even after all socio-economic variables are introduced, pointing to an independent influence of the labour market situation. Secondly, controlling for the impact of the household situation on the relationship between respondents’ labour market position and their health could be considered artificial, since it is more than plausible that the household’s situation depends (at least partly) on the respondent’s labour market position.

4.4.2 Employment quality in perspective: Belgium compared to other EU-countries

In a next step, the typological approach is validated by focusing on precarious employment in particular. Specifically, the precarious employment category from a labour market typology is compared with specifications for precarious employment based on the idea of a summed scale (Van Aerden 2018). Data from the three most recent waves of the European Working Conditions Survey (EWCS 2005, 2010 and 2015) are used to analyse the prevalence, cross-national distribution, evolution and socio-economic profile of the different specifications for precarious employment. This allows for a validation of the typological approach (defining types of jobs by means of Latent Class Cluster Analysis), while at the same time putting things in perspective by comparing the Belgian situation with that of other EU-countries.

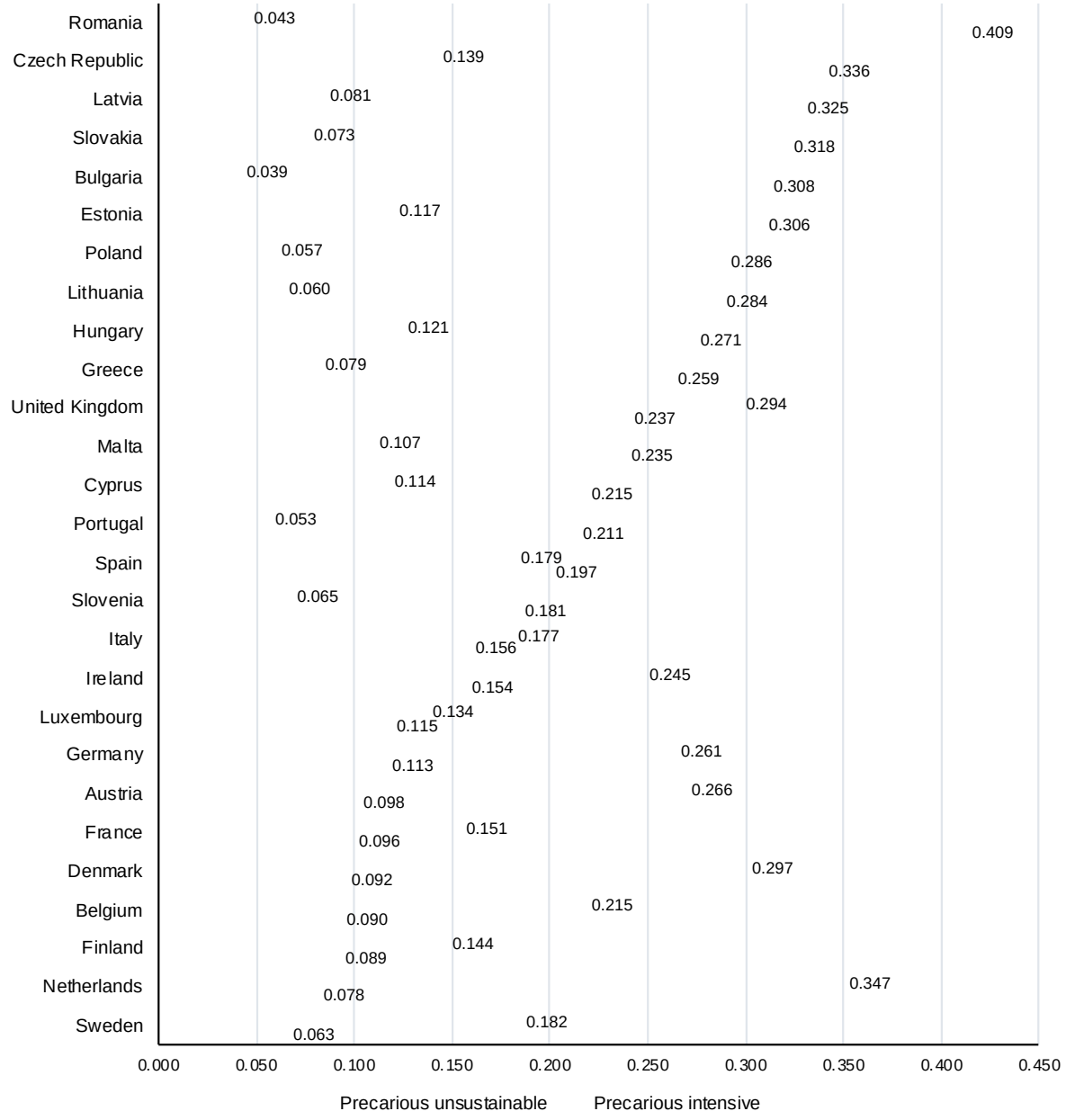
Descriptive analyses show that the typological approach appears as the most accurate and detailed approximation of the labour market reality, because two types of precarious jobs – each with a distinct profile in terms of employment conditions and relations – are discerned in Europe. The first type can be described as ‘precarious intensive’, since adverse working time arrangements are one of the main defining features of this job type. The second type is labelled ‘precarious unsustainable’ because of the low amount of weekly working hours and the low level of monthly income, in addition to the overall adverse working conditions and relations profile. A very interesting observation in this regard is that the mean scores of countries on the summed employment precariousness scale appear to mask large cross-national variation in the dominant type of precarious employment. Countries with a high prevalence of precarious intensive jobs usually have a lower share of precarious unsustainable jobs and vice versa (figure 11). Belgium is characterised by a general low score on the precariousness scale and particularly low levels of ‘intensive precarious employment’. However, the typological approach also shows that ‘precarious unsustainable employment’ is more frequent in Belgium (Van Aerden 2018).

This means that the general ‘precarious job type’ from the previous study, which was focused on the Belgian situation only, is in fact a category composed of two different types of precarious employment. However, it becomes clear from both the analyses of the European data and from the profile of the ‘precarious job type’ derived from the Belgian data that the

precarious unsustainable job type is the dominant form of precarity in the Belgian labour market.

The evolution of precarious employment in the period 2005-2015 is also considered. The share of precarious intensive jobs has decreased in Europe between 2005 and 2015, while the share of precarious unsustainable jobs has increased in the same period. For Belgium, a small decline in precarious intensive jobs and a small to moderate rise in precarious unsustainable jobs can be seen between 2005 and 2015. On top of this, our results confirm – for Europe as a whole, but also for Belgium – the conclusion from previous studies that precarious employment is often found among workers in a disadvantaged position in terms of socio-economic status. Precarious unsustainable employment is a particularly feminised phenomenon (Van Aerden 2018).

Figure 11. Cross-national distribution of the precarious job types in the typology (%)



Source: Van Aerden 2018

4.4.3 The mental health of unemployed Brussels youth

A final analysis aims at exploring the evolution of the mental health gap between employed and unemployed Belgian youth. The analyses are based on data from five waves of the Belgian Health Interview Survey (HIS) and consider, among other things, the prevalence ratios of mental distress and possible mental disorders for unemployed compared to employed youth in the three Belgian Regions between 1997 and 2013 (table 29). For Belgium as a whole, a consistent tendency towards higher prevalence ratios of mental distress/disorders for unemployed versus employed youth was observed. Similar observations were made for the separate regions, but the prevalence ratios often remained insignificant due to low sample sizes. The analyses also show a pattern towards rising prevalence ratios during the 1997-2013 period. A Cochrane's Q test did not indicate that the prevalence rates of mental distress or possible mental disorder of the unemployed were significantly different between the years. Looking at the absolute prevalence, it becomes clear that changing prevalence rates over the years are both due to decreases in mental distress and disorder among employed youth and increases among unemployed youth (Huegaerts et al. 2017).

Table 29. Frequencies (N), prevalence (%) and prevalence rates (PR) and 95% confidence intervals (CI) of mental distress and possible mental disorder in unemployed compared to employed youth in Belgium and the BCR from 1997 to 2013 (HIS-sample)

	Brussels Capital Region					**Belgium**				
	Unemployed		Employed		Unemployed/ Employed	Unemployed		Employed		Unemployed/ Employed
Mental distress										
Year	*N*	*%*	*N*	*%*	*PR (CI)*	*N*	*%*	*N*	*%*	*PR (CI)*
1997	31	50.00	69	36.13	**1.38 (1.01-1.89)**	85	42.08	253	30.12	**1.40 (1.15-1.69)**
2001	9	33.33	56	31.46	1.06 (0.60-1.88)	42	34.71	258	28.70	1.21 (0.93-1.58)
2004	22	44.00	49	29.70	**1.48 (1.00-2.19)**	67	43.51	207	26.20	**1.66 (1.34-2.06)**
2008	18	40.91	56	32.18	1.27 (0.84–1.80)	63	43.45	172	26.96	**1.61 (1.29-2.02)**
2013	8	57.14	36	30.00	**1.90 (1.12-3.23)**	38	46.91	127	27.97	**1.68 (1.27-2.21)**
Probable mental disorder										
Year	*N*	*%*	*N*	*%*	*PR (CI)*	*N*	*%*	*N*	*%*	*PR (CI)*
1997	18	29.03	32	16.75	**1.73 (1.05-2.86)**	50	24.75	121	14.40	**1.72 (1.28-2.30)**
2001	7	25.93	29	16.29	1.59 (0.78-3.27)	29	23.97	126	14.02	**1.71 (1.20-2.44)**
2004	11	22.00	27	16.36	1.34 (0.72-2.51)	33	21.43	100	12.66	**1.69 (1.19-2.41)**
2008	11	25.00	31	17.82	1.40 (0.77-2.56)	43	29.66	77	12.07	**2.46 (1.77-3.41)**
2013	5	**35.71**	14	11.67	**3.06 (1.30-7.22)**	22	27.16	54	11.89	**2.28 (1.48-3.53)**

PR (CI) in bold equals significant according to the p<0.05 threshold

Source: Huegaerts et al. 2017

It is important to draw attention to the fact that the results concerning the relation between employment, social context and health presented here are mere associations: the causality can indeed go in both directions. Based on previous research, we can assume that causation and selection effects are simultaneously at play, with causation (from socio-economic position to health) often being the strongest effect. In any case, our results indicate that precarious labour market situations are to be taken serious as a public health risk and suggest that stable and secure employment of good quality is the healthiest form of employment.

4.5 Overall conclusions and recommendations

By focussing on employment situations and living arrangements and their association with health and mortality, we have selected issues which are at the forefront of today's international research and of high policy relevance. The findings presented in this report contribute to a better knowledge of (i) the evolution of socio-economic inequalities in mortality in Belgium, (ii) the health and mortality associations of the de-standardisation of employment situations and family formation processes in Belgium and (iii) the contribution of employment situations and living arrangements to the creation, the conservation and even the increase of socio-economic differences in health and mortality in Belgium. These findings are of considerable relevance for various levels of policy-making: national, regional, local and even within companies. A clear example can be found in the last part of the results section. Our findings make clear that the potential health impact of labour market policies should be considered whenever labour market reforms are planned. Policy makers should be (made) aware of the fact that flexible labour market policies may stand at odds with policies aimed at longer and sustainable working careers. Another important finding is that spatial inequalities in mortality do not disappear when controlling for the social group. Other factors are therefore involved to explain the differences in mortality between regions, districts and municipalities: the physical environment (exposure to air pollution, noise, etc.), the social environment (presence or absence of a social mix) and the supply of and access to health care (very unevenly distributed). These are specific issues on which national, regional and local policies can and must act.

At the same time, the studies presented in this report also serve to make policy-makers and the (international) research community aware of the richness and uniqueness of existing data sources in Belgium. Especially the linked census-data with mortality data from the register and death certificates offer a very valuable source of information. However, also survey data such as the GGPS are still under-used in social-epidemiological research.

Finally, an important result of this project was that important steps were taken to develop a long-term research agenda for the social-epidemiological field in Belgium. The linked census- and mortality-data offer numerous possibilities to further explore the relationships between employment situations/trajectories, living arrangements and health/mortality. Several projects aimed at seizing these opportunities have already commenced. In the future, human and financial resources should be provided to establish a "watchdog" cell aimed at updating and monitoring the database and performing trend analyses.

5. DISSEMINATION AND VALORISATION

5.1 Valorisation

The research on socio-economic patterns in health and mortality is relevant in ways that transcend a fundamental-research point of view. If this research can be summarised in one statement, it makes clear that the de-standardisation of working and living arrangements in the past decades did not come without a penalty in terms of mortality and ill-health. The multiple findings in this research project all together point into the direction that labour market and family related instability and uncertainty are among the most powerful drivers of persisting and even increasing socio-economic inequalities in health and mortality. The wider implications of this project and knowledge about the role of employment situations and living arrangements are of great importance for different actors, from health professionals over social partners and non-profit organisations to policymakers. Although the health inequalities affect both men and women and all age groups, two target groups deserve special attention. First, women aged 40 to 65 deserve special attention because they are particularly vulnerable in the event of divorce/separation. Secondly, people over 65 years of age deserve special attention because there will be more and more of them in the future and because the reduction in mortality after the age of 65 contributes most to overall gains in life expectancy at birth.

In the period 2016-2018, team members of the CAUSINEQ project were consulted by the cabinet of the Minister of Public Health Policy De Block. This consultation fitted in an interdepartmental action to combat socio-economic inequality in health in Belgium. Of course, the results presented in this report clearly point out that public health is not the only policy domain concerned when wanting to impact the social determinants of health. Labour market policies, housing policies, family policies and even social security policies can have a clear influence on socio-economic health inequalities. The results of this project therefore provide valuable information not only for the Federal Public Service Health, Food Chain Safety and Environment, but also for the Federal Public Service Employment, Labour and Social Dialogue, the Federal Public Service Social Security and the Federal Public Planning Service Social Integration.

The results could also be used by the social partners and more specifically by the Belgian trade union organisations and employer representatives, because of the important role of labour market dynamics in creating and conserving socio-economic health inequalities in Belgium. Also other organisations in the Belgian public health field could benefit from the results presented in this report: the different observatories for health, Sciensano, the sickness insurance funds and Fedris.

On the 21st of October 2019, a CAUSINEQ symposium was held. One of the main goals of this Symposium was to disseminate the results of the project and to actively involve the relevant actors in the policy field. On before-mentioned day, they were invited to reflect upon the results of our project and to consider its policy implications. About 70 persons visited the

symposium. After an outline of the most important research results, a panel discussion was organised with four representatives of Belgian organisations that showed specific interest in the results of the project: Sarah Missinne (Gemeenschappelijke Gemeenschapscommissie Brussel), Louis Warlop (Verbond van Belgische Ondernemingen), Helen Barthe Batsalle (Observatoire de la Santé du Hainaut) and Youssef El Otmani (Confédération des Syndicats chrétiens). The main topic of the panel discussion – which was moderated by Pol Gerits and Sophie Sokolowski (FGOV Health) – was how to translate the conclusions of the CAUSINEQ project into actual policy measures that help to reduce the social inequalities in health and mortality in Belgium. Below, the most important points made in the panel discussion are summarised.

5.1.1 Health (equity) in all policies

The panel members stress that it is necessary to consider health (implications) in all policy domains (a so-called transversal approach), because the results of the CAUSINEQ project show that different elements of individuals' (living) situation are important in determining their health status. A good and accessible healthcare system is indispensable, but not sufficient to tackle social health inequalities. Thus, battling inequalities in health should not be a concern of public health departments/agencies alone. Equity in health should be(come) a goal in different policy domains, such as education, housing, family, social security, mobility and labour market. The educational system is particularly important because it greatly influences outcomes later in life. At the moment, this system is known to create and reinforce socio-economic inequalities. To include health and health equity in all policies, it would be necessary to raise awareness among employees in public services about the importance to reflect about the health and equity impact of their work/projects.

5.1.2 Prevention

Prevention is also a key factor in improving the health of the population. A study of the 'Liberale Mutualiteit' shows that investments in prevention actually saves money (in health or other policy domains), because of the beneficial results in terms of population health. However, the challenge with regard to prevention is to make sure that the most vulnerable groups in society are reached and affected by the prevention campaigns as well. Studies have shown that very general health prevention initiatives actually increase social inequalities in health, because the most advantaged social groups are most likely to benefit from these initiatives.

5.1.3 The quality of employment

A conclusion drawn by the panel members from the CAUSINEQ study results is that the quality of employment is very important. This means that it is not only important for people to have a job, but that also the characteristics of that job count with regard to health and well-being. This seems to be a commonplace, but the members of the panel asserted that policy makers often forget the quality of work and employment as a health-related policy variable.

The results from the project clearly show that not only unemployed, but also individuals in precarious/non-standard employment suffer considerable (mental) health problems. Belgium performs fairly well in the matter of employment quality – certainly compared to some of the other EU27 member states – but the share of precarious jobs still is considerable (more or less 15%). Since this share has been increasing in recent years, it is important to watch over the impact of (potential) policy measures.

The quality of work and employment as a health determinant in Belgium should be studied more profoundly. An obstacle in that regard is that data about health risks at the workplace are not easily available to the research community, certainly when it comes to register data. A suggestion of the panel members is to focus more specifically on psychosocial and musculoskeletal risk factors at the workplace. This can be accomplished by providing access to and sharing relevant data from the workplace on the one hand and by adapting the content/system of the general mechanisms of health prevention (such as the periodic medical examinations) on the other hand. The panel members stress that more means should be invested in concrete initiatives aimed at specific groups of employees with a clear risk profile when it comes to the health and well-being effects of their job.

Another important point raised by the panel members is how the amount of work in society can be organised in such a way that everyone who wishes to enter the labour market can take part and earn a decent income. A possible challenge in this regard is the emergence of new technologies such as artificial intelligence, since they tend to threaten specifically those job profiles that already have a difficult position on the labour market. It might be interesting to consider certain systems of working time reduction, in order to divide employment more equally among individuals in society.

5.2 Dissemination

Dissemination of the results of the CAUSINEQ project is crucial to create awareness about the existence of socio-economic health inequalities in contemporary society and to foster policy change aimed at countering the detrimental health effects of de-standardised life courses. Therefore, disseminating the results was considered an essential component of the project.

The results of the CAUSINEQ project on socio-economic inequalities in health and mortality have been disseminated to a wider academic as well as non-academic audience. A list of all (peer-reviewed) publications related to the project is provided in the next section of the report. The total number of published or submitted scientific articles related to the project is 22. In addition, 4 master thesis and 5 PhDs were (partly) prepared in the context of the CAUSINEQ project. On top of this, results were presented at different national and international congresses, workshops and symposia. Several articles related to the project appeared in Belgian newspapers. A full list of these communications is provided below. Finally, a project website (http://www.causineq.be) was developed.

On Monday 21 October 2019, a Symposium with the title ‘Causes of health and mortality inequalities in Belgium: multiple dimensions, multiple causes’ was organised at the premises of the Vrije Universiteit Brussel. The goal of this symposium was to present the most important research results of the CAUSINEQ project and thus inform representants from the policy field and other researchers about the current situation and the important new knowledge with regard to socio-economic health and mortality inequalities in Belgium.

Participation in national congresses/workshops/symposia

Hagedoorn, P., H. Vandenheede, K. Vanthomme, S. Gadeyne (2015), “The effects of individual and area-level socioeconomic status on mortality from cancer of the head and neck in Belgium, 2001-2011”, *Methods in Epidemiology*, 17 September 2015, Leuven, Belgium (Best Poster Price).

Eggerickx T., Sanderson J.-P., (2016), «Lecture de données sociodémographiques des arrondissements de Charleroi et de Thuin», Communication au colloque *Quel rôle doit jouer la promotion de la santé pour une meilleure qualité de vie des aînés ?,* Centre local de Promotion de la Santé de Charleroi-Thuin, Charleroi, Belgique.

Eggerickx T., (2016), «Les inégalités sociales et spatiales de mortalité en Belgique», Communication au colloque organisé par le CEPAG-Mouvement d'éducation populaire sur *Riches et pauvres, à la vie à la mort*, Namur, Belgique.

Eggerickx T., (2017), «Les inégalités sociales et spatiales de mortalité en Belgique (1991-2016)», Communication au colloque organisé par le CEPAG-Mouvement d'éducation populaire sur *Pensions : un avenir radieux... mais pas pour les travailleurs!*, Namur, Belgique.

Eggerickx T., Sanderson J.-P., Vandeschrick C., (2018), «Les inégalités sociales et spatiales de mortalité en Belgique depuis 1991*»,* Communication au *Midis de la Recherche*, DEMO-UCL, Louvain-la-Neuve, Belgique.

Eggerickx T., Sanderson J.-P., (2018), «La situation démographique du sud de l’Entre-Sambre-et-Meuse (vieillissement, migrations internes, inégalités face à la santé et à la mort...)», Communication au *Plateforme intersectorielle du sud de l'Entre-Sambre-et-Meuse*, Florennes, Belgique.

Eggerickx T., Sanderson J.-P., Vandeschrick C., (2018), «Social inequalities in mortality in Belgium from 1991 to today: exploitation of life tables by social group», Communication au *Data4Research: couplages de données innovants pour des recherches innovantes sur la mortalité*, StatBel Bruxelles, Belgique.

Eggerickx T., (2018), Participation à la table ronde «*Ageing is the future: Let us built it together*», Palais Royal de Bruxelles, Belgique.

Eggerickx T., Vandeschrick C., (2018) «Les tables de mortalité par groupe social - Causineq», Observatoire de la Santé du Hainaut, Havré, Belgique.

Eggerickx T., Sanderson J.-P., (2019), « Vieillissement, santé et mortalité dans l’Entre Sambre et Meuse au prisme des inégalités sociales», Communication au Colloque *Qualité de vie, vieillissement et inégalités au Sud Entre Sambre et Meuse. Des données pour construire votre politique locale,* Plateforme Intersectorielle du Sud Entre Sambre et Meuse, Cerfontaine, Belgique.

Eggerickx T., (2019), «Le vieillissement de la population en Wallonie dans sa diversité sociale et spatiale», La ligue des droits humains, Participation au Apéro-débat *Seniors, l'âge d'or,* Perwez, Belgique.

Eggerickx T., (2019), «Les inégalités sociales de santé et de mortalité aux âges élevés» *Bien vieillir en Wallonie*, Observatoire de la santé du Hainaut, Charleroi, Belgique.

Participation in international congresses/workshops/symposia

Hagedoorn, P., H. Vandenheede, D. Willaert, K. Vanthomme, S. Gadeyne (2014), "Regional and socioeconomic inequalities in lung cancer mortality in Belgium (Flanders and Brussels-Capital Region, 2001-2009)", *Dutch Demography Day*, 10 December 2014, Utrecht, the Netherlands.

Hagedoorn, P., H. Vandenheede, D. Willaert, K. Vanthomme, S. Gadeyne (2014), "Regional and socioeconomic inequalities in lung cancer mortality in Belgium, 2001-2009" *European Public Health Conference*, 19-22 November 2014, Glasgow, Ireland (poster presentation).

Vanthomme, K., H. Vandenheede, P. Hagedoorn, S. Gadeyne (2014), "Socio-economic differences in lung cancer mortality in Belgian men and women (2004-2005): does it matter where you live?" *European Population Conference*, 25-28 June 2014, Budapest, Hungary (poster presentation).

Gadeyne, S., H. Vandenheede, C. Vanroelen (2015), "Does education protect against the detrimental effect of unemployment. Male mortality in Belgium 2001-2011", *2nd Annual International Conference on Demography and Population Studies*, 15-18 June 2015, Athens, Greece.

Hagedoorn, P., H. Vandenheede, K. Vanthomme, S. Gadeyne (2015), "The effects of individual and area-level socioeconomic status on mortality from cancer of the head and neck in Belgium, 2001-2011", *Chaire Quetelet*, 18-20 November 2015, Louvain-la-Neuve, Belgium.

Van Aerden, K., S. Gadeyne, C. Vanroelen (2015), "The health and well-being associations of different types of employment and labour market positions in Belgium", *2015 GGP Users Conference*, 30 November-1 December 2015, Vienna, Austria.

Vanthomme, K., H. Vandenheede, P. Hagedoorn, S. Gadeyne (2015), "Socioeconomic differences in lung cancer mortality in Belgian men and women (2004-2005): does it matter who you live with?" *1st Annual International Conference on Public Health*, 4-7 May 2015, Athens, Greece.

Gadeyne, S., C. Vanroelen (2016), "Does education protect against the detrimental effect of unemployment? Male mortality Belgium 2001-2011", *European Population Conference 2016*, 31 August-3 September 2016, Mainz, Germany.

Hagedoorn, P., H. Vandenheede, K. Vanthomme, S. Gadeyne (2016), "The association between individual and area-level socioeconomic status and mortality from cancer of the head and neck, Belgium 2001-2011", *European Population Conference 2016*, 31 August-3 September 2016, Mainz, Germany.

Majérus P. (2016), «La dé-standardisation des parcours de vie peut-elle expliquer en partie l'augmentation des inégalités matrimoniales de mortalité en Belgique?», Communication lors du *XIXe colloque international de l'AIDELF– configurations et dynamiques familiales* – 21 au 24 juin 2016, Strasbourg, France.

De Moortel, D., Hagedoorn, P., Vanroelen, C., Gadeyne, S. (2017), "Employment status and mortality in times of high and low regional unemployment: the protective effect of education?" *Comparing Health across societies CHASE conference*, Ghent, Belgium.

Eggerickx T., Sanderson J.-P., Vandeschrick C., (2018), «Inégalités sociales de mortalité au-delà de 65 ans. Le cas de la Belgique», Communication au Chaire Quetelet/AIDELF, *Comment vieillissons-nous?,* Louvain-la-Neuve, Belgique.

Newspaper & other articles

Le Soir, 22/01/2016, *Les inégalités sociales de mortalité en Belgique*
Journal Télévisé de RTLTVi, 22/01/2016, *L'espérance de vie: la fracture sociale*
De Morgen, 30/05/2018, *Flexibiliteit op het werk verhoogt risico op gezondheidsproblemen*
Het Laatste Nieuws, 30/05/2018, *Flexibiliteit op het werk verhoogt risico op gezondheidsproblemen*
Metro, 30/05/2018, *Flexibel werk veroorzaakt gezondheidsproblemen*
Le Soir, 24/12/2018, *Les inégalités sociales impactent l'espérance de vie*
Le Vif, 24/12/2018, *Comment les inégalités sociales impactent l'espérance de vie*
The Brussels Times, 24/12/2018, *Social inequality affects life expectancy*
De Morgen, 26/12/2018, *Waarom u beter niet werkloos bent in Aalst*
De Standaard, 21/10/2019, *Vlaming met goede job leeft langer*
Bruzz, 21/10/2019, *Arme Brusselaar heeft hogere levensverwachting dan arme Vlaming*
Visie, 22/11/2019, *Levensverwachting stijgt, maar niet voor iedereen evenveel*

6. PUBLICATIONS

Article publications in chronological order

Eggerickx, T., Gadeyne, S., Gourbin, C., Majérus, P., Masquelier, B., Sanderson, J.-P. et al. (2016). Inégalités sociales de mortalité en Belgique. De multiples dimensions, de multiples causes. *Science connection*, 40-45.

Hagedoorn, P., H. Vandenheede, K. Vanthomme, S. Gadeyne (2016a), "Regional inequalities in lung cancer mortality in Belgium at the beginning of the 21st century: the contribution of individual and area-level socioeconomic status and industrial exposure", *Plos One*, vol. 11 (1), 18 p. (http://doi.org/doi:10.1371/journal.pone.0147099) (SCI impactfactor: 3,057).

Hagedoorn, P., H. Vandenheede, K. Vanthomme, S. Gadeyne (2016b), "A cohort study into head and neck cancer mortality in Belgium (2001-11): are individual socioeconomic differences conditional on area deprivation?", *Oral Oncology*, vol. 61, pp. 76-82 (http://dx.doi.org/10.1016/j.oraloncology.2016.08.014) (SCI impactfactor: 4,286).

Van Hemelrijck, W., D. Willaert, S. Gadeyne (2016), "The geographic pattern of Belgian mortality: can socio-economic characteristics explain area differences?, *Archives of Public Health*, vol. 74 https://doi.org/10.1186/s13690-016-0135-y (RG Impactfactor: 2,19).

Bourguignon M.**,** Eggerickx T.**,** Sanderson J.-P., (2017), «Quels territoires de santé gérontologique pour repenser l'adéquation entre offre et besoins d'aides en Wallonie?», *Revue Francophone sur la Santé et les Territoires*, pp. 1-23, https://rfst.hypotheses.org/files/2017/06/Bourguignon_Eggerickx_Sanderson_-Rfst-2017.pdf

Eggerickx T., Léger J.-F., Sanderson J.-P., Vandeschrick C., (2017), «L'évolution de la mortalité en Europe du 19e siècle à nos jours», *Espace, Populations, Sociétés*, [Online], 3 , http://journals.openedition.org/eps/7314

Huegaerts, K., Puig-Barrachina, V., & Vanroelen, C. (2017). The mental health of unemployed Brussels youth: the role of social and material resources. *Archives of Public Health*, *75*(1), 19. https://doi.org/10.1186/s13690-017-0187-7

Van Aerden, K., S. Gadeyne, C. Vanroelen (2017), "Is any job better than no job at all? Studying the relations between employment types, unemployment and subjective health in Belgium", *Archives of Public Health*, vol. 75 (55) (DOI 10.1186/s13690-017-0225-5).

Vanthomme, K., L. Vandenborre, H. Vandenheede, P. Hagedoorn, S. Gadeyne (2017), "Site-specific cancer mortality inequalities by employment and occupational groups: a cohort study among Belgian adults, 2001-2011", *BMJ Open*, (https://doi.org:10.1136/bmjopen-2016-015216).

De Moortel, D., P. Hagedoorn, C. Vanroelen, S. Gadeyne (2018)," Employment status and mortality in the context of high and low regional unemployment levels in Belgium (2001–2011): A test of the social norm hypothesis across educational levels", *Plos One* 13(2), e0192526. https://doi.org/10.1371/journal.pone.0192526.

Eggerickx T., Léger J.-F., Sanderson J.-P., Vandeschrick C., (2018), «Inégalités sociales et spatiales de mortalité dans les pays occidentaux. Les exemples de la France et de la Belgique», *Espace, Populations, Sociétés*, [Online], 1-2, http://journals.openedition.org/eps/7800.

Eggerickx T., Sanderson J.-P., Vandeschrick C., (2018), «Éditorial : les inégalités sociales et spatiales de santé et de mortalité», *Espace, Populations, Sociétés*, [Online], 1-2, http://journals.openedition.org/eps/7808.

Eggerickx T., Sanderson J.-P., Vandeschrick C., (2018), «Les inégalités sociales et spatiales de mortalité en Belgique : 1991-2016», *Espace, Populations, Sociétés*, [Online], 1-2, http://journals.openedition.org/eps/7416

Eggerickx T., Sanderson J.-P., Vandeschrick C., (2018), (responsables scientifiques), « Les inégalités sociales et spatiales de santé et de mortalité », *Espace, Populations, Sociétés*, [Online], 1-2. https://journals.openedition.org/eps/7330

Hagedoorn, P., H. Vandenheede, K. Vanthomme, S. Gadeyne (2018). "Socioeconomic Position, Population Density and Site-Specific Cancer Mortality: A Multilevel Analysis of Belgian Adults, 2001–2011." *International Journal of Cancer*, vol. 142(1), pp. 23–35.(https://doi.org/10.1002/ijc.31031).

Vanthomme, K., Vandenheede, H., Hagedoorn, P., Gadeyne, S. (2018). "Parental and/or personal socioeconomic circumstances? What explains site-specific cancer mortality inequalities among young Belgian adults?" *Journal of Cancer Science and Clinical Therapeutics*, vol. 2(2), pp. 54-72. (DOI: 10.26502/jcsct.5079008)

Eggerickx T., Sanderson J.-P., Vandeschrick C., (2019), "Mortality in Belgium from the 19th century to today. Variations by age, sex, marital status, and social and spatial contexts", *Quetelet Journal* (accepted for publication).

Majérus P., Eggerickx T., Masquelier B., Sanderson J.-P., Vandeschrick C., (2019), «Les inégalités régionales et matrimoniales de mortalité en Belgique. Pour le meilleur et pour le pire!», *Espace, Populations, Sociétés* (accepted for publication).

Vanthomme K, Gadeyne S (2019) Unemployment and cause-specific mortality among the Belgian working-age population: The role of social context and gender. *PLoS ONE* 14(5): e0216145. https://doi.org/10.1371/journal.pone.0216145

Eggerickx, T., Sanderson, J.-P., Vandeschrik, C., Donadille, C. (2020) "Social inequalities in mortality after age 65 in Belgium", *Quetelet Journal* (submitted for publication).

Van Cleemput O., Masquelier B., Sanderson J.-P., Eggerickx T. (2020) "Excess mortality in children living in one-parent families in Belgium." *European Journal of Population* (to be submitted).

Other publications in chronological order

Chif, F. (2015), Les inégalités spatiales de mortalité en Belgique. Une analyse par niveau d'instruction de 1991 à 2010. Master thesis.

Lherm, E. (2015), La santé des immigrés en question. Les inégalités de mortalité selon le statut migratoire en Belgique de 1991 à 2009. Master thesis.

Damiens, J. (2018). Environnement de vie et mortalité. L'impact du logement et de l'environnement immédiat sur la mortalité en Belgique entre 1991 et 2016. Master thesis.

De Vestel, J. (2018), Unemployment and mortality in Belgium: An exploration of the 2011 census. Master thesis.

Van Aerden, K. (2018). *Contemporary employment arrangements in Europe and their relation with workers' well-being.* Doctoral dissertation. Vrije Universiteit Brussel, Brussels.

Balogh, R., Van Aerden, K., Vanthomme, K., Gadeyne, S. & Vanroelen, C. (2019a). The effect of employment status in 2001 and all-cause and cause specific mortality among Belgian workers (working paper).

Balogh, R., Van Aerden, K., Vanthomme, K., Gadeyne, S. & Vanroelen, C. (2019b). The effect of employment trajectories on all-cause and cause specific mortality among Belgian workers (working paper).

Sanderson J.-P., Eggerickx T., Vandeschrick C. (2019), «Construction des groupes sociaux. Notes méthodologiques», *Démographie et Sociétés*, Documents de travail, Centre de recherche en démographie, Louvain-la-Neuve.

Vandeschrik, C., Eggerickx, T., Sanderson, J.-P. (2019). "Les tables de mortalité par groupe social. Notes méthodologiques.", *Démographie et Sociétés*, Documents de travail, Centre de recherche en démographie, Louvain-la-Neuve.

Verhelpen, V. (2019). L'impact de la pollution automobile sur la mortalité en milieu périurbain belge entre 1991 et 2015. Master thesis.

Damiens, J. (2020). «Environnement de vie et mortalité. L'impact du logement et de l'environnement immédiat sur la mortalité en Belgique entre 1991 et 2016», *Démographie et Sociétés*, Documents de travail, Centre de recherche en démographie, Louvain-la-Neuve.

Plavsic, A. (2022*). L'homicide conjugal parmi les morts violentes en Belgique du 20^{e} siècle à nos jours.* Doctoral thesis (in progress). Louvain-la-Neuve.

Damiens, J. (2023). *L'impact du contexte résidentiel et de ses changements sur le suicide chez les Belges entre 20 et 64 ans.* Doctoral thesis (in progress). Louvain-la-Neuve.

Van Cleemput, O. (2023). *The burden of Unintentional Injuries in Belgium.* Doctoral thesis (in progress). Louvain-la-Neuve.

7. ACKNOWLEDGEMENTS

The authors would like to thank the members of the Follow-Up Committee:

- Herman Van Oyen
  Scientific Institute in Public Health
- Anouck Billiet
  Observatoire Wallon de la santé
- Marie-Madeleine Leurquin
  Centre d'éducation du patient
- Marc Debuisson
  IWEPS
- Dominique Dubourg
  Observatoire Wallon de la santé
- Pol Gerits
  Federal Public Service Health, Food Chain Safety and Environment
- Perrine Humblet
  ULB (Faculté de santé publique)
- Sophie Sokolowski
  Federaal Instituut voor Duurzame Ontwikkeling
- Alain Leveque
  ULB (Faculté de santé publique)
- Marielle Smeets
  Federal Public Service Health, Food Chain Safety and Environment
- Karel Van Damme
  Federale Overheidsdienst Werkgelegenheid, Arbeid en Sociaal Overleg
- Henk Van Hootegem
  Steunpunt tot bestrijding van armoede, bestaansonzekerheid en sociale uitsluiting
- Solveig Wallyn
  Vlaams Agentschap Zorg en Gezondheid
- Heidi Cloots
  Vlaams Agentschap Zorg en Gezondheid
- Michel Willems
  SPF Economie, Direction thématique Société
- Ive Marx
  Universiteit Antwerpen

REFERENCES

Adveev A., Eremenko T., Festy P., Gaymu J., Le Bouteillec N., Spinger S., (2011), Populations et tendances démographiques des pays européens (1980-2010), *Population-F*, 66 (1), pp. 9-133.

Antonovsky A., (1967), Social class, life expectancy and overall mortality, *The Milbank* Memorial Fund Quarterly, vol. 45, no. 2, part 1, pp. 31-73.

Balogh, R., Van Aerden, K., Vanthomme, K., Gadeyne, S. & Vanroelen, C. (2019a). The effect of employment status in 2001 and all-cause and cause specific mortality among Belgian workers (working paper).

Balogh, R., Van Aerden, K., Vanthomme, K., Gadeyne, S. & Vanroelen, C. (2019b). The effect of employment trajectories on all-cause and cause specific mortality among Belgian workers (working paper).

Benach J., Muntaner C., Benavides F. G., Amable M., Jodar P. (2002), A new occupational health agenda for a new work environment, *Scandinavian Journal of Work Environment & Health*, 28(3), 191-196.

Benach J., Solar O., Vergara M., Vanroelen C., Santana V., Castedo A., Ramos J., Muntaner C. (2010), Six Employment Conditions and Health Inequalities: A Descriptive Overview, *International Journal of Health Services*, 40 (2), 269-280.

Benach, J., Puig-Barrachina, V., Vives, A., Tarafa G., Muntaner C. (2012), The challenge of monitoring employment-related health inequalities, *Journal of Epidemiology and Community Health, 66(12), 1085- 1087.*

Berntsen K.N., (2011), Trends in total and cause-specific mortality by marital status among elderly Norwegian men and women, *BMC Public Health*, 11, p. 537.

Bessin M. (1999),La compression du temps: une déritualisation des parcours de vie, *Education permanente*, 138 (1), 75-85. : Polity Press.

Blum A., Houdaille J., Lamouche M., (1989), Eléments sur la mortalité différentielle à la fin du XVIIIe siècle et au début du XIXe siècle, *Population*, 1, pp. 29-53.

Bonnefoy X., (2007), Inadequate Housing and Health: An Overview, *International Journal of Environment and Pollution* 30 (3–4), pp. 411–429.

Borrell C., Azlor E., Rodríguez-Sanz M., Puigpinós R., Cano-Serral G., Pasarín M.I., Martínez J.M., Benach, J., Muntaner, C. (2008), Trends in socio-economic mortality inequalities in a southern European urban setting at the turn of the 21st century, *Journal of Epidemiology and Community Health*, vol. 62 (3), 258– 266.

Bosch G. (2004), Towards a New Standard Employment Relationship in Western Europe, *British Journal of Industrial Relations*, 42(4), 617-636.

Bourdieu P. (1986), The forms of capital, pp. 241-258 In J. Richardson (Ed.) *Handbook of Theory and Research for the Sociology of Education.* New York: Greenwood.

Bourguignon M., Eggerickx, T., Sanderson J.-P., (2017), Quels territoires de santé gérontologique pour repenser l'adéquation entre offre et besoins d'aides en Wallonie?, *Revue francophone sur la santé et les territoires*, pp. 1-23.

Boyer R., Durand J. P. (1993), *L'après-fordisme.* Paris: Syros.

Brockmann H., Klein T., (2004), Love and Death in Germany: The Marital Biography and Its Effect on Mortality, *Journal of Marriage and Family*, 66, 3, pp. 567-581.

Brown D., Leyland A. H., (2010), Scottish mortality rates 2000-2002 by deprivation and small area population mobility, *Social Science & Medicine*, 71, 1951-1957.

Burgoa M., Regidor E., Rodriguez C., Guitierrez-Fisac J.L., (1998), Mortality by cause of death and marital status in Spain, *The European Journal of Public Health*, 8, 1, pp. 37-42.

Bugeja-Bloch F., (2013), *Logement, la spirale des inégalités*, Paris, Puf.

Cambois E., Jusot F., (2007), Ampleur, tendance et causes des inégalités sociales de santé et de mortalité en Europe : une revue des études comparatives, *Bulletin épidémiologique hebdomadaire*, 2-3, pp. 10-14.

Caselli G., Vallin J., (2002), Les variations géographiques de la mortalité, Démographie : analyse et synthèse. III. Les déterminants de la mortalité, sous la direction de G. Caselli, J. Vallin et G. Wunsch, Editions de l'INED, Paris, pp. 373-415.

Chatelard S., Vaucher P., Wolff H., Bischoff T., Herzig L., Panese F., Bodenmann P., (2012), Le médecin face aux inégalités sociales de santé : quel pouvoir d'action?, *Revue médicale suisse*, (341), 1061.

Cranford, C. J., Vosko, L. F., Zukewich, N. (2003), The gender of precarious employment in Canada, *Industrial Relations*, 58 (3), 454-482.

Dawson A., (1991), Family structure and children's health and well-being: Data from the 1988 National Health Interview Survey on Child Health, *Journal of Marriage and the Family*, 53(3):573–584.

Deboosere P., Gadeyne S., (2002), Can regional patterns of mortality in Belgium be explained by individual socio-economics characteristics, *Reflets et Perspectives*, XLI, n°4, pp. 87-103.
Deboosere P., Fiszman P., (2009), De la persistance des inégalités socio-spatiales de santé. Le cas belge, *Espace, Populations, Sociétés*, 1, 1-12.

Deboosere P., Gadeyne S., Van Oyen, H. (2009), The 1991–2004 evolution in life expectancy by educational level in Belgium based on linked census and population register data, *European Journal of Population*, 25(2), 175-196.

Deboosere P., Lesthaeghe R., Surkyn J., Willaert D., Boulanger P.-M., Lambert A., Lohlé-Tart L, (2009b). *Monographie 4: Ménages et familles en Belgique - Enquête Socio-économique 2001 - Monographies*. Technical Report 4, Direction générale Statistique et Information économique.

De Moortel, D., P. Hagedoorn, C. Vanroelen, S. Gadeyne (2018)," Employment status and mortality in the context of high and low regional unemployment levels in Belgium (2001–2011): A test of the social norm hypothesis across educational levels", Plos One 13(2), e0192526. https://doi.org/10.1371/journal.pone.0192526

De Vestel, J. (2018), Unemployment and mortality in Belgium: An exploration of the 2011 census. Master thesis.

Devlieger H., Martens G., Bekaert A.(2005), Social inequalities in perinatal and infant mortality in the northern region of Belgium (the Flanders). *The European Journal of Public Health* 15.1: 15-19.

Diez Roux A. V., Mair C., (2010), Neighboroods effect on health, *Annals of the New York Academy of Sciences*, 1186, pp. 125-145.

Duchene J., Thiltgès E., (1993), La mortalité des plus de 15 ans en Belgique : les disparités régionales en 1985-1987, *Espace, Populations, Sociétés*, 1, pp. 61-74.

Eggerickx T., Hermia J.-P., Kesteloot C., De Maesschalck F., Gerber P., Lord S., Sohn C. (2009), *Analyse spatiale et longitudinale des inégalités sociales en Belgique et au Luxembourg (DESTINY), Rapport final de la Phase 1*. Bruxelles: Politique Scientifique Fédéral.

Eggerickx T., Hermia J.-P., Surkijn J., Willaert D, (2009b), (avec la collaboration de L. Dal, M. Poulain et J.- P. Sanderson) Les migrations internes en Belgique, Monographie 2 de l'Enquête socioéconomique de 2001. Bruxelles : DGSIE.

Eggerickx T., Sanderson J.-P., (2010), Les inégalités spatiales de mortalité en Belgique: 1980-2005, *Démographie et Santé*, Cudep, Bordeaux, pp. 145-161.

Eggerickx T., Debuisson M., Sanderson J.-P., (2012), La mortalité des jeunes enfants de moins d'un an en Belgique, de 1840 à 1925. Une approche spatiale, *Annales de Démographie Historique*, 1, pp. 25-61.

Eggerickx T., Léger J.-F., Sanderson J.-P., Vandeschrick C. (2017), « L'évolution de la mortalité en Europe du 19e siècle à nos jours», *Espace, Populations, Sociétés*, [Online], 3.

Eggerickx T., Léger J.-F., Sanderson J.-P., Vandeschrick C. (2018a), Inégalités sociales et spatiales de mortalité dans les pays occidentaux. Les exemples de la France et de la Belgique, *Espace, Populations, Sociétés*, [Online], 1-2.

Eggerickx T., Sanderson J.-P., Vandeschrick C. (2018b), Les inégalités sociales et spatiales de mortalité en Belgique : 1991-2016, *Espace, Populations, Sociétés*, [Online], 1-2.

Eggerickx T., Sanderson J.-P., (2019), Migrations résidentielles, ségrégation sociale et vieillissement démographique: le cas de l'espace périurbain bruxellois, *Espace populations sociétés,* 2.

Facey M. E., Eakin J. M. (2010), Contingent work and ill-health: Conceptualizing the links, *Social Theory & Health*, 8 (4), 326-349.

Ferrie J. E. (1999), Health consequences of job insecurity, pp. 59-99 In J. E. Ferrie, M. G. Marmot, J. Griffiths, & E. Ziglio (Eds.), *Labour market changes and job insecurity. A challenge for social welfare and health promotion*. Copenhagen: World Health Organization. Regional Office for Europe.

Gadeyne S., (2006), *The ultimate inequality: Socio-economic differences in all-causes and cause-specific mortality in Belgium in the first part of the 1990s*, NIDI CBGS Publications, 39, Bruxelles, 260 p.

Galobardes B., Lynch J., Smith G.D. (2007), Measuring socio-economic position in health research, *British Medical Bulletin*, 81-82 (1), 21-37.

Ghosn W., Kassié D., Jougla E., Salem G., Rey G., Rican S. (2012), Trends in geographic mortality inequalities and their associations with population changes in France, 1975-2006, *European Journal of Public Health*, vol. 23, n°5, 834-840.

Goldman N., Hu Y., (1993), Excess mortality among the unmarried: A case study of Japan, *Social Science & Medicine*, 36, 4, pp. 533-546.

Grimmeau J.-P., Romainville A., Beyts N., (2010), Evolution de la géographie de la mortalité en Belgique, 1840-2002, *Histoire de la population de la Belgique et de ses territoires*, sous la

direction de T. Eggerickx et J.-P. Sanderson, Chaire Quetelet 2005, Presses Universitaires de Louvain, pp. 613-626.

Hagedoorn, P., H. Vandenheede, K. Vanthomme, S. Gadeyne (2016a), "Regional inequalities in lung cancer mortality in Belgium at the beginning of the 21st century: the contribution of individual and area-level socioeconomic status and industrial exposure", Plos One, vol. 11 (1), 18 p. (http://doi.org/doi:10.1371/journal.pone.0147099) (SCI impactfactor: 3,057).

Hagedoorn, P., H. Vandenheede, K. Vanthomme, S. Gadeyne (2016b), "A cohort study into head and neck cancer mortality in Belgium (2001-11): are individual socioeconomic differences conditional on area deprivation?", Oral Oncology, vol. 61, pp. 76-82 (http://dx.doi.org/10.1016/j.oraloncology.2016.08.014) (SCI impactfactor: 4,286).

Hagenaars J.A., McCutcheon A.L. (2002), Applied Latent Class Analysis. Cambridge University Press.

Haynes R., Reading R., Gale S. (2003), Household and neighbourhood risks for injury to 5-14 year old children, *Social Science & Medicine*, 57(4):625–636.

Hemström Ö., (1996), Is Marriage Dissolution Linked to Differences in Mortality Risks for Men and Women? *Journal of Marriage and Family*, 58, 2, pp. 366-378.

Herjean P., (2006), L'approche multiniveau de la santé, *Cahiers de géographie du Québec*, 50(141), pp. 347-355.

Herttua K, Martikainen P., Vahtera J., Kivimaki M. (2011), Living alone and alcohol-related mortality: a population-based cohort study from Finland, PLoS Med., 8(9), e1001094.

Hu Y., Goldman N. (1990), Mortality Differentials by Marital Status: An International Comparison, *Demography*, 27 (2), 233–250.

Huegaerts, K., Puig-Barrachina, V., & Vanroelen, C. (2017). The mental health of unemployed Brussels youth: the role of social and material resources. *Archives of Public Health*, *75*(1), 19. https://doi.org/10.1186/s13690-017-0187-7

Huisman M., Read S., Towriss C., Deeg D., Grundy E., (2013), Socioeconomic Inequalities in Mortality Rates in Old Age in the World Health Organization Europe Region, *Epidemiologic Reviews*, vol.15, pp. 84-97.

Hummer R.A., Roger R.G., Eberstein I.W., (1998), Sociodemographic differentials in adult mortality: A review of analytic approaches, *Population and Development Review*, 24 (3), pp. 553-578.

Jasilionis D., ShkolnikovV., Andreev E., Jdanov D., Meslé F., Vallin J., (2014), L'avant-garde en matière d'espérance de vie montre-t-elle la voie au reste de la population? , *Population*, vol.69, 4, pp. 589-615.

Jessop, B. (1994), The transition to post-fordism and the schumpeterian workfare state, pp.15-37 In R.Burrows & B. Loader (Eds.), *Towards a Post-Fordist Welfare State?*. London: Routledge.

Kawachi I, Kennedy B., (1999), The relationship of income inequality to mortality: does the choice of indicator matter?, *Social Science & Medicine*, 45, pp. 1121-1127.

Kendrick D., Mulvaney C., Burton P., Watson M., (2005), Relationships between child, family and neighbourhood characteristics and childhood injury: A cohort study, *Social Science & Medicine*, 61(9):1905–1915.

Kohli M. (1986), The world we forgot : a historical review of life course , pp. 271-303 In V.W. Marshall (Ed.), *Later life. The social psychology of aging.* Beverly Hills: Sage.

Kohli M. (1989), Le cours de vie comme institution social, ENQUETE, Biographie et cycle de vie. (http://enquete.revues.org/document78.html).

Koskenvua M., Kaprio J., Kesäniemi A., Sarna S., (1980), Differences in mortality from Ischemic Heart Disease by marital status and social class, *Journal of Chronic Diseases*, 33, 2, pp. 95-106.

Koskinen S., Joutsenniemi K., Martelin T., Martikainen P. (2007), Mortality differences according to living arrangements, *International Journal of Epidemiology*, 36(6),1255-1264.

Kraus A.S., Lilienfeld A.M., (1959), Some epidemiologic aspects of the high mortality rate in the young widowed group, *Journal of Chronic Diseases*, 10, 3, pp. 207-217.

Kunst A.E., Mackenbach J.P. (1994), International variation in size of mortality differences associated with occupational-status, *International Journal of Epidemiology,* 23(4), 742-750.

Laflamme L , Diderichsen F., (2000), Social differences in traffic injury risks in childhood and youtha literature review and a research agenda, *Injury Prevention*, 6(4):293– 298.

Lagasse R., Humblet P., Lenaerts A., Godin I., Moens G., (1990), Health and social inequities in Belgium, *Social Science & Medicine*, vol. 31, n°3, pp. 237-248.

Laing G., Logan S., (1999), Patterns of unintentional injury in childhood and their relation to socio-economic factors, *Public Health*, 113(6):291–294.

Lerch M., Oris M., Wanner P., (2017), Périurbanisation et transformation du gradient de la mortalité urbaine en Suisse, *Population*, 1, vol. 72, pp. 95-126.

Lerman R. I., (2002), Marriage and the Economic Well-Being of Families with Children: A Review of the Literature. URL http://webarchive.urban.org/ publications/410541.html.

Lesthaeghe R., van de Kaa D.J. (1986), Twee demografische transities? pp. 9-24 In: D. van de Kaa en Lesthaeghe, R. (ed.), *Bevolking: groei en krimp*. Deventer: Van Loghum Slaterus.

Lesthaeghe R., Surkyn J. (2006), Grondslagen en verspreiding van de Tweede Demografische Transitie, *Justitiële Verkenningen*, 32(3), 75-102.

Link B. G., Phelan J. (1995), Social conditions as fundamental causes of disease. *Journal of health and social behaviour,* Spec No, 80-94.

Lipietz A. (1987), *Mirages and Miracles. The Crisis of Global Fordism*. London: Verso.

Macintyre S., (1997), The Black Report and beyond what are the issues?, *Social Science and Medicine*, vol.44, n°6, pp. 723-745.

Mackenbach J. P., Stribu I., Roskam A.-J., Schaap M., Menvielle G., Leinsalu M., Kunst A., (2008), Socioeconomic inequalities in health in 22 European countries, *The New England Journal of Medicine*, june 5, pp. 2468-2481.

Mackenbach J. P., (2012), The persistence of health inequalities in modern welfare states: The explanation of a paradox, *Social Science & Medicine*, 75, pp. 761-769.

Manzoli L., Villari P., Pirone M., Boccia A., (2007), Marital status and mortality in the elderly: A systematic review and meta-analysis, *Social Science & Medicine*, 64, 1, pp. 77-94.

Marang-Van de Mheen P.J., Davey-Smith G., Hart C.L., Gunning-Schepers L.J. (1998), Socio-economic differentials in mortality among men within Great Britain: time trends and contributory causes, *Journal of Epidemiology and Community Health*, 52(4), 214-218.

Martikainen P. (1995), Women's employment, marriage, motherhood and mortality: a test of the multiple role and role accumulation hypotheses, *Social Science and Medicine*, 40(2), 199–212.

Martikainen P., Valkonen T., Martelin T. (2001), Change in male and female life expectancy by social class: decomposition by age and cause of death in Finland 1971-95, *Journal of Epidemiology and Community Health*, 55(7), 494-499.

Martikainen P., Martelin T., Nihtilaä E., Majamaa K., Koskinen S., (2005), Differences in mortality by marital status in Finland from 1976 to 2000: Analyses of changes in marital-status distributions, socio-demographic and household composition, and cause of death, *Population Studies*, 59, 1, pp. 99-115.

Mauldon J., (1990), The Effect of Marital Disruption on Children's Health, *Demography*, 27(3): 431–446.

Meijer M., Röhl J., Bloomfield K., Grittner U., (2012), Do neighborhoods affect individual mortality? A systematic review and meta-analysis of multilevel studies, *Social Science & Medecine*, 74, pp. 1204-1212.

Meslé F., Vallin J. (1996), Reconstructing long-term series of causes of death : the case of France, *Historical Methods,* 29(2), 72-87.

Meslé F., Vallin J., (2002), La transition sanitaire : tendances et perspectives, *Démographie : analyse et synthèse. III. Les déterminants de la mortalité,* sous la direction de G. Caselli, J. Vallin et G. Wunsch, Editions de l'INED, Paris, pp. 439-461.

Meslé F., (2005), Espérance de vie et mortalité aux âges élevés, *Retraite et société*, 2, n° 45, pp. 89-113.

Meslé F., VALLIN J. (2008), Impact of ICD-10 implementation on the continuity of cause-of-death statistics. The case of France, *Population-E*, 63(2), 347-359.

Mortelmans D., Snoeckx L., Dronkers J., (2009), Cross-regional Divorce Risks in Belgium: Culture or Legislative System?, *Journal of Divorce & Remarriage*, 50, 8, pp. 541-563.

Mulder C. H., Lauster N. T., (2010), Housing and family: An introduction, *Housing Studies*, 25(4), pp. 433-440.

Muntaner, C., Lynch, J., & Smith, G. D. (2000). Social capital and the third way in public health. *Critical Public Health*, *10*(2), 107–124. https://doi.org/10.1080/713658240

Murphy M., Grundy E.M.D., Kalogirou S., (2007), The increase in marital status differences in mortality up to the oldest age in seven European countries, 1990-99, Population Studies, 61, 3, pp. 287-298.

Nizard A., Vallin J., (1977), La mortalité par statut matrimonial. Mariage sélection ou mariage protection, *Population*, pp. 95-125.

Oris M., Lerch M., (2009), La transition ultime. Longévité et mortalité aux grands âges dans le bassin lémanique, Transitions dans les parcours de vie et construction des inégalités, sous la direction de M. Oris et al., Lausanne, 2009, pp. 407-432.

Östberg V., (1997), The social patterning of child mortality: the importance of social class, gen- der, family structure, immigrant status and population density, *Sociology of Health & Illness*, 19(4):415–435.

Painter G., Lee K., (2009), Housing tenure transitions of older households: Life cycle, demographic, and familial factors, *Regional Science and Urban Economics* 39(6), pp. 749-760.

Paugam S. (2000), *Le salarié de la précarité: les nouvelles formes de l'intégration professionnelle*. Paris: Presses Universitaires de France.

Phelan J. C., Link B. G., Diez-Roux A., Kawachi I., Levin B. (2004), 'Fundamental causes' of social inequalities in mortality: a test of the theory, *Journal of Health and Social Behavior,* 45(3)**,** 265-285.

Phelan J. C., Link B. G., Tehranifar P. (2010), Social conditions as fundamental causes of health inequalities: theory, evidence, and policy implications, *Journal of Health and Social Behavior,* 51(1), 28-40.

Pierson C. (2007), Beyond the Welfare State?: The New Political Economy of Welfare. 3th edition. Cambridge

Pressat R., (1985), Contribution des écarts de mortalité par âge à la différence des vies moyennes, *Population*, n°4-5, pp. 766-770.

Preston S., Heuveline P. and Guillot M., (2001), *Demography. Measuring and Modeling Population Process*, Blackwell Publishing.

Quinlan M., Mayhew C., Bohle P. (2001), The global expansion of precarious employment, work disorganization, and consequences for occupational health: A review of recent research, *International Journal of Health Services*, 31(2), 335-414.

Reading R., Jones A., Haynes R., Daras K., Emond A (2008), Individual factors explain neighbourhood variations in accidents to children under 5 years of age, *Social Science & Medicine*, 67(6):915–927.

Reich R. B. (1991), *The Work of Nations: Preparing Ourselves for 21st Century Capitalism*. New York: AA Knopf.

Reid A., Van den Boomen N., (2015), The faces of death: regional differentiation in cause-specific mortality in the past, *The History of Family*, 20, 3, pp. 309-319.

Remes, P. Martikainen, T. Valkonen, (2011), The effects of family type on child mortality, *European Journal of Public Health*, 21(6):688–693, Dec. 2011.

Renard F., Gadeyne S., Devleesschauwer B., Tafforeau J., Deboosere P. (2017), Trends in educational inequalities in premature mortality in Belgium between the 1990s and the 2000s: the contribution of specific causes of death, Journal Epidemiol Community Health, 71(4), pp. 371-380.

Rican S., Jougla E., Salem G., (2003), Inégalités socio-spatiales de mortalité en France, *BEH*, n°30-31, 142-145.

Riley C., (2001), *Rising Life Expectancy. A Global History.* Cambridge University Press.

Rittich K. (2004), *Vulnerability at work: legal and policy issues in the New Economy*. Toronto: University of Toronto.

Roelfs D.J., Shor E., Kalish R., Yogev T., (2011), The Rising Relative Risk of Mortality for Singles: Meta-Analysis and Meta-Regression, *American Journal of Epidemiology*, 174, 4, pp. 379-389.

Rosanvallon P. (2000), The new social questions. Rethinking the welfare state. New Jersey: Princeton university press.

Roussel L., Girard A. (1982), Régimes démographiques et âges de la vie, *Les âges de la vie.* Actes du VIIe colloque National de Démographie, Tome 1, *Travaux et documents de l'INED*, cahier n°96, 15-23.

Scott-Marshall H. (2005), *A political economy lens on work-related insecurity in the new economy: evaluating the consequences for health*. Dissertation. Toronto: University of Toronto.

Shurtleff D., (1955), Mortality and Marital Status, "Public Health Reports (1896-1970)", 70, 3, pp. 248-252.

Siegel C. D., Graves P., Maloney K., Norris J. M., Calonge B. N., Lezotte D., (1996), Mortality from intentional and unintentional injury among infants of young mothers in Colorado, 1986 to 1992, *Archives of Pediatrics & Adolescent Medicine*, 150(10):1077–1083.

Spini D., Widmer E., (2009), Transitions, ingalités et parcours de vie : l'expérience lémanique, *Transitions dans les parcours de vie et construction des inégalités,* sous la direction de M. Oris et al., Lausanne, 2009, pp. 3-23.

Standing G. (2011), *The precariat. The new dangerous class*. London: Bloomsbury Academic.

Thomson E., Hanson T. L., McLanahan S. S., (1994), Family Structure and Child Well-Being: Economic Resources vs. Parental Behaviors, *Social Forces*, 73(1):221–242.

Valkonen, T. (1999), The widening differentials in adult mortality by socio-economic status and their causes, in J. Chamie, R.L. Cliquet (eds.), "Health and Mortality. Issues of global

concern", Population Division, United Nations Secretariat and Population and Family Study Centre.

Valkonen T., (2002), "Les inégalités sociales devant la mort", *Démographie : analyse et synthèse. III. Les déterminants de la mortalité,* sous la direction de G. Caselli, J. Vallin et G. Wunsch, Editions de l'INED, Paris, pp. 351-372.

Valkonen T., Martikainen P., Blomgren J., (2004), Increasing excess mortality among nonmarried elderly people in developed countries, *Demographic Research*, 2, 12, pp. 306-330.

Vallin J., Meslé F. (2013), De la transition épidémiologique à la transition sanitaire : l'improbable convergence générale, in D. Tabutin, B. Masquelier (dir.), *Ralentissements, résistances et ruptures dans les transitions démographiques*, Actes de la Chaire Quetelet 2010, Louvain-la-Neuve, Presses Universitaires de Louvain, pp. 257-290.

Van Aerden, K., S. Gadeyne, C. Vanroelen (2017), "Is any job better than no job at all? Studying the relations between employment types, unemployment and subjective health in Belgium", Archives of Public Health, vol. 75 (55) (DOI 10.1186/s13690-017-0225-5).

Van Aerden, K. (2018). *Contemporary employment arrangements in Europe and their relation with workers' well-being.* Vrije Universiteit Brussel, Brussels.

Van Hemelrijck, W., D. Willaert, S. Gadeyne (2016), "The geographic pattern of Belgian mortality: can socio-economic characteristics explain area differences?, Archives of Public Health, vol. 74 https://doi.org/10.1186/s13690-016-0135-y (RG Impactfactor: 2,19).

Van Oyen H., Deboosere P., Lorant V., Charafeddine R., (2010), *Les inégalités sociales de santé en Belgique*, Société et Avenir, Politique Scientifique Fédérale, Academia Press, Gent, 200 pp.

Vanthomme, K., L. Vandenborre, H. Vandenheede, P. Hagedoorn, S. Gadeyne (2017), "Site-specific cancer mortality inequalities by employment and occupational groups: a cohort study among Belgian adults, 2001-2011", BMJ Open, (https://doi.org:10.1136/bmjopen-2016-015216).

Vanthomme K, Gadeyne S (2019) Unemployment and cause-specific mortality among the Belgian working-age population: The role of social context and gender. PLoS ONE 14(5): e0216145. https://doi.org/10.1371/journal.pone.0216145

Vedrennevilleneuve, E., (1961), L'inégalité sociale devant la mort dans la première moitié du XXe siècle, *Population*, n°4, pp. 665-698.

Vosko L. F. (2011), *Managing the margins. Gender, citizenship and the international regulation of precarious employment*. New York: Oxford University Press.

Weitoft G.R., Hjern A., Haglund B., Rosen M. (2003), Mortality, severe morbidity, and injury in children living with single parents in Sweden: a population-based study, *Lancet*, 361(9354), 289–295.

Widmer E., Ritschard G., Müller N., (2009), Trajectoires professionnelles et familiales en Suisse : quelle pluralisation ?, pp. 253-272 In M. Oris (ed.), *Transitions dans les parcours de vie et construction des inégalités*. Lausanne: Presse polytechniques et universitaires romandes.

Willems S., Van de Geuchte I., Alaluf V., Impens J., Van Nespen I., Maulet N., Roland M., De Maeseneer J., (2007), Problématique des inégalités socio-économiques de santé en Belgique, *Santée conjuguée*, avril, n°40, pp. 25-34.

Yonnet P. (2006), *Le recul de la mort. L'avènement de l'individu contemporain.* Paris: Gallimard.