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Unlivable.

Housing conditions, residential course, and mortality by suicide in Belgium. A study of Belgian administrative data.

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GENERAL ABSTRACT

Belgium presents the highest suicide rate in Western Europe. Studies on the determinants of suicide mortality include many aspects of an individual's life course but often forget the role of the residential course, in terms of quality of the living environment and mobility. Still, residential context and transitions, are at the core of human experiences and strong predictors of wellbeing and life satisfaction. This thesis investigates the relationship between three dimensions of the living environment and suicide mortality among the working-age population living in Belgium and gives specific attention to the life-course context. First, I study how social expectations over homeownership can impact the relationship between housing tenure and suicide mortality, according to an individual's age, gender and household composition. Second, I examine the relationship between housing quality, satisfaction over the neighbourhood and suicide mortality, and the relative importance of these environmental determinants, according to gender and life stages. Finally, I estimate the relationship between residential mobility and suicide mortality, giving particular attention to the partnership context of the move. An alternative outcome – antidepressant consumption – is considered to answer this question. Based on Belgium population data, providing high-quality information on the whole working-age population living in Belgium, this thesis brings together living environment conditions and transitions, life course trajectories and suicide mortality – the theoretical stakes, the methodological challenges and the complexity and limits of this relationship.

RÉSUMÉ GÉNÉRAL

La Belgique présente le taux de suicide le plus élevé d'Europe occidentale. Les études sur les déterminants du suicide incluent de nombreux aspects des parcours de vie, mais omettent souvent le rôle du parcours résidentiel – à la fois en termes de qualité de l'environnement de vie et de mobilité. Pourtant, le lieu de vie et les transitions résidentielles sont au cœur de l'expérience humaine et des facteurs majeurs dans le bien-être des personnes. Cette thèse se penche sur la relation entre trois dimensions du parcours résidentiel et le suicide, parmi la population en âge de travailler résidant en Belgique, tout en offrant une attention spécifique aux parcours de vie des individus. Tout d'abord, j'ai étudié le rôle des normes sociales autour de l'accès à la propriété dans la relation entre statut d'occupation du logement et risque de suicide en fonction de l'âge, du genre et de la situation familiale. Dans un deuxième temps, j'ai examiné la relation entre les conditions de logement, la satisfaction quant au quartier de résidence et la mortalité par suicide, ainsi que l'importance relative des déterminants environnementaux, selon différentes étapes de la vie active et le genre. Troisièmement, j'ai estimé la relation entre la mobilité résidentielle et le suicide, en tenant compte des potentielles formations et ruptures d'union concomitantes à ces changements de domicile. Cette question a aussi été traitée avec une autre variable dépendante, la consommation d'antidépresseurs. En se basant sur des données de population belges – permettant un accès à des données de grande qualité sur la totalité de la population active enregistrée en Belgique – cette thèse approfondit la relation entre le lieu de vie et ses transitions, les parcours de vie et la mortalité par suicide : les enjeux théoriques, les défis méthodologiques ainsi que la complexité et les limites de cette question.

In memory of Maureen D.

« Et quand le soir, dans vos belles maisons, vous allez embrasser vos petits-enfants, avec votre bonne conscience, au regard de Dieu, vous avez probablement plus de sang sur vos mains d'inconscients, que n'en aura jamais le désespéré qui a pris des armes pour essayer de sortir de son désespoir. »

Abbé Pierre, Discours au Palais des Congrès, 1984

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INTRODUCTION

"There is nothing like staying at home for real comfort", as the British author Jane Austen wrote in *Emma*. From March 2020 to early 2022, staying at home was a reality for most of the population to restrain the propagation of Covid-19. This situation shed light on the inequalities in housing comfort among the populations. The size of the place and its conformity to the needs of the inhabitants, its requirements for renovation, the possibility for the persons to personalise and adapt their residence, its energetical functioning, its location and the services and amenities nearby, the will or the obligation to find a new place; those existing questions were then rediscovered in the sense of emergency. Some studies showed that poor-quality housing during the forced isolation related to Covid-19 was particularly detrimental to mental health and quality of life (in Australia: Bower et al., 2021; in three European countries: Keller et al., 2022). Others reminded the link between housing problems and adverse health outcomes, leading to a higher risk of being contaminated and spreading the disease (in the US: K. Ahmad et al., 2020; in England: Tinson & Clair, 2020). We were all in the same boat facing the pandemic, while others were in makeshift rafts.

In Belgium, the right to decent housing was added to the Constitution in 1994 (Wallonie Logement, s. d.). Still, there exist inequalities in the living environment regarding basic installations (presence of central heating, overcrowded habitats), level of comfort, and immediate environment. In this thesis, I chose a comprehensive approach to the living environment. The living environment is defined as the built features that constitute the place of residence of the individual. It then includes the housing, immediate surroundings, and neighbourhood. The living environment is where the individual spends a significant amount of time. It gathers several aspects of the residential experience of the individual. In Belgium, a poor living environment, characterised by overcrowding and damp problems in the housing, or air pollution in the surroundings, is more frequent in the Brussels region and less visible in Flanders than in Wallonia (Aerts et al., 2020; Winters & Heylen, 2014). Previous studies have investigated the relationship between housing conditions and all-cause mortality in Belgium. At the level of the statistical sectors, Otavova et al. (2022) showed that nearly

20% of all deaths in Belgium between 1991 and 2020 might be associated with housing deprivation (Otavova et al., 2022). At the level of the individuals, a study could show that living in excellent housing conditions is associated with a longer life expectancy (+5.6 years for men and +4.1 years for women in 1992-1996, +3.7 years for men and +3.3 years for women in 2011-2015) than living in poor housing conditions (Damiens, 2020). Being an owner is also associated with a longer life expectancy (+4.2 years for men and +2.4 years for women in 1992-1996; +5.7 years for men and +3.8 years for women in 2011-2015) than being a tenant. The excess mortality related to housing conditions and housing tenure can still be observed after controlling for the demographic and socioeconomic characteristics of the individuals (Damiens, 2020). Some studies on green spaces and air pollution proved their negative association with diabetes mortality (Rodriguez-Loureiro, Casas, et al., 2022) and lung and breast cancers (Bauwelinck et al., 2022; Rodriguez-Loureiro, Verdoodt, et al., 2022).

Social inequalities in health and mortality have increased from the 1990s to the 2020s. Better working conditions, food, healthcare, hygiene, and environmental improvements have led to a general increase in life expectancy and reduced premature mortality (Meslé & Vallin, 2002; Vallin & Meslé, 2013). However, this increase in life expectancy and the reduction of avoidable mortality has been faster for the wealthiest populations than for the most deprived ones. This led to more significant socioeconomic inequalities in mortality over time (Eggerickx et al., 2020; Jasilionis et al., 2014; Mackenbach et al., 1997). The rise in health inequalities can be seen in the relationship between housing tenure and mortality. Tenants have an increasingly higher risk of dying than owners (Damiens, 2020). But for housing comfort, a previous article showed that, in Belgium, the gap between the populations living in poor quality and excellent quality housing in terms of mortality has narrowed over the last decades (Damiens, 2020). This can be explained by a higher risk of living in inadequate housing, even for more advantaged and educated populations. As we will see through this thesis, housing conditions depend on individuals' socioeconomic status and many other factors, such as marital and parental status, the region of residence, or the life stage.

Disruptive life events, such as union dissolution, job loss, or difficulty finding stability for younger and middle-aged adults (van der Heijden et al., 2011), happen for a larger share of the population. This is especially true for Belgium, where the housing market is characterised by a short supply (especially in the social renting market) and high real estate prices (De Decker et al., 2017). However, it is essential to note that no other studies support this result. The relation between different parts of the living environment experience – such as housing conditions, quality of the immediate surroundings and residential mobility – with health and mortality in Belgium was little studied.

Still, this relationship is worth studying. Some physical elements can explain that the living environment is a determinant of health and mortality: accidents, infectious diseases, or chronic illnesses depend on the environment's layout, insulation and temperatures, or its location (Bonnefoy, 2007; M. Shaw, 2004a). But there is also a psychosocial component of the relation between the quality of the residential course – in terms of comfort and residential changes – and health. We know that reasonable satisfaction with the living environment determines well-being and mental health (Evans et al., 2003; J. H. Lee, 2022) and that residing environment transitions can play a role in people's well-being, interpersonal relations and integration into their community (Oishi & Talhelm, 2012). The relationship between the residential context and mortality due to suicide – the most extreme well-being and mental health indicator – has not been studied yet.

Every day, about 2,000 persons die due to suicide worldwide. Six of them die in Belgium. Suicide is one of the ten leading causes of death in Belgium. Like other causes of death, it follows some social rules and recurrences already noticed and studied. Previous studies could show the advantage of being married (Kõlves et al., 2010; Kyung-Sook et al., 2018; Lorant, Kunst, Huisman, Bopp, & Mackenbach, 2005), a woman (Callanan & Davis, 2012; Shiner et al., 2009), or a migrant (Bauwelinck et al., 2017; Brennecke et al., 2020) in reducing the risk of dying by suicide. As for all-cause mortality, there are socioeconomic inequalities in mortality due to suicide. Highly educated

individuals generally present a lower risk of suicide than individuals with a lower level of education (Lorant, Kunst, Huisman, Bopp, & Mackenbach, 2005; Lorant, Kunst, Huisman, Costa, et al., 2005; Øien-Ødegaard et al., 2021; Pompili et al., 2013), and both employment and good working conditions are associated with lower suicide mortality (Amiri, 2022; Cunningham et al., 2022; Howard et al., 2022). As for all-cause mortality, socioeconomic inequalities in suicide mortality increase over time, especially for women (Lorant et al., 2018). But compared to causes of death that generally result from one disease process or traumatic injury, the determinants of suicide are broader and more diverse. Among the numerous factors, the living environment has rarely been studied in its association with suicide. It can be easily understood that poor environmental and residential conditions can affect one's well-being and mental health and participate in increasing suicide risk. Reversely, a predisposition to poor mental health – the most major determinant of suicide - can also be the cause of less life stability in terms of educational, professional, personal, and housing careers and lower socioeconomic status (Avison et al., 2008; Slominski et al., 2011). This thesis investigates how multiple dimensions of the residential context are associated with suicide mortality. It mobilises theories and concepts from demography, sociology, and psychology to explain those relations. Using longitudinal datasets from Belgian administrative sources, this thesis will examine how housing conditions, the immediate environment, and the residential course can impact one's suicide risk and how these associations evolve over the life course and differ across genders and partnership situations.

This thesis is divided into nine chapters, including four empirical chapters that can be considered four independent research articles. The first part of the thesis presents the general context of the research through the literature, a portrait of Belgium and a presentation of the data and methods. The first chapter introduces the known determinants of suicide, the theoretical framework, and the empirical works surrounding suicide mortality. The second chapter offers the specific context of suicide in Belgium, compared with European countries, and attempts to explain the specificity of this country. The third chapter presents the data and details the methodological approaches. The

fourth chapter introduces the research questions of this thesis. The second part of the thesis includes four empirical chapters. The fifth chapter, the first empirical chapter, questions the relationship between homeownership and suicide risk. Are tenants more at risk of ending their own life due to suicide than owners? The social norms surrounding homeownership and its variation across the life course, household composition, and gender will be mobilised to understand the relation. The sixth chapter investigates the relationship between housing conditions, neighbourhood conditions, and suicide mortality. Again, a specific focus is given to the life-course approach and how the quality of the place of residence can affect suicide mortality differently according to the life stage and gender. The seventh chapter studies how residential mobility can be related to suicide risk. The attention is drawn to the partnership transitions that can be responsible for the moves and how mobility can affect individuals differently according to their life course, their gender, and their concomitant life events. The eighth chapter provides a complementary vision of residential mobility in the context of union dissolution, using an alternative outcome: the consumption of antidepressants. This chapter helps us better understand the importance of suicide as a mental health indicator. Finally, the last part of the thesis and ninth chapter exposes concluding remarks, presents our contribution to the literature and main limitations, and gives recommendations.

CHAPTER 1
GENERAL STATE OF THE ART

I.WHAT IS SUICIDE

1. History of suicide: centuries of stigma

Before the word "suicide" emerged, the first debates about self-inflicted death occurred in Antiquity. At that time, suicide was close to the Stoic doctrine, which claimed that a "good life" was better than life (Minois, 1995). Aristotle was one of the first to criticise what he considered a form of selfishness, at least about the interests of the City (Garrison, 1991). The development of Christianity led to a virulent condemnation of suicide. The injunction not to kill included the Christians' own lives. From the beginning of the Middle Ages, suicide was associated with a crime, a "self-murder," and should call for punishment. The bodies of the suicide were tortured and buried without ceremony, and their property was confiscated, leaving the families with few means to support themselves (Minois, 1995). In 17th-century England, this requisitioning of the families' properties led to the first registration of suicides (Bartel, 1960). Already at this time, suicide fascinated the first population scientists: after the creation of the London Bills of Mortality, John Graunt quickly targeted deaths related to "insanity" and "lunacy", notably to observe how the suicide reports were biased (Boulton & Black, 2012). At this time, social inequalities in condemning suicides appeared (Pinguet, 1984). On the one hand, suicides were associated with different motives depending on who died due to them. Honour, or even piety, was often put in the foreground when a knight died by suicide after a humiliation or when a pious woman took her own life after a rape. References to martyrs, ancient heroes, and heroines, such as Ajax or Lucretia, were then made. Peasants, conversely, were accused of cowardice, ungodliness, and selfishness when poverty led them to suicide (Minois, 1995; Pinguet, 1984). Two centuries ago, suicide was still considered a crime in all European countries. Although modern days approach suicide - and mental health in general - differently, there is still a taboo surrounding this cause of death. Suicide represents the failure of a social system to help individuals bear their existence, and it still can be linked to a feeling of shame or ostracisation of the persons who died and their family and friends (Cvinar, 2005;

Sheehan et al., 2018). This can translate into a possible bias in the declarations of suicide mortality and disparities in data quality according to the cultural and religious context (Schomerus et al., 2015).

2. Defining suicide with intention

There is no clear consensus about the definition of suicide. It is first possible to distinguish direct and indirect suicides (Wreen, 1988). Direct suicides result from a self-induced action, or absence of action, leading to death, with the clear intention to die. Indirect suicides can be considered as all life-threatening behaviours or attitudes that put the survival of the individual into question in the longer term but without a clear intention to die. Shneidman classifies direct suicides into six main categories (Shneidman, 1977): rational (to escape a source of pain and suffering); reactional (in the case of an adverse life event, a loss); vengeful (to punish someone); manipulative (to create guilt, or a negative feeling in someone else, or to contradict someone's plans); psychotic (in the frame of a psychiatric disease or delusional episode), and accidental (when the suicide is reconsidered too late). This distinction puts forward the central issue in the definition of suicide for decades: the intention to die (Kubie, 1967). In this thesis, suicide will be defined as an act of self-harm with the intent to die directly after this action (Rosenberg et al., 1988). This notion makes all the difference between accidental and suicidal mortality. In most cases, it is relatively easy to determine whether someone caused their death. Yet, it is more difficult to know whether that death was entirely intentional and whether the individual was fully conscient of the consequences of their action. Suicidal people can have several intentions when they self-harm. Those intentions can vary through the suicidal process and remain unclear for the individuals themselves. The intention was even said to be too vague to be included in a definition of suicide (Andriessen, 2006). Still, it is what defines suicide.

II. WHAT DETERMINES SUICIDE

Before presenting the epidemiology of suicide in Chapter 2, a review of the existing literature and knowledge on suicide determinants helps understand its mechanisms. Suicide is motivated by deep and intimate reasons, is the result of a seemingly insoluble form of malaise, and is partly impulsive and unexpected; still, it is a social fact. Like all other causes of death, suicide obeys precise socio-economic and demographic rules. Researchers in sociology, psychiatry, biology, and other fields focused on this unique cause of death and its determinants. This section presents the theoretical and empirical work surrounding suicide and its psychiatric, demographic and socioeconomic factors. Finally, it focuses on what is known about the environmental determinants of suicide and presents a definition of the residential context and course.

1. Psychiatric theoretical framework

Several psychiatric models attempted to theorise suicide. One of the models underlying contemporary suicidology is the *stress-diathesis model* (Mann et al., 1999). According to this theory, the suicidal process is rooted in two elements. First, the person holds a particular vulnerability, which lies in their genes or their upbringing - a depressed or suicidal parent, childhood trauma - and which predisposes them to a more pessimistic, depressive, or impulsive temperament. This may be akin to a melancholy character or a tendency to be more easily affected by life's adverse events, with no possibility of rebound or resilience. It is then that a second element, a catalyst or stress factor, intervenes and pushes the individual into already fragile entrenchments, leading to higher suicide risks. This theory explains how the life course and adverse events can impact individuals' suicidal behaviours differently according to personal predispositions.

The second model is the *interpersonal model* of suicide. According to this framework, the social bond and the relation to the environment are at the heart of the suicidal process (Joiner, 2005). When an individual feels like a burden to others or does not feel like a part of their community, they can develop suicidal ideations or behaviours. This follows Williams' "*Cry of Pain*" theory: suicide would

respond to feeling trapped in a situation with no escape or future improvement (J. M. G. Williams & Williams, 1997a). In continuity, the *Learned Helplessness theory* explains that low control over one's environment and a high level of discomfort are associated with higher risks of suicide (Seligman, 1972). These theories explain that people highly dissatisfied with their living conditions can develop feelings of sadness, disappointment, and a sense of ostracisation from their community, leading to higher suicide risks.

A third model to put forward is the *motivational-volition model*. Without contradicting the other two, this theory explains the transition from a depressive state to suicide. In addition to a (motivational) framework justifying suicide and involving the two previous approaches, O'Connor (2011) adds a volitional phase. The act of suicide results from a process that starts with a poor mental health state that deteriorates thoughts and actions, which are followed by suicidal thoughts, ranging from the simple desire to live no longer to elaborating a detailed plan for a suicide attempt or a completed suicide if the attempt leads to death. The volition phase is the impulsive move that transforms negative feelings into concrete, irreversible actions. Feeling trapped, in the sense of defeat or despair, motivates the person to put thoughts into acts (O'Connor, 2011). Two additional elements, namely a reduction in fear of death and an increased tolerance of pain, for example in the context of chronic painful diseases, would increase the risk of suicide (Joiner, 2005). Easy access to a means of self-injury (firearm, height, opportunities…) is also a significant determinant in transforming suicidal thoughts into behaviours (Nordentoft, 2007; Staikowsky et al., 2008). Psychiatrists use the "*Risk-Emergency-Danger*" scale to measure patients' probability of attempting suicide. The risk is estimated by the psychological, social, and demographic characteristics of the person; the emergency represents the step of the suicidal process if the person is thinking about suicide or is more concretely planning to commit suicide; the dangerousness is related to the possibilities and opportunities one has to put their life at risk (Staikowsky et al., 2008).

2. Psychiatric predispositions and cognitive factors: empirical arguments

Empirical psychiatric literature shows that some behaviours, personality traits, and psychiatric predispositions are associated with higher suicide risks. The first determinant of suicide mortality is a previous suicide attempt (Nordentoft, 2007; R. C. O'Connor & Nock, 2014; Staikowsky et al., 2008), followed by mental health pathologies (Nordentoft, 2007; R. C. O'Connor & Nock, 2014). Populations suffering from mental illnesses risk are involved in more suicidal behaviours during their lifetime (Borges et al., 2010), especially when they suffer from depression (Hawton et al., 2013). According to a Finnish study based on a follow-up of depressed adults over five years (Holma et al., 2010), a phase of depression is associated with a 21 times higher risk of dying by suicide than during non-symptomatic periods. Among the population suffering from bipolar personality disorder, also called manic-depressive disorder, the suicide rate is 20 times higher than in the general population (Miller & Black, 2020). This can be explained in particular by the characteristics of this disease, namely the alternation between periods of hyperactivity associated with risky behaviour (alcohol, drugs, speed) and periods of great despair close to depression. As for people with schizophrenia, the suicide risk is about ten times higher than the general population in the UK (Osborn et al., 2008). Indeed, this disease leads to a loss of psychic unity, sometimes delusional and vague thoughts. In particular, frequent depressive episodes are observed in newly diagnosed young people (Osborn et al., 2008; Palmer et al., 2005). Fear of the disease and the social isolation it causes can lead to comorbid depression and suicidal behaviour (Palmer et al., 2005).

Physical disorders and chronic pain are associated with higher suicide risk (Hooley et al., 2014; Racine, 2018). Consuming painkillers (especially opiates) allows a temporary reduction in pain that reduces the fear of suffering during the suicide attempt, thus promoting the implementation of a suicidal scenario (Racine, 2018). Physical health conditions, such as brain injuries, are associated with increased suicide risk, independently from sex and gender (Ahmedani et al., 2017). Suicidal behaviours and mortality are also particularly present among cancer patients (Robson et al., 2010).

Habits and substance consumption can also play a role in the suicidal act and increase the dangerousness of the situation. A large amount of literature could confirm that completed suicide was often associated with alcohol use, both in terms of long-time alcohol disorders and in alcohol consumption short-time before the suicide (Cherpitel et al., 2004; M. S. Kaplan et al., 2014). The use of drugs, opioids, and heavy drinking was shown to be associated with increased risks of suicide than non-consumption. These substances can change people's behaviours, leading to irrational or disinhibited behaviours. Occasionally, consumption can be a symptom of poor mental health, a psychological vulnerability, or a coping mechanism for facing adverse life events or previous trauma related to higher suicide rates (Wilcox et al., 2004).

Some personality traits also matter in the risk of suicide. The decision-making process is strongly emphasised in psycho-medical research on suicide (Olié et al., 2015). A particular form of rigidity, difficulty adapting, or lack of capacity to maintain goal-oriented behaviours in an uncertain context is a factor of fragility facing suicide. Suicidal individuals are said to have a more frequent aversion to negative feelings and a need to cut them off as quickly as possible, with little regard for the long-term consequences. An experiment was conducted with suicidal and non-suicidal subjects in a win-loss game called the Iowa Gambling Task, in which four packs of cards - A, B, C, and D - were offered. A and B were disadvantageous in the long run, associated with high wins but even higher losses. On the contrary, C and D were advantageous in the long run but related to short-term losses. Individuals who had previously attempted suicide were likelier to choose packages A and B, offering the most significant immediate gains and long-term losses. In contrast, the control group, composed of depressed but non-suicidal individuals, realised after a few rounds that packages C and D were preferable over time (Olié et al., 2015; Richard-Devantoy et al., 2014). Those personality traits depend on biomarkers and cognitive capacities related to the executive functions of the individual. At the physiological level, this difference in decision-making may result from a dysfunction of the prefrontal cortex, the front part of the brain (Olié et al., 2015).

3. Social factors of suicide

a. Integration and regulation

At the end of the 19th century, Emile Durkheim illustrated the concept of "social fact" with the example of suicide. Although suicide is the most individual act possible, the most irreversible decision a person can make for themselves, it is still **the front part of the brain**. The sociologist observed that the elderly commit suicide more than the young, men more than women, the poor more than the rich, and the single more than the married. Based on the suicide study, Emile Durkheim exposed two concepts to identify the social laws explaining suicidal behaviour (Durkheim, 1897). First, social *integration* defines the social bond that holds an individual to their community. According to Durkheim, social links are changing in modern times, from a strong community and collective bond to more individualisation, where social relations are tightening around the nuclear family. Suicide can be altruistic when the integration is too high: the individual uses suicide as a sacrifice towards their peers. An example of this type of suicide can be found in political suicide or public immolations that carry a political or social message. Suicide can be called egotistic when the integration is too low and the individual is isolated. In this case, society does not offer coping mechanisms for the individual, and resources for facing negative feelings or life events are lacking (Durkheim, 1897; Heikkinen et al., 1993a). Then, as a second concept, *regulation* represents the set of social norms and values to which the individual can refer and hold on. They frame the individual and limit their aspirations and needs. This regulation can be ensured by laws, institutions, religion, family, or education. A fatalist suicide is said to happen when the person has too little room for manoeuvre. The overflow of norms or the situation does not give enough perspective, and the individual feels trapped. Conversely, anomic suicide follows a breakdown or loosening of existing social norms or frustration related to changing conditions. The possibilities are now more numerous and blurred, which does not provide a framework for aspirations and desires (Durkheim, 1897; Puffer, 2009).

Based on this theoretical framework, we can better understand that the demographic and socioeconomic characteristics of the individual can lead them to higher or lower suicide risk. In addition to the psychological determinants of suicide, age, sex, marital and parental status of the individual, as well as their educational and professional attainment, will play on their level of integration within society, their norms and values, and their exposure to them. The following section presents the sociodemographic and socioeconomic determinants of suicide.

b. Demographic factors

Age

All age categories, from the early teenage to the later-life stages, are concerned with suicide. The extreme ages are getting more interest in the literature (Shiner et al., 2009). On the one hand, teenagers and young adults are most at risk of encountering for the first time symptoms of specific mental health disorders, such as schizophrenia, bipolar disorders, or eating disorders, which are highly related to suicide risks among the young (Bilsen, 2018; Reiss, 2013). The young are also generally more impulsive and aggressive than older populations, which is a trait highly related to violence, including self-oriented violence (McGirr et al., 2008). On the other hand, older people are particularly at risk of suicide for specific factors, such as social exclusion, neurocognitive pathologies and impairment, as well as the loss of mobility, and physical pain and illnesses (Conejero, Olié, Courtet, et al., 2018; Conwell et al., 2010). Middle-aged adults, from their mid-20ies to their late 60ies, present the highest numbers of suicide, and suicide is one of the leading causes of death at this age. Regarding suicide rates, older men (75+) present higher suicide rates than middle-aged men due to high suicide numbers in a smaller population. Shiner et al. (2009) regretted that the mid-life adults' suicide determinants were less studied, while this is the life stage where the investment in work and family is the most intense and where the risk factors are the most numerous, diverse, and related to the life-course (Shiner et al., 2009). Since then, suicide risk

in mid-life has been more studied, especially in partnership trajectories, but remains less studied than other age groups.

Sex and gender

Men are way likelier to die due to suicide than women. This difference cannot be explained by a tendency for women to be less affected by adverse life events or depressive states. On the contrary, women present a higher risk of severe depression than men (Brault et al., 2012; Murphy, 1998). Literature from the 1990s explains this gender gap in suicide by the personality traits and the social performance expected from the two genders: men will more likely hide their feelings and under-declare depressive symptoms but tend to be more independent and decisive than women (Murphy, 1998). Women, on the other side, would be better at finding coping mechanisms – such as communicating about their struggles - before considering ending their own life (Murphy, 1998). This idea, however, ignores that women are also more likely to attempt suicide than men at least once during their lifetime (Gisle & Van Oyen, 2013; Roelands et al., 2018; Skogman et al., 2004). However, compared to women, men tend to have a higher chance of making several suicide attempts during their lifetime and choosing a more violent method (Skogman et al., 2004). Men are more susceptible to using firearms[1] or dying by hanging; women are likelier to poison themselves (Callanan & Davis, 2012). This difference could be explained by a higher chance for men to have a firearm in their household or to the representation of violence – traditionally associated with masculinity – as well as more increased access for women to lethal medication, as they tend to consult healthcare more often (Callanan & Davis, 2012).

Household composition, marital status, and parenthood

Among the suicide determinants, family composition and marital status are often studied. Family ties and links within the household are part of the most substantial social relations that can exist, even though family ties outside the home are also gaining more and more interest (Purcell et al.,

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[1] Firearms is the second method used by men to die by suicide in Belgium, and the third for women after hanging and poisoning for women (Centre de prévention du suicide, 2022).

2012). This can be easily understood through the lens of the Durkheimian theories: family and household composition are a source of social integration to the community and represents a community to belong to; it also offers a reference in terms of norms and values and morally regulates the person (Durkheim, 1897; Frey & Cerel, 2015). The household composition was shown to be highly associated with suicide mortality (Denney, 2010; Kyung-Sook et al., 2018; Lorant, Kunst, Huisman, Bopp, & Mackenbach, 2005) and suicidal behaviours (Gisle & Van Oyen, 2013). Findings highlight the higher suicide risk of individuals living in single-person households (Olfson et al., 2022; R. J. Shaw et al., 2021). Even though isolation can be an explanatory factor, a longitudinal study conducted in the UK could not prove that subjective loneliness explained or mediated this association (R. J. Shaw et al., 2021). For men, a real gap in suicide mortality is observed between the partnered and the unpartnered individuals. Being in a marital or non-marital relationship is associated with a lower suicide risk for men only (Kyung-Sook et al., 2018; Petrović et al., 2009; R. J. Shaw et al., 2021), which can be explained by the positive impact a partner can have on men's wellbeing, coping mechanisms and frequency of contact with healthcare professionals (R. J. Shaw et al., 2021). Living with an individual who is not a partner is not associated with decreased suicide risk for men, showing the positive effect of a romantic partner and intimate proximity (R. J. Shaw et al., 2021). For women, the relationship between partnership and suicide risk is unclear. Some studies show that partnered women have a slight advantage compared to unpartnered women (Denney, 2010; Kyung-Sook et al., 2018; Lorant, Kunst, Huisman, Bopp, & Mackenbach, 2005; Masocco et al., 2008), while others show no association (R. J. Shaw et al., 2021), or even that single women have a lower suicide risk than married women (Petrović et al., 2009). When it comes to parental status, the gender differences are reversed. If having a child is associated with lower suicide risk, this advantage is more visible for women than men (Dehara et al., 2021; Qin & Mortensen, 2003).

Household composition and family can go through changes and transitions. Among them, partnership dissolutions are particularly associated with suicide risk. Many studies showed that

divorcees had a higher risk of suicide than never-married individuals (Kyung-Sook et al., 2018; Lorant, Kunst, Huisman, Bopp et al., 2005; Øien-Ødegaard et al., 2021). This higher risk of suicide for divorced individuals is particularly evident if the divorce is recent (Stack & Scourfield, 2015) and for men (Ide et al., 2010; Kõlves et al., 2010; Petrović et al., 2009). Some studies demonstrated the possible selection effect in the relationship between separation and suicide mortality: mental health issues increase the risk of separation, especially when the two partners have predispositions to poor mental health (Butterworth & Rodgers, 2008). Precedent mental health struggles are an essential factor in the higher risk of suicide of divorced individuals (Kõlves et al., 2010). Even though there are few studies about the causality in the relationship between separation and suicide (Ide et al., 2010), older studies could already show that separation was associated with a higher risk of first depressive episodes (Bruce & Kim, 1992a). A longitudinal follow-up of a group of individuals from New Haven showed that people who had never experienced depressive episodes developed severe depression, suicidal ideation, or even suicidal behaviour following their divorce. Because it shatters a life trajectory and social links, divorce disrupts a person's mental and social balance (Bruce & Kim, 1992a).

Nationality and cultural factors

Studies in European countries demonstrated that the suicide rates were lower for immigrants than for natives but remained dependent on the country of origin and on the individual's socioeconomic situation (in Belgium: Bauwelinck et al., 2017; in Germany: Brennecke et al., 2020). A Swedish study suggested that the gap decrease with the stay duration in the country: after 21 to 31 years of stay in Sweden, the immigrants presented a suicide risk very close to the Swedish population (Hollander et al., 2020). A first explanation of the relatively lower risk of suicide for migrant populations is a selection effect. People who migrate from another country generally have physical and mental health advantages. They are younger than the native population and healthy enough to move to another country. This can be confirmed by a lower all-cause mortality rate for foreigners than Belgian natives (Deboosere, Gadeyne, 2005). In the case of suicide, a cultural aspect can be

added. Religious affiliation is not associated with lower suicide risks than atheism in modern, secular societies (O'reilly & Rosato, 2015). In other parts of the world, such as Eastern Europe and Latin America, a comparative study showed that higher religiosity was related to lower suicide risks (Hsieh, 2017): suicide is considered a sin in most monotheist religions. Other paths were explored, such as different habits in terms of alcohol and drug consumption, which are very condemned in some cultures or religious backgrounds. Culture also defines the priorities, values, and standards of people. Performance, success, and financial ease are more or less prominent in people's well-being. When one's equilibrium is endangered, the reactions will differ, and so will the probability of self-harm (Lester, 2013). For example, a divorce might impact suicide more significantly in Europe than in Japan (Stack, 1992).

c. Socioeconomic factors

Professional activity

The relation between occupation and suicide risk is plural. First, unemployment is associated with a higher risk of suicide than being employed for both men and women (Amiri, 2022; Cunningham et al., 2022). Having a job is associated with many advantages. On the one hand, remuneration helps improve living conditions and entitlements to paid leaves and other health-related benefits. To my knowledge, few studies focused on the relation between the income level of the individuals and their risk of suicide, but some suggested that suicide mortality tended to increase for people with lower income (Agerbo et al., 2001; S.-U. Lee et al., 2017), but other could not show any association between income and mental health (Araya et al., 2003). On the other hand, a job offers a sense of belonging to society and a purpose that also structures the days and weeks of the individual (Cunningham et al., 2022).

Working conditions are other possible determinants of suicide risk. Bad working conditions and too many hours can be related to suicide mortality. A Korean study showed that working more than 45 hours a week was associated with higher suicide mortality than working less than 45 hours

a week (H.-E. Lee et al., 2020). Such a relationship cannot be observed with accidental mortality. Poor working conditions, like unstable employment, low task safety, or feeling ostracised, are associated with higher suicide risks (Howard et al., 2022). Similarly, the experience of being harassed or bullied at the workplace is associated with a higher suicide risk (Leach et al., 2020). Losing meaning, autonomy, or acknowledgement at work harms happiness and mental health (Howard et al., 2022). Some specific jobs are particularly associated with suicide because they give the individual the lethal means or the opportunities to end their lives or are very stressful. We can cite police officers, veterinarians and medical doctors or nurses, veterans, farmers, or blue-collar workers who have direct access to firearms, drugs or other means to attempt their lives (Van Orden et al., 2010). Other demanding job activities, such as being a firefighter, part of the medical staff, or being a military member, are particularly associated with post-traumatic stress disorders closely linked to higher suicide risks (Howard et al., 2022).

Educational attainment

The link between education level and suicide risk is not evident. In 2006-2008, a study conducted in Barcelona showed that men with a low level of education are more prone to suicide risk than men with higher education. This tendency is less visible among women, and the authors insist that this relationship has attenuated over time (López-Contreras et al., 2019). This could be explained by a selection effect: poor mental health would cause a higher risk of dropping out of school, lower educational attainment, and a higher risk of suicide. Low education plays a role in the other dimensions of life, such as employment, income, and life stability. Some authors justify the gender differences by the strong attachment of men to their professional achievements, while women could compensate for low educational attainment with their family role (Artazcoz et al., 2004a; López-Contreras et al., 2019). Nonetheless, for women, another study highlighted that, in Belgium, a higher educational achievement is associated with higher suicide risk (Lorant et al., 2021a). This could be explained by the difficulty for highly educated women to pursue a career while replying to other social and family-related injunctions, such as managing their household or caring for their

family. Other authors could show higher risks of suicide for the highly educated populations (Pompili et al., 2013): people with higher education would also have higher expectations in terms of living conditions, life quality, and comfort, making them more susceptible to experience feelings of failures or disappointment, which are determinants of suicide (Fergusson et al., 2003; Pompili et al., 2013).

4. The living environment as a suicide determinant?

In the broader definition, environmental factors can gather many aspects of the residential context, from housing conditions to climate change. In this thesis, the environmental question is limited to the close environment: the place of residence and the immediate surroundings. Some previous studies focused on the relationship between climate change, natural disasters and suicide mortality without drawing univocal conclusions about the direction or strength of this association (Dumont et al., 2020; Kõlves et al., 2013; M. N. Williams et al., 2015). Contrary to other determinants of suicide, the living environment, in terms of housing conditions, immediate environment, and residential changes, has been very little studied. However, it relates to the previously cited factors: the living environment will depend on the individual's demographics, household composition and family life, socioeconomic achievements, and financial possibilities. This section presents the existing literature linking suicide mortality and the living environment. The following chapters develop arguments regarding the relationship between the living environment and mental health outcomes.

So far, the relationship between housing conditions and suicide has been mainly studied through the lens of housing affordability or housing tenure. Home eviction is a decisive factor for suicide, as shown in a study conducted in the US on almost 1,000 eviction- or foreclosure-related suicides between 2005 and 2010 (Fowler et al., 2015). Homeownership and housing stability are also closely related to suicide, with a higher risk of suicide for tenants than owners. In Belgium and other European countries, Lorant et al. (2005) showed that tenants had a higher risk of suicide for both

men and women and that housing tenure was a more significant risk factor than education facing suicide hazard and more consistent for both sexes (Lorant, Kunst, Huisman, Costa, et al., 2005). Based on Register data, but without accounting for the duration of residence, a longitudinal study in the UK and Wales highlighted that tenants had a higher risk of suicide than owners-occupiers (G. Lewis & Sloggett, 1998). This advantage for owners is justify by their more significant ontological security (Hiscock et al., 2001), defined as individuals' confidence in their own identity, environment, integrity, and the constancy of their material possessions. Some interviews conducted in the UK showed that homeownership has a substantial benefit on people's health and state of mind, as it gives more strength in people's relation to their place of residence, more control, and more stability in their housing career and their life course (Hiscock et al., 2001). On the contrary, not achieving this milestone is associated with a feeling of failure or an uncompleted housing trajectory. Homeownership is strongly related to mental health and well-being: this argument is developed in Chapter 5 of this thesis.

Literature has rarely focused on the relationship between housing characteristics and suicide, but it has already studied other mental health outcomes, such as depression, life satisfaction, or even suicide ideations. A recent study conducted in South Korea put forward the vital link between housing conditions and suicide ideations for men and women. Lee (2022) showed higher risks of suicide ideations for men living in housing with structural problems (related to the materials of the housing, its resistance to temperatures and moisture) and for women living in housing with functional issues (linked to the equipment, the noise and lighting, and the heating of the housing) (J. H. Lee, 2022). To our knowledge, this Korean study was the first to make such a link between suicidal thoughts and housing conditions using this type of characteristics of the place of residence. The relationship between housing quality and well-being was theorised by Evans, Wells, and Moch (2003). For them, various mediators link housing quality and a person's mental health. First, they discuss the sense of belonging and identity that household members may feel toward their place of residence. Second, they put forward a sense of control over the environment, as previously

highlighted in the section about housing tenure. Third, they shed light on the social role of the neighbourhood, which allows interactions and relations. Finally, the feeling of control and adaptability of one's space is highlighted as a factor of well-being and fulfilment of people in their immediate environment (G. W. Evans et al., 2003). An in-depth investigation of the relationship between housing characteristics and mental health is presented in Chapter 6.

Few dimensions of the neighbourhood of residence were directly studied regarding suicide. Helbich et al. (2019) presented the higher suicide risk of older adults in Dutch municipalities where green spaces were lacking (Helbich et al., 2019). Then, the association between air quality and suicide risk was also investigated by previous analyses that showed that the exposition to air pollution was associated with higher risks of suicide (Davoudi et al., 2021; Heo et al., 2021), especially in low-income regions (Heo et al., 2021). A longitudinal study conducted in Hong Kong over 13 years put forward the strong relationship between the built environment and suicide mortality: authors could demonstrate that being far from an urban centre or living in a very densely occupied district was associated with higher suicide risk (Jiang et al., 2021). The neighbourhood of residence is a crucial part of the link between the living environment and physical, mental, and social well-being. The community does not provide its inhabitants equal amenities, opportunities, and services. The difference in quality between neighbourhoods can affect an individual's physical and mental health and well-being. Three elements come into play in this "neighbourhood effect" (Herjean, 2006). First, poor quality or lacking services make it harder for people to communicate with the institutions, to get benefits and information about their situation and possible opportunities (Leslie & Cerin, 2008; Visser et al., 2021). Second, the physical environment can be stressful and detrimental to mental health and well-being: air pollution, noise from industries or activities, smell, crime, and poor esthetics can go from being unappealing to being harmful to the inhabitants' health and survival (Baranyi et al., 2021; Blackman et al., 2001). Finally, the cohesion of the neighbourhood as a social group is an important variable that can be a possible source of social well-being and help reduce social inequalities. While privileged communities tend to

disconnect their social network from the area where they live, the most disadvantaged prefer to anchor their social network close to where they live (Belle, 1983; Dominguez & Arford, 2010; Pinkster, 2007). Chapter 6 provides a deeper explanation of the neighbourhood-related determinants of mental health and well-being.

The relationship between residential mobility and suicide was indirectly investigated. Some recent literature investigated the possible consequences of early-life mobility on future suicidal behaviours. A Danish register-based study could show that multiple relocations during childhood and teenage were associated with higher risks of attempted suicides up to age 40 (Webb et al., 2016). Another study could show that childhood residential moves could increase the risk of psychiatric disorders, including drug misuse and antisocial personality disorders (Mok et al., 2016). It is to be noted that parental housing characteristics are determinants for children's well-being (Breysse et al., 2004), well-being later in life (Clair, 2019; Leventhal & Newman, 2010) and future housing characteristics (Galster & Wessel, 2019). To our knowledge, no study observed the relationship between residential mobility during adult ages and suicide risk at the same life stage. However, internal migration is also a social and mental challenge at the individual level. A longitudinal study in the US highlighted a negative relationship between residential mobility and mental health, especially for introverted individuals who moved several times during childhood and early adulthood (Oishi & Schimmack, 2010). A selection effect could explain the relation: another study showed that individuals with severe mental illnesses had twice the risk of moving than those without mental health struggles (Lix et al., 2006). Choi & Oishi (2020) regret the limited number of studies that allow us to understand the psychological implications of residential moves and the lack of data helping us understand the role of the context of the move and concomitant life events in relation (Choi & Oishi, 2020). A detailed review of the relationship between mobility and mental health, especially in the context of partnership transitions, is presented in Chapter 7.

III. WHAT DETERMINES THE RESIDENCE AND ITS CHANGES

Before presenting the research questions that will guide this thesis, it is helpful to have a better vision of the determinants of the living environment quality and residential mobility, to understand the possible confounders in the relationship between the residential context and suicide mortality.

1. Life course and residential context

The quality of the place of residence varies over the life course and according to life events. There are two main approaches explaining the relationship between housing and life stage. First, the housing ladder considers that populations always aspire for better housing conditions, and they follow this linear path along they acquire financial means (Morrow-Jones & Wenning, 2005). Second, the housing life-cycle defines the ideal housing conditions, depending on the household compositions and the life events (Morrow-Jones & Wenning, 2005; Rossi, 1955). Housing is supposed to be adapted for the different stages of life, the union formation, and the expansion of the family, but also to its shrinking and dissolution. In this case, increasing the housing conditions can mean living in a smaller place or decreasing the housing comfort if this matches the household's needs and capacities. Going further, the notion of a housing career defines housing change as a specific life change linked to evolutions in other life dimensions (W. A. Clark, 2013; W. W. A. Clark & Dieleman, 1996). The time spent in a dwelling can delimitate one's life stage, and a move can represent a transition from one life state to another.

Following the life course approach, expectations over housing conditions and mobility patterns differ over life stages and events (A. Bernard et al., 2014; W. A. Clark, 2013; Mulder & Wagner, 1993). Propension to migrate within a country generally increases during the 20ies and then decreases with age from age 30 (A. Bernard et al., 2014; Coulter & Van Ham, 2013). Young adults are the most mobile population, as they experience shorter and more numerous unions and

educational and economic constraints and opportunities (A. Bernard et al., 2014). This lifestyle can lead them to live between parental housing, student rooms, shared accommodation, and first flats or houses. Later, transitions to stable unions, a first child, or increasing the number of children are related to a higher chance to move, especially in single-family houses (Kulu & Steele, 2013), and to upgrade housing conditions and accede to homeownership (Feijten & Mulder, 2005; Rabe & Taylor, 2010). In addition, the last decades were the theatre of many societal changes. Ages at first marriage and first childbirth are rising in Western countries (Arnett et al., 2014; Gubernskaya, 2010; Lesthaeghe, 2014), but they still depend on personal characteristics, such as educational level and socioeconomic status (Dribe et al., 2014), which can delay individuals' first mobility out of the parental residence and access to homeownership. With people living longer also comes the question of healthy ageing. Mobility also concerns older adults, whose family trajectories are less linear than before, more marked by later separations and divorces (Raley & Sweeney, 2020), and projects to change their living environment when they retire (Atkins, 2018).

Union dissolutions often follow longer-term and more stable relationships for middle-aged and older adults, who are more traditionally expected to be settled down (Kohli & Künemund, 2005). A study conducted in the UK could show that after the 30ies, "immobility seems the be the norm for individuals" (Coulter & Van Ham, 2013), and this desire for stability then increases with age. Partnerships have significant implications on mid-life individuals – regarding social and emotional links, resources, finances, and everyday life maintenance – therefore, divorce or separation in middle or later age is costly (Amato, 2000). Nonetheless, compared to other age groups, middle-aged adults in their 40ies and early 50ies are the likeliest to go through divorces and separation, blended family reconstruction, financial problems and income variations, parental tasks, professional challenges, and caretaking of older family members (Koo et al., 2017). The life-course paradigm implies that a change in one dimension of someone's life is interrelated with changes in other life dimensions (W. A. Clark, 2013; W. W. A. Clark & Dieleman, 1996; Mulder & Wagner, 1993). Life course events, such as partnership transitions, parenthood, job losses or professional

changes, and residential mobility, often happen hand in hand. Union formations or dissolutions are especially closely related to housing trajectories. After most union dissolutions, at least one of the two ex-partners will quickly move out of the family home. Being separated or divorced is associated with an increased risk of residential mobility, compared to being married or never-partnered, for both men and women (Kulu et al., 2021a): this higher risk peaks at the moment of separation and decreases over time. In Belgium, the probability of a move remains higher for separated individuals for a longer time – more than a year – after the union dissolution than in most European countries (Kulu et al., 2021a). All those elements can lead individuals to mobility patterns they did not expect or want. They can change the sociological meaning behind mobility, making people unsatisfied with their housing careers and challenging them to find a new residential equilibrium (Coulter & Van Ham, 2013). Moreover, the real estate market in Belgium does not make these moves easy. In many European countries, higher divorce rates and splitting of families have led to higher housing demands. Still, the housing supply is not adapted to society's needs at the beginning of the 21st century, especially in the social renting market that targets low-income households (De Decker et al., 2017). In some countries, such as Belgium, the housing system is said to be "static": real estate availabilities and prices are particularly low and do not adapt much to society's needs and changes, and housing policies are not very effective (van der Heijden et al., 2011).

2. Gender and living environment

In addition to this life course approach, we must distinguish men and women. First, life courses and roles attributed to women and men in society and at home differ. Both sexes go through different experiences in the labour market, in their family life, and regarding their economic resources (Drobnič & Blossfeld, 2004; Weichselbaumer & Winter-Ebmer, 2005). Even though attitudes have been changing in the last decades, life courses are strongly dependent on society's historical and economic context. For a large part of the 20th century, men have been more expected

to be breadwinners and more invested in their careers than women, who are expected to be caretakers and involved in family life (Corna, 2013; Drobnič & Blossfeld, 2004; J. S. O'Connor et al., 1999). Moreover, attachment to material belongings, such as a house, furniture items, and installations in the housing are different for both genders. Men tend to prioritise material possessions more in defining a "comfortable life" than women (Dittmar, 1989; Hitlin & Piliavin, 2004; Noguti & Bokeyar, 2014).

3. *Socioeconomic characteristics and residential context*

The living conditions, including housing and environmental conditions, depend on socioeconomic status. Educational attainment, occupational status, and income level will provide different opportunities regarding housing and neighbourhood quality and access to homeownership. People with higher socioeconomic status will presumably live in better-quality housing in higher-quality and less deprived areas and have a higher chance of owning their habitat (Palacios et al., 2021). A German study suggested that populations with low income, low education, and unstable occupational status had a higher risk to declare living in a polluted, noisy, and unsatisfying environment (Kohlhuber et al., 2006). This is also the case for vulnerable populations, such as foreign individuals and asylum seekers (Kohlhuber et al., 2006; Walther et al., 2020). However, studies showed that the association between socioeconomic status and living environment quality is not systematic. Emelianoff (2010) highlighted that poor-quality housing was occupied by more than just deprived populations. The author estimates that 50% of the intermediate-quality housing was inhabited by poor households (Emelianoff, 2010). This idea was also supported in Belgium by Damiens (2020) & Van Aerden (2019), that showed that a more socially diverse population was now susceptible to living in low-quality housing or neighbourhoods (Damiens, 2020; Van Aerden et al., 2019).

Then, Emelianoff (2010) suggested that poor-quality housing not only reflected socioeconomic status but was also a catalyser of these inequalities (Emelianoff, 2010). Low-quality housing,

residential instability, and deprived neighbourhoods are associated with poorer health outcomes, which can translate into difficulties in higher education and finding or keeping a high-earning job (Palacios et al., 2021; Thomson et al., 2013). Housing instability and real estate market volatility also determine household deprivation (Dewilde, 2012). Tenants – who have less control over their environment and, on average poorer housing conditions – face worse housing conditions (Macintyre et al., 2003) and more significant budgetary constraints and spend a higher share of the monthly budget devoted to housing (Bugeja-Bloch, 2013). But the opposite is true: a household's socio-economic and financial level will determine its housing tenure. In Belgium, the risk of living under the poverty threshold of a homeowner with a loan or mortgage is 8%, compared to 40.3% for tenants paying rent at market prices (Lahaye et al., 2013). Homeownership is a segregating and unequal phenomenon strongly linked to social class and position in the labour market (Hiscock et al., 2001; Mulder & Lauster, 2010).

CHAPTER 2
EUROPEAN AND BELGIAN CONTEXTS

I. GLOBAL & EUROPEAN CONTEXTS OF SUICIDE

Worldwide, in 2019, the WHO estimated more than 700 000 suicides yearly, equivalent to one suicide every 40 seconds (World Health Organisation, 2021). Three-quarters of them happen in low- and middle-income countries. A precise analysis of suicide mortality worldwide is complex: the WHO evaluated that only 80 member states had vital registration with a good enough quality to investigate suicide mortality (World Health Organisation, 2021). However, it is possible to estimate that suicide is the fourth leading cause of death for young adults aged 15 to 29 (after road injury, tuberculosis and interpersonal violence). Self-harm and violence is the third cause of death (2nd for men, 6th for women) worldwide for the 15- to 49-year-old population and the 10th (9th for men, 12th for women) for the 50- to 69-year-old adults in the 2010s (Institute for Health Metrics and Evaluation (IHME), 2020). Suicide represents about 1% of deaths worldwide (Institute for Health Metrics and Evaluation (IHME), 2020; World Health Organisation, 2021). This preventable cause of death is more prevalent in Africa (11,2 suicides per 100,000 individuals) than in Europe (10.5 per 100,000) and Asia (10.2 per 100,000). Suicide rates are the lowest in the Eastern Mediterranean region (6.4 per 100,000) (World Health Organisation, 2021). More than two-thirds of worldwide suicides are completed by men (12.6 suicide per 100,000 men, compared with 5.4 suicide per 100,000 women). However, the gender gap is more visible in high-income countries than in low and middle-income countries, where the female suicide rate is 7.1 per 100,0000. Over time, suicide rates have decreased by 36% between the early 2000s and late 2010s, especially in Europe and Western Pacific. In parallel, suicide rates increased 17% in the Americas during the same period (World Health Organisation, 2021). At the global level, Belgium is ranked between the 13th and 18th countries (depending on the year) with the highest age-standardised suicide rate since the early 2000s until the late 2010s (Institute for Health Metrics and Evaluation (IHME), 2020).

In Europe, in 2015, we estimate that 56,000 individuals died due to suicide, representing 1.1% of the total deaths (Eurostat, 2018). There are more deaths due to suicide than murders and war kills. 80% of these suicides concern men, and 31% are aged 45 to 60 (Institute for Health Metrics and Evaluation (IHME), 2020). Suicide is the second cause of death of the population aged 15-49 in Western Europe and Belgium (right after tumours). For the 50 to 69-year-old population, suicide remains the 7th cause of death, the first external cause in Belgium and Western Europe (Institute for Health Metrics and Evaluation (IHME), 2020).

Figure 2.1 - Age-standardized suicide rates in European countries, in 2015, per 100,000 inhabitants
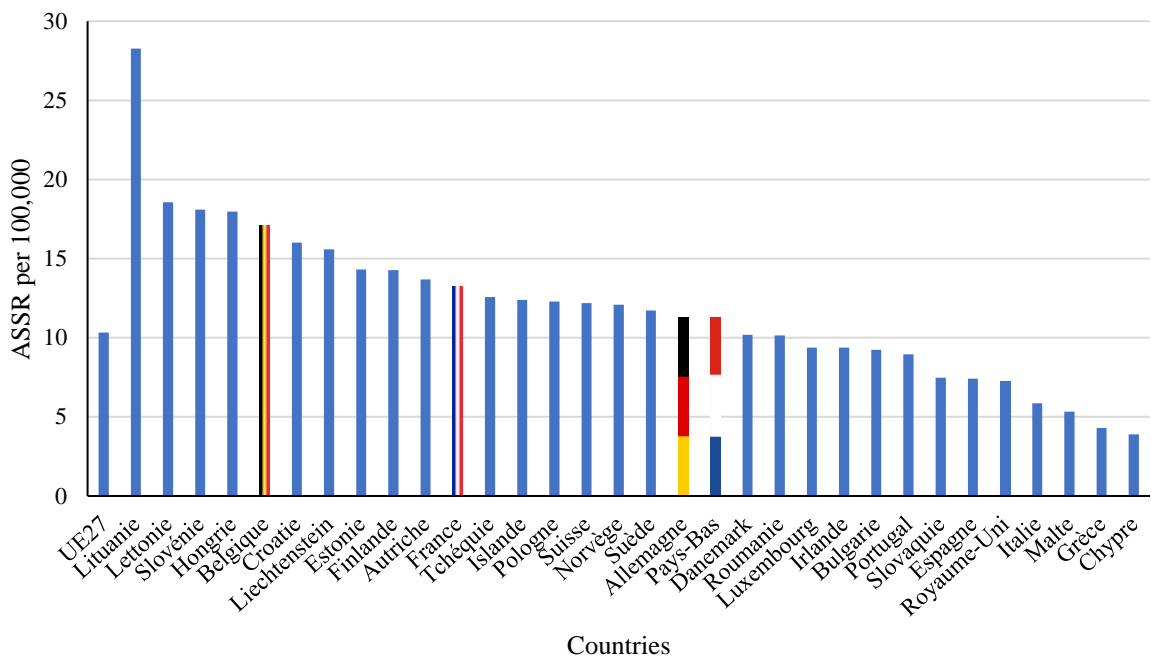
Source : (Eurostat, 2018).

II.   A BELGIAN EXCEPTION?

Regarding age-standardized suicide rates (Figure 2.1), Belgium is the 5th country with the highest suicide rate in Europe, after Lithuania[2], Latvia, Slovenia, and Hungary, and the 1st country in

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[2] Lithuania's very high suicide rate is very noticeable. Some explanatory hypotheses are the deplorable living conditions of the rural populations. In Lithuania, most suicides happen in small rural towns, where poverty is three times higher than in the rest of the country, and social isolation is very common. Except in big cities, Lithuania also faces a real

Western Europe. With 17 suicides per 100.000 inhabitants, it comes way before France (13 per 100,000), Germany and the Netherlands (11), and Luxembourg (9). It is also way higher than the EU-27 average, which counts more than ten suicides per 100,000.

It is possible to question why suicide is a frequent cause of death in Belgium. Surprisingly, very few studies tried to explain this Belgian phenomenon. Some comparative studies put forward that in Belgium, just like in many other countries in Europe and the world, suicide mortality has decreased since the early 1990s for both sexes and all ages, especially for the populations aged 65 and more (Alicandro et al., 2019). As a first explanation, it is possible to argue that some cultural factors lead to higher self-harm risks in Belgium. For instance, Belgium is part of the countries (with France, Austria, Germany, and Switzerland) where frustration at work is strongly associated with higher risks of suicide, especially for individuals with low or intermediate levels of education; authors assume that in Belgium, working conditions can be stressful and challenging, with little satisfaction and high degrees of frustration (Zhuo et al., 2020). Another example is the response given facing negative feelings and mental health struggles. A study on about 3,000 individuals aged 18-65 from Flanders (where the suicide rate is very high) and in the Netherlands (where suicide is much rarer) showed the different approaches facing mental health: the Dutch respondents found it easier to reach out for help in case of psychological issues, and were less shameful with regards to psychotherapeutic solutions, such as medication use or psychotherapy (Reynders et al., 2014). Nonetheless, Belgium was one of the first countries to legalise voluntary end-of-life for some irrecoverable physical pathologies. In 2002, a ground-breaking Belgian law gave a legal frame to euthanasia – when the medical practitioner ends the patient's life – and assisted suicide – when the end of life comes from the patients themselves. The ICM-10 classifies euthanasia as Y66 (Non-administration of surgical and medical care). In death certificates, assisted suicides are often coded as euthanasia but sometimes as suicides, not allowing to make a difference between assisted and

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estate crisis: the building industry suffered from the 2008 crisis. Consequently, renovation works stopped, and many manual workers lost their jobs and could not reimburse their mortgage loans (Thiery, 2017).

non-assisted suicide in analyses based on death certificates. Studies showed that in Belgium, the acceptance of euthanasia and assisted suicide increased dramatically from the 1980s to the late 2000s: the public has become more open about personal responsibility in end-of-life decisions (Cohen et al., 2006). This is also visible in the numbers of euthanasia and physician-assisted suicides: those rose by 267% between 2010 and 2019, with 2,357 reported assisted deaths in 2019 (Du Bus, 2020). It is to be noted that, in 2007, most of them were euthanasia and less than 4% of them were estimated to be assisted suicides (Chambaere et al., 2010).

Second, the state of the mental healthcare system in Belgium is worrying. While the number of psychiatrists increased in most EU-12 countries, going from 14 practitioners for 100,000 inhabitants in 2000 to almost 20 in 2016, the number of psychiatrists in Belgium has remained the same, with about 17 psychiatrists for 100,000 inhabitants over the 2000-2016 period (For a Healthy Belgium, 2022). A report by the Flemish government showed that the waiting time to get an appointment in a mental health centre was longer: in 2017, they estimated that 22% of the patients had to wait at least two months before getting a first appointment (Cloots & Roelandt, 2018), while it was the case for 16% of the patients in 2013. Despite a long waiting time before getting taken charge by mental health specialists and sometimes several months before getting treatment, Belgium's health system covers almost entirely the costs related to consultations with psychologists and psychiatrists and most treatments (Toshniwal, 2023).

Third, the difference in suicide rates between European countries lies in mortality data quality and suicide registrations. A comparative study in 25 European countries – which do not include Belgium – showed that a higher stigma towards persons with mental health issues and suicidal behaviours was associated with lower suicide risk (Schomerus et al., 2015), possibly due to an under-declaration of self-inflicted death in contexts where it is socially rejected. An investigation of the data quality about suicide was made in fifteen countries, comparing the number of suicides declared by railways companies and the national suicide statistics (Reynders et al., 2011). Belgium

and the Netherlands presented the strongest accordance between the two sources. Conversely, the statistics in the Czech Republic, Latvia, Poland, Italy, and France were somewhat unreliable, with an apparent under-declaration of the numbers of railway-related suicide in the national statistics (Reynders et al., 2011). The comparison between the suicide rates and the ratio between accidents and suicide (the excess mortality by accidents compared to suicides) can explain the significant differences between European countries in suicide rates.

Figure 2.2 – Age-standardized suicide rates (per 100,000 inhabitants) and the ratio of accidents and suicides for each European country in 2015 for men and women.

B/ Women
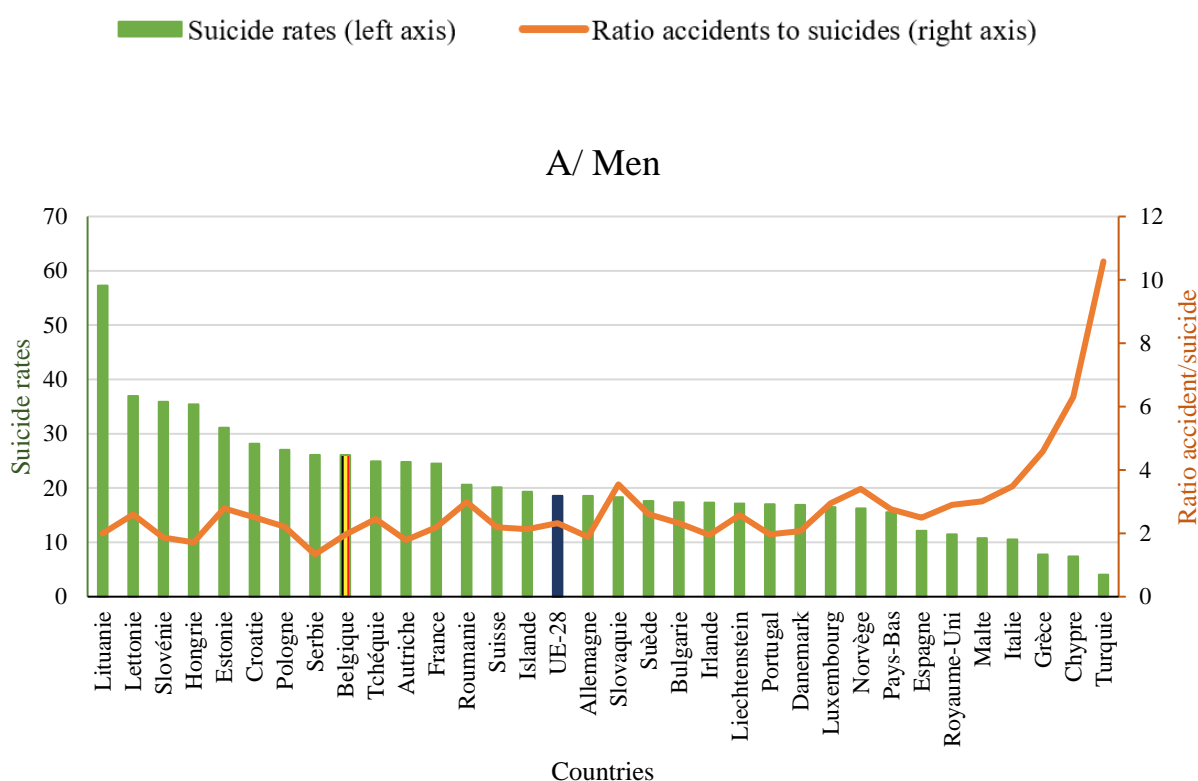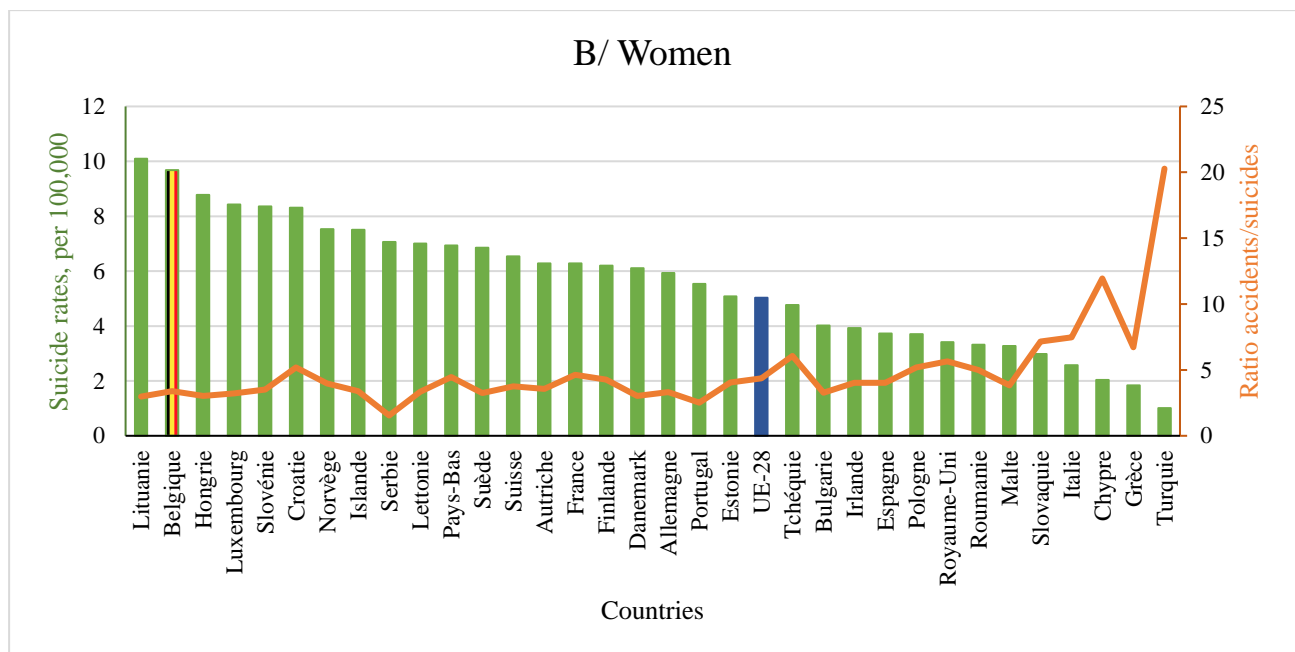
Source: Eurostat, 2015.

When comparing the suicide rates with the ratio of accidents to suicides (the number of deaths by accidents divided by the number of deaths by suicide), we notice patterns. In Western, Central, and Nordic Europe, in countries such as Belgium, France, the Netherlands, and Denmark, where the suicide rates are relatively high, or at least close to the European average, the ratio of accidents to suicides is low. There are two to three times for men and about five times for women more accidents than suicides. Conversely, in Southern Europe, the suicide rates are often low, but the number of accidental deaths is much higher than in other countries. In Cyprus, for instance, we estimate a suicide rate of seven per 100,000 inhabitants for men and two per 100,000 for women, but there are six times more accidents for men and 35 times more for women. In other countries like Spain, Italy, Greece, Malta, and Turkey, we notice the same trend: low suicide rates and higher risks of accidents. With this Figure 2.2, we can raise the question of an under-declaration of suicide deaths in some contexts. The literature supports this idea. In Spain, the comparison between several data sources could indicate that the national statistics underestimate the number of suicides (Giner & Guija, 2014) and declare an accidental death in many cases where the forensics agencies assumed the suicide. The same underestimations of suicide mortality could be at play in Greece, where the

national statistics are inconsistent with police registers (Tragaki & Lenos, 2016). If the quality of the suicide registrations can be questioned, the cultural acceptance of suicide can also be seen as a determinant in this underestimation of suicide (Schomerus et al., 2015). Also, religious adherence in Southern Europe (Cyprus, Greece) is a factor in low suicide rates (Eskin, 2020). This comparison allows us to think that in Belgium, suicide mortality is not a taboo, and a good quality in mortality statistics can also explain an exceptionally high suicide rate.

III.   THE BELGIAN CONTEXT

For the last decades, Belgium has numbered about 2000 suicides per year, i.e., more than six suicides per day. The total number of suicides per year has slightly decreased from 1998-2016, with a slight decrease for men and robust stability for women (Figure 2.3).

Figure 2.3 - Yearly numbers of suicides for men, women, and the total population living in Belgium, 1998-2016
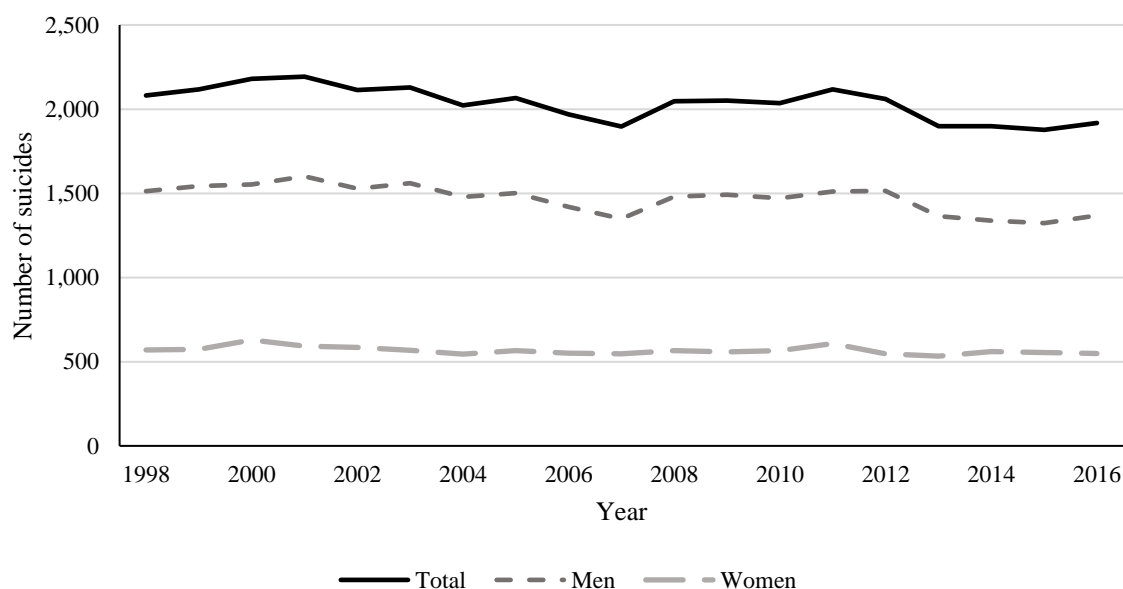
Source: Death certificates, calculations by the author.

The age-standardised suicide rates increased from the late 1960s to the 1990s, then decreased progressively in the 2010s (Figure 2.4). It is to be noted that suicide-related data before 1998 is not

very reliable. First, the 10th International Classification of Diseases was implemented in 1998. Identifications of suicides with the 9th and 10th classifications are not fully comparable. In the 9th classification, some circumstances of the death, related to accidents or drug poisoning, appeared to be misleading for physicians who declared the causes of death (Stewart et al., 2017). Then, the quality of death certificates was shown to have improved since 1993. Before that, misinterpretations and coding mistakes were more numerous. A new model of death certificates was implemented after 1998, leading to strict control of the death certificates, drastically limiting coding errors (Renard et al., 2014).

Figure 2.4 - Age-standardised suicide rates in Belgium (1968-2015)
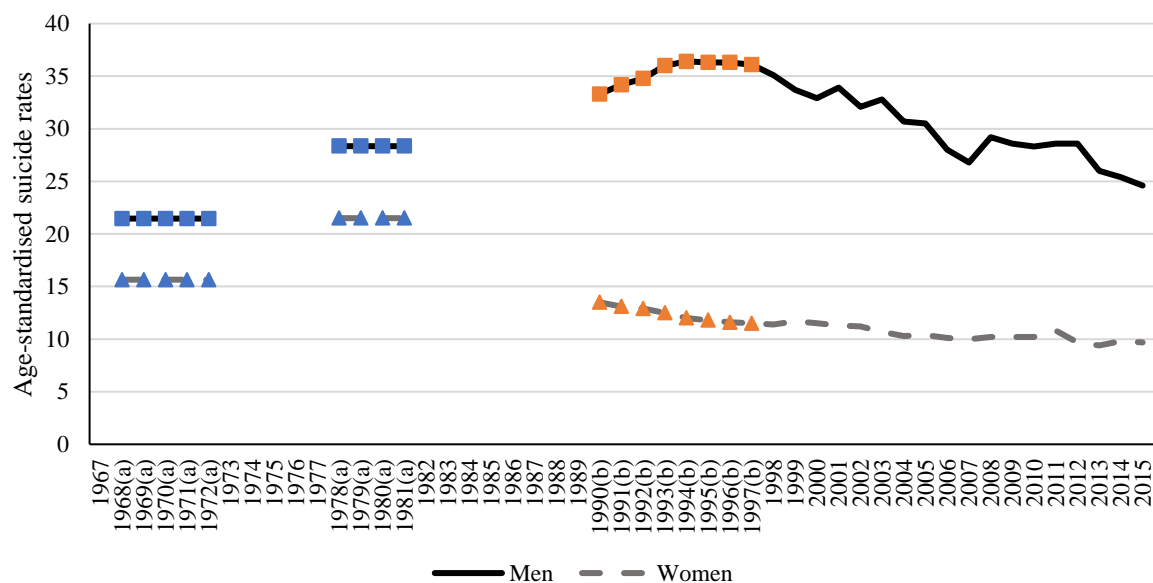
Source: Death certificates (1998-2015); (a) (Moens, 1984) (b) (Institute for Health Metrics and Evaluation (IHME), 2020)

The empirical literature about suicide mortality in Belgium is somewhat limited. Between the early 1990s and the beginning of the 21st century, suicide determinants have not significantly changed, as shown by a study based on the National sentinel network of general practitioners (Bossuyt & Van Casteren, 2007). Men are at a higher risk of suicide and usually exert more violent methods. Spring and fall are the periods of the year with the highest rates of suicide (Bossuyt & Van Casteren, 2007). However, Casas et al. (2022) showed that suicide mortality had increased during high

temperatures in the Brussels-capital region (Casas et al., 2022). Being married is associated with a lower suicide risk than being non-married (single, divorced, widow·er), and being less educated is associated with a higher risk of suicide than being highly educated (Lorant, Kunst, Huisman, Bopp et al., 2005). Bauwelinck et al. (2017) showed that persons of Italian origin, and especially persons of Moroccan or Turkish origin, were less likely to die by suicide than Belgian populations, and the relationship intensified after controlling the socioeconomic characteristics of the individuals. The risk of suicide increases for second-generation migrants compared to first-generation ones (Bauwelinck et al., 2017).

Suicide trends by age observed in Belgium are similar to that observed in other countries, such as England and Wales (Shiner et al., 2009).

Suicide rates increase with age, especially for men. From age 80, suicide rates for men have increased dramatically. For women, suicide rates are the highest in their mid-life, in their 50ies (Figures 2.5 & 2.6). When looking at the number of suicides for men and women and by age, suicide numbers are the highest in mid-life. In 2002, suicides increased from age 15 to age 45 for men and from age 13 to age 55 for women (Figure 2.5). Then, the number of suicides decreases for both men and women to get very low at older ages. In 2012, the trends were the same, but the peaks of suicide appeared later in life for men, in the early 50ies (Figure 2.6).

Figure 2.5 - Age-specific suicide rates (log scale) per 100,000 inhabitants, in 2002 and 2012, for men and women and number of suicides.
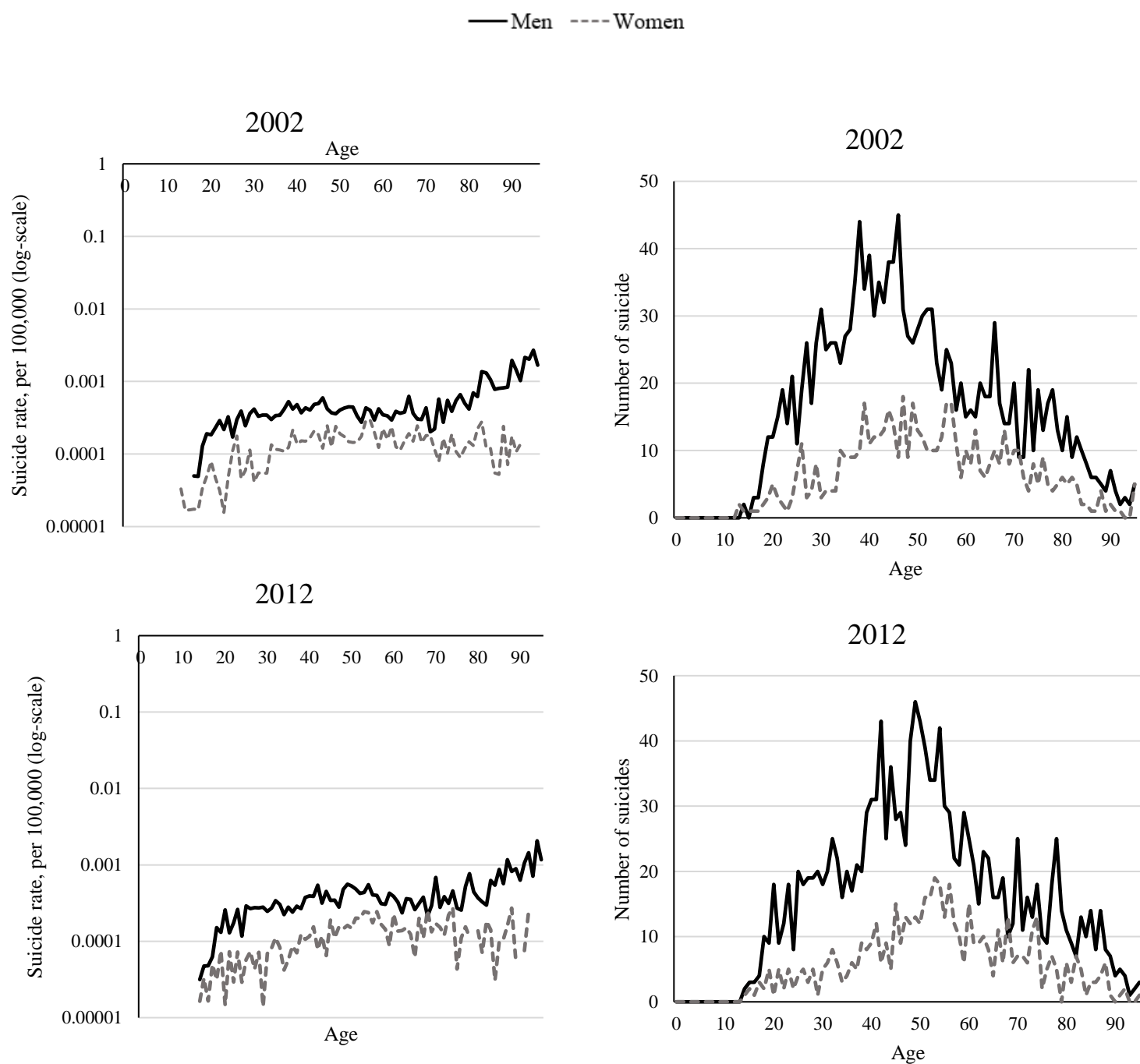
Source: Death certificates, 2002 and 2012

A comparison between the total population and the population who died by suicide allows us to understand the population under study better and draw a portrait of the specificities of the people who died by suicide. Table 2.1 presents descriptive characteristics of the population aged 25 to 69 living in Belgium in 2002 and the characteristics of the population who died by suicide in 2002-2006.

Table 2.1 – Descriptive table of the population aged 25 to 69 living in Belgium in 2002 and the 25 to 69-year-old population who died by suicide in 2002-2006.

	Total population in 2002				Population who died due to suicide in 2002-2006			
	Men		Women		Men		Women	
	#	%	#	%	#	%	#	%
Very low housing quality	799,537	26.60%	773,339	25.72%	2,546	31.01%	983	29.26%
Low housing quality	762,775	25.38%	778,861	25.90%	2,442	29.74%	1,053	31.35%
High housing quality	934,717	31.10%	945,404	31.44%	2,207	26.88%	904	26.91%
Very high housing quality	508,246	16.91%	509,189	16.93%	1,016	12.37%	419	12.47%
Low neighbourhood satisfaction	884,217	29.42%	888,452	29.55%	2,603	31.70%	1,079	32.12%
Intermediate neighbourhood satisfaction	939,455	31.26%	934,421	31.08%	2,574	31.34%	1,071	31.88%
High neighbourhood satisfaction	1,181,740	39.32%	1,183,996	39.38%	3,035	36.96%	1,209	35.99%
Primary	352,515	11.73%	395,521	13.15%	906	11.03%	373	11.10%
Lower Secondary	703,905	23.42%	690,102	22.95%	2,299	28.00%	811	24.14%
Higher Secondary	835,891	27.81%	799,115	26.58%	2,433	29.63%	953	28.37%
Higher	760,829	25.32%	788,334	26.22%	1,466	17.85%	834	24.83%
Unknown	352,277	11.72%	333,804	11.10%	1,108	13.49%	388	11.55%
Unemployed	61,854	2.06%	288,482	9.59%	249	3.03%	277	8.25%
Inactive	187,064	6.22%	321,744	10.70%	411	5.00%	364	10.84%
Employee	2,119,498	70.52%	1,914,668	63.68%	5,506	67.05%	2,162	64.36%
Liberal	260,603	8.67%	135,222	4.50%	669	8.15%	144	4.29%
Unknown	376,398	12.52%	346,760	11.53%	1,377	16.77%	412	12.27%
Married with children	1,151,121	38.60%	1,063,642	35.59%	2,654	32.77%	868	26.17%
Married without children	735,243	24.66%	756,307	25.30%	1,121	13.84%	638	19.23%

Unmarried with children	145,274	4.87%	131,537	4.40%	478	5.90%	98	2.95%
Unmarried without children	180,269	6.05%	140,229	4.69%	629	7.77%	227	6.84%
Lone-parent	123,560	4.14%	310,675	10.39%	451	5.57%	506	15.25%
Isolated	498,109	16.70%	433,222	14.49%	2,407	29.72%	844	25.44%
Other	148,429	4.98%	153,188	5.13%	358	4.42%	136	4.10%
Flanders	1,434,982	47.75%	1,429,869	47.55%	4,181	50.91%	1,587	47.25%
Wallonia	1,207,284	40.17%	1,215,289	40.42%	3,271	39.83%	1,424	42.39%
Brussels	363,151	12.08%	361,718	12.03%	760	9.25%	348	10.36%
Owner	2,078,137	69.15%	2,096,034	69.71%	4,804	58.50%	1,951	58.08%
Tenant	731,527	24.34%	743,905	24.74%	2,640	32.15%	1,121	33.37%
Unknown	195,753	6.51%	166,937	5.55%	768	9.35%	287	8.54%
Urban	1,299,891	43.25%	1,319,913	43.90%	3,436	41.84%	1,628	48.47%
Suburban	882,930	29.38%	880,791	29.29%	2,501	30.46%	894	26.62%
Rural	822,596	27.37%	806,172	26.81%	2,275	27.70%	837	24.92%
Belgian	2,696,222	89.71%	2,734,747	90.95%	7,765	94.56%	3,221	95.89%
Other European	227,824	7.58%	198,395	6.60%	386	4.70%	116	3.45%
Non-European	76,512	2.55%	70,631	2.35%	50	0.61%	22	0.65%
Unknown	4,859	0.16%	3,103	0.10%	11	0.13%	0	0.00%
Very good health status	749,171	24.93%	735,578	24.46%	1,529	18.62%	507	15.09%
Good health	1,406,070	46.78%	1,382,554	45.98%	3,365	40.98%	1,188	35.37%
Intermediate health	511,149	17.01%	566,383	18.84%	1,719	20.93%	868	25.84%
Bad health	128,735	4.28%	132,278	4.40%	688	8.38%	417	12.41%
Very bad health status	33,222	1.11%	29,886	0.99%	212	2.58%	129	3.84%
Unknown	177,070	5.89%	160,197	5.33%	699	8.51%	250	7.44%
Less than a year in the housing	392,214	13.05%	355,395	11.82%	1,429	17.40%	574	17.09%

1-2 years	456,394	15.19%	441,201	14.67%	1,612	19.63%	610	18.16%
3-5 years	442,952	14.74%	455,042	15.13%	1,347	16.40%	557	16.58%
> 5 years in the housing	1,713,857	57.03%	1,755,238	58.37%	3,824	46.57%	1,618	48.17%
1st decile of multiple deprivations	541,336	18.01%	544,791	18.12%	1,641	19.98%	668	19.89%
2nd	452,256	15.05%	452,699	15.06%	1,288	15.68%	546	16.25%
3rd	216,890	7.22%	220,163	7.32%	703	8.56%	289	8.60%
4th	311,922	10.38%	311,667	10.37%	867	10.56%	363	10.81%
5th	277,132	9.22%	276,354	9.19%	770	9.38%	323	9.62%
6th	237,963	7.92%	238,124	7.92%	636	7.74%	257	7.65%
7th	253,070	8.42%	249,771	8.31%	606	7.38%	240	7.14%
8th	248,663	8.27%	246,377	8.19%	595	7.25%	237	7.06%
9th	243,286	8.09%	242,872	8.08%	596	7.26%	238	7.09%
10th (least deprived)	222,899	7.42%	224,058	7.45%	510	6.21%	198	5.89%
Total	3,005,417		3,006,876		8,212		3,359	

Source: Death certificates, National Register 2002-2006, Census 2001—calculations by the author.

Note: For more information about the variables (including the housing quality and neighbourhood satisfaction score), please refer the Chapter 6.

It is possible to notice that the population who died by suicide generally presented poorer socioeconomic characteristics than the total population. They frequently lived in more impoverished housing conditions and less satisfactory neighbourhoods. Even if differences are not large, the people who died by suicide generally inhabited more deprived areas than the general population, according to the Multiple Deprivation Index. Unlike tenants, owners were less frequent among adults who ended their own life than in the total population. Men who died by suicide were less represented among the higher educated people than the general male population. For women, the differences in educational attainment between those who end their own life and the general population was less visible than for men. Unemployed individuals and people with unknown socio-professional status were overrepresented among those who died by suicide, but the differences are less dramatic than for other variables.

Regarding geographic characteristics, people living in Brussels were underrepresented among the suicided population. At the same time, Walloon women and Flemish men presented a high frequency of suicide, compared to the total repartition of the people in Belgium. Women living in urban areas are overrepresented, while women living in suburban areas were underrepresented among those who died by suicide.

Regarding individuals' demographics, differences are to be observed according to nationality. Foreign adults, especially those with a non-European nationality, died by suicide less frequently than Belgian, given their percentage in the total population in Belgium. In general, people in a marital or non-marital relationship were underrepresented among the suicided population, except for those in a cohabiting relationship without children at home. Lone parents and one-person households were overrepresented among those who died by suicide. People who died by suicide were, on average, less healthy than the total population in Belgium and more likely not to have answered the question about self-assessed health. Finally, individuals who died by suicide were more susceptible to having lived a shorter time in their residence than the population in Belgium.

While Belgium presents one of the highest suicide rates in Europe, it is also marked by a specific heterogeneity of suicidal behaviours on its territory.

Figure 2.7 - Belgium municipalities according to their suicide rates in 2011-2015

Belgium 2011-2015
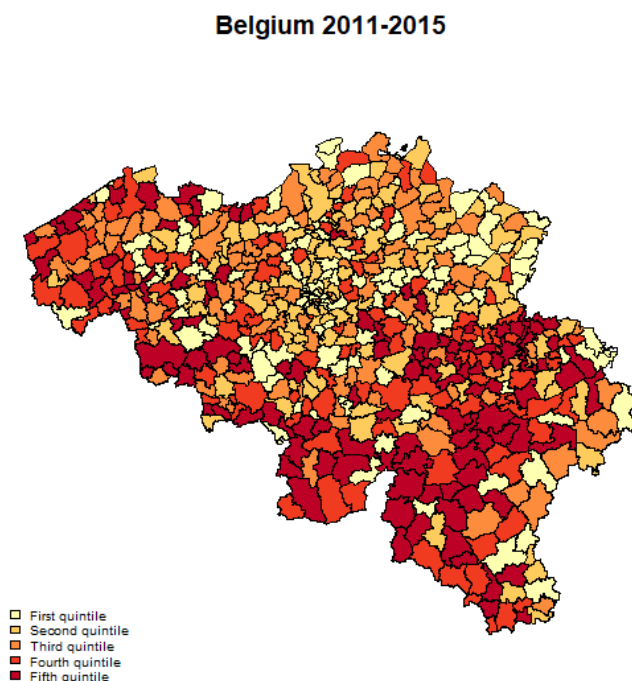
Crude suicide rates of Belgian municipalities in quintiles (20%)

Source: Death certificates, National Register, 2011-2015.

Note : Suicide rates per 100,000: First quintile = [0 ; 9.59[; Second quintile = [9.59 ; 12.38[; Third quintile = [12.38 ; 15.78[; Fourth quintile = [15.78 ; 20.51[; Fifth quintile = [20.51 ; 66.01]

Figure 2.7 represents the crude suicide rates (not standardised by age) for each municipality in Belgium. The first and second quintiles gather municipalities with a suicide rate below ten suicides per 100,000 inhabitants and between 10 and 12 suicides per 100,000 inhabitants, respectively. Those municipalities with low suicide risks are primarily located in the country's North, the Limburg and Antwerp province, Brussels, and the two Brabants. The third and fourth quintiles gather municipalities with 12 to 16 and 16 to 20 suicides per 100,000 inhabitants, respectively. They are located in the North-West part of the country, the West and East Flanders province, and the Luxembourg province. Finally, the fifth quintile represents municipalities with 20 to 66 suicides

per 100,000 inhabitants. It is mainly present in the South part of the country, in some parts of the Luxembourg, Liège, Namur, and Hainaut provinces, as well as in West Flanders, close to the coast. In general, we observe that more deprived areas of Belgium (Hainaut, Liège and Namur provinces, for instance) are associated with higher suicide risks, as already stated in the literature (Hooghe & Vanhoutte, 2011). The structure by age also explains some disparities in suicide mortality over the territory: older areas (Western Flanders) present higher suicide risks than younger areas (Brussels). Despite regional recurrences, the municipalities of the same province are very different. However, the higher risk of suicide associated with Wallonia, compared to Flanders and the Brussels-capital region, is immediately visible. My calculations based on the death certificates estimate that the age-standardised rates of suicide are 15.7 per 100,000 in Flanders, 20.2 in Wallonia and 11.5 in Brussels region.

Since 1997, Health Interview Surveys (HIS) have been organised periodically at the population level. They allow us to draw a portrait of mental health in Belgium. The report of the HIS 2018 (Gisle, 2020) showed that 7.4% of people in Belgium were suffering from depression in 2018, a figure which is higher than in 2004 (6%). As far as suicidal behaviour is concerned, 13.9% (CI95%=12.8-15.1; 12.3% [10.7-13.8] for men; 15.5% [14.0-17.1] for women) of the population aged 15 and over have already thought about ending their lives during their lifetime, and 4.3% (CI95%=3.6-4.9; 4.2% [3.2-5.2] for men; 4.4% [3.6-5.1] for women) has suicidal ideations in the last 12 months before the interview. In 2018, 4.3% (CI95%=3.7-4.9; 3.1% [2.4-3.8] for men; 5.4% [4.5-6.4] for women) of the population aged 15 and over had already attempted suicide during their lifetime, and 0.2% (CI95%=0.1-0.4; 0.2% [0.0-0.3] for men; 0.3% [0.1-0.3] for women during the last 12 months before the interview. The figures related to suicidal thoughts and attempts are slightly decreasing in Flanders (about -35% of suicidal thoughts in the latest 12 months between 2013 and 2018) and in Brussels (about -20% of suicidal thoughts in the latest 12 months between 2013 and 2018), and increasing in Wallonia (about +20% of suicidal thoughts in the latest 12 months between 2013 and 2018) (Gisle, 2020). Depressive disorders and suicidal behaviours are

highly dependent on the socioeconomic level of individuals. In particular, education is a decisive factor in the distribution of suicidal tendencies: the more educated are less likely to face depressive or suicidal disorders (Gisle, 2020).

IV. HOUSING IN BELGIUM

Since the first housing laws and policies in the 19th century, Belgium privileged two housing and residential experience aspects: access to homeownership and residential immobility. At first, Catholic and Liberal politicians dreaded urbanisation and industrialisation. They feared the epidemics related to big cities and the development of immoral behaviours, such as alcoholism, and prostitution. Still, they also wanted to limit the creation of trade unions and the organisation of strikes. The 1889 Housing Law promoting homeownership helped reduce social movements: if workers had a long-term mortgage to pay, they might not get involved in strikes (Goossens & Lammertyn, 1982; Smets, 1977). In 1869, another policy led to the development of commuting means with advantageous fees (De Decker, 2011). This could invite workers to commute and continue to live in a smaller town instead of moving closer to their working place in bigger cities. Those two pillars of the Belgian housing system led to more residential stability and the vision of owned-occupied detached houses as the preferred housing type for households and families.

More recently, this tendency to prefer homeownership and stability remains. On the one hand, residential mobility is still associated with high transaction costs. In 2002, the Flemish government attempted to reduce the taxes related to residential moves, but the perception of the costs remained high in the whole country. On the one hand, mortgage periods are getting longer. Since 2005, the 20-year limit has been abrogated, and mortgages are now limitless. Also, big Belgian cities, especially Brussels, are easily accessible, encouraging commuting by train, bus or car, with the democratisation of company cars (De Decker, 2011).

Meeus & De Decker (2015) explored how the Belgian government could influence the projects of residential mobility and immobility of the population living in Belgium. They interviewed 67 residents and showed that homeownership and residential stability are still considered the ideal housing choices that households can make (Meeus & De Decker, 2015). Some argue that mobility is often associated with economic development, and ecological issues would encourage people to live closer to their working place and reduce their everyday commuting. Still, housing careers in Belgium are marked with homeownership and long-term stability, partly because policies advantage homeownership and make it difficult for most households to be more mobile. In addition to policies, the authors show that mentalities in Belgium normalise discourses and practices about residential stability. In other terms, becoming and remaining a homeowner in the same housing is valorised and looked for by households (Meeus & De Decker, 2015).

After War world II, the housing difficulties in 1945-1970 were solved by constructing separate houses and urban spreading. Belgium reinforced this vision of planned urbanism. In other contexts, such as the Netherlands, different solutions were found, such as relying on smaller and lower-cost housing and standardised flats (Heynen, 2015). This choice had consequences on the prices and the availabilities of housing. Over the last decades, the price of the square meter has increased. The rarity of new residential land explain that real estate prices has risen, and housing development has slowed. Since the 1990s, the square meter prices have increased by 4 to 5% each year, which defines Belgium as one country where the long-term price increase was the highest in the EU (Housing Europe, 2010). This rise affected housing mortgages and the private renting sector, including low-quality rented dwellings. The nominal expenditures related to housing and energy has increased in EU, but it has increased even faster in Belgium.

Figure 2.7 – Nominal expenditures per inhabitant related to housing (water, gas, electricity and other fuels included), in Euros, 2000-2022.
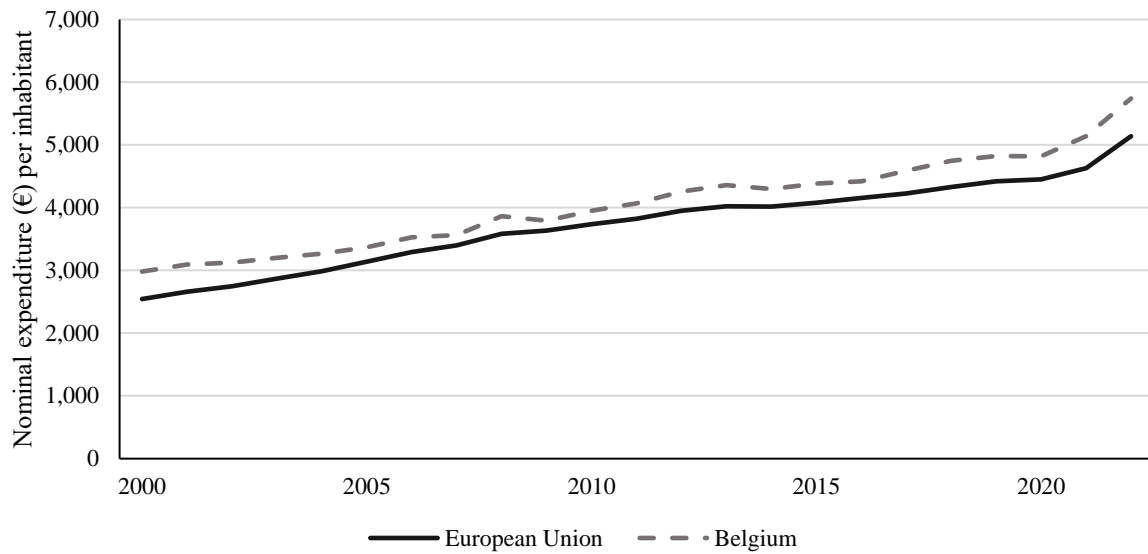
Source: Eurostat (online data code: P RC_PPP_IND__custom_7359621).

This Belgian housing system presented some advantages during the 2008 Global Economic Crisis. It is possible to define Belgium's housing market as "static" in opposition to dynamic markets. Static systems present incentives for construction, homeownership and residential stability, and short provision in social rental residences. during the 1990s and the 2000s, the tax system kept on encouraging homeownership. Private individuals often design and acquire new properties and then modify their homes rather than move out. The number of real estate transactions is minimal. In these countries, mobility is rarer than in "dynamic" systems, and homeownership is an asset for households, thanks to the rising prices of the property, but difficult to accede for low-income families (De Decker et al., 2017; van der Heijden et al., 2011). In such a context, the housing market is substantial, and the economic crisis had a minimal influence on it (van der Heijden et al., 2011).

De Decker et al. (2017) even assumed that the Belgian was not affected by the global crisis of 2008 in an article entitled "Crisis? What crisis?" (De Decker et al., 2017). In the worldwide recession, Flanders has increased the social housing stock by 8% in 2008-2015. The global Crisis did not impact private individuals' housing situation in a country where a large share of the population own-occupy and is involved in very long-term and safe mortgages. After the Crisis, Flanders implemented the 2009 Investment Program to protect the middle classes and the younger workers

from a housing shortage (De Decker et al., 2017). Many households urgently needed housing, and the long "waiting lists" for low-cost housing were getting more extensive and criticised by the population. One objective of this Program was to increase the social housing stock; another solution was found in alternative "modest" dwellings that are not social housing but are still a good solution for lower-income households. Also, some groups (disabled, marginalised populations) are targets for this policy. Still, in 2015, the social housing market only represented 6% of the total housing market in Flanders (De Decker et al., 2017; Poggio & Whitehead, 2017). The 2009 measures were shown to have failed, partly because of the principle behind social housing and subsidised housing: they sometimes involved lifelong contracts. Households would benefit from advantageous rents and loans but would then take decades to refund them. In 2016, the social housing contracts were limited to 9 years. The objective is to define the social rental market as a step and encourage the users of social housing to enter the private rental market then or become homeowners (De Decker et al., 2017). In Wallonia, the opposite trend emerged: the number of public housing has dramatically decreased after 2008, due to the destruction of social housing blocks in Liège province. They have been replaced by "balanced-rent housing" that is managed by public institutions but whose rent is not regulated or limited, so more expensive that social housing (Anfrie et al., 2019).

Between 1995 and 2022, the number of households has increased by 23% due to natural and migratory population growth and the evolution of household composition (Statbel, 2023b). The increasing number of separations, divorces, and single-person households has contributed to a need for more dwellings. In parallel, during the same period, the number of houses increased by 9%, and the number of apartments doubled (Statbel, 2022b). In Wallonia especially, evolution of the number of flats allowed the total number of dwellings to be higher than the number of households (Anfrie et al., 2019). In 2022, we counted 5,074,676 households in Belgium for 5,680,956 dwellings (Statbel, 2022b, 2023b).

Despite a solid system that protected individuals from the 2008 Recession, the housing market prices has drastically increased during the 2010s. This is particularly visible in the private rental sector. The rent value is often way higher than the value of the residence, which is explained - again - by the short stock in the rental industry but also by the tax system that encourages investment in real estate (De Decker et al., 2017; Hansens, 2022). Private investors are more numerous, while public institutions are less present in regulating the housing market. In practice, this can be detrimental for the household renting their residence, leading many individuals to contract loans and get indebted to afford a home. Belgium is not an exception: in Europe, between 2010 and 2021, average rental prices have risen by 16% in European Union (Hansens, 2022). In Brussels especially, the situation is critical. In 2019, a public initiative led to the selection of 89 citizens to discuss and find solutions to this crucial problem. Discussants suggested regulating real estate prices and indexing them with their actual value to limit inflation. However, this suggestion still needs to be implemented (Hansens, 2022). Between 2010 and 2020, the prices of real estate units has increased by about 33%, and rent costs by 29% (Statbel, 2023c, 2023a). In parallel, the average income of the working-age population working full-time has only increased by 23% (Statbel, 2022c). In 2020-2022, the prices increased drastically: only in two years, the real estate prices have increased by 15%.

CHAPTER 3

RESEARCH QUESTIONS

Among other factors, the living environment –the physical features that compose the place of residence – is rarely studied as a suicide determinant. This thesis aims to answer the question: "How is the residential context – in terms of the quality of the living environment and residential transitions – related to suicide risk among the working-age population in Belgium?". It contributes to the literature in four ways. First, this thesis investigates, for the first time, the relationship between some parts of the residential experience – such as housing quality, neighbourhood conditions and residential mobility – and suicide mortality. Second, it focuses on the working-age population and the life stages within this group, from young adults to early retired. This population is less studied regarding mental health and its heterogeneity is rarely questioned, in spite of its numerous challenges and evolutions, profession-, family- and housing-wise. Third, it relies on a high-quality dataset, gathering administrative population data for Belgium, allowing it to cover all registered individuals and follow them over time. This information source enables us to reconstruct people's trajectories regarding residential pathways and partnership transitions. Fourth, it suggests methodologies that are less usual to answer those questions. It includes event history analyses to evaluate the time at risk of suicide and competing-event models to control for alternative outcomes. It also presents an understudied approach that measures relative importance to rank the predictors according to their role in the variance of suicide.

The first question I want to develop is the relationship between housing tenure and suicide. Tenants have higher risks of suicide than owners (Lorant, Kunst, Huisman, Costa, et al., 2005). Does this relation depend on the individual's life stage, age, marital and parental status? How can we explain the differences between men and women? In this chapter, we evaluate if homeownership is negatively related to suicide risk independently of individual characteristics. We hypothesise that the negative relation between homeownership and suicide strengthens for middle-aged adults (mid-30s to late 50s) when the social norm of homeownership weighs particularly heavily, that is, in their working and childrearing years, especially when men live with a partner and/or children; for middle-aged and older childless and unpartnered women. Chapter 5 is entitled "Do tenants suffer

from status syndrome? Homeownership, norms, and suicide in Belgium" and will answer this question.

Then, I want to investigate the relationship between residential conditions – in terms of housing conditions and neighbourhood characteristics – and suicide risk. Better housing conditions are associated with fewer suicidal ideations (J. H. Lee, 2022), but are they associated with lower suicide mortality? Similarly, are better neighbourhood conditions related to lower suicide risks? Does this relation differ over the life stages and across the genders? I examine if worse housing quality and neighbourhood satisfaction are associated with higher suicide risk, even after controlling for individual characteristics. I hypothesise that good neighbourhood satisfaction might reduce the gap in the detrimental impact of poor housing conditions on suicide risk. I investigate whether the relationship between housing conditions and suicide increases with age for women and decreases for men. I finally study the relative importance of housing and neighbourhood conditions on suicide risk compared to other predictors. Chapter 6, "The right place. Housing conditions, neighbourhood satisfaction, and suicide in Belgium," covers this question.

Finally, I examine the relationship between residential mobility and suicide. Do residential moves increase suicide risk? Does the context of the move – in terms of partnership transitions – matter? To what extent do residential moves participate in the positive association between union dissolutions and suicide? I explore whether mobility is associated with a higher risk of suicide than immobility and whether mobilities in the context of union dissolution are associated with higher suicide risk than immobility. On the contrary, I assume mobility in the context of union formation or no union change is associated with a higher suicide risk for women only. In the context of union dissolutions, I test whether moving is related to a higher risk of suicide than staying in the previously shared place. I finally hypothesise that the relationship between mobility and suicide depends on the life course and is stronger for middle-aged adults than younger and older active

populations. Chapter 7, titled "Residential mobility, life course, and suicide in Belgium: is it all about context?" answers this question.

Chapter 8 also treats these questions with an alternative data source and the outcome variable: antidepressant consumption. No previous study investigated how residential mobility can interfere with the relationship between union dissolution and antidepressant treatment. We evaluate if individuals who leave the shared accommodation after the separation present higher antidepressant increases than individuals who stay in the previously shared place. We also expect gender differences: women who leave the housing would show a higher antidepressant consumption before the breakup and tend to initiate the separations more often. In addition, repartnerhsip tends to protect individuals, especially women, from socioeconomic loss. Moving in the context of union dissolution would be associated with lower antidepressant consumption when the individual repartners than when they move without entering a new partnership, especially for women. This 8th chapter is entitled: 'Moving out and moving on: the impact of mobility in a context of union dissolution on mental health in Belgium".

CHAPTER 4
DATA AND METHODS

I. DATA

The dataset used was initially requested in the frame of the Causineq project. This research project was conducted from 2012 to 2019 and led to the redaction of a final report (Van Aerden et al., 2019). The Belgian statistical office (StatBel) renewed access to the data for future projects and authorised using the available data in the present research. The dataset is part of the DEMOBEL project led by Statbel. The DEMOBEL database gathers register-based information with 1991, 2001 and 2011 Belgium census information and civil registry certificates. This comprehensive database allows us to support social scientists and demographers in understanding demographic and socioeconomic phenomena (Statbel, 2019). To protect the respondents' privacy, all databases were pseudonymised, thanks to codifying all names and sensitive information (such as the precise date of birth or the address). This code allowed the merging of the different datasets. All files were carefully protected, thanks to the UCLouvain servers.

1. Death certificates

In Belgium, each death is registered in the civil registry. This data source contains demographic and socioeconomic information about the deceased individual and details on the death, where it occurred, and its cause. The place and cause of death are certified by a medical doctor or nurse, while other information is completed by the civil registrars (Cohen et al., 2006; Houttekier et al., 2011). The regional health administration checks information within the death certificates, which can ask for additional information from the physician who declared the cause of death (Houttekier et al., 2011). The high quality of the death certificates is guaranteed by numerous error checks (Houttekier et al., 2011; Renard et al., 2014).

Each death has an immediate cause of death. If this death is the consequence of pathology or another cause, this information is given as an underlying cause of death. If other pathologies or causes interfere, associated and intermediate causes of death can be added to the certificate. All

causes are indicated thanks to a specific categorisation, the 10th International Classification of Diseases (ICD). In Belgium, this version of the ICD was used in 1998 and is still used in 2023. In this thesis, death certificates provide information about deaths due to suicide in Belgium. In all chapters, a strict definition of suicide was chosen, defined by all self-harm leading to death, via the X60-X84 codes in the ICD-10.

The declaration of suicide can be directly made by a physician who does not doubt the intentional character of the death. In case of doubt, a judiciary procedure is opened to determine whether the death is caused by deliberate self-harm or related to a crime, an accident, or a natural cause. Finding the answer is complex and can take time in some instances. This thesis will cover the 2001-2015 period. Before this period, the quality of the mortality datasets in Belgium was less elaborate, with less systematisation in the checks and verifications of the data quality (Renard et al., 2014). Moreover, it used the 9th classification of the ICD until 1998, which does not allow a strict comparison with the following period. After 2015, a rise in "mortality with unknown intent" was visible in the datasets available at the time of this study. In many recent cases, a judge has not yet proved the intention of death. It is difficult to know whether an answer will be found, and I preferred restricting observations on older deaths, whose information will not be updated anymore.

2. Census 2001 and 2011

The 2001 Belgian socioeconomic survey (or 2001 Belgian Census) was conducted in October-November 2001 among the Belgian population living in Belgium through self-administrated questionnaires sent by postal mail. It is the last traditional census of Belgium, where the population census is highly debated for data privacy and associated costs. All the population living in Belgium was requested to reply: 10,296,349 persons responded to the 2001 census, and we estimate that 3.1% of the population did not reply to the questionnaire, even after at least three reminders (Lorant & Dauphin, 2004). This data source is one of the most detailed in Belgium, giving precious

information about environmental conditions, satisfaction with one's environment, and subjective health.

The 2011 census is the first register-based census in Belgium. Previous censuses were already based on the National Register, but the respondents could correct the information in the census questionnaire: in 2011, the registers were the only information source. This database is derived from other sources, such as the 2001 census, the national register, the social security register, employment registers, the educational register and university administrations, land registers, and cadasters. Like the previous census, it provides socioeconomic information about the population living in Belgium. This register-based data collection avoids the non-responses and relies on good-quality registers. Theoretically, registers are up to date, but we can regret verifying the quality of the 2011 census through control based on a population sample. Also, this census, contrary to the previous one, gathers a minimal number of indicators related to housing conditions and living environment: it gives limited information on housing tenure, the type of building, the presence of a bathroom, central heating, and about the household density (number of rooms and number of inhabitants). The 2001 Census presented many variables related to the housing and immediate environment, including scales of quality of the infrastructures within the housing (double glazing, garden, kitchen, e.g.), the need to renovate some elements (windows, walls, roof, electric system), and the satisfaction about the neighbourhood characteristics (green spaces, roads, air quality…) and services (healthcare, administrative offices…). The 2011 census is the latest direct and exhaustive source of information on individuals' housing conditions and socioeconomic status.

The main downside of a census is that it does not allow following up individuals over time. They represent a specific situation in 2001 and 2011 that may or may not represent the situation between the censuses. Also, for the housing and environmental conditions, we can regret that only one person in the household gave answers in 2001. It is difficult to measure to what extent the other household members could participate in the response and influence the respondent. In addition,

the census 2001 counts a lot of missing values. Regarding housing quality and neighbourhood conditions, we can estimate up to 15% of missing values for some questions. This problem will be addressed in Chapter 6, discussing the bias induced by such high rates and the use of multiple imputations of the missing values. For 2011, the cadastral register is the only source of information about housing conditions. It is not updated regularly, except in case the renovations require a specific permit. It is not easy to estimate the quality of this data.

3. National Register

All individuals domiciliated in Belgium must register at their municipality office. The National Register gives information about the sociodemographic characteristics of the *de jure* population. The National Register does not cover some parts of the population living in Belgium, such as the asylum seekers and the people with no legal stay allowed. It also excludes homeless populations, European civil servants and diplomatic staff from the ambassies (Poulain et al., 2013).

On January 1st, it provides information on the household composition, marital status, nationality, and place of residence in terms of statistical sector and municipality. It is then possible to reconstruct the household composition based on this data source by using the individual identifier, the household identifier – defined by the identifier of the reference member – and the relations between each household member with the reference member. Other information, such as age, marital status, and dates of marriages, enable defining the types of unions (marital or nonmarital) between the individuals. Some inconsistencies exist in this large-scale dataset and require corrections. The household identifier can change from one year to another without any change in the household composition: there are no strict rules on who is these reference members. Also, the configuration can change depending on the household's reference member, especially in multigenerational households. The typical typology of households used in Belgium (LIPRO) is a reasonable basis (Van Imhoff & Keilman, 1991). Still, it lacks details on complex households, such as multigenerational households or families with more than two couples within the same roof.

Between these yearly files, additional information is given on changes in situations regarding change of residence, household composition, marital status, or nationality. These files enable us to reconstruct partnership transitions and residential courses and have the changes' dates (month, year). It allows us to know the municipality of residence of the household, as well as the changes in place, both between municipalities and within the same municipality. From this, we can retrieve the individual's region and area of residence. The definition of urban, suburban and rural areas is derived from the Belgian urban hierarchy typology. The urban area gathers the agglomerations and their direct surroundings, while the suburban area is defined by the suburbs, the alternating migrant areas and the small cities. In rural areas, all municipalities are excluded from the urban hierarchy (Vanderstraeten & Van Hecke, 2019). One area for improvement in this dataset is the need for an explicit declaration of nonmarital unions: we use a definition backed up by literature, that defines non-marital union by the presence of only two opposite-sex adults in the household, with an age gap under 15 years between them (Lodewijckx & Deboosere, 2011). It excludes same-sex couples and partnerships with an age gap higher than 15.

II. POPULATION UNDER STUDY

This thesis will focus on working-aged adults for several reasons. First, as discussed in Chapter 1, the extreme age groups are more studied in the scientific literature than middle-aged groups regarding suicide mortality or mental health outcomes (Shiner et al., 2009). However, the population aged 20 to their late 60ies counts the most significant number of suicides. Second, younger and older populations' mental health and suicide risk are closely related to their cognitive, psychiatric, and health-related situations – information we cannot observe. Teenagers and young adults are at a high risk of developing mental illness symptoms and dying because of untreated or undiagnosed psychiatric disorders (Bilsen, 2018; Reiss, 2013). On the other hand, older populations face many health challenges, a possible loss of independence in their everyday life, and cognitive issues that can lead to a higher risk of self-harm and suicide mortality (Conejero, Olié, Courtet et

al., 2018; Conwell et al., 2010). As we cannot access people's psychiatric information, it is difficult to disentangle the suicide determinants related to the living environment and the life course from what is related to mental illnesses or psychiatric pathologies. Third, my objective is to examine how the life course interferes with the relationship between the living environment and suicide risk. More specifically, I will question how the partnership transitions, marital and parental status, and gender can modify this relationship. Mid-life populations are the most active: changing one dimension in their life can affect the other dimensions of their existence (W. A. Clark, 2013; W. W. A. Clark & Dieleman, 1996). Middle-aged adults seek more stability in their housing trajectories (Coulter & Van Ham, 2013) and high-quality living environments (Dieleman & Everaers, 1994; Gibler & Tyvimaa, 2015; Mulder, 2013). Conversely, young populations depend more on their parents' situations and decisions. Older adults are no longer linked to their professional careers, hence more freedom in their life course and residential patterns. The objective is also to focus on the mid-life population and show the heterogeneity within this population by comparing the life stages of this working age: we assume that younger adults in their 20ies will have a different approach to their living environment and their residential mobility than mid-adults in their 40ies or older adults in their 60ies (Coulter & Van Ham, 2013).

Depending on the chapters, the age groups will differ slightly. In Chapters 5 and 6, respectively, about homeownership and housing conditions and their relation to suicide mortality, adults aged 25 to 69 are under study. I excluded the young adults aged 20 to 24 living at their parent's residence. In Belgium, young adults live on average at their parents' until 26, which is longer than in most European countries (Torfs, 2022). In this case, housing tenure and quality are not the individuals' but an indication of their parental wealth or living conditions. I wanted to include young retirees aged 65 to 69 and their possible changes in housing and conditions associated with their income loss. In chapters 7 and 8, about residential mobility, the population under study is adults aged 20 to 64. Here, I included the first moves of young adults from parental housing, but I did not want to study retirement-related moves.

III. METHODS

All studies were conducted in StataMP 17 and RStudio (R 4.2.1).

1. Bivariate methods

Suicide rates will be calculated for population characteristics, including housing tenure, quality, and neighbourhood satisfaction. Other bivariate methods include the analyses of variance (ANOVA). This statistical tool is often used to compare several observation groups, test for significant differences, and understand the relationship between dependent and independent variables. The ANOVA is expressed through an F-statistic, giving information on the variability of the dependent variable according to population subgroups. It defines a null hypothesis, according to which there is no apparent difference between the different subgroups in the variability of the dependent variable. If the null hypothesis is rejected, we assume that our dependent variable (here, mortality due to suicide) presents a difference between the different subgroups or characteristics given by one of our independent variables (e.g., single, married, divorced, widow). The bivariate analysis will include other descriptive tools like graphs and tables.

2. Multivariate methods

When trying to explain a phenomenon such as suicide, many factors should be taken into account. Multivariate analyses involve more than one type of information within a statistical analysis. The advantage of these methods is that to give the effect of one variable independently from the impact of other variables included in the model. In this thesis, several ways are used and will be explained in this section.

a. Logistic regression

Logistic regressions or logit models are classification models that are very common in multivariate analysis. They are used to estimate the probability of a discrete event occurring, according to a set of independent variables. This model gives probabilities, hence a dependent variable that is most

often dichotomous, recoded 0 or 1. The principle of this method is based on a logit transformation of the odds, the ratio between the probabilities of success and the probabilities of failure. More specifically, this method is based on the logistic function (1):

$$logit(x) = \frac{1}{1 + \exp(-x)} \tag{1}$$

From this function, odds can be estimated as such (2):

$$\text{logit (odds)} = \ln\left(\frac{x}{1-x}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_k X_k \tag{2}$$

Here, *logit(x)* is the dependent variable, our probability of suicide, while X is the independent variables. The β parameters, also called coefficients, are estimated through several iterations, thanks to the maximum likelihood estimation. To interpret the logit of the odds, the beta estimates can be transformed into odds ratio, which gives the odds that an event will occur compared to the odds of the event not happening. Odds ratios lower than one indicate lower odds of our interest happening, while odds ratios higher than one point higher odds of our outcome of interest.

b. Event history analysis

Similarly, event history analyses help understand the associations between an event's experience and some individuals' characteristics. More specifically, some of these methods estimate the risk for an event to happen at a certain point in time according to a series of predictors. Event history analyses distinguish discrete states defined by the independent variables and events that mark transitions between states. For instance, over a period, a first migration is an event that leads an individual to change states from non-migrant to migrant. To be in such a situation, we must clearly define the population at risk of experiencing the event. In our example, a first migration can only be lived by people who have never migrated.

Cox proportional hazard model is a regression model used to investigate the association between the time individuals are at risk of an event and several predictors simultaneously. Cox models

provide hazards, noted *h(t)*. In our case, the hazard function can be interpreted as the risk of dying due to suicide at time t. the hazard function can be written as follows (3):

$$h(t, X) = h_0(t) \, exp\left(\sum_{i=1}^{p} \beta_i X_i\right) \qquad (3)$$

where *h0(t)* is the baseline hazard at the beginning of the observation, the risk value if all the predictors are equal to zero. *X* is the vector of the *p* covariates of the model and *β* are the regression coefficients. The coefficients are often expressed in terms of hazard ratios. When the hazard ratio is positive, it indicates that the risk of suicide happening at time t for a specific category is higher than the risk of suicide for the reference category or an extra unit of a continuous variable.

Predicted relative hazards of suicide were calculated to investigate some interactions. They are not dependent on the baseline hazards, and they can be read as follows (4):

$$\widehat{hr} = \frac{\widehat{h(t, X)}}{h_0(t)} = \exp \hat{\beta} X \qquad (4)$$

The advantage of event history analysis is that we can censor individuals and put their observations to an end. An observation is censored if it did not go through the event of interest for a specific time, at the end of an observation period, or after a certain age. For instance, in Chapter 7, we observe individuals aged 20 to 64 from January 1st, 2008, to January 1st, 2015. This means that if an individual reaches the age of 65 without dying due to suicide at that time, it is right-censored. Similarly, on January 1st, 2015, all individuals under observation who did not die by suicide were right-censored.

Some other types of right-censoring can happen before the end of the observation. One can die due to other causes, move abroad, or be deregistered for unqualified reasons. Some censors can be qualified as informative or non-informative. In the case of informative censors, we assume that the event that led to the censoring can bias the results relative to our primary failure. In our case, dying from another cause is not entirely independent of dying due to suicide. Previous studies show that

physical pains, some diseases, or pathologies can lead to suicide risk (Conejero, Olié, Calati, et al., 2018a). Also, some unhealthy behaviours, such as alcohol and drug use, are associated with increased suicide risk (Värnik et al., 2007) and lethal pathologies (Room et al., 2005). In Chapter 5, we also consider residential mobility as a possible informative censor, as mobility and suicide are not independent.

These informative censors can be considered alternative outcomes that are not fully independent from suicide and can "prevent" suicide from happening or being observed. In previous studies using event history analysis to investigate suicide determinants, these competing risks were not accounted for (Bauwelinck et al., 2017; H.-E. Lee et al., 2020), mainly due to a lack of data. One of the methodological contributions of this thesis is to use competing-risk models to control for alternative outcomes. The Fine-Gray sub-distribution hazard models are usually mobilised to estimate the hazard of an event in the context of existing competing risks or alternative outcomes. It is based on the cumulative incidence function of the two events considered (Austin et al., 2021). The general survival analysis is defined as a cause-specific hazard function. The cumulative incidence function can be retrieved from the hazard function and be written as such (5):

$$CIF_c(t_f) = \sum_{f'=1}^{f} \hat{I}_c(t_f) = \sum_{f'=1}^{f} \hat{S}(t_{f'-1}) * \hat{h}_c(t_{f'}) \tag{5}$$

Where $\hat{I}_c(t_f)$ is the incidence probability of failure from an event c at time t_f; $\hat{h}_c(t_{f'})$ is the hazard function that estimates the time of failure of the event of interest t_f; $\hat{S}(t_{f'-1})$ is the overall probability of survival until time t-1, just before the event happens. The incidence probability of failing at a specific time is the product of the failure hazard from survival until the failure. The cumulative incidence is the sum of all incidences associated with all events f possible. The Fine-Gray sub-distribution hazard model (Fine & Gray, 1999) allows the derivation of the hazard model in the same way as a Cox model, except that it models a hazard function derived from the CIF, enabling it to control for the presence of the previous competing events.

Another type of censor is left-censor, when all observations do not start simultaneously. In Chapter 7, we allow individuals to enter the observation later than January 1st, 2008, in two cases. First, if they reach the age of 20 between this date and the end of the year 2014. Second, if they get domiciliated and registered in Belgium for at least one year during our observation period. Their observation starts when they register, and time at risk is calculated in consequence.

c. Relative importance of predictors

In addition, to observe which categories of the population are more at risk of suicide (according to age, marital status, or levels of housing comfort…), another question that arises is to understand the relative importance of a predictor compared to another (e.g. is age more important than housing comfort when it comes to suicide?). This aspect of the multivariate analysis is rarely considered in the existing literature on mortality and, *a fortiori*, suicide determinants. Investigating the differences between population subgroups defined by the determinants is often preferred. Still, the relative importance of the information carried by the variables is often omitted. To estimate the weight of a predictor on suicide risk, we calculated the pseudo-partial corrections to evaluate the relative importance of each predictor on the outcome – the suicide risk, or in other terms, the weight of this predictor on the studied phenomenon controlling for all other variables in the model. As we are working on a dichotomous outcome (suicide or not), we used pseudo-partial correlations (*R*) calculated based on logistic models (Bhatti et al., 2006). The use of pseudo-partial correlations allows using categorical and dichotomous variables among the predictors, as we work with the Wald statistics. The pseudo-R statistic is then calculated as such from logistic regression (6):

$$R = \sqrt{\frac{Wald\ statistic - 2K}{-2LL_0}} \qquad (6)$$

The partial correlation can be negative or positive, according to the direction of the relation. But in our case, the weight will be taken as an absolute value, as the order is already given through the

models, and only the weight of the relation interests us. *K* is the degree of freedom for the variable. LL_0 is the log-likelihood of the model that contains only the intercept.

An alternative – and a more usual – way to measure the relative importance of the predictors on our interest outcome is to compare the Akaike Information Criterion (AIC) of the full models – that contain all the selected covariates – with different models that omit one variable at a time. The difference in AIC between the full model and the model deprived of a predictor estimates the relative importance of this predictor in the model, given the other predictors. The AIC is often used as a tool to assess the goodness of fit of a model and can be defined such as: $AIC = 2K - 2(Log - Likelihood)$ where *K* is the degree of freedom, and the log-likelihood is the log of the maximal value of the likelihood function of the model. The higher the likelihood, the better the model. By extension, the lower an AIC, the better the model fits.

A comparison of these two methods to compare the relative importance of the predictors is suggested in Chapter 5.

IV. WORKING WITH POPULATION DATA

Many usual statistical tools, such as p-values and confidence intervals, are part of inferential statistics. This approach is used in survey analysis when the data is collected among a part of the population. It aims to generalise results found in a representative population sample to the total population. Inferential statistics are based on the central limit theory: if the samples are large, the distribution of the sample means will be close to a normal distribution (Lamorte, 2016). In many cases, samples are preferred in social sciences because finances and time are more manageable and less expensive (Gibbs et al., 2017). Research based on samples needs to attribute a level of confidence when they want to generalise the estimates to the whole population. Some tools, like *p*-values or confidence intervals, are required to validate these estimates. The *p*-value, for instance, gives the probability of the sample statistics in the context where the sample was derived from a

population in which the null hypothesis is precisely true (Gibbs et al., 2017; R. M. Warner, 2012). The confidence intervals gather 95% of the possible estimates if the model is reiterated with many more representative samples from the same population (R. M. Warner, 2012).

In our case, we work on population data, which is a dataset that already covers the whole population. Should we use inferential statistics? A first school interprets inferential statistics for population data, as population data are still at risk of randomness. In this case, we assume there is a "super-population" from which our interest population is drawn. This super-population can be supposed to exist or to have existed in other circumstances. The reality covered through administrative datasets can be considered one possibility, among other possibilities. Because of data collection biases and randomness, the estimates provided by the models are not descriptive and do not represent strict reality. Many studies based on Belgian population data strictly used inferential statistics in their interpretation (Balogh et al., 2021; Bauwelinck et al., 2022; Mendoza et al., 2023).

Another school takes the definition of inferential statistics as strictly as possible. Where there is no inference process, the inferential statistics tools do not represent any "significance" of the results. In my thesis, I prefer this second school for several reasons. First, I work on suicide, a rare event in the population. Among more than 11 million inhabitants, Belgium counts 2,000 suicides a year. Our estimates are surrounded by large confidence intervals, representing the rareness of this event and the small numbers, not of the relations' weakness. Also, I find it difficult to justify using inferential tools, as the principle of randomness often used appears hard to quantify. Access to Belgian administrative data is a real asset: it is a high-quality source of information covering the population's quasi-wholeness. Registration is compulsory in Belgium, and only illegal migrants are not covered by these data sources. In addition, the strict use of inferential statistics in population data analysis is problematic, mainly because it could lead to ignoring some possible results and encountering a type-II error, i.e. missing out a "real" effect (Bernardi et al., 2017). In a study based

on the educational system in the US, Gibbs (2017) showed that the interpretation of inferential statistics could be misleading. For instance, many population-based studies considered that teachers' effectiveness did not vary between their first year of teaching and the following years because those results were "not significant," This element was then disregarded as a potential factor in educational system quality (Gibbs et al., 2017). Even though the estimates indicated a relation, Flores and Park (2013) rejected the relation between race and college completion after accounting for the characteristics of the school (Flores & Park, 2013; cited by Gibbs et al., 2017). White and Gorard (2021) speak of a "cult" of inferential statistics and highly criticise the use of these tools in analysing population data. Following their idea, inferential statistics should be strictly used when we expect results to be generalised to a larger population (White & Gorard, 2017).

In my thesis, I choose a compromising presentation of the results - still displaying all 95% confidence intervals - but interpretations do not follow inferential statistics rules strictly. On the contrary, results are interpreted with more nuance and according to other information (White & Gorard, 2017), such as the substantive significance in the difference between the estimates. Bernardi et al., (2017) suggested to replace statistical significance by sociological or substantive significance. Instead of the inferential statistics, they argue that the use of an "informed benchmarking of the estimates" to measure whether the effect strength is strong enough to conclude. Knowing that suicide is a rare event, a plausible threshold to define a social significance of a result would be a different of 5 percentage-points between estimates (odds-ratios or hazard ratios), and an overlapping of less than 20% of the confidence intervals between categories or with the reference category. Regarding predicted relative hazard ratios, the relative scale might make it difficult to really compare the estimates and come with a substantial threshold: still the confidence intervals can help us estimate the strength of a relationship. I suggest that an overlapping of less than 20% of the confidence intervals indicates a reliable effect strength. More precisely, I define that two categories presented a socially significant difference in suicide mortality if the confidence interval of the first does not cover more than a fifth (20%) of the confidence interval of the second.

CHAPTER 5

DO TENANTS SUFFER FROM STATUS SYNDROME? HOMEOWNERSHIP, NORMS, AND SUICIDE IN BELGIUM[3].

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[3] This chapter was co-written with Professor Christine Schnor (UCLouvain) and published in 2022 in *Demographic Research*. This paper was presented online at the *International Population Conference* in 2021 and the *European Population Conference* in 2020.

I. INTRODUCTION

Among the socioeconomic determinants that affect suicide risk, housing conditions and tenure are poorly studied due to a lack of good-quality data. Existing studies often reduce housing tenure to its economic dimension (Lorant, Kunst, Huisman, Costa, et al., 2005). On the one hand, homeowners can be considered a selected population, as homeownership requires material resources and access to information about credit programs and available real estate (Haurin et al., 2007). On the other hand, previous research has demonstrated that homeownership is associated explicitly with better physical and mental health (Herbert & Belsky, 2008; Hiscock et al., 2001; Ineichen, 2003; Macintyre et al., 2003) and lower risk of suicide for both sexes (DeBastiani et al., 2019; Lorant, Kunst, Huisman, Costa, et al., 2005). Homeownership is viewed as an essential milestone in the residential experience. It is normative for life stages when financial stability is expected to be achieved (Hiscock et al., 2001), i.e., when one is getting older, is married, or is a parent. Not performing this social norm by a given age could be interpreted as a failure and may increase the risk of poor mental health to a different extent for men and women (Cleary, 2012). Suicide and homeownership are strongly associated with socioeconomic background (educational attainment, occupation, income), but they are also subject to social norms related to gender, age, life events, and living arrangements (Ellaway et al., 2016; Lorant, Kunst, Huisman, Bopp, Mackenbach, et al., 2005).

To our knowledge, no previous studies investigate the role of gender and social norms on the relationship between housing tenure and suicide. We aim to evaluate whether the relationship between homeownership and suicide differs according to age, life stages, and living arrangements, considering the social norm of homeownership in the life course for each gender. We want to provide a more nuanced view of the link between homeownership and suicide without claiming a causal relation.

I. LITERATURE REVIEW

1. *Social determinants of suicide: the status syndrome*

Recent studies affirmed and extended Durkheim's theorisation of the socioeconomic and demographic inequalities in suicide. Social status (Marmot, 2004a) provides an essential framework for understanding the link between social norms, well-being, and potential suicide. It stresses that social inequalities in mental health and mortality go beyond the rich/poor dichotomy and depend on one's position compared to one's peers. Individuals' decisions are influenced by others' life courses and social expectations of when life events should happen and in what order (Liefbroer & Billari, 2010). These expectations are asserted in two ways: through internalised condemnation (manifesting as feelings of shame or guilt) of some behaviours or decisions, or their absence, at a certain age (Heckhausen, 1999; Horne, 2003), and through social rejection (expressed through conflict or gossip) of events happening outside a normative age span (Liefbroer & Billari, 2010). Insecurity about one's social integration and interpersonal relations is detrimental to a person's mental health, feeding the risk of depressive states and life-threatening behaviours (Heikkinen et al., 1993b; Milner et al., 2012). Moreover, socially disadvantaged individuals face more uncertainty and have lower self-esteem and a negative social image. They may cumulate stress factors, creating obstacles to their relations with others (R. C. O'Connor & Nock, 2014; Stansfeld et al., 1997). Men, who are traditionally expected to ensure their household's material security (Payne et al., 2008a), and women, to a lesser extent, are at a significantly higher risk of suicide when they are unemployed (Artazcoz et al., 2004b) or have lower education – and working conditions (Blakely et al., 2003) and employment status (Milner et al., 2013; Min et al., 2015) partly mediate this relationship.

The impact of social norms is heavier in contexts where norm transgression is less common. For example, an analysis of 38 countries showed that divorce was more detrimental to well-being in countries where divorce was rare (Kalmijn, 2010). Another study in 24 European countries showed that childlessness was associated with poorer psychological well-being in countries where family

norms were more rigid (Huijts et al., 2013). Liefbroer and Dourleijn (2006) also demonstrated that the risk of divorce for individuals who had cohabited before marriage was always higher than for those who married without any period of cohabitation. Still, this relation was robust and visible when cohabitation was rare – cohabitants show there an unusual tendency to avoid marital commitment and might have less trust in their relationship – or widespread – people who marry directly are a very selected population that might have excellent compatibility or personal dispositions to avoid union dissolutions (Liefbroer & Dourleijn, 2006). Regarding housing tenure, we can expect that, in countries such as Belgium, where the transition to homeownership is normative, not achieving this milestone could have more detrimental effects on mental health than in countries where being a tenant is more common. In Belgium, where most of the population achieves homeownership, we can consider that tenants might be a selected population, with a shallow socioeconomic position or a less stable family life, compared to the rest of the people.

Mental health outcomes are related not only to social norms but also to individual demographic characteristics. Being a woman is associated with more frequent suicidal thoughts and attempts, while being a man is linked with a higher risk of suicide (Blair-West et al., 1999; Bossuyt & Van Casteren, 2007; Payne et al., 2008a; Van der Heyden et al., 2009a). In contrast to the pressure on men to hide their inner struggles, women's better handling and expressing their feelings can explain this paradox (Dykstra & Keizer, 2009a; Payne et al., 2008a). Instead of seeking help or expressing their depressive states, men are likelier to turn to substance abuse or violence as coping mechanisms, hence their higher risk of not surviving suicide attempts (Cleary, 2012; Payne et al., 2008a).

For both genders, suicide risk increases with age and tends to peak in middle age (Stack, 1982a, 2000), as this phase of life includes many personal and professional challenges but also disruption, frustration, and disappointment (Graham, 2015a; Milner et al., 2012), such as marital separation or job loss. Older adults' well-being might depend more on health status and chronic pain (Conejero

et al., 2016; Conejero, Olié, Calati, et al., 2018b). Being involved in an active social life or a family life and living with a partner or with children (Conejero et al., 2016; Conejero, Olié, Calati, et al., 2018b; Hooghe & Vanhoutte, 2011) are associated with better physical and mental health (Borges et al., 2010; J. M. G. Williams & Williams, 1997b), but differently for both genders. However, family norms for men and women are central to societal expectations. For women, being childless during the reproductive years is associated with poorer well-being (Graham, 2015a) and higher suicide risk (Stack, 1982a, 2000), while the trend is reversed for never-married women aged 65 and over (Graham, 2015a; Hank & Wagner, 2013). For men, marital status counts more than parenthood regarding their life satisfaction (Dykstra & Keizer, 2009a) and suicide rate (Bruce & Kim, 1992b).

1. The social norm of homeownership

Homeownership is a social norm, an accepted way of living and behaviour that people believe others expect of them (Ajzen & Fishbein, 2005; Liefbroer & Billari, 2010). At a certain age, access to the property is scheduled according to the social ideal. It represents the possibility of engaging in long-term material projects, such as buying and maintaining a dwelling through a mortgage. Not attaining this status can be perceived as a failure, a deviation from the norm (Bugeja-Bloch, 2013; Hiscock et al., 2001). Being a tenant as a 20-year-old single and childless young worker or student may be socially accepted, whereas being a tenant as a 50-year-old partner and parent may not comply with the norm and may suggest material instability. When around 70% of Europeans (OECD, 2015, 2017) own their dwelling, being a tenant can result in deprivation. It can feed social stigma about vulnerable groups, such as single mothers or the lower-educated (Bugeja-Bloch, 2013). Homeownership enhances one's status in society, bringing about a sense of achievement and better confidence in the future. Consequently, homeowners may adopt a healthier lifestyle, leading to a longer life and better physical and mental health (Ignatieff, 1996; Marmot, 2004a).

2. Housing tenure: A determinant of well-being and suicide risk

Homeownership is positively associated with the individual's well-being (Herbert & Belsky, 2008), except for low-income households who sacrifice their comfort and ability to pay their bills by becoming owners (Mulder & Lauster, 2010). Homeownership is often related to a better situation than rented housing (Herbert & Belsky, 2008; Ineichen, 2003) regarding geographical location, environment, and housing quality (Macintyre et al., 2003). In addition, tenants are less likely than homeowners to renovate at their own expense as their dwelling may only be temporary (Herbert & Belsky, 2008). The symbolic meaning of housing affects health: the home is considered a place of safety, belonging, and control, set against the uncertainties of the outside world (M. Shaw, 2004b). Hiscock et al. (2001) applied the concept of ontological security to refer to well-being associated with homeownership. Most of the 43 homeowners and tenants they interviewed reported homeownership as a social achievement and an investment in their future well-being and that of their offspring. Homeowners reported more self-esteem, confidence for the future, and a better appreciation of life in general (Hiscock et al., 2001). These advantages are apparent for all household members of an owned-occupied accommodation – from children to older adults (Galster et al., 2007). For some younger or middle-aged adults, the experience of living in an owner-occupied place can mean living or returning to the parental home or living at a partner's place. In such a situation, they can benefit from a better living environment. Still, they can also suffer from a low level or a loss of economic independence, hence poorer mental health outcomes (Copp et al., 2017).

According to the literature, it is difficult to discern whether the beneficial effect of homeownership on mental health stems from a selection effect, a causal effect, or a combination of both (Hiscock et al., 2001; Macintyre et al., 1998). People who can afford to buy and keep their dwelling may be predisposed toward better mental health and better access to medical and mental health resources, social support, and material options for overcoming life issues and depressive states (Ellaway et al., 2016; Holupka & Newman, 2012; Slominski et al., 2011; Smith et al., 2003). The therapeutic effect,

or the causal effect, of housing tenure is more challenging to apprehend. Being an owner does not always render immediate advantages in terms of health or having the resources to counter suicidal thoughts or behaviours, and it entails the pressure of taking a long-term financial obligation (Macintyre et al., 1998; Smith et al., 2003); however, it does provide better housing quality and a higher social standing (Herbert & Belsky, 2008; Hiscock et al., 2001).

In empirical studies, homeownership has been associated with a lower risk of suicide. Studies in the United States (DeBastiani et al., 2019) and Europe (Lorant, Kunst, Huisman, Costa, et al., 2005) describe housing tenure as a significant determinant in suicide risk, among other socioeconomic factors such as education and occupational category. In Norway, Finland, Denmark, Belgium, and England/Wales, higher risks of suicide were found for tenants compared to owners, especially in Norway and Denmark for men and in most of these countries for women, whatever their educational level (Lorant, Kunst, Huisman, Costa, et al., 2005). However, little is known about how social norms related to homeownership can affect the relationship between housing tenure and suicide and how this relationship varies according to age and household composition for men and women.

3. Housing tenure in Belgium

For the following, we draw on recent work by Schnor and Mikolai (2020), who described Belgium's housing market (Schnor & Mikolai, 2020). Homeownership, or living in an owner-occupied accommodation, is normative in Belgium (Fikse & Aalbers, 2021), as shown by its high prevalence of homeownership (69% in 2001) compared to the rest of the European countries and its housing structure marked by a short supply of affordable rental housing (OECD, 2015, 2017). The social housing sector accounts for only about 6% of the country's housing stock, which is insufficient to provide for all those whose low income qualifies them for social housing, forcing some of them to rent on the private market (Andrews et al., 2011). In Belgium, housing prices have increased in recent decades, outpacing the rest of Europe (OECD, 2017). Belgium's tax system is advantageous

for homeowners compared to tenants. Still, the banking system does not facilitate access to ownership for low-earning households, as loans remain hard to get (Lahaye et al., 2013). Many tenants (34%) than owners (2.4%) spend 40% or more of their income on housing. The financial means of tenants have weakened over time, which makes renting financially difficult and undesirable as a tenure status (Halleux & Strée, 2012; Hiscock et al., 2001; OECD, 2015; Schnor & Mikolai, 2020). Belgium's 2001 census data shows that single women and single mothers are at risk, with little access to homeownership and good-quality housing (Vanneste et al., 2007).

In Belgium, for the period 2011–2015, the life expectancy of homeowners is estimated to be 5.6 years longer for males and 3.6 for females than for their tenant counterparts (Eggerickx et al., 2018; Van Aerden et al., 2019). Being a tenant in the Belgian context – where homeownership is widespread – is tantamount to going against the tide. This norm's transgression can harm people's self-esteem, social integration, and well-being (Hiscock et al., 2001; Huijts et al., 2013; Kalmijn, 2010; Liefbroer & Billari, 2010). Some quantitative literature approached the question of the social norm with topics other than homeownership (Huijts et al., 2013; Kalmijn, 2010; Liefbroer & Dourleijn, 2006), while some qualitative studies could already highlight that being a tenant could be a synonym for lack of self-esteem and low life satisfaction (Hiscock et al., 2001).

4. Research hypotheses

Literature shows that homeownership positively affects well-being and mental health (Galster et al. 2007; Herbert and Belsky 2008). **As a first *hypothesis*, we assume that homeownership is negatively related to suicide risk independently of demographic, socioeconomic, and health-related characteristics, including educational level, occupational category, and subjective health (H1).**

Homeownership is seen as a significant achievement in terms of residential experience and is normative, especially for those expected to have achieved financial stability, i.e., those who are getting older or have children or a resident partner. Not complying with this social norm by a given

age and family status may be interpreted as a failure and may increase the risk of poor mental health, social stigmatisation, depression, and suicide. **Our *second hypothesis* is that the negative relation between homeownership and suicide strengthens for middle-aged adults (mid-30s to late 50s) in their working and childrearing years when the social norm of homeownership weighs particularly heavily (H2).**

However, we do not expect the same patterns for men and women. As homeownership highly depends on economic resources, men, traditionally seen as the breadwinner, are expected to take responsibility for the material comfort of their partner and/or children and feel some pressure to provide security for the whole household. **Our *third hypothesis* is that middle-aged male tenants have a higher risk of suicide than owners, especially when living with a partner and/or children (H3).** Contrary to men, women are not traditionally expected to ensure the material security of the household. Women are the only ones responsible for their housing career when they are unpartnered. Women of childbearing age who do not have children have poorer well-being on average, suggesting a link with their infringement of the traditional expectations of motherhood. Women without a partner and/or without children may benefit from homeownership because of the sense of belonging and trust in the future it provides. Homeownership may also compensate for instability in other areas of their life course. On the other hand, renting may signal instability and a lack of social integration and investment in the future. The cumulation of renting and going against the traditional expectations of gender norms may be detrimental to middle-aged women's well-being and consequently impact their risk of suicide. **Our *fourth hypothesis* is that tenant women have a higher risk of suicide, especially if they are middle-aged and older childless and unpartnered tenants (H4).**

II. DATA

The data combines socioeconomic information from Belgium's 2001 census (Enquête socio-économique générale), demographic information from Belgium's National Register for 2001–2003, and information about the date and cause of death from Belgium's death certificates for 2002–2003. The census consisted of one questionnaire per individual and one questionnaire per household about housing. Information about homeownership does not indicate which household member owns the home; consequently, we cannot make any differences between actual homeowners and people who live in an owner-occupied place without actually owning it (e.g., younger adults living with their parents). For simplicity, we will refer to homeownership to define living in a place owned by at least one household member.

1. Analytical sample.

As our data on homeownership stems from the 2001 census, we restricted our observation period to suicides committed in 2002. As a robustness check, models considering suicides in 2002 and 2003 were conducted and are presented in the methodological appendix (Appendix, Figure A-M1). We concentrate on the adult population aged 25–69 in 2001, i.e., individuals born between 1932 and 1981. We excluded suicides among the young and the old due to the specificity of their motives and orientation toward specific factors. Unlike older people, working-age adults are less exposed to extreme isolation due to their work activities, are more frequently exposed to friend and family relationships, and have greater mobility. Similarly, health problems are less prevalent and less of a source of mobility deprivation. For young people under 25, as they most often live with their parents, it makes little sense to consider their housing tenure. Our analytical sample includes N=3,000,870 men (17,405 deaths, including 1,098 suicides in 2002) and N=2,996,314 women (9,333 deaths, including 441 suicides).

2. Variables

In the housing questionnaire, the household reference member was asked to indicate whether the household owned the dwelling or rented it from the private or the public sector. As the social housing market is marginal in Belgium (Andrews et al., 2011), only two categories were kept: owner and tenant. The social housing market only represents less than 3% of the total housing supply, so it was included in the "tenant" category. This answer is attributed to all household members without knowing which member is the legitimate owner. Complex configurations (e.g. homeowners renting one room of the housing they live in) cannot be spotted: as soon as the accommodation is occupied by their owner, the category "owner" will be attributed. The questionnaire also gathered information about housing quality, such as at least one bathroom within the dwelling, the presence of central heating, and the household density, i.e., the number of inhabitants per room. Those variables will be considered covariates, as housing tenure is associated with better housing quality (Macintyre et al., 2003), and poor housing conditions are related to depression and anxiety (Singh et al., 2019a). More variables are available in the questionnaire and will be studied in Chapter 6. Here, only the variables present in the 2011 Census were selected to reiterate the analysis in 2011-2012 in future research.

The dependent variable, death by suicide, is defined by the 10th revision of the International Classification of Diseases as codes X60 to X84.

The study will include a series of covariates. Household compositions are strong determinants of homeownership (Mulder & Lauster, 2010) and suicide risk (Conejero et al., 2016; Hooghe & Vanhoutte, 2011). Living arrangements were reconstructed based on information on the relationship of each household member to the reference member and on the civil status of all household members available in the National Register. The parental relationship is here defined by the presence of children (biological, adoptive, or step) in the household and not by being a biological parent. Finally, where there is an unrelated individual within the household, we assume

an unmarried partnership, a broad way of defining a coresident couple that can also include situations of flat sharing and thus overestimate the phenomenon. The nationality of the person (Belgian, other European, non-European) implies different general health status (migrants show a better health status for selection reasons: Deboosere & Gadeyne, 2005), cultural factors (e.g., religiosity can lead to rejecting suicide: Wu et al. 2015) and problems of socioeconomic integration that impact individuals' risk of suicide (Bauwelinck et al., 2017) and access to homeownership (Davidov, Weick 2011). The region of residence (Flanders, Wallonia/Brussels) is a factor to consider in the relation, as regions conduct different policies in terms of housing and mental healthcare. The area of residence (urban, suburban, rural) influences people's access to homeownership, as being a tenant is way more common in cities than in the countryside (Xhignesse et al., 2014) and suicide risk (Hooghe & Vanhoutte, 2011). The educational attainment (primary, low secondary, high secondary, higher education) and occupational status also condition access to homeownership (Rameli et al., 2016) and suicide risk (Conejero et al., 2016). For this last variable, we distinguished between unemployed, inactive populations, permanent work contracts, temporary contracts, and self-employed activities. Literature showed that professional contracts significantly impacted attitudes and well-being (De Cuyper et al., 2010). In Belgium, job insecurity and fairness are factors in the active population's well-being, health, and attitudes toward the labour market and organisations (Bernhard-Oettel et al., 2011; De Witte et al., 2012). The 2001 census also yields information about the individual's subjective health status based on a five-level scale (very good, good, intermediate, bad, very bad). The models including this variable are presented in the Appendix in this chapter. In future chapters, they will be included in the main results.

III. METHODS

We first used multinomial logistic regressions to estimate the likelihood of dying by suicide in 2002. Our dependent variable distinguishes suicide (1) and death from another cause (2) to survival (0). We build up our model step-wisely. Model 1 estimates the relationship between housing tenure

and suicide, controlling for age. In a second series of models, we check whether our results are robust when we include information on housing quality – measured by the presence of a bathroom, the presence of central heating, and density of occupancy – demographic characteristics (nationality, region, and area of residence, household configuration), educational level and occupational status (see Table 1). As subjective health is highly related to suicide rates (see Appendix, Table A-2), we only presented models controlling for this covariate in the Appendix (Table A-4). Models presented in this section include age as a linear specification with a quadratic term. More flexible models, based on five-year age groups, are shown in the methodological appendix (Appendix A-M2).

We estimated interaction effects between age and housing tenure to test our hypothesis of the age-dependent social norm of homeownership on the risk of suicide in Belgium. In these models, we use multinomial logistic regressions, distinguishing suicide (1) and deaths from other causes (2) from survival (0). Results for death from other causes are displayed in the appendix (Figure A-6). Finally, we estimated a threefold interaction between age, housing tenure, and living arrangements to address whether specific household configurations increase individual vulnerability. To do so, we calculated the predicted probabilities of suicide for homeowners and tenants according to their age and for different household configurations.

IV. RESULTS

1. Suicide and age

Figure 5.1 shows age-specific suicide rates for men and women.

Figure 5.1 - Suicide rates (per 1,000) per age, male and female population aged 20–69, 2002.
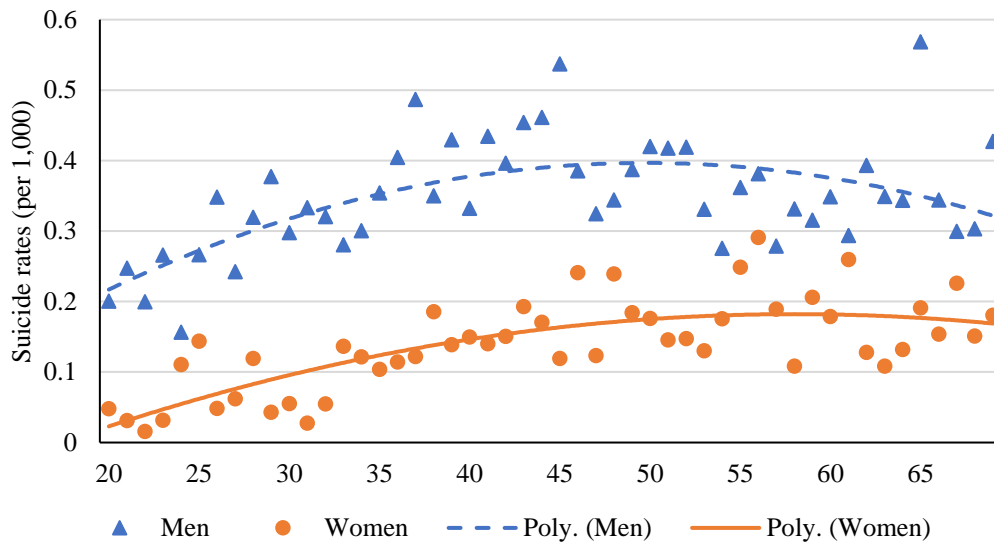
There is a rise in suicide from young adulthood, from approximately 20 to 35, followed by a peak in the 40s and the 50s for men and women and a subsequent decrease. In our model, next to a linear term, we add a quadratic term to approximate these curvilinear trends. This method is equivalent to a log-quadratic function, put forward by Horiuchi (2003), to assess the acceleration of human mortality among the middle-aged adult population (Horiuchi, 2003).

2. Homeownership, age, and household composition

In 2001, throughout all adult ages, most women and men residing in Belgium were homeowners (see Appendix, Figure A-1). The proportion of young owners in their early 20s is very high, reflecting that many young adults live in their parents' homes. From 20 to 29, young people start to get independent, hence a drop in homeownership. At 26, the proportion of owners is at its lowest (50%) and then increases rapidly, probably due to Belgian housing policies that provide incentives to acquire property (Lahaye et al. 2013). From age 40, the proportion of owners reaches 70%, and after that, it remains high. Men and women show similar patterns.

We observe that the proportion of homeowners is substantially lower among singles and cohabiting couples than among married couples (Table A-1, Appendix). Regarding residence with children, 78.1% of men and 73.7% of women living with their children are owners. Among people living without children, the proportion of homeowners is lower (57.7% for men and 62.6% for women).

3. Main effects

Regression model results are presented as coefficients in Table 5.1 for men and women, including the main variables of interest: housing tenure, age, and household type.

Table 5.1 - Multinomial logistic regression results (Relative risk ratios and [95% CIs]) on the likelihood of suicide or death from other causes in 2002 (vs. survival), male and female population aged 25–69.

		SUICIDE				OTHER			
		Men		Women		Men		Women	
		Model1	Model2	Model1	Model2	Model1	Model2	Model1	Model2
Housing tenure (ref. Owner)									
	Tenant	1.72	1.36	2	1.56	1.87	1.42	1.75	1.45
		[1.51 - 1.97]	[1.17 - 1.59]	[1.63 - 2.46]	[1.23 - 1.97]	[1.80 - 1.94]	[1.37 - 1.48]	[1.63-2.46]	[1.37 - 1.52]
	Unknown	2.69	1.21	3.2	1.66	2.9	1.32	3.2	1.3
		[2.24 - 3.23]	[0.80 - 1.82]	[2.38 - 4.31]	[0.88 - 3.13]	[2.24 - 3.23]	[1.20 - 1.46]	[2.38-4.31]	[1.13 - 1.49]
Age		1.07	1.08	1.16	1.2	1.11	1.11	1.16	1.14
		[1.03 - 1.11]	[1.03 - 1.14]	[1.09 - 1.24]	[1.11 - 1.30]	[1.09 - 1.13]	[1.09 - 1.12]	[1.09-1.24]	[1.12 - 1.17]
Age²		0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
		[0.99 - 1.00]	[0.99 - 1.00]	[0.99 - 1.00]	[0.99 - 1.00]	[0.99 - 1.00]	[0.99 - 1.00]	[0.99-1.00]	[0.99 - 1.00]
Bathroom (ref. yes)									
	No		1.01		1.4		1.17		1.32
			[0.76 - 1.33]		[0.90 - 2.19]		[1.10 - 1.25]		[1.20 - 1.45]
Central heating (ref. yes)									
	No		1.04		1.04		1.17		1.18
			[0.89 - 1.20]		[0.82 - 1.31]		[1.12 - 1.21]		[1.13 - 1.25]
Household density									
			1		1		1		1
			[0.99 - 1.00]		[0.99 - 1.00]		[0.99 - 1.00]		[0.99 - 1.00]
Household type (ref. Married w children)									
	Married w/o children		0.94		1.59		1.04		1.14
			[0.76 - 1.16]		[1.16 - 2.18]		[0.99 - 1.09]		[1.06 - 1.22]
	Cohabitant w children		1.22		0.97		0.9		0.83
			[0.83 - 1.79]		[0.44 - 2.14]		[0.77 - 1.05]		[0.65 - 1.06]
	Cohabitant w/o children		1.27		1.14		0.93		1.2
			[0.91 - 1.77]		[0.58 - 2.22]		[0.84 - 1.04]		[1.03 - 1.39]
	Single		1.73		2.93		1.27		1.17
			[1.36 - 2.21]		[1.89 - 4.55]		[1.17 - 1.36]		[1.04 - 1.31]
	Lone-parent		1.44		1.65		1.14		1.07
			[1.05 - 1.99]		[1.05 - 2.61]		[1.03 - 1.26]		[0.95 - 1.21]
	Unknown, other		1.11		1.34		1.12		1.27
			[0.85 - 1.47]		[0.84 - 2.16]		[1.04 - 1.20]		[1.15 - 1.41]

Civil status (ref. Single)					
	Married	1.07	0.95	0.79	0.66
		[0.85 - 1.35]	[0.63 - 1.45]	[0.74 - 0.85]	[0.59 - 0.73]
	Widow·er	0.411.47	1.09	1.05	0.85
		[0.96 - 2.24]	[0.69 - 1.72]	[0.97 - 1.15]	[0.77 - 0.94]
	Divorced	1.23	1.23	1.02	0.85
		[0.98 - 1.54]	[0.86 - 1.77]	[0.96 - 1.09]	[0.77 - 0.93]
	Unknown	1.43	1.09	0.76	0.31
		[0.59 - 3.46]	[0.21 - 5.61]	[0.56 - 1.02]	[0.18 - 0.55]
Region of residence (ref. Flanders)					
	Wallonia	1.24	1.25	1.33	1.18
		[1.07 - 1.42]	[1.00 - 1.55]	[1.28 - 1.38]	[0.12 - 1.24]
	Brussels	0.86	0.7	1.04	1.1
		[0.65 - 1.14]	[0.47 - 1.05]	[0.97 - 1.11]	[1.01 - 1.20]
Area of residence (ref. urban)					
	Suburban	1.06	0.75	0.91	0.9
		[0.84- 1.32]	[0.52 - 1.08]	[0.86 - 0.96]	[0.83 - 0.97]
	Rural	1.13	0.93	1.05	0.99
		[0.94 - 1.35]	[0.70 - 1.23]	[1.00 - 1.11]	[0.93 - 1.06]
Nationality (ref. Belgian)					
	European	0.36	0.29	0.75	0.6
		[0.25 - 0.53]	[0.14 - 0.60]	[0.70 - 0.81]	[0.53 - 0.67]
	Non-European	0.18	0.39	0.67	0.71
		[0.08 - 0.41]	[0.14 - 1.10]	[0.58 - 0.77]	[0.59 - 0.85]
Educational level (ref. Primary or less)					
	Lower Secondary	0.88	1.05	0.91	0.9
		[0.72 - 1.07]	[0.76 - 1.46]	[0.87 - 0.95]	[0.84 - 0.96]
	Higher Secondary	0.8	1.27	0.9	0.91
		[0.65 - 0.99]	[0.90 - 1.78]	[0.86 - 0.95]	[0.85 - 0.98]
	Higher, tertiary	0.6	1.46	0.75	0.73
		[0.60 - 0.76]	[1.01 - 2.09]	[0.71 - 0.80]	[0.67 - 0.80]
	Unknown	0.8	0.99	1.07	1.16
		[0.62 - 1.03]	[0.66 - 1.48]	[1.02 - 1.12]	[1.08 - 1.24]
Occupational status (ref. Unemployed)					
	Inactive	0.84	0.69	0.63	0.79
		[0.66 - 1.06]	[0.50 - 0.94]	[0.59 - 0.66]	[0.40 - 0.52]
	Permanent contract	0.57	0.51	0.38	0.38

	[0.48 - 0.68]		[0.39 - 0.68]		[0.36 - 0.40]		[0.33 - 0.43]	
Temporary contract	0.94		0.30		0.50		0.38	
	[0.66 - 1.34]		[0.14 - 0.66]		[0.42 - 0.60]		[0.31 - 0.47]	
Liberal, independent	0.63		0.64		0.38		0.31	
	[0.49 - 0.82]		[0.37 - 1.12]		[0.35 - 0.41]		[0.20 - 0.49]	
Unknown	0.59		0.71		0.41		0.49	
	[0.43 - 0.83]		[0.43 - 1.17]		[0.37 - 0.46]		[0.41 - 0.58]	
N	2,996,314	2,996,314	3,000,870	3,000,870	2,996,314	2,996,314	3,000,870	3,000,870

Notes: Model 1 controls for age and quadratic term of age; Model 2 controls for Model 1 + household type, region, area of residence, nationality, education, occupational category, presence of a bathroom, presence of central heating, and household density.

Notes bis: [a] no response or information about housing tenure; [b] measured through the number of household members per room; [c] collective households, households above 16 persons, flat-sharing.

Sources: Census of Belgium 2001, National Register data, death certificates; authors' calculations.

The results show that renting is related to higher suicide risk among men and women, and this finding is robust to all controls (cf. Model 1 and Model 2). This is not specific to suicide mortality, as mortality risks from other causes are higher for tenants than owners. In addition, we observe that age is associated with an increased risk of suicide among men and women. The effect of household type is gendered. Men show a higher risk of suicide if they are unmarried (whether or not they live with a partner); the presence of children is not associated with men's suicide risks. Women's risk of suicide is lower if they are married and live with children. Women in cohabiting relationships have a higher suicide risk, but this might be driven by a selection effect: controlling for subjective health, differences between women in marital and cohabiting unions disappear. Women living without a partner have a higher risk of suicide, especially if they live without children.

When comparing suicide and mortality from other causes, we first notice that women who are single with no children or married without children face a higher risk of suicide than married women with children. In comparison, they do not encounter higher mortality risk from other causes. Results also show that better-educated women show a higher risk of mortality from suicide than women with low educational levels. This result aligns with recent studies (Lorant et al., 2021a). One explanatory hypothesis could be the high prevalence of professional fatigue or burnout among highly skilled women who combine a dense professional life with heavy responsibilities at home. Empirical studies do not support this hypothesis (Győrffy et al., 2016; Verdonk et al., 2010), but Chapter 6 and the conclusion will approach this question.

Additional results present the predicted probabilities of suicide for owners and tenants by region of residence, nationality, educational attainment, and occupation status. They are displayed in the Appendix (Figures A5.2 to A5.5)[4]. Results highlight that the association between housing tenure

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[4] Figures A5.2 to A5.5 (Appendix) present the predicted probabilities of suicide of owners and tenants according to several individual characteristics (region of residence, nationality, educational level, and occupational status). First, Flemish residents show a higher risk of suicide when they rent than when they own their housing (Appendix – Figure A5.2). Such a gap is not visible for Walloon and Brussels residents, especially for men. The strong promotion of homeownership in Flanders might explain a relative stigmatisation or selection of tenants (Fikse & Aalbers, 2021). Second, Belgian people show a visibly higher risk of suicide than European, especially than non-European foreigners

and suicide is stronger in Flanders than for residents of Wallonia/Brussels (Figure A5.2) and Belgian population than foreign people (Figure A5.3). Also, the association is more robust for men who graduated from at least higher secondary education and women who graduated from secondary education (Figure A5.4). Unemployed and self-employed populations show a more substantial negative relation between homeownership and suicide risk as well (Figure A5.5). Disparities in terms of age and household composition will be detailed in further analyses.

4. Interaction between housing tenure and age

Figure 5.2 illustrates the interaction effects of housing tenure and age in predicted probabilities of suicide, drawing on Model 1 (without other control variables, main effect results presented in Appendix, Table A5.4) and Model 2 (with control covariates, except subjective health, results shown in Figure 5.2).

(Appendix – Figure A5.3). This result can be explained by a well-known better physical and mental health status for non-Belgian populations (Deboosere & Gadeyne, 2005b). A double selection effect is at stake. The population moving and entering a new country might be in better shape than those who remain in their country. And a health issue might lead people to return to their original place of living (Deboosere & Gadeyne, 2005b). For Belgian and foreign populations, the risk of suicide is higher for tenants. Regarding education, men with primary and tertiary education do not show a clear suicide mortality difference between owners and tenants (Appendix – Figure A5.4). On the contrary, men from lower or higher secondary education are advantaged when they are homeowners. For women, only women who graduated from higher or higher secondary education show a higher risk of suicide when they are tenants. Finally, almost all occupational categories present higher suicide mortality when they are tenants, except men and women who have temporary work contracts (Appendix – Figure A5.5). The contradiction between long-term homeownership costs and a short-term uncertain source of income can understand. For instance, a study showed that temporary work contracts are associated with delayed access to homeownership (McGrath & Keister, 2008). Unemployed and inactive populations show the highest levels of suicide, especially when they cumulate this situation with a tenant status.

Figure 5.2 - Multinomial logistic regression on the risk of suicide in 2002, predicted probabilities.

Owner ———   Tenant — · — ·
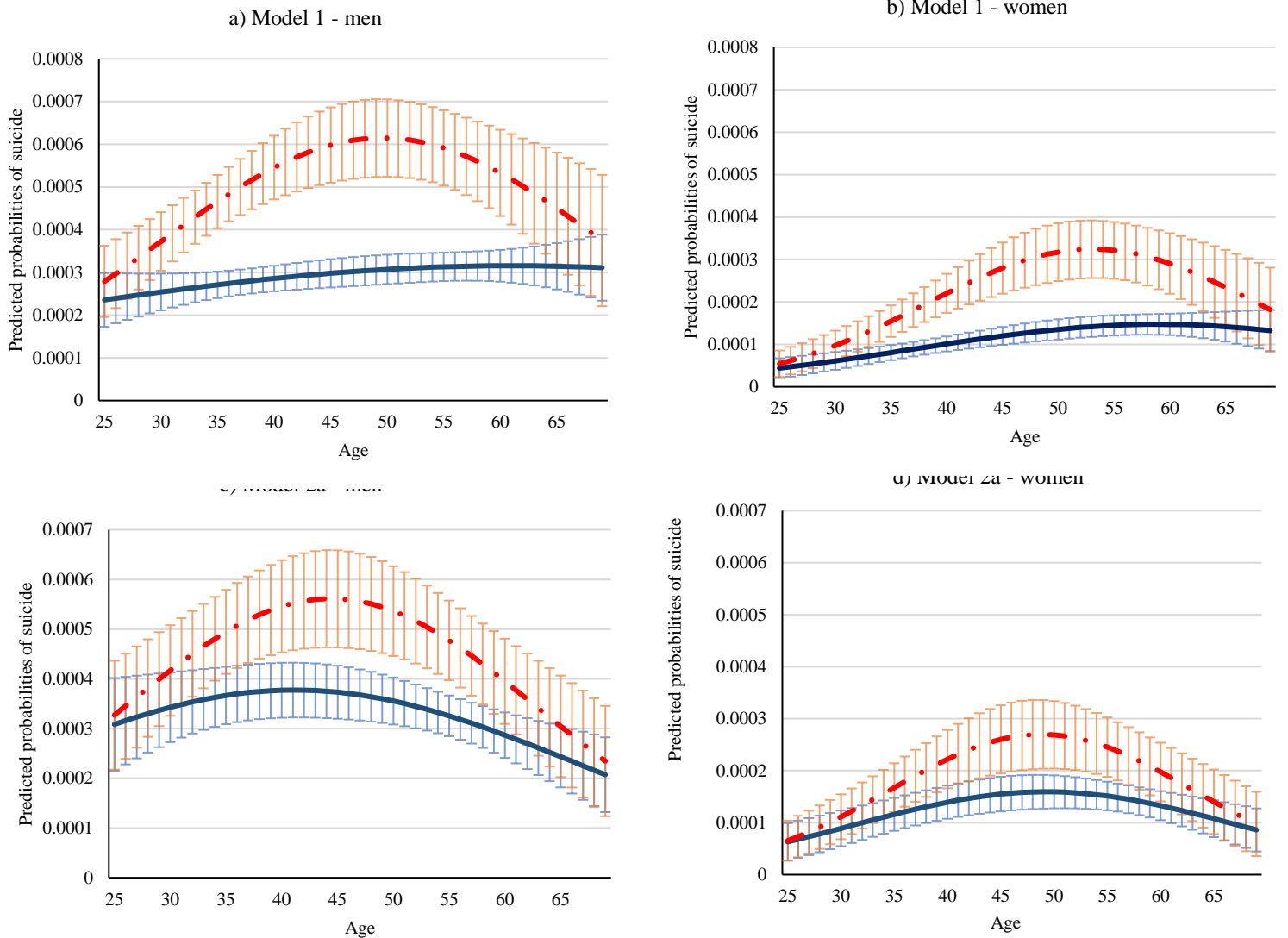
a) Model 1 - men

b) Model 1 - women

c) Model 2a - men

d) Model 2a - women

The predicted suicide rates are higher among tenants than among owners, with a peak among tenants in their 40s and 50s: from 39 to 55 for men and from 45 to 55 for women. Controlling individuals' background accounts for some, but not all, of these differences in middle age. Thus, excess suicide rates for tenants in their 40s and 50s cannot be explained by socioeconomic and demographic variables. We note that only subjective health has a noticeable impact on confidence intervals. After adding self-reported health, the effect strength of the relationship between housing tenure and suicide is weaker, even in middle-aged adults.

5. Interaction between housing tenure, age, and marital status

Next, we estimate a threefold interaction between housing tenure, age, and marital status. We first model this interaction based on Model 1 (without other control covariates, results presented in Appendix, Table A5.4) and then based on Model 4 (with control covariates, results shown in Figure 5.3 in predicted probabilities). The number of suicides in each category is relatively low (Appendix, Figure A5.5). Hence the large confidence intervals in our observations require careful consideration.

First, married men have a higher predicted probability of dying due to suicide between the early 30s and the mid-50s when they are renters compared to homeowners (Figure 5.3). Also, married women renting have a higher predicted probability of dying from suicide during their 50ies than their owning counterparts.

The second noticeable result is for unpartnered women and persists after controlling for housing quality and demographic and socioeconomic characteristics (Figure 5.3). This result shows that being a tenant is associated with a higher rate of suicide for women from their late 30s to their early 50s, that is, in their normative childrearing years.

Figure 5.3 - Multinomial logistic regression on the risk of suicide in 2002, predicted probabilities.

a) Model 2b - married men

b) Model 2b - married women

c) Model 2b - cohabiting men

d) Model 2b - cohabiting women

e) Model 2b - single men

f) Model 2b - single women

Notes: Model 2b, based on Model 2 (controlling for housing quality, household type, nationality, region, area of residence, educational attainment, and occupational category), including an interaction between housing, marital status and a quadratic term of age.

Note bis: Results for other causes of death are presented in Appendix A-6

Sources: Census of Belgium 2001, National Register data, death certificates; authors' calculations.

6. Interaction between housing tenure, age, and parenthood

We carry out the same exercise according to parental status, i.e., whether people have children in the same household. Men and women not living with children show a higher risk of suicide when renting their dwellings than homeowners. This is true for men from their 30s to their late 50s and women from their mid-30s to 60s after controlling for housing quality, demographics, and socioeconomic variables (Figure 5.4). Men living with children also show a slightly higher risk of suicide when they are tenants in their early 50ies (Figure 5.4).

Lastly, we test whether household type – the combination of marital and parental status –reveals further insights into the relations. The results are not displayed because this did not yield significant results, likely due to low numbers of suicides in most categories. The findings confirm that, after controlling for housing-related, demographic, and socioeconomic information, only childless single women still have a higher risk of suicide when renting their accommodation. Conversely, married male tenants are not at a higher risk of suicide compared to owners, whether having children living in their home or not, once their background characteristics are accounted for.

Figure 5.4 – Multinomial logistic regression on the risk of suicide in 2002, predicted probabilities.
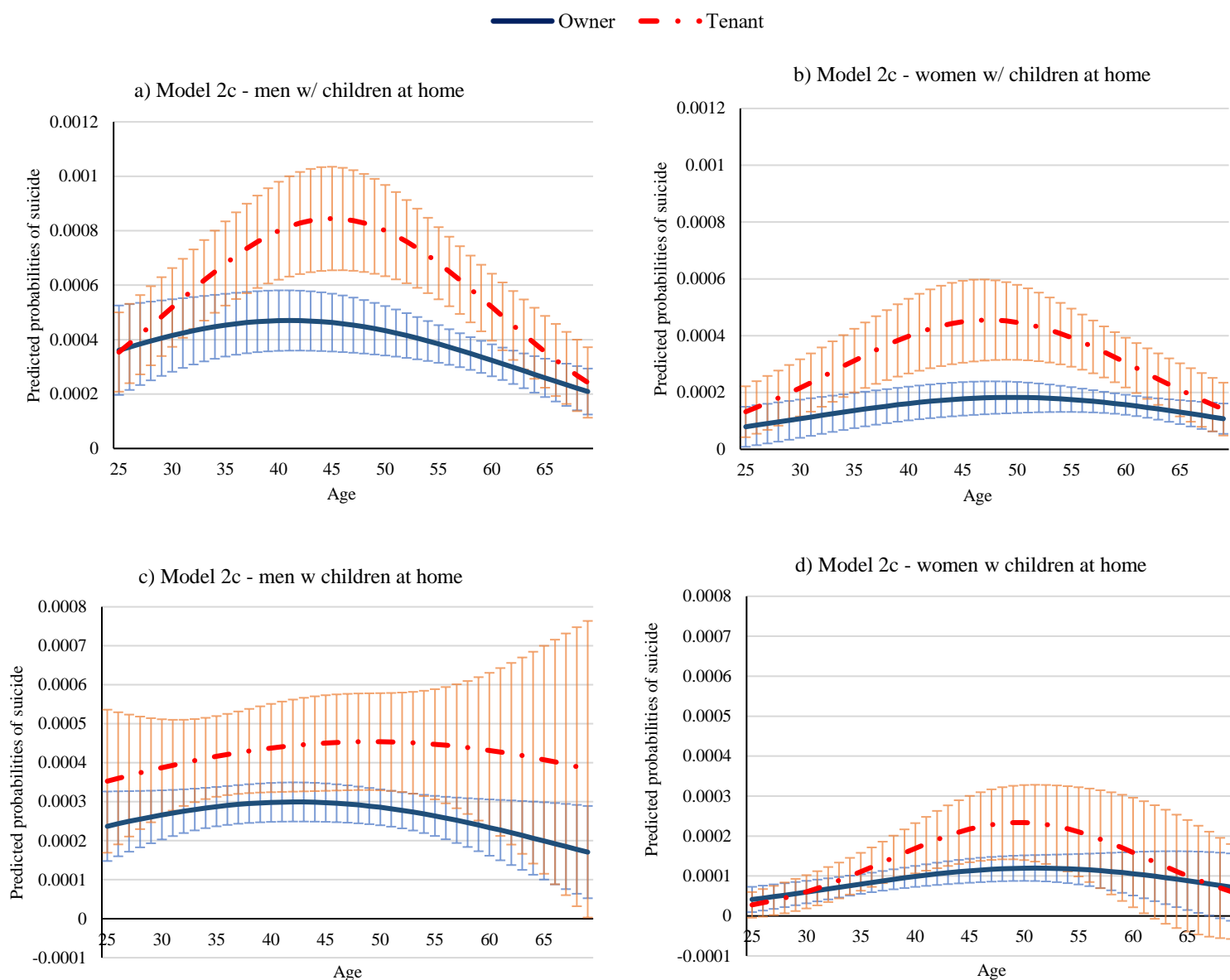
Notes: Model 2c, based on Model 2 (controlling for housing quality, household type, nationality, region, area of residence, educational attainment, and occupational category), including an interaction between housing and a quadratic term of age.

Note bis: Results for other causes of death are presented in Appendix A-6

Sources: Census of Belgium 2001, National Register data, death certificates; authors' calculations.

V. DISCUSSION & CONCLUSION

1. Main findings

For the Belgian context, this study explores whether housing tenure and suicide risk are associated and whether this association changes across age groups and household situations and differs for men and women. The population of interest for this study is people aged 25 to 69 who lived in Belgium in 2002. In this study, we cannot distinguish who is, among all the household members, the legal owner of the housing. For simplicity, we define homeownership as the occupation of a house owned by one of the household members without knowing whether the individual is the owner.

The risk of suicide is higher for tenants than for owners for both sexes. In this cross-sectional study, we cannot conclude that housing tenure directly impacts suicide risk. Still, we could observe that the relation persists even after controlling for demographic characteristics, educational attainment, and occupation status. This is in accordance with our first hypothesis and previous research for Belgium (Lorant, Kunst, Huisman, Costa, et al., 2005) and other countries (e.g., the United States: DeBastiani et al., 2019).

We then find that suicide rates peak in the late 40s and early 50s for men and a bit later for women. The predicted probabilities of suicide are higher for tenants, compared to owners, when the social pressure to own one's dwelling tends to be the strongest, i.e., between the late 40s and the early 60s, when one is supposed to have achieved financial and personal stability. We thus confirm our second hypothesis and suggest an interpretation of this result through the prism of Marmot's "status syndrome" (2004). Being a renter at this age means going against a social norm, which can entail feelings of frustration or shame compared to peers (Horne, 2003; Liefbroer & Billari, 2010), and also point to other sources of instability in terms of job interpersonal relations, or geographical setting (Mulder & Lauster, 2010).

The association between housing tenure and suicide according to marital configurations is not entirely linked to gender norms in Western societies. On the one hand, married men have a higher risk of suicide when a tenant, confirming the traditional expectation for men to guarantee material security for their family (Dykstra & Keizer, 2009a; Payne et al., 2008a). However, this higher risk of suicide for tenants also applies to married women, which may indicate higher homeownership expectations for married people, regardless of gender. On the other hand, unpartnered women – especially during their childrearing years – have a higher risk of suicide when they are tenants. This does not apply to men. These women may feel uncertain about their future if they are tenants with no housing permanence or security. When a woman is the only one responsible for her residential and material stability, being a tenant can increase the risk of losing her housing security, especially for low-income women.

Men and women with no children at home in mid-life have a higher predicted probability of suicide when they are tenants. This nuances our third hypothesis. We did not expect men's suicide risk to be strongly related to their housing tenure when they are not living with children, as we assumed that the pressure on them to provide security for the whole household would not be so heavy compared to when they are responsible for children. Women and men without children and a dwelling they own may lack a sense of achievement, belonging, and ontological security (Hiscock et al., 2001). Our results may, however, also mask gender-specific narratives. The data on coresidence with children does not indicate parental status. This means that persons who live without children may be childless, or their children may have left the parental home. The adult may also have gone through a separation and not live with their biological children – which is more likely to happen to fathers. In some cases, this might explain the higher risk of suicide for some tenant men without children at home. Moreover, women's well-being is highly affected by their parental status during their childrearing years (Graham, 2015a): cumulating the absence of children and the lack of homeownership could harm women's mental health and be associated with their suicidal behaviour.

After adding self-reported health, the loss of effect strengths for nearly all interaction results indicates that we cannot rule out a selection effect in the relationship between housing tenure, age, household composition, and suicide. However, the subjective dimension of this health indicator and its high statistical correlation with suicide risk (Appendix, Table A-2) lead us to present results without controlling for this variable. Suicide in our sample occurred soon after participation in the 2001 census, which includes this subjective health measure; those who committed suicide in 2002 were likelier to report a poorer health status in 2001 compared to the general population. In future chapters, I made a different choice: despite a relatively high correlation between suicide risk and subjective health (correlation coefficient is -0.1), this does not justify the exclusion of such a significant determinant of suicide from our main models.

2. Limitations

Four elements limit our interpretation and call for caution. First, the number of suicides in our observation period is low (Appendix, Table A5.3), especially as we break the population down according to multiple characteristics: gender, age, and household categories and only refer to deaths in 2002. Appendix A5.7 presents models with an additional year of observation (2003) with similar results. The only exceptions are the results for married men, for which we no longer observe the impact of housing tenure, and for single men, we observe an increased suicide risk among mid-life tenants. Those differences could stem from a change of housing tenure between 2001 and 2003 – married persons and newly separated persons are likelier to change their housing tenure (Mulder & Lauster, 2010) – hence a decision to remain as close as possible to the 2001 information and to only consider suicides in 2002.

Second, even though Belgian administrative data is strongly framed by laws and high quality (Statbel 2019), the number of suicides can be underestimated, as the motivation for the self-harm cannot be determined in some cases, and the cause of death can be classified as unknown or as an accident.

However, the numbers of undetermined intent deaths are very low and represent 2 to 3% of the suicides 2002.

Third, using a categorical variable for age would allow for more flexible modelling of the phenomenon. This is presented in Appendix A5.8 and confirms most results found in Figures 5.2 to 5.4, except that the effect of housing tenure for single women disappears. Due to the distribution of suicide rates over the population's life course and the small number of suicides, the linear specification using a quadratic term of age was preferred in the main models. However, the results with and without this specification do not vary much, and in future chapters, the quadratic term will not be added to the models. Fourth, accounting for other socioeconomic characteristics such as income level and parents' socioeconomic category may also shed light on the inequality of access to homeownership and parental support.

Finally, our analyses cannot conclude a causal relationship between homeownership and suicide. Many factors at stake were not accounted for, such as the individual's and family's psychiatric context or the cultural and religious background. Our results do not exclude the possibility of a selection effect. On the one hand, housing tenure can impact mental health. But on the other hand, poor mental health can have consequences on the socioeconomic situation and stability and be a determinant of individuals' life course and housing tenure (Hiscock et al., 2001; Macintyre et al., 1998). A predisposition to mental health issues can reduce people's chance of graduating, getting and a keep a job, pursuing a long-term relationship, and achieving homeownership (Ellaway et al., 2016; Holupka & Newman, 2012; Slominski et al., 2011; Smith et al., 2003). This can reflect a possible negative impact of depressive or suicidal symptoms on socioeconomic steadiness, relational stability, and personal achievements.

In addition, the socioeconomic situation's role in the association between housing tenure and suicide cannot be ruled out. One important limitation of this work is the lack of information about individuals' and households' income, a significant determinant of housing tenure and living

conditions. Income information would have helped estimate the role of this economic struggle in the relationship between housing tenure and suicide. The socioeconomic characteristics used – education and occupation – only draw a limited portrait of the individual's financial situation. On the one hand, educational attainment can be dated information that also depends on a generational effect and does not always represent the actual living conditions. On the other hand, the occupation categories – inactive, employed, liberal – gather very diverse situations. Information about the individual's and the possible partner's income would help better understand the mechanisms at stake in the relationship between homeownership and suicide. It would help disentangle the role of social norms from the role of socioeconomic precariousness in suicide inequalities. For instance, the higher suicide probability of unpartnered women when tenants would also be explained by the higher precariousness of separated or divorced women and single mothers who face an increased risk of poverty.

Regarding future research, we recommend longitudinal analyses that study how transitions between housing tenure statuses and their impact on suicide mortality. They would provide a better understanding of the relation and its possible causal nature. In addition, as homeownership is widespread in Belgium, we cannot exclude that the tenants represent a selected population with poor socioeconomic characteristics and a higher risk of life course instability. Comparative studies, including contexts where homeownership is less common (e.g., in Germany, where tenants are about 50% of the population) and even more common (e.g., in Eastern European countries such as Romania, where 90% of the people are homeowners) could give more insight about this possible selection effect.

3. Contribution

With this study, we contribute to previous research focusing on the poorly studied age- and family-status-related homeownership norm. Our analysis allows for a better understanding of gender-specific inequalities and determinants of suicide risk by underlining the importance of social standards and expectations. Our results call for policies for reducing self-harm to account for social norms – especially gender norms – and their potentially detrimental effects on personal well-being and societal integration. Our analyses and description of the Belgian specificities also encourage a more extensive supply for the rental market, especially the social rental market, to support more accessible access to housing in Belgium for households who cannot afford homeownership.

Takeaway message from Chapter 5

❖ This study examines the varying association between housing tenure and suicide risk according to sex, age (for adults), and household composition.

❖ We find that homeownership was negatively associated with suicide risk for both men and women, before and after controlling for age, housing quality, and demographic and socioeconomic characteristics.

❖ Interacting age and housing tenure, we find that renting is associated with a higher risk of suicide among adults in their 40s and 50s but not among younger and older adults. Homeownership is associated with a lower suicide risk for middle-aged populations, specifically married men (and women to a lesser extent), unpartnered women, and individuals living without children.

❖ Our research provides a better understanding of the role of gender and family norms in the association between housing tenure and suicide mortality.

CHAPTER 6

THE RIGHT PLACE

HOUSING CONDITIONS, NEIGHBOURHOOD SATISFACTION AND SUICIDE IN BELGIUM[5]

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[5] This chapter is still under review and was presented at the European Population Conference in 2022, at Groningen University, Netherlands, and the International Population Conference in 2021.

I. INTRODUCTION

The living environment is one crucial part of the individuals' experience: it includes the physical built features surrounding their residence, in terms of housing conditions and their immediate environment. Housing conditions and immediate environment quality are closely related to socioeconomic characteristics, which in turn are both determinants and consequences of mental health and suicide: on the one hand, socioeconomic difficulties can lead to adverse life events and obstacles that can decrease satisfaction and mental health (Hudson, 2005); on the other hand, predispositions to poor mental health can lead to downward social mobility, by making it hard to follow studies and keep a stable and high-earning job (Cornaglia et al., 2015; Slominski et al., 2011). Still, even after controlling for socioeconomic characteristics, housing and neighbourhood quality are associated with an extensive series of mental health outcomes such as life satisfaction, depression, anxiety, and the ability for individuals to have self-esteem and trust in the future (G. W. Evans et al., 2003; Gibson et al., 2011; Singh et al., 2019b; Wright & Kloos, 2007).

This study aims at estimating the relationship between living environment – in terms of housing comfort and neighbourhood characteristics – and the risk of suicide, thanks to a more comprehensive set of housing- and neighbourhood-related indicators than used so far in the literature. It includes the inside and outside features of the housing, the energetical installations, and the general layout of the residence, as well as the satisfaction over neighbourhood amenities and close services. This chapter also questions the interaction between housing conditions and neighbourhood characteristics and their association with suicide. Finally, it investigates the relationship between housing conditions and suicide mortality in different adult life stages. This research relies on a high-quality dataset resulting from the coupling of the 2001 Belgian Census, the National Register, and the death certificates between 2002 and 2006, allowing to have information on all the Belgian residents aged 25 to 69 from the Census 2001 to 31st December 2006.

II.   REVIEW OF LITERATURE

1. Living environment and mental health

a. Housing and mental health

According to the Learned Helplessness theory, low control over one's environment and a high level of discomfort are associated with higher risks of suicide (Seligman, 1972). Especially for low-income households, changing residences is complex, expensive, and demanding, which leads individuals to feel trapped in an unsatisfactory situation (J. H. Lee, 2022; Seligman, 1972). Previous studies already focused on the relationship between housing conditions and mental health. However, these studies present limitations that were put forward by meta-analyses (G. W. Evans et al., 2003; Singh et al., 2019b): the limited number of environmental predictors (quantitative studies often concentrate on one element at a time and the types of components are usually the same from a study to another); the lack of socioeconomic control variables in the model; the impossibility to draw causal conclusions.

In quantitative studies, housing quality is measured through a few indicators. One element often used in papers is the type of building: is the housing located in a private house, a low-rise building, or a high-rise building? Living in a high-rise building is associated with a higher risk of anxiety and depression than living in a separate housing, especially for women at the highest levels (Singh et al., 2019b). A study in Tehran conducted in 2020 (in the context of the Covid-19 outbreak) on 400 residents highlighted the better mental health status of people living in private housing than those living in buildings divided into several housing (Akbari et al., 2021). Overcrowding is also a factor put forward in some studies: it reduces the privacy of each member and their sense of belonging in their environment (Bonnefoy, 2007; G. W. Evans et al., 2003; M. Shaw, 2004a; Singh et al., 2019b). A large-scale Chilean study proved a positive association between overcrowding within the household and depressive symptoms (Ruiz-Tagle & Urria, 2022).

In qualitative studies, the indicators used to measure housing quality are more diversified. In a research based on 2,104 women interviewed, housing instability and disarray, a place considered dark, too worded, and noisy, was associated with a higher risk of depression and anxiety (Suglia et al., 2011). Regarding the energetical quality of the housing, some qualitative papers show a strong association between excellent housing energetical quality and better mental health outcomes (Gibson et al., 2011). Another article, based on the interviews of the inhabitants of 54 houses in Northern Ireland, proved that renovations of the warmth and energy systems of the housing were associated with improved happiness and life satisfaction (Shortt & Rugkåsa, 2007). Moreover, a lack of ventilation, mould, and dampness in the accommodation, as well as an inability to keep the place warm enough, can be a source of anxiety, depression, or suicidal ideations, as shown by previous qualitative studies (Boomsma et al., 2017; Harrington et al., 2005; J. H. Lee, 2022).

One South Korean study based on population-based panel data is particularly worth developing, as it is, to our knowledge, one of the first population-based papers to use a more extensive set of variables in their analyses, making a difference between structural and functional issues. Functional items gather ventilation, restriction of outside noise, heating systems, and lighting. Structural elements are related to the fact that the residence is located in a permanent building, the quality of the used materials, and the resistance of the housing concerning heat, fire, and moisture (J. H. Lee, 2022). This research demonstrates that functional issues increased the depression risk of women and middle-aged adults, while structural issues were associated with more depression for men and older adults (J. H. Lee, 2022). Residential satisfaction mediates housing quality and suicide ideation, especially for young men (J. H. Lee, 2022).

b. Neighbourhood characteristics and mental health

The neighbourhood characteristics and the immediate environment are also known to be related to mental health, thanks to previous studies. Poor aesthetics or odorous nuisance can diminish the pleasure spent in daily activities, such as family quality time or physical exercise, leading to less well-

being (Abed Al Ahad et al., 2022) and poor self-perceived health (Klompmaker et al., 2019). A study from Ireland showed that a positive appreciation of area cleanliness is related to a lower risk of depression (Mohan & Barlow, 2023). The regulation of traffic and noise plays a crucial role in the safety of the immediate living environment (Edwards et al., 2006). Air quality is another factor in one's respiratory health and risk of chronic diseases: living close to a polluting factory or activity is associated with a higher risk of chronic diseases (Claeson et al., 2013): the perspective of immediate health issues is added to the worries about future health issues for all members of the household, including young children (Abed Al Ahad et al., 2022). Air quality is presented as a significant determinant of mental health in quantitative studies (Abed Al Ahad et al., 2022; Bakolis et al., 2021; Davoudi et al., 2021; R. Zhang et al., 2021). Similarly, the relationship between mental health and green spaces is proved by analyses (Astell-Burt & Feng, 2019; Callaghan et al., 2021; Cohen-Cline et al., 2015; L. Wood et al., 2017). A lack of greenery is associated with less healthy behaviours, less physical activity, and a lower propensity to develop social interactions and social support (Akbari et al., 2021; Ayala-Azcárraga et al., 2019). However, the literature is not univocal. Some papers could not prove that neighbourhood characteristics were associated with mental health (Collings et al., 2009; Dykxhoorn et al., 2023; Leslie & Cerin, 2008).

The relation between close services and mental health has been less studied. First, the populations with mental health struggles are more in touch with community healthcare and social services than the general population (Brener et al., 2007; Farmer et al., 2001). Some environmental items were investigated. An Irish study on a representative population sample showed that a better perception of service provision was associated with better mental health outcomes, especially in more deprived communities (Mohan & Barlow, 2023). This can be explained by the low presence of healthcare centres, social services, and administrative offices in low-income districts (Bacqué & Fol, 2007; Hussein et al., 2016). Such inequalities of repartition of the public or private services on the territory can reflect the low political influence of the disadvantaged populations, who may have more trouble defending their interests, controlling their environment, and improving their living conditions

(Emelianoff, 2008; Herjean, 2006). Belgium was shown to be a country where ethnic segregation was higher than in other European countries such as Denmark or the Netherlands. This repartition would be explained by the limited social housing and its concentration in disadvantaged neighbourhoods (E. K. Andersson et al., 2018). A study of 1500 inhabitants of Hamilton, Ontario, Canada, showed that the neighbourhood's resources were predictors of a low number of mental healthcare practitioners and unmet mental healthcare needs (Law et al., 2014). Low-income and deprived areas are also at a higher risk of stigmatisation through the mass media or as a matter of reputation in the region (Hastings, 2004). This decreases opportunities in terms of educational attainment, social capital, and job seeking and can be detrimental to the social cohesion within the neighbourhood, feeding a sense of insecurity (Herjean, 2006). Nonetheless, the literature is again not univocal about the relation between neighbourhood characteristics and mental health outcomes. A study conducted in London showed that such stigmatisation of the district of residence vehiculated by the media has a minimal impact on the individuals' well-being, contrary to housing-related disadvantages (Watt, 2020).

2. Interaction between housing and neighbourhood

So far, little attention has been targeted toward this interaction between housing and the neighbourhood. Previous studies showed that neighbourhood quality buffered the detrimental effect of housing quality on mental health (Jones-Rounds et al., 2014; Kasl et al., 1982). The association between poor housing quality and distress symptoms was less visible in high-quality neighbourhoods (Kasl et al., 1982, cited by Rollings et al., 2017). A study conducted on 8 European cities came to the same conclusion; in low-quality neighbourhoods, the relation between housing quality and psychological well-being was more substantial than in higher-quality neighbourhoods (Jones-Rounds et al., 2014). The interpretations lie in the cumulation of two environmental disadvantages and the high dependence of low-income neighbourhood inhabitants on the social network to maintain psychological well-being and life satisfaction. When living in poor-quality

neighbourhoods, inhabitants tend to limit their social network to local but strong contacts (Pinkster & Völker, 2009; Wilson, 2012). In insecure and unclean neighbourhoods that lack green spaces where to meet, inhabitants are not encouraged to cultivate social interactions close by, hence a population who retreats to their housing. Living in inadequate housing might reduce even more social interactions and support (Jones-Rounds et al., 2014; Kylén et al., 2017; Wells & Harris, 2007). Indeed, the residence is also a place of social interaction. A qualitative study following improvements in housing qualities, such as renovations of the design of the housing (walls, kitchen, ceiling), showed that, among low-income women, social withdrawal was partially mediating the relationship between poor housing quality and low level of well-being (Wells & Harris, 2007). Better housing conditions were associated with better mental health and social support (Wells & Harris, 2007). However, another study could not prove that better neighbourhood characteristics could reduce the relationship between poor housing quality and children's low well-being (Rollings et al., 2017).

3. Housing conditions and mental health: differences over the life course and across genders

The literature already addressed the question of socioeconomic inequalities in health and their variations over the life course. We can cite two opposing theories. First, the cumulative inequality theory suggests that socioeconomic privilege in the early life course will give future advantages to ageing individuals (Ferraro & Shippee, 2009). Thus, each experience shapes the individual's trajectory and health outcomes throughout their life course. Conversely, the "age as leveller" theory implies that social inequalities in health tend to attenuate over the life course, as biological factors play a more and more critical role in health. In contrast, social factors matter less with age (Corna, 2013). According to previous studies, women would tend to follow the cumulative inequality approach of ageing: the gap between more and less privileged women in terms of health status increase with age (Bracke et al., 2020; C. Lee & Park, 2020). Conversely, men tend to present more

convergence with age: the social inequalities in health tend to decrease throughout life (Bracke et al., 2020; Carmel & Bernstein, 2003).

Very few studies investigated this question at the housing conditions and living environment level. British research highlighted that the relationship between green spaces and well-being varied across life courses (Astell-Burt et al., 2014). For men, the relation decreased with age: the detrimental impact of low access to greenery on well-being was more visible for younger and middle-aged men. For women, the gap in well-being was more intense for older individuals (Astell-Burt et al., 2014). Other studies put forward that negative environmental experiences early in life, such as deprivation at the level of the neighbourhood or little access to green spaces during childhood or teenage, were associated with a higher risk of anxiety, depression, and poor well-being later in life (Jones et al., 2018; Pearce et al., 2018), but they did not investigate the sex-specificities.

III. RESEARCH HYPOTHESES

This chapter addresses a general research question: "How are housing conditions and neighbourhood characteristics associated with suicide risk?" As a first hypothesis, we assume that **worse housing quality is associated with higher suicide risk, even after controlling for the demographic and socioeconomic characteristics of the individual (H1).** As a second hypothesis, we expect **worse neighbourhood satisfaction to be associated with higher suicide risk, even after controlling for the demographic and socioeconomic characteristics of the individual (H2).** For our third hypothesis, we expect an interaction effect between housing conditions and neighbourhood satisfaction, as shown by Jones-Rounds et al. (2014). More specifically, **we assume that the negative association between poor housing conditions and suicide risk would be less visible in good neighbourhoods than in poor quality ones (H3).** As a fourth hypothesis, we expect the relationship between housing conditions and suicide risk to differ over the life course, differently for both genders. As women tend to follow a cumulative

inequality in health, **we expect the relationship between housing conditions and suicide to get stronger with age and housing quality to have a more critical role in suicide risk for older women**. On the other hand, men show a convergence in social inequalities in health with age. **We expect the relationship between housing conditions and suicide to be stronger for younger and middle-aged men than older men and a more important predictor of suicide risk for younger and middle-aged men (H4).**

IV. DATA AND METHODS

1. Datasets and population selection

This analysis is based on the 2001 Belgian socioeconomic survey that gathers housing-relation, neighbourhood-related and socioeconomic characteristics, the National Register, and the death certificates for 2002-2006. I consider only people registered in Belgium during the 2001 Census. Residents who arrived after 2001 are excluded. The population of interest includes adults aged 25 to 69, as mental health issues for younger and older people are assumed to follow particular paths. On the one hand, teenagers and young adults are most at risk of encountering for the first time symptoms of specific mental health disorders, such as schizophrenia, bipolar disorders, or eating disorders, which are highly related to suicide risks among the young (Bilsen, 2018; Reiss, 2013). On the other hand, older people are particularly at risk of suicide, possibly due to the loss of mobility, decreasing physical health, chronic pain, but also less social contact (Carlo et al., 2019; Suresh Kumar et al., 2015; Szanto et al., 2001). We excluded all individuals living in the collective household (care facilities, hospitals, monasteries, and other religious houses, military compounds, prisons…) who may not have chosen their place of living.

2. Variables

a. Suicide indicator

Suicide is considered all types of intentional self-harm that led to death, i.e., all deaths categorised as X60 to X84, as well as Y87.0-87.2, according to the 10th ICD, whether this cause is declared as immediate, initial, or intermediate. We restrict our observation to January 1st, 2002, and December 31st, 2006, i.e., the five years following the 2001 Census. We count 88,470 deaths for men, including 5,158 suicides and 48,903 deaths for women, including 2,030 suicides in 2002-2006, among the population aged 25 to 69 in 2001.

b. Housing-related indicators

The 2001 Census provides information on the place characteristics (type of building, presence of a garden, overcrowding, presence of at least one bathroom), energetical items (presence of central heating), insulation (presence of double glazing, quality of the windows, of the roof, of the walls) and the quality of the installations (quality of the electric system, of the pipes). A codebook of the housing-related variables is presented in the appendix (Table A1). Only one reference member in each household answered this questionnaire. Based on these indicators, a score is built and attributed to all household members. This score is a weighted mean of the housing-related indicators divided into quartiles (very low, low, high, very high).

The weighting process of the mean is simple: it gives a weight of 2 for the presence of some essential items (bathroom, central heating) and to the indoor features (quality of the inside walls, of the electric system, of the windows, and presence of double-glazing). We assume that this category of items is immediately visible to the inhabitants and impact their everyday life. The literature supports this idea. The immediate environment affects mental health more than distant elements (Rollings et al., 2017). Energetical poverty and low insulation are associated with poorer mental health and well-being (Boomsma et al., 2017; G. W. Evans et al., 2003). Contrarily, a lower weight (of 1) is given to the general layout of the housing (type of building, presence of a garden,

overcrowding) because they depend on the place of living and individual's expectations. Having a garden and living in a separate house and a low household density are more common in peri-urban or rural areas than in urban areas. The inhabitants will also consider these elements differently according to their expectations and life stage. The outdoor items (quality of the outside walls, pipes, and roof) are also less weighted (1) in the score. These elements are a bit more distant and less visible to the individual than indoor items, and studies proved their lower impact on well-being than closer items (Ochodo et al., 2014; Rollings et al., 2017).

c. Neighbourhood-related indicators

Neighbourhood-related indicators cover the subjective quality of the surroundings' characteristics (cleanliness, quietness, aesthetics), amenities, and natural elements (green spaces, air quality), as well as the close services (healthcare, administrative, social, and cultural services). A codebook of the housing-related variables is presented in the appendix (Table A2). Based on these variables, a score is built, following the same process as the housing quality score, and divided into population thirds (low, intermediate, high). All household members are given the same score, according to the responses of the household reference member.

Some higher weights (2) are associated with the most subjective elements (aesthetics, cleanliness, quietness), as it was supported by the literature that more subjective characteristics are more impactful on mental health (L. Zhang et al., 2019). Air quality is also weighted to a higher degree (2), as it was primarily presented as a significant determinant of mental health and suicide in studies (Abed Al Ahad et al., 2022; Bakolis et al., 2021; Davoudi et al., 2021; Heo et al., 2021; R. Zhang et al., 2021). Similarly, the relationship between suicide risk and access to green spaces has been proven (Bakian et al., 2015; Mendoza et al., 2023). On the contrary, the services are less weighted (1) in the mean. The relationship between services and mental health was less studied, and more mental health issues were also associated with more use of social services and healthcare (Brener et al., 2007; Farmer et al., 2001).

d. Covariates

The study includes demographic and socioeconomic covariates that were already introduced: age, household composition (married with children, married without children, cohabiting unions with children, cohabiting unions without children, single parents, single without children, other households), nationality (Belgian, other European, non-European), region of residence (Flanders, Wallonia, Brussels), area (urban, suburban rural), educational attainment (primary, lower secondary, upper secondary, higher education), occupational status (unemployed, inactive, employed, independent).

In addition, the number of years spent in the housing is also considered in the covariates, as it can represent not only the relation to the housing and the feeling of belonging to the neighbourhood but also the level of satisfaction related to the housing. It was calculated based on the information about residential mobility provided in the National Register during the 1996-2001 period. A last covariate covers the socioeconomic characteristics of the municipalities of residence and their possible evolution in case of mobility. The Belgian Index of Multiple Deprivation (BIMD) was developed in the ELLIS project (Otavova et al., 2023). It represents a multidimensional estimation of the socioeconomic level of the municipality based on several scales related to housing conditions, employment, education, income, or crime. It is based on the Census 2001. Using maximum likelihood, a synthetic score was established, to rank municipalities based on their level of deprivation, and divide them into deciles of municipalities, the first decile being the 10% of the Belgian communes that are the most deprived. I must highlight the inclusion of some housing characteristics (proportion of housing with bathroom or central heating and tenants in each municipality) in constructing this index. Nonetheless, the housing information has a low weight in the index (20%), and there is a high correlation between all the domains.

3. A word on missing values

One of the downsides of the 2001 census is the high rates of missing values in the questions about housing and neighbourhood conditions. 310,693 respondents (5.17% of the population) did not reply to any questions about housing or neighbourhood conditions. 14.94% of the population (897,101 individuals) did not respond to at least half of the questions about housing conditions, and 7.28% (437,174 individuals) did not reply to at least half of the questions about environmental conditions. We believe the missing information is not random based on previous studies using census data in Belgium. Individuals who did not reply to the questionnaire, especially about the socioeconomic-related questions, presented an excess mortality risk compared to the trend of the most underprivileged groups (Bourguignon et al., 2022). Moreover, the non-responses are particularly common for foreigners (European or non-European) with a language barrier. Among people who did not respond to any question about their housing or neighbourhood, about a third were foreigners (while they represent 10% of the population). The literature has already addressed this question in Belgium (Brée et al., 2016). Also, the people who did not respond to these questions are likelier to have not replied to most questions of the questionnaire, making it hard to draw their comprehensive socioeconomic and demographic portrait. The population who did not respond to any living environment-related question was also overrepresented among those who died by suicide in 2002 (46.4 suicides per 100,000 for the non-respondents vs 24.3 per 100,000 in the general population).

We suggest a correction through two steps. First, we allow the population to have missing values to three questions maximum by score. The mean was recalculated based on the available indicators. Second, we used multiple imputations. For the housing-related score, every missing value was attributed to the mean score of housing quality to the population with the same educational level, occupational status, household composition, nationality, and region of residence. This way, all respondents who shared the same characteristics for those five elements and did not respond directly to the housing-related questions would be associated with the same housing score, the

mean of the score of the population with the same characteristics. For the neighbourhood-related indicator, we attributed the mean score of the people residing in the same statistical sector. In Belgium, statistical sectors are the smallest geographical unit, with more than 20,000 sectors counted and an average of 500 inhabitants each. Models without these multiple imputations are presented in Appendix (Table A2 and A3); results remain similar before and after the imputation.

4. Analytical strategies

Descriptive analyses are presented by comparing crude suicide rates, and housing and neighbourhood quality score means according to individual characteristics. The associations between suicide rates or environmental scores and independent variables are shown through analyses of variances (ANOVA).

To investigate the relationship between environmental quality and the risk of suicide in 2002-2006, we use an event history model. Individuals become at risk as soon as they respond to the Census 2001. The primary outcome is death by suicide. Apart from suicide, other censoring events could then be considered, such as death from other causes and international outmigration. We also right-censored individuals who moved out of the housing they inhabited in 2001, as the information about accommodation and neighbourhood does not match their housing conditions anymore, and we have no way to estimate if they improved or got worse. We then use Cox models to evaluate the risk of suicide for the population aged 25 to 69 years old living in Belgium between 2002 and 2006. Predicted relative hazards of suicide were calculated to investigate some interactions between housing quality and neighbourhood satisfaction levels according to age groups. The discretisation of age into 15-year groups (25-39; 40-54; 55-69) is commonly used in the literature about inequalities in health and mortality over the life course (Clarke et al., 2014; Katikireddi et al., 2020).

We finally calculated the pseudo-partial correlations to evaluate the relative importance of each predictor on the outcome – the suicide risk, or in other terms, the weight of this predictor on the studied phenomenon controlling for all other variables in the model.

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5. Robustness check and additional analyses

One of the limitations of our study is the possible confounding effect of mental health. On the one hand, Mental health struggles are a primary determinant of suicide mortality (Conejero, Olié, Calati, et al., 2018a). On the other hand, a predisposition to mental health struggles can also predict less stable life courses. Predisposition to poor mental health is associated with a higher risk of dropping out of the educational system before graduating (Cornaglia et al., 2015; Esch et al., 2014). Previous experiences of psychological distress and mental health struggles are also associated with future life instability, a higher risk of life disruptions, and changes in family structure (Avison et al., 2008). Mental health also strongly determines adult socioeconomic attainment, including professional achievement and income level (Slominski et al., 2011). This can lead to lower socioeconomic status and poorer living conditions, including poor housing and environmental conditions.

To test the role of subjective health on the relationship between the living environment and suicide, analyses are reiterated for the population who declared themselves healthy or very healthy at the 2001 census. We assume that individuals – especially women (Davis et al., 2008) – who self-reported a good or very good subjective health status had fewer mental health struggles than individuals who declared intermediate, poor, or very poor subjective health. These results are presented in Table 6.3. The 2001 census includes a question about self-reported health status. The development of subjective health measures as a proxy for objective health is encouraged by the studies showing how correlated both indicators were (Hunt & McEwen, 1980), not only for physical but also for psychological health. Individuals with depressive symptoms and mental health struggles report poorer subjective health than mentally healthy individuals. A study on older adults showed that individuals with depressive symptoms tended to declare poorer physical health, quality of life, and subjective health than healthy individuals and even individuals with Alzheimer's disease (Scocco et al., 2006). Another study on parents showed that poor self-reported health and quality of life were strongly associated with depressive symptoms for women, while it was less the case for men (Davis et al., 2008).

Supplementary analyses are presented in the appendix. Another replication of the results without the multiple imputations of the missing values is also shown in the appendix to check the robustness of our methodological choice and have a better understanding of how the missing values (that we know are not at random) might bias our estimates (Appendix Table A6.3-A6.4). Finally, alternative scores, based on Principal Component Analyses, are presented and used as housing and neighbourhood characteristics scores in our analyses to check the robustness of the weighted means (Appendix, Table A6.7 and A6.8 show the components; Table A6.9 displays the results). Thanks to Fine-Gray sub-distribution hazard models, an alternative analysis considering competing events was conducted to control for the occurrence of a competing event that is death from another cause (Appendix, Table A6.10) and the change of residence (Table A6.11). Instead of excluding the population who died from another cause or moved out, we consider that it can be an alternative outcome to suicide that can bias our results.

V. RESULTS

1. Description

About 24 per 100,000 of the population aged 25 to 69 died from suicide in 2002. Suicides represent 7% of deaths in the age range.

Figure 6.1 - Suicide rates of men (A) and women (B) for the general population and men and women from extreme quartiles of housing quality

A/ Men
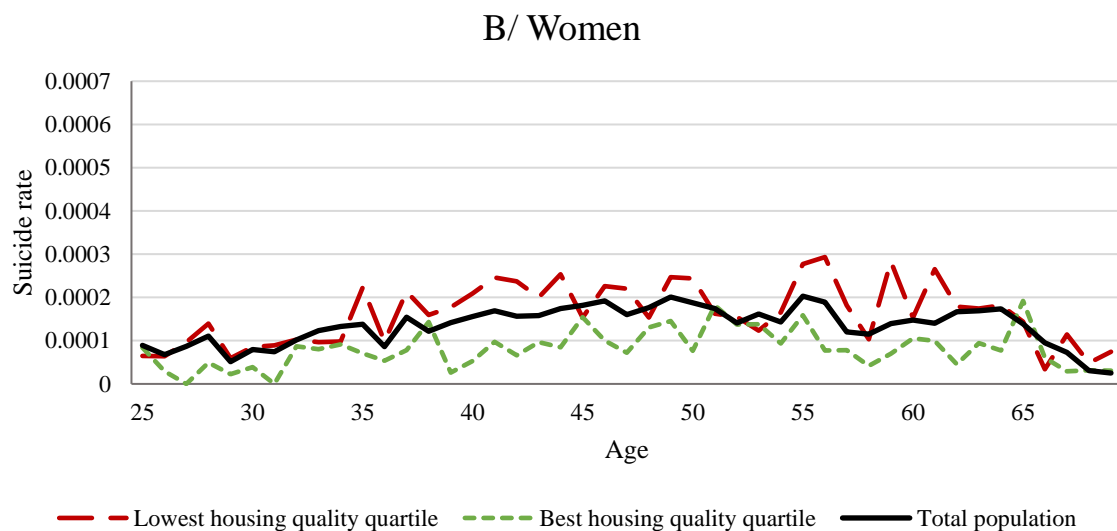
B/ Women

Source: Census 2001, death certificates 2002-2006. Author's calculations.

The rate of the 25-69-year-old population follows a curvilinear trend, increasing from the mid-20-ies to the mid-40ies for men and the late 40ies for women and decreasing progressively until the late 60ies. Figure 6.1 displays the suicide rates for all men and women and the suicide rates related to the extreme quartiles of the population according to the housing-related score we elaborated. The "lowest quartile" represents 25% of the people with the lowest housing quality. Men and women from this "lowest quartile" show higher suicide rates than the general population, while

men and women from the "highest quartile" – living in the best housing quality – present a lower risk of suicide at all ages.

Figure 6.2 - Suicide rates of A/ men and B/ women for the general population and the lower and higher thirds of the population according to their neighbourhood satisfaction.

A/ Men

B/ Women
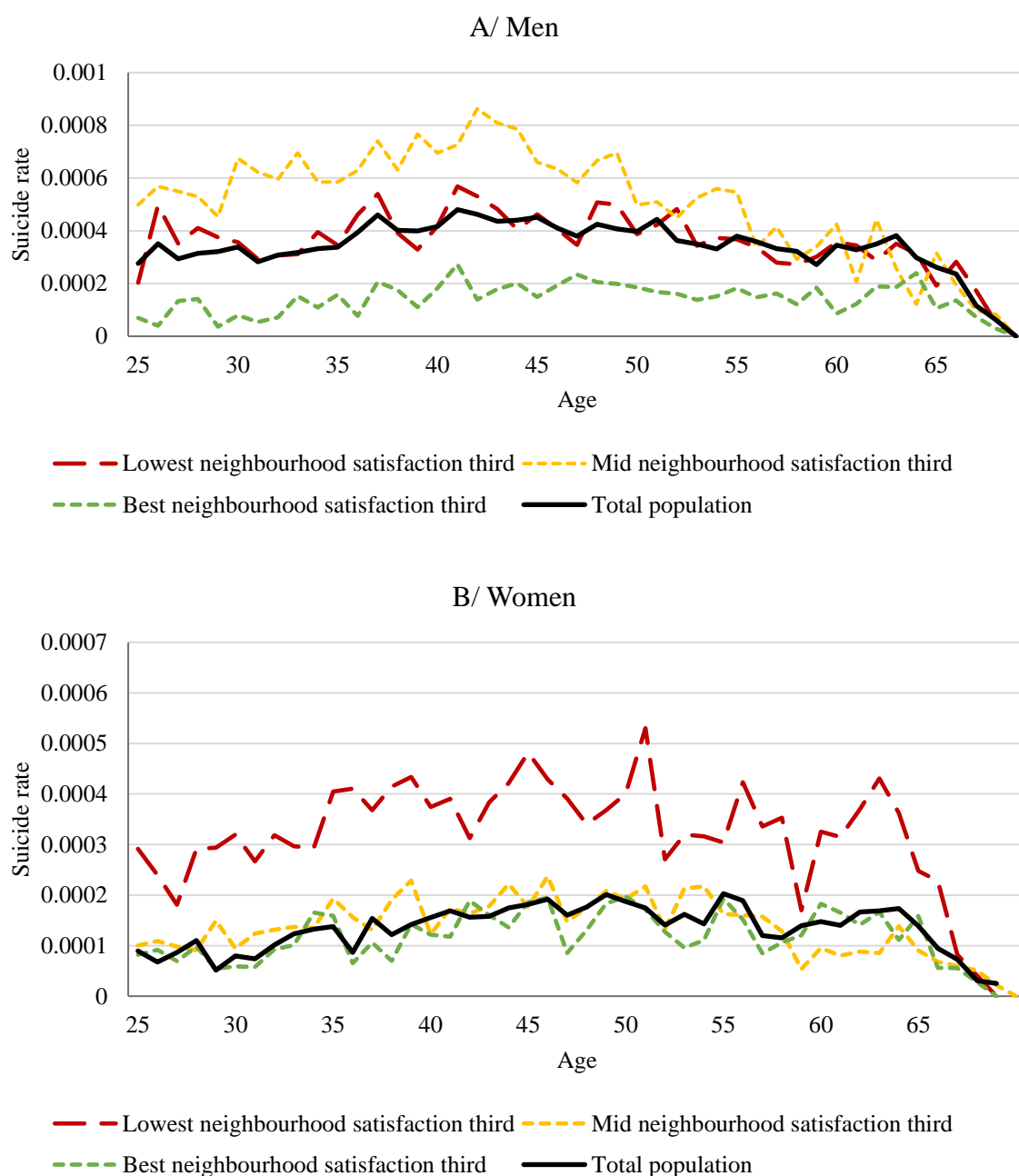
Source: Census 2001, death certificates 2002-2006. Author's calculations.

Regarding the three levels of the neighbourhood satisfaction score, we notice gender-specific trends. Suicide repartition by age still follows the curvilinear trend for the lower and higher thirds (Figure 6.2). However, for men, the suicide risk for the lower third – the least satisfied by their neighbourhood and close services – is very close to the general population. In contrast, the higher third is associated with a lower risk of suicide. Conversely, for women, the risk of suicide of the higher third – the most satisfied with their neighbourhood amenities and services – is very close to the general population's. In contrast, the lower third is associated with higher rates for all ages. The suicide rates of the intermediate neighbourhood satisfaction mainly explain this. For men, their suicide rate is higher than the lower (less satisfied) third, and for women, their suicide rate is slightly higher than the higher (more satisfied) third.

Table 6.1 presents the suicide rates of the population according to the characteristics of the people that will be mobilised in the models.

Table 6.1 - Suicide rates, mean of housing quality score and mean of neighbourhood satisfaction score of the 25-69 year-old population living in Belgium, in the 2002-2006 period, according to individual characteristics, with results of ANOVA tests between suicide rates or means of scores and predictors.

	Suicide rate			Housing quality score mean			Neighbourhood satisfaction score mean		
	Mean	Std error	ANOVA	Mean	Std error	ANOVA	Mean	Std error	ANOVA
Very low housing quality	0.00142	0.00003	****						
Low housing quality	0.00144	0.00003							
High housing quality	0.00102	0.00002							
Very high housing quality	0.00084	0.00003							
Low neighbourhood satisfaction	0.00129	0.00003	****						
Intermediate neighbourhood satisfaction	0.00126	0.00002							
High neighbourhood satisfaction	0.00113	0.00002							
Primary	0.00025	0.00004	****	0.8161	0.0002	****	0.8519	0.0002	****
Lower Secondary	0.00028	0.00003		0.8407	0.0002		0.8434	0.0002	
Higher Secondary	0.00024	0.00002		0.8593	0.0002		0.8520	0.0001	
Higher	0.00018	0.00002		0.8881	0.0002		0.8569	0.0002	
Unemployed	0.00023	0.00005	****	0.7989	0.0004	****	0.8321	0.0004	****
Inactive	0.00025	0.00005		0.8300	0.0003		0.8612	0.0003	
Employee	0.00019	0.00002		0.8595	0.0001		0.8515	0.0001	
Liberal	0.00026	0.00006		0.8825	0.0003		0.8595	0.0003	
Marital couple, children	0.00018	0.00002	****	0.8820	0.0001	****	0.8596	0.0001	****
Marital couple, no children	0.00016	0.00002		0.8838	0.0001		0.8629	0.0002	
Nonmarital couple, children	0.00021	0.00006		0.8043	0.0004		0.8408	0.0004	
Nonmarital couple, no children	0.00033	0.00007		0.8070	0.0004		0.8405	0.0004	
Single, children	0.00027	0.00006		0.7989	0.0003		0.8365	0.0003	

Single, no children	0.00051	0.00005		0.7894	0.0002		0.8397	0.0002	
Other	0.00021	0.00006		0.8184	0.0004		0.8484	0.0004	
Flanders	0.00025	0.00002	****	0.8270	0.0001	****	0.8746	0.0001	****
Wallonia	0.00025	0.00002		0.7901	0.0001		0.8265	0.0002	
Brussels	0.00019	0.00003		0.7206	0.0002		0.8107	0.0002	
Owner	0.00020	0.00002	****	0.8937	0.0001		0.8625	0.0001	****
Tenant	0.00032	0.00003		0.7274	0.0002		0.8176	0.0002	
Urban	0.00025	0.00002	*	0.8216	0.0001	****	0.8287	0.0001	****
Suburban	0.00024	0.00002	p<.5	0.8726	0.0001		0.8711	0.0001	
Rural	0.00024	0.00003		0.8789	0.0002		0.8794	0.0001	
Belgian	0.00026	0.00002	****	0.8572	0.0001	****	0.8562	0.0001	****
Other European	0.00014	0.00004		0.8210	0.0003		0.8346	0.0003	
Non-European	0.00007	0.00004		0.7026	0.0006		0.8069	0.0006	
Very good health status	0.00014	0.00002	****	0.8297	0.0001	****	0.8704	0.0001	****
Good health	0.00019	0.00002		0.8157	0.0001		0.8584	0.0001	
Intermediate health	0.00033	0.00004		0.7793	0.0002		0.8292	0.0002	
Bad health	0.00068	0.00012		0.7501	0.0004		0.7977	0.0004	
Very bad health status	0.00096	0.00029		0.7349	0.0008		0.7553	0.0001	
Less than a year in the housing	0.00034	0.00005	****	0.7608	0.0002	****	0.8459	0.0002	****
1-2 years	0.00030	0.00004		0.7727	0.0002		0.8447	0.0002	
3-5 years	0.00026	0.00004		0.7950	0.0002		0.8482	0.0002	
> 5 years in the housing	0.00021	0.00002		0.8281	0.0001		0.8587	0.0001	

Source: 2001 Census, National Register and death certificates (2002-2006). Calculations by the author.

Note for the ANOVA test: *: p<0.5; **: p>0.1; ***: p>0.01; ****: p>0.001.

People living in better housing quality present lower suicide risk, except for the two first quartiles: the very low housing conditions are associated with slightly lower suicide rates than the low housing conditions (Table 6.1). The population that is better satisfied with their neighbourhood shows lower suicide rates. Suicide rates are also lower for individuals with higher education and employed individuals. People in marital unions and parents also present a lower suicide risk than isolated individuals or persons in non-marital unions. Compared to Flanders or Wallonia, living in Brussels is also related to lower suicide rates. Homeowners present a lower suicide risk than tenants, just like foreign individuals compared to Belgian individuals. When it comes to areas of residence (urban, suburban, rural), no apparent difference between the suicide rates could be observed. Results clearly show that suicide risk is positively associated with poorer subjective health. Longer times of residence in the housing are related to lower suicide risks.

Table 6.1 also displays the means of housing quality scores according to the different characteristics. On average, a better educational level is associated with better housing conditions. Similarly, unemployed or inactive populations live in lower housing quality than employees or independent workers. On average, individuals in marital unions also present higher housing quality, while in isolated households, lone parents live in worse conditions. Brussels is associated with a lower housing score mean than the two other regions, and this is also the case for urban households compared to rural or periurban ones. Owners live in better quality housing than tenants, which is also the case for Belgians compared to foreigners. We can also notice that poor self-reported health status and shorter time spent in housing are associated with worse housing conditions.

The relations are different for the means of neighbourhood satisfaction scores and not as expected. People who graduated from lower secondary school present the lowest level of satisfaction. This is also the case for unemployed people, while the inactive population is the most satisfied with their surroundings. Brussels residents and populations living in urban areas are the least happy with their immediate environment. Regarding household composition, the precedent trends are followed:

married individuals also present the highest level of satisfaction. At the same time, the isolated and lone parents are less satisfied with their neighbourhood amenities and services. Owners are more satisfied with their neighbourhood than tenants. This is also the case for Belgians compared to foreigners, especially non-European individuals. People reporting worse subjective health also report less satisfaction with their neighbourhood. Overall, a longer time in the residence is linked to better satisfaction.

2. Multivariate regression models

a. Housing conditions and suicide

Table 6.2 shows the results of a Cox proportional hazard model on the risk of suicide of the 25 to 69-year-old population living in Belgium.

Table 6.2 - *Cox proportional hazard model of the risk of suicide in 2002-2006 expressed in Hazard ratios (HR) and 95% confidence intervals.*

	Men			Women		
	OR	*IC95%*		OR	*IC95%*	
Housing quality (ref. Very Low)						
Low	0.994	*0.913*	*1.083*	0.955	*0.833*	*1.094*
High	0.944	*0.870*	*1.024*	0.877	*0.768*	*1.000*
Very high	0.877	*0.789*	*0.975*	0.773	*0.648*	*0.923*
Neighbourhood satisfaction (ref. Low)						
Intermediate	0.932	*0.860*	*1.010*	1.044	*0.918*	*1.186*
HIgh	1.007	*0.934*	*1.085*	1.000	*0.884*	*1.130*
Age	0.982	*0.979*	*0.985*	0.977	*0.972*	*0.983*
Housing tenure (ref. Owner)						
Tenant	1.383	*1.281*	*1.493*	1.200	*1.060*	*1.358*
Unknown	1.398	*1.194*	*1.638*	1.606	*1.266*	*2.038*
Household composition (ref. Marital couple, children)						
Marital couple, no children	0.829	*0.748*	*0.919*	1.391	*1.180*	*1.638*
Non-marital couple, children	1.283	*1.101*	*1.494*	0.831	*0.582*	*1.185*
Non-marital couple, no children	1.546	*1.354*	*1.765*	2.182	*1.731*	*2.750*
Single, children	1.510	*1.309*	*1.742*	2.194	*1.842*	*2.614*
Single, no children	2.396	*2.200*	*2.609*	3.184	*2.717*	*3.733*
Other	1.145	*0.982*	*1.336*	1.546	*1.201*	*1.990*
Unknown	2.533	*0.815*	*7.868*	8.211	*2.043*	*33.003*

Region (ref. Flanders)						
Wallonia	1.012	*0.946*	*1.082*	1.014	*0.909*	*1.132*
Brussels	0.820	*0.727*	*0.924*	0.812	*0.669*	*0.985*
Area (ref. Urban)						
Suburban	1.173	*1.081*	*1.273*	0.863	*0.757*	*0.985*
Rural	1.106	*1.014*	*1.206*	0.891	*0.775*	*1.026*
Nationality (ref. Belgian)						
Other European	0.512	*0.434*	*0.602*	0.511	*0.383*	*0.681*
Non-European	0.269	*0.171*	*0.424*	0.539	*0.309*	*0.941*
Unknown	0.831	*0.311*	*2.219*	0.000	*.*	*.*
Educational level (ref. Primary)						
Lower Secondary	1.112	*1.002*	*1.235*	1.065	*0.900*	*1.260*
Upper Secondary	0.950	*0.852*	*1.060*	1.246	*1.047*	*1.482*
Higher	0.749	*0.665*	*0.843*	1.314	*1.093*	*1.580*
Unknown	0.861	*0.748*	*0.991*	0.840	*0.671*	*1.052*
Occupational status (ref. Unemployed)						
Inactive	0.864	*0.693*	*1.077*	1.142	*0.921*	*1.415*
Employee	0.910	*0.756*	*1.096*	0.978	*0.814*	*1.174*
Liberal	1.009	*0.817*	*1.247*	1.259	*0.956*	*1.658*
Unknown	1.034	*0.844*	*1.267*	0.849	*0.659*	*1.094*
Time spent in the housing (ref. Under 1 year)						
1-2 years	0.818	*0.735*	*0.910*	0.820	*0.687*	*0.979*
3-5 years	0.698	*0.625*	*0.779*	0.665	*0.554*	*0.798*
5 years+	0.656	*0.595*	*0.724*	0.663	*0.565*	*0.778*
Subjective health (ref. Very good)						
Good	1.299	*1.190*	*1.418*	1.677	*1.420*	*1.980*
Intermediate	2.097	*1.892*	*2.324*	3.533	*2.947*	*4.237*
Bad	3.573	*3.138*	*4.067*	8.318	*6.784*	*10.200*
Very bad	4.469	*3.673*	*5.438*	13.525	*10.310*	*17.742*
Unknown	1.794	*1.461*	*2.202*	2.937	*2.132*	*4.045*
Deciles of BIMD (ref. most deprived)						
2	1.058	*0.946*	*1.184*	1.110	*0.925*	*1.332*
3	1.045	*0.913*	*1.197*	1.277	*1.027*	*1.587*
4	1.036	*0.914*	*1.174*	1.351	*1.108*	*1.649*
5	0.993	*0.870*	*1.133*	1.339	*1.085*	*1.652*
6	0.984	*0.855*	*1.133*	1.261	*1.005*	*1.583*
7	0.871	*0.754*	*1.007*	1.184	*0.941*	*1.489*
8	0.962	*0.832*	*1.112*	1.307	*1.034*	*1.652*
9	0.969	*0.837*	*1.122*	1.258	*0.992*	*1.596*
Least deprived	0.964	*0.822*	*1.129*	1.172	*0.902*	*1.522*

Failures	4,123	1,573
Observations	2,527,183	2,540,061
Log Likelihood	-58666.063	-22206.813

Results show a negative relation between housing quality and suicide risk for both sexes. For men, compared to being in the 25% of the population living in Belgium in the worst housing conditions, we estimate that high housing quality is related to 5.6% lower suicide risk and living in very high housing quality (being part of the 4th quartile) is associated with 12.3% lower suicide risk. For women, still compared with the quartile living in the poorest housing conditions, high housing quality is associated with a 12.3% lower suicide risk, and living in excellent housing conditions is linked to a 22.7% lower suicide risk. For men especially, the difference between very low and low housing qualities are not strong enough to be noted as significant, as they do not reach a 5 percentage-point gap (see chapter 4, page 95).

Regarding neighbourhood satisfaction, intermediate satisfaction is associated with a 7% lower suicide risk than low neighbourhood satisfaction for men only. Otherwise, there is no visible difference between the different levels of neighbourhood-related satisfaction.

In Table 6.2, we also observe that tenants are associated with a higher suicide risk than owners: 38% higher for men and 20% for women. Our results also highlight that a marital union is associated with a decreased suicide risk for men while being a parent is related to a lower suicide risk for women. Individuals residing in Brussels show a lower suicide risk than those who live in the two other regions. Associations between educational level and suicide differ between men and women. Men with higher levels of education show lower suicide risk, while women with higher levels of education show higher suicide risk compared to primary-educated populations. This result confirms previous research, showing this Belgian exception (Lorant et al., 2021b). Better subjective health is strongly linked to lower suicide risk.

Table 6.3 reiterates the previous model, but only for the share of the population who declared being in good or excellent health in 2001 at the Census. This covers about 76% of the men (60% of the suicides) and 74% of the women (48% of the suicides).

***Table 6.3** – Cox proportional hazard model on the risk of suicide in 2002-2006 expressed in Hazard ratios (HR) and 95% confidence intervals on the population who declared being in good or very good health conditions in 2001.*

	Men			Women		
	OR	*IC95%*		OR	*IC95%*	
Housing quality (ref. Very low)						
Low	0.961	0.859	1.076	0.854	0.689	1.058
High	0.891	0.802	0.990	0.935	0.773	1.131
Very high	0.812	0.712	0.927	0.835	0.658	1.060
Neighbourhood satisfaction (ref. Low)						
Intermediate	0.876	0.789	0.973	1.003	0.831	1.210
High	0.902	0.819	0.993	0.920	0.771	1.098
Age	0.988	0.983	0.992	0.987	0.979	0.995
Housing tenure (ref. Owner)						
Tenant	1.448	1.311	1.599	1.171	0.971	1.412
Unknown	1.222	0.969	1.543	1.680	1.157	2.438
Household composition (ref. Marital couple, children)						
Marital couple, no children	0.820	0.716	0.938	1.480	1.175	1.863
Non-marital couple, children	1.302	1.089	1.557	0.916	0.593	1.415
Non-marital couple, no children	1.447	1.215	1.723	2.211	1.583	3.089
Single, children	1.650	1.376	1.978	2.629	2.077	3.327
Single, no children	2.498	2.241	2.784	3.389	2.702	4.251
Other	1.207	0.994	1.465	1.802	1.277	2.542
Unknown	1.425	0.200	10.131	9.052	1.267	64.680
Region (ref. Flanders)						
Wallonia	1.012	0.928	1.103	0.927	0.791	1.086
Brussels	0.843	0.725	0.979	0.682	0.517	0.900
Area (ref. Urban)						
Suburban	1.177	1.060	1.306	0.836	0.693	1.008
Rural	1.164	1.041	1.301	0.823	0.671	1.009
Nationality (ref. Belgian)						
Other European	0.505	0.407	0.627	0.598	0.403	0.889
Non-European	0.281	0.155	0.512	0.653	0.287	1.486
Unknown	0.459	0.064	3.265	0.000	0.000	.

Educational level (ref. Primary)						
Lower Secondary	1.009	0.870	1.170	1.034	0.775	1.378
Upper Secondary	0.819	0.704	0.952	1.204	0.906	1.600
Higher	0.609	0.519	0.714	1.022	0.762	1.372
Unknown	0.954	0.776	1.172	0.870	0.573	1.322
Occupational status (ref. Unemployed)						
Inactive	0.806	0.558	1.165	1.038	0.717	1.503
Employee	0.813	0.613	1.079	0.906	0.687	1.196
Liberal	0.900	0.662	1.225	1.210	0.823	1.780
Unknown	0.993	0.736	1.339	0.877	0.612	1.255
Time spent in the housing (ref. Under 1 year)						
1-2 years	0.848	0.741	0.972	0.876	0.676	1.136
3-5 years	0.711	0.617	0.819	0.705	0.539	0.921
5 years+	0.666	0.587	0.756	0.741	0.584	0.939
Deciles of BIMD (ref. most deprived)						
2	0.956	0.822	1.112	0.941	0.715	1.238
3	1.045	0.875	1.248	1.293	0.944	1.770
4	0.945	0.802	1.115	0.990	0.732	1.338
5	0.958	0.808	1.135	1.064	0.780	1.452
6	0.877	0.730	1.054	1.152	0.835	1.590
7	0.828	0.688	0.997	0.971	0.700	1.347
8	0.892	0.741	1.075	1.034	0.738	1.449
9	0.963	0.801	1.157	1.084	0.779	1.509
Least deprived	0.908	0.743	1.110	1.031	0.720	1.478
Failures	2,491			758		
Observations	1,912,590			1,871,627		
Log Likelihood	-34190.322			-10650.301		

Source: Census 2001, National Register and death certificates 2002-2006. Author's calculations.

For men, the results observed in Table 2 are also visible in Table 3. Compared to living in very low housing conditions (1st quartile), living in high, and very high conditions is associated with 11%, and 19% lower suicide risk. For women, the relation is weaker, and the confounding effect of health status on the link between housing and suicide is visible. Compared to living in very low housing conditions, women who live in high housing conditions (3rd quartile) are associated with a 6.5% decreased suicide hazard. But women living in low (2nd quartile) and very good (4th quartile)

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housing conditions are associated with close suicide risks, respectively, with a 15% and 16% lower suicide risk.

For neighbourhood-related satisfaction, results also differ from the models on the whole population. The confounding effect of health status on the relation between the living environment and suicide appears for both genders. For men, the intermediate satisfaction over the neighbourhood amenities and services is still associated with the lowest risk of suicide (-12%). Poor satisfaction is associated with a 10% decreased suicide risk than low satisfaction. For women, a high level of satisfaction is related to an 8% lower suicide risk than a low level of satisfaction in the neighbourhood.

For other covariates, associations and relations remain very close to the models for the whole population. It is to be noted that the higher suicide risk for women with higher education – compared to primary education – does not appear anymore. This feeds the hypothesis presented in Chapter 5: a high prevalence of professional fatigue or burnout would be present among highly skilled women who combine a dense professional life with heavy responsibilities at home. Future studies should investigate how women's education and professional activity may negatively impact their physical and mental health.

b. Interaction between housing quality and neighbourhood satisfaction

Interaction terms were added to the model. Figure 6.3 presents the interaction between the population quartiles based on the housing quality score (very low, low, high, very high housing quality) and the three population shares defined by their neighbourhood satisfaction (low, intermediate, and good neighbourhood satisfaction). Results are given separately by sex and expressed as predicted relative hazard of suicide, based on Cox proportional hazard models. Models control for the same covariates as the previous model.

Figure 6.3 – Predicted relative hazard of suicide for A/ men and B/ women according to neighbourhood satisfaction level (low, intermediate, high) for each of the housing quality quartiles (very low, low, high, very high).
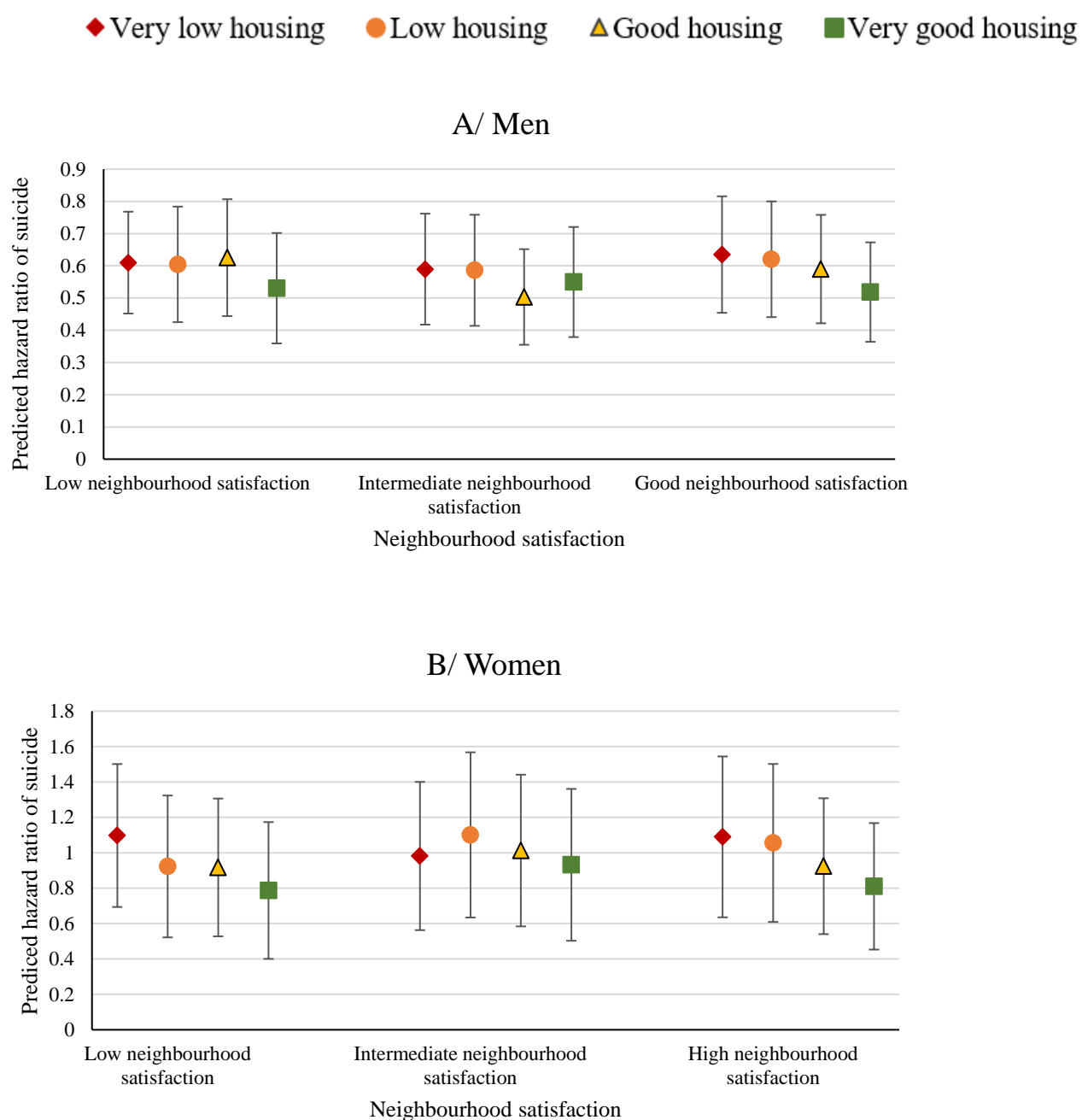
Source: Census 2001, National Register and death certificates 2002-2006. Author's calculations.

Note: Figure 6.3 is based on a model controlling for age, household composition, housing tenure, nationality, region, area of residence, education, occupation, subjective health, years spent in the housing, and municipal index of multiple deprivation.

For men, we can notice that the level of satisfaction with the neighbourhood does not change the relationship between housing conditions and suicide. In other terms, living in a satisfactory neighbourhood does not decrease the predicted relative hazard of suicide for individuals living in poor housing conditions, compared to accumulating both poor quality housing and neighbourhood. For women, the trend is similar: better housing conditions are associated with lower suicide risk in both low- and high-satisfaction neighbourhoods. Overall, the overlapping of the confidence intervals is larger than the 20% threshold defined in the methodological section to quantify effect strength (see section 4.4, page 95). No interaction effect is noticeable between housing conditions and neighbourhood satisfaction.

c. By gender and age group

Interactions

Figure 6.4 presents the predicted relative hazards of suicide according to the interaction between the level of housing quality (very low, low, high, very high) and the individual's age category (25-39, 40-54, and 55-69). Overall, results must be taken cautiously. Looking strictly at the differences between estimates, for men, housing conditions seem like strong determinants of suicide for younger adults. For the 25-39 age group, better housing conditions are associated with lower suicide risk. The gradient remains for men aged 40 to 54. For men aged 55 to 69, the relation between housing conditions and suicide is not as linear: individuals living in high housing quality present the highest suicide risk, while men living in low and very low housing quality are associated with low suicide risk, as low as men living in the best housing quality. For women, we see the gradient according to which better housing quality is associated with lower suicide risk for all age groups. The oldest age group (55 to 69) has a higher suicide risk linked to low-very low housing conditions than to high-very high housing quality. But again, the effect strength is rather limited. The differences in predicted relative hazards are visible and exceed a gap of 5 percentage-point between the "very low" and "very high" categories for young and middle-aged men and for women

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of all age groups. However, the overlapping of the confidence interval exceeds 20% and does not allow to conclude of a strong effect of age on the relationship between housing quality and suicide mortality.

Figure 6.4 - Predicted relative hazard of suicide for A/ men and B/ women according to their age group for each of the housing quality quartiles (very low, low, high, very high).
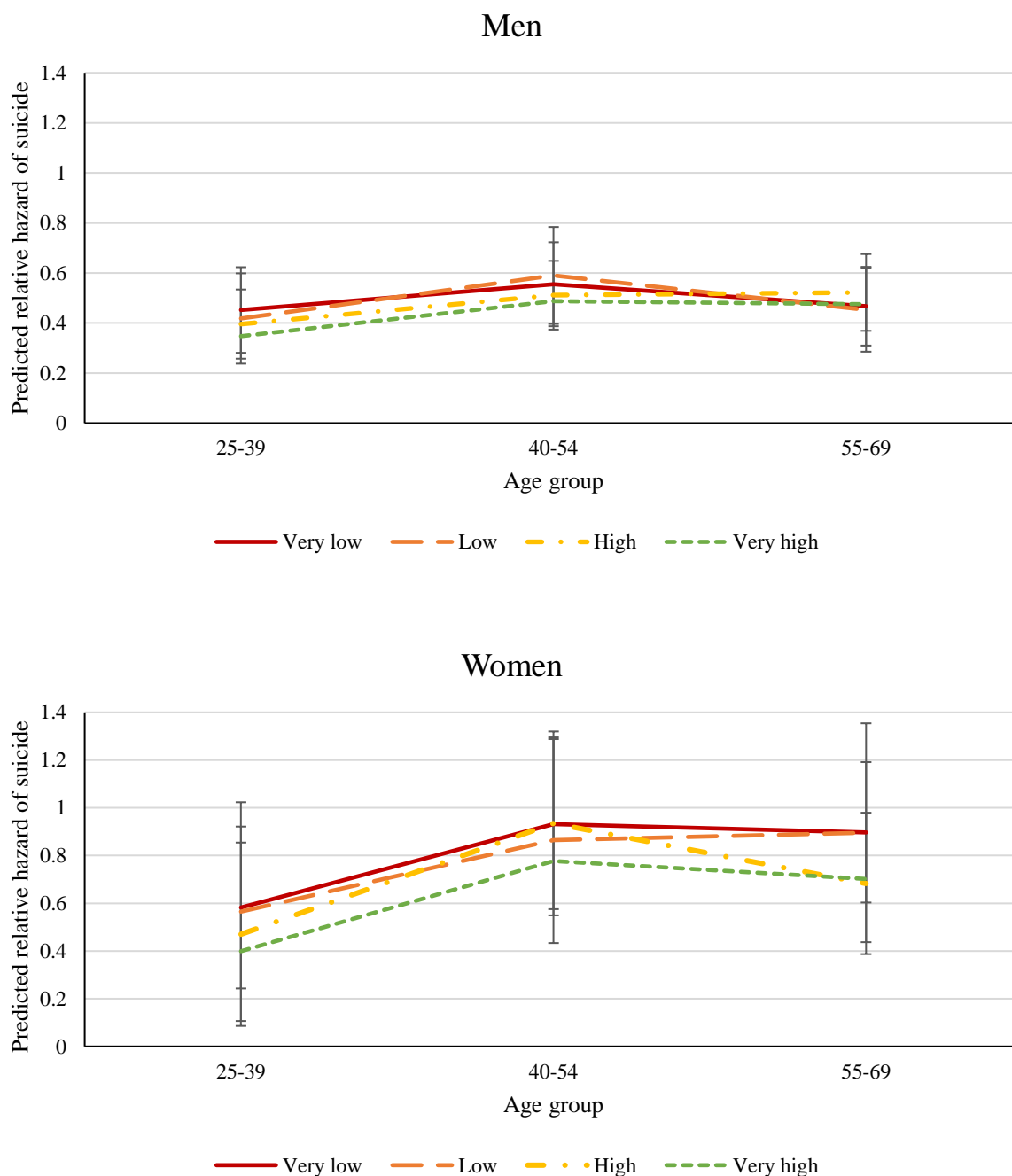
Pseudo-partial correlations

Previous results describe the variation of the suicide hazards for each extra unit of a continuous predictor or category compared to a reference category of a discrete predictor. But they do not allow us to know the importance of one predictor on the outcome, given the effect of the others. With pseudo-partial correlations, we can estimate the relative weight of each predictor in the variance of the suicide risk. Table 6.4 presents the pseudo-partial correlations of every predictor in the risk of suicide for each large age group (25-39; 40-54; 55-69) for men and women separately. This ranking's robustness is also tested in Appendix (Table A6.6) with another method based on comparing the Akaike Information Criterion (AIC) after removing each predictor individually.

Table 6.4 – Pseudo-partial correlations, in absolute numbers, between the predictors and suicide risk (based on a logistic model), for men and women, according to different age groups and rank of each predictor.

MEN	25-39		40-54		55-69	
	PCP	Rank	PCP	Rank	PCP	Rank
Health	0.0039	1	0.0041	1	0.0027	2
Household composition	0.0024	2	0.0029	2	0.0019	3
Age	0.0019	3	0.0006	7	0.0029	1
Housing quality	0.0018	4	0.0019	4	0.0007	5
Years spent in housing	0.0015	5	0.0022	3	0.0010	4
Region	0.0010	6	0.0010	6	0.0000	8
Homeownership	0.0008	7	0.0013	5	0.0007	6
Neighbourhood satisfaction	0.0008	8	0.0002	9	0.0000	8
Area	0.0008	9	0.0005	8	0.0000	8
Occupation	0.0008	10	0.0001	10	0.0000	8
Nationality	0.0002	11	0.0000	12	0.0000	8
Education	0.0000	12	0.0000	13	0.0002	7
Municipality IMD	0.0000	13	0.0000	14	0.0000	8

WOMEN	25-39		40-54		55-69	
	PCP	Rank	PCP	Rank	PCP	Rank
Health	0.0032	1	0.0041	1	0.0021	2
Household composition	0.0020	2	0.0022	2	0.0008	5
Age	0.0014	3	0.0000	11	0.0022	1
Housing quality	0.0010	4	0.0014	4	0.0004	7
Nationality	0.0009	5	0.0007	6	0.0011	4

Years spent in housing	0.0008	6	0.0020	3	0.0012	3
Occupation	0.0006	7	0.0008	5	0.0000	9
Homeownership	0.0005	8	0.0004	8	0.0003	8
Region	0.0004	9	0.0000	11	0.0000	9
Area	0.0003	10	0.0003	9	0.0000	9
Neighbourhood satisfaction	0.0000	11	0.0005	7	0.0000	9
Education	0.0000	12	0.0003	9	0.0000	9
Municipality IMD	0.0000	13	0.0000	11	0.0005	6

Source: Census 2001, National Register and death certificates 2002-2006. Author's calculations.

In Figure 6.5, we can see that subjective health remains, by far, the primary determinant of suicide. Housing conditions matter much in the risk of suicide, compared with other predictors, and this importance differs according to the category of the population. For younger men (25-39), housing quality is the 4th predictor, after subjective health, household composition and age. For middle-aged men (40-54), it is also the 4th predictor, after subjective health, household composition, and the number of years spent in the housing. Finally, for older men (55-69), housing quality appears to be a bit less determinant in the risk of suicide. It is the 5th determinant, after age, self-reported health status, household composition, and years spent in the housing. The effect of neighbourhood satisfaction on suicide is very weak, except for younger men. For women, housing quality appears to be a decisive factor in suicide risk as well. For younger women (25-39) and middle-aged women (40-54), it is the 4th predictor of suicide, after subjective health, household composition age. Finally, for older women (55-69), it is the 7th predictor of suicide, after subjective health, age, years spent in the housing, household composition, nationality, and the municipality deprivation index. Neighbourhood satisfaction is a significant suicide determinant for women aged 40 to 54 but not for other age groups. After checking the robustness of the results, comparing the AIC gives comparable conclusions about the ranking of the most important predictor.

d. A specific portrait of Brussels

The Brussels-capital region offers a particular housing landscape. It is a more densely inhabited region in Belgium, with smaller housing than the other regions. More than 50% of the population living in Brussels lives in an apartment, while it is the case for about 15% in Flanders and Wallonia.

Also, the people living in Brussels are less often homeowners: in 2001, we still count approximately 52% of tenants in Brussels, for about 25% in the other regions. According to Table 6.1, housing quality and neighbourhood satisfaction are lower in Brussels than in Flanders and Wallonia. In parallel, Brussels presents lower suicide rates than the two other Belgian regions and includes a more diverse and younger population. For example, 31% of the people living in Brussels have a non-Belgian nationality, while it is the case of about 12% of the population in Belgium. In such a context, we can question whether the results observed in Belgium are still observed in Brussels only.

Table 6.5 - *Cox proportional hazard model of the risk of suicide in 2002-2006 expressed in Hazard ratios (HR) and 95% confidence intervals; Brussels region only.*

	Men			Women		
	OR	*IC95%*		OR	*IC95%*	
Housing quality (ref. Very high)						
Very low	1.145	*0.861*	*1.522*	1.382	*0.972*	*1.964*
Low	0.970	*0.719*	*1.309*	0.657	*0.418*	*1.034*
High	0.719	*0.217*	*2.380*	2.414	*0.817*	*7.135*
Neighbourhood satisfaction (ref. High)						
Intermediate	1.059	*0.797*	*1.406*	0.905	*0.621*	*1.318*
Low	1.094	*0.832*	*1.440*	0.935	*0.646*	*1.355*
Age	0.983	*0.972*	*0.994*	0.974	*0.959*	*0.989*
Housing tenure (ref. Owner)						
Tenant	1.255	*0.964*	*1.634*	1.114	*0.788*	*1.575*
Unknown	1.044	*0.622*	*1.753*	1.552	*0.849*	*2.839*
Household composition (ref. Marital couple, children)						
Marital couple, no children	1.210	*0.770*	*1.900*	2.675	*1.458*	*4.910*
Non-marital couple, children	0.988	*0.445*	*2.189*	1.361	*0.459*	*4.033*
Non-marital couple, no children	2.059	*1.284*	*3.303*	3.815	*1.984*	*7.338*
Single, children	2.011	*1.140*	*3.550*	1.797	*0.954*	*3.385*
Single, no children	3.610	*2.590*	*5.033*	3.590	*2.101*	*6.135*
Other	1.104	*0.542*	*2.250*	1.810	*0.757*	*4.329*
Unknown	0.000	*0.000*	*.*	0.000	*0.000*	*.*
Nationality (ref. Belgian)						
Other European	0.488	*0.332*	*0.718*	0.472	*0.271*	*0.820*
Non-European	0.431	*0.232*	*0.801*	0.507	*0.201*	*1.276*
Unknown	0.512	*0.071*	*3.666*	0.000	*0.000*	*.*

Educational level (ref. Primary)						
Lower Secondary	0.936	*0.640*	*1.368*	1.468	*0.799*	*2.696*
Upper Secondary	0.735	*0.491*	*1.100*	1.849	*1.003*	*3.407*
Higher	0.794	*0.537*	*1.173*	2.248	*1.217*	*4.151*
Unknown	0.576	*0.353*	*0.940*	0.844	*0.411*	*1.734*
Occupational status (ref. Unemployed)						
Inactive	0.829	*0.393*	*1.748*	1.898	*0.928*	*3.881*
Employee	1.217	*0.686*	*2.160*	1.225	*0.646*	*2.323*
Liberal	1.059	*0.522*	*2.150*	1.099	*0.398*	*3.035*
Unknown	1.357	*0.704*	*2.614*	1.742	*0.813*	*3.735*
Time spent in the housing (ref. Under 1 year)						
1-2 years	0.756	*0.541*	*1.055*	1.080	*0.675*	*1.730*
3-5 years	0.596	*0.414*	*0.858*	0.752	*0.451*	*1.256*
5 years+	0.669	*0.487*	*0.918*	0.751	*0.474*	*1.191*
Subjective health (ref. Very good)						
Good	1.947	*1.343*	*2.822*	1.098	*0.648*	*1.859*
Intermediate	2.738	*1.805*	*4.153*	3.628	*2.138*	*6.158*
Bad	4.702	*2.876*	*7.685*	9.527	*5.369*	*16.904*
Very bad	11.015	*6.416*	*18.910*	14.908	*7.410*	*29.993*
Unknown	3.386	*1.729*	*6.633*	2.518	*0.988*	*6.415*
Deciles of BIMD (ref. most deprived)						
2	1.013668	*0.751*	*1.369*	1.302	*0.883*	*1.920*
3	1.238241	*0.737*	*2.080*	1.402	*0.720*	*2.728*
4	1.062	*0.662*	*1.704*	1.986	*1.225*	*3.219*
5	1.222	*0.659*	*2.267*	0.843	*0.306*	*2.322*
6	1.092	*0.691*	*1.725*	1.254	*0.708*	*2.221*
7	0.930	*0.470*	*1.841*	0.716	*0.258*	*1.988*
8	2.922	*1.056*	*8.085*	2.514	*0.574*	*11.017*
9	1.950	*0.613*	*6.199*	0.000	*0.000*	*.*
Least deprived	2.840	*0.686*	*11.767*	0.000	*0.000*	*.*
Failures	441			183		
Observations	343,996			346,475		
Log Likelihood	-5377.855			-2192.862		

Results in Table 6.5 show that associations previously observed in Table 6.2 are not confirmed for Brussels. There is still a higher risk of suicide for men living in very low housing quality compared to men living in high and very high-quality housing. However, low housing quality is associated with a 14% higher suicide risk than very low housing quality. For women, unexpectedly, there exists

a 38% and 141% higher risk of suicide for women living, respectively, in low (2nd quartile) and very high (4th quartile) housing quality, compared to those living in the worst housing quality. Only women in high housing quality (3rd quartile) are associated with lower suicide mortality than the reference category. For men, high neighbourhood satisfaction is associated 9% higher suicide risk think being unsatisfied by the neighbourhood. For women, better satisfaction is associated with lower suicide risks. We must note that the small numbers of suicides in Brussels (441 for men and 183 for women) add some uncertainty to our results.

Separate analyses were also conducted in Wallonia and Flanders. Their results are consistent with the main models: we still observe lower suicide mortality for people living in better housing conditions and no association between neighbourhood satisfaction and suicide.

VI. DISCUSSION

1. Interpretation of the results

This chapter investigates the relationship between living environment and suicide. To our knowledge, this research is the first to address the issue through an extensive series of housing characteristics and the satisfaction of a diverse list of neighbourhood amenities and services and to present the relative importance of individual, demographic and socioeconomic indicators on suicide risk. It shows how the relationship between housing quality and suicide varies according to neighbourhood satisfaction and life stages. The use of Belgian population data is an asset: the 2001 Census is a unique – yet underused – source of information about the living environment, and the National Register and death certificates allow to follow the population at risk of suicide for five years.

a. *First hypothesis: housing quality and suicide*

As a first contribution, I showed that very good housing conditions are associated with a lower risk of suicide, for both men and women **(H1 is validated),** after controlling for demographic and socioeconomic individual characteristics, as well as by subjective health, the number of years spent in the housing and the deprivation level of the municipality. This result resonates with previous studies. For instance, higher quality energetical installations are associated with better mental health outcomes (Gibson et al., 2011) and more happiness (Shortt & Rugkåsa, 2007). In a Korean study, additionally to papers investigating housing conditions through one specific element (such as overcrowding or type of building), a more extensive series of housing characteristics (functional and structural items) showed that better housing was associated with better mental health outcomes and fewer suicide ideations (J. H. Lee, 2022). Here, I contribute by showing the association between housing quality and suicide mortality. In addition, models were reiterated for the population who declared a good or very good health status in 2001 to evaluate the confounding role of self-reported health in the relation. The gradient according to which better housing conditions are associated with lower suicide hazards is confirmed for men but not women. For women, the relationship between housing and suicide for women appears to be partially confounded by health status.

Mental health struggles are both responsible for higher suicide risk (Conejero, Olié, Calati, et al., 2018a) but also for more unstable life courses, lower socioeconomic situations (Slominski et al., 2011) and poorer living conditions and environment. For men, this role of mental health predispositions is less visible, possibly because it might impact life course and housing career less. Another explanation is that men tend to under-declare their struggles, especially regarding mental health, leading to overestimating their self-reported health status (Davis et al., 2008; Oliffe et al., 2020). However, and this is a general comment about our quality scores, this change in the result for women might also be explained by housing quality levels that are close to each other. The difference in housing quality between the 'low' and 'high' categories is challenging to quantify or apprehend. It is essential to avoid overinterpreting minimal differences in individuals' experiences.

b. Second hypothesis: Neighbourhood satisfaction and suicide

Second, no clear relationship between neighbourhood satisfaction and suicide risk was retrieved from the results for men or women. For the population who declared a very good or good health status, the association appears, even though the intermediate level of satisfaction is associated with the lowest hazard of suicide for men and is not associated with lower suicide risk for women, compared to a low level of satisfaction. We can say the negative relation between neighbourhood satisfaction and suicide is confounded by health status **(H2 is partially validated for the healthy population).** Previous papers showed unclear relationships between neighbourhood characteristics and mental health. For instance, a study in New Zealand could not prove a relationship between neighbourhood deprivation level and suicide risk (Collings et al., 2009). In another study, only some specific elements of the neighbourhood (walkability, safety, and traffic noise) were associated with mental health outcomes, contrary to other factors such as access to green spaces, aesthetics, or quality of the services (Leslie & Cerin, 2008). Another study highlighted that the relationship between neighbourhood environment and mental health at the community level was highly mediated by compositional factors and individual characteristics (Dykxhoorn et al., 2023). We must note that we use a subjective measure of neighbourhood characteristics. Mental health can bias perceptions: depression can lead to a more pessimistic vision of reality, especially for women (Nieto et al., 2020). Our findings do not confirm this idea. Here, a low level of satisfaction is associated with a higher hazard of suicide only for people who declared a better health status. It is possible that individuals with poor subjective health – who have trouble moving or walking in their surroundings – have less contact with their immediate environment, judge it differently and pay attention to different elements, such as accessibility, than healthy populations. Hence, neighbourhood quality is not a strong determinant of suicide risks in less healthy people.

These results are not consistent over the whole territory of Belgium. In the Brussels-capital region, associations between the living environment quality and suicide differed from those observed in Flanders and Wallonia - which follow the national pattern. For men, there is still an overall

association between better housing conditions and lower suicide risks. This is not verified for women: women with the best housing conditions are associated with higher suicide risks than women living in the worst housing conditions. Small numbers can explain these unexpected results. Also, because the Brussels region's housing quality was less favourable than in the other Belgian areas, we can believe that the Brussel population living in very high housing quality is a selected population – possibly more privileged and educated.

c. Third hypothesis: Interacting housing and neighbourhood

The results do not allow us to conclude there is an interaction effect between housing conditions and neighbourhood effect on suicide risk **(H3 is not validated).** This result follows a previous study showing that the visible relation between housing conditions and children's well-being was not stronger or weaker in poor-quality neighbourhoods than in high-quality neighbourhoods (Rollings et al., 2017). Also, I believe that living in a good quality neighbourhood does not only positively impact mental health for people living in bad quality housing. People compare themselves to their peers in a social group such as a neighbourhood. This comparison can have positive or negative effects on healthy behaviours and influence individuals in their choices and lifestyle, in terms of diet, consumption of tobacco, alcohol, or drugs, or when it comes to preventive care or counselling (Thoits, 2011). Health and suicide are highly related to social norms and the individual's position within their environment (Durkheim, 1951; Marmot, 2004b). An inferiority complex harms mental health and self-esteem (e.g., Vogel et al., 2014). In a study led by 328 participants from Alberta (Mishra & Carleton, 2015), relative deprivation – a socioeconomic level that is perceived as lower compared to others – was associated with poorer physical and mental health outcomes after accounting for absolute socioeconomic characteristics (Mishra & Carleton, 2015). A study among older adults showed that downward social comparison – considering oneself not doing as well as peers – was associated with a significantly higher depression risk (Cheng et al., 2008). Social comparison and the sense of being behind in terms of

personal and professional achievement was also a determinant of burnout among working-age adults (Buunk & Schaufeli, 1993). Therefore, for people living in poor housing quality comparatively to their neighbourhood, it adds shame and guilt of not fitting into the community's standards to the initial struggle to live in an unsatisfactory place. In Chapter 5, I already used the concept of social status to explain the disparities of suicide between tenants and homeowners: compared to owners, suicide risk among tenants was higher in situations when homeownership was the most socially expected, for middle-aged adults, for married men, and unpartnered women. I suggest future studies to improve the knowledge about relative housing conditions compared to the neighbourhood or municipality standards.

d. Fourth hypothesis: Differences over the life stages

Finally, my study addressed the question of the life course and compared the relationship between housing conditions and suicide for three large age groups (25-39, 40-54, and 55-69). The results confirm that the relationship differs across life stages. For men, better housing conditions are associated with lower suicide risk for the two younger age groups (25-39 and 40-54). The relation is no longer visible for the older age group (55-69). For women, the link is visible for the younger (25-39) and especially the older (55-69) age groups but is weaker for middle-aged women (40-54). However, these observations must be nuanced by the low effect strength of the associations **(H4 is not validated),** and the overlapping of the confidence intervals that exceeds the threshold defined in the methodological section (see chapter 4, page 95). It is not possible to come to a firm conclusion on the possible interaction effect between housing conditions and life stages on suicide risk of men and women.

In addition to analysing the interaction effect, pseudo-partial correlations help observe the relative importance of individual characteristics, including housing and neighbourhood characteristics, regarding suicide risk and given the impact of other predictors. For men and women, housing quality is more critical in suicide risk than many other predictors, such as education, occupation or

the region of residence. For older age groups, housing slightly loses importance for women. **This finding also nuances the fourth hypothesis**, as the relation between housing-related inequalities and suicide does not seem to attenuate for men clearly and does not increase for women. This result is unsurprising given that the population under study is working age. Housing conditions are an essential preoccupation for active men and women.

Belgium is characterised by a rather traditional division of labour, where the figure of the male breadwinner is still essential and where the gap between men's and women's earnings and career development is visible at old ages (Dewilde, 2012). For men in their childbearing and childrearing years, housing conditions are directly associated with their material and economic resources and the level of comfort they can offer to their family and themselves (Dittmar, 1989; Hitlin & Piliavin, 2004; Noguti & Bokeyar, 2014). For women in childbearing and childrearing years, the material comfort of the household is less associated with their role within the family unit. However, especially in a context in which women tend to have fewer financial resources than men at the end of their professional life (Dewilde, 2012), poor housing conditions or low-quality neighbourhoods for women in their 50ies and 60ies might be the reflection of life events, such as union dissolutions or widowhood, that indicate a precariousness and economic hardship for women. We must note that after separation, women are at a higher risk of poverty and have a lower chance of acceding homeownership than men (Jalovaara & Kulu, 2019; Leopold, 2018a).

2. Methodological aspects and limitations

This study presents some limitations. First, it cannot establish a causal relationship between living environment quality and suicide mortality. The results do not account for the residential course of the individual, or the variation of their living environment throughout time, but only their situation at the time of the 2001 Census. With more information on housing conditions and neighbourhood satisfaction over time, it could be possible to investigate the potential causal nature of the relation. To partially overcome this problem and at least control for one potential confounder in the link, I

ran models on the population who declared a good or very good subjective health status in 2001 (Table 6.3). I assume this population does not encounter a significant physical or psychical health issue or does not reveal it in the Census. Based on our results, we can think that a predisposition to physical or mental health issues is a possible confounder in the relationship between housing and suicide for women. For men, poor housing conditions are associated with higher suicide risk, even for individuals who have not declared any previous physical and mental health issues. Also, the role of the socioeconomic situation in the relation between the living environment and suicide is not fully apprehended. This possible confounder could be controlled with more insight through the addition of income information in our models. This way, it would be easier to disentangle the living environment's role from the materials conditions – that allow individuals to accede a good-quality housing and neighbourhood – on the individual risk of suicide.

Second, the variables that measure housing conditions can be questioned, especially regarding neighbourhood characteristics. The perception of the amenities and services in the neighbourhood can be highly dependent on the individual's state of mind: poor mental health and depressive states can bias perceptions and encourage pessimism (Herwig et al., 2010). Again, this possible bias was examined by selecting the subjectively healthy population. Also, we must note a relatively high correlation between the multiple deprivation level of the municipality of residence and the housing quality score (correlation coefficient is 0.21) on the one hand and the neighbourhood satisfaction score (correlation coefficient is 0.17) on the other. Results with and without these variables are however unchanged.

Third, we can consider that mortality due to other causes and residential mobility is not a neutral censor. Indeed, we assume that death from another cause (including death due to substance abuse) and residential mobility are independent of the risk of suicide. In addition, our results show that short residence duration (less than a year) is associated with higher suicide risk than longer time spent in the housing. Residential changes and suicide may not be independent of each other. Fine-

Gray sub-distribution models were then conducted to treat death from another cause and mobility not as a censor but as a competing failure. They give close results to what we observe in the Cox proportional hazard models regarding the relationship between the living environment and suicide (Table A6.10 and A6.11): the association between housing conditions and suicide risk is not biased by these alternative outcomes.

Fourth, the construction of the housing and neighbourhood condition scores could be seen as too arbitrary. Other scoring methods, including Principal Component Analysis and Multiple Factor Analysis (more suitable for the nature of the variables), were attempted but needed to be more easily interpretable. In additional material (Table A6.7 to A6.9), you can find the results obtained with this scoring method. This method presents very similar results. The components drawn from this method confirm our choices in weighting more some elements, such as the inside characteristics of the housing, the essential items, and the close environment characteristics and weighting less the outdoor housing characteristics and the services. Cox models also give similar conclusions as our main models.

Fifth, the high rate of missing values for each indicator related to housing quality or neighbourhood satisfaction is a drawback of our source of information. We suggested solving this problem through multiple imputations, as we assume that missing values are not random in our case. Models without these multiple imputations (that thus exclude all the individuals who did not reply to at least three housing- and neighbourhood-related variables, about 9% of the population) are presented in Appendix (Tables A6.3 and A6.4). Results remain robust compared to what is observed in Tables 6.2 and 6.3.

Finally, a significant asset of this study is using a high-quality dataset, coupling the 2001 Census, the National Register, and the death certificates, to investigate the relationship between environmental conditions and suicide risk in Belgium with population-based data. The 2001 Census is, in Belgium, one of the most detailed sources of information about housing and

neighbourhood characteristics, but it is getting old. Since 2001, Belgium conducted important housing policies. Belgium's federal government implemented "sustainable city contracts" between 2004 and 2009 (Francq et al., 2010): they aimed at acknowledging the housing issues at the level of the municipality, the limits of the housing market in some parts of the territory, and help low-income households and young adults to accede to good-quality dwellings. Even though the results of these policies are not prominent and did not change substantially the Belgian landscape (Francq et al., 2010), housing conditions in Belgium improved between the early 2000s and the late 2010s. Results from the SILC survey in 2015-2017 (Service de lutte contre la pauvreté, la précarité et l'exclusion sociale, 2019) could show a decrease in the number of housing-related issues – such as energetical poverty, lack of insulation, absence of central heating, proper light and bathroom – for the general population and the low-income households. Nonetheless, overcrowding is more and more common, especially for the deprived populations (Service de lutte contre la pauvreté, la précarité et l'exclusion sociale, 2019). I wonder how these improvements may have changed the relationship between the living environment and suicide in Belgium. I encourage future Belgian Census to question the population's housing conditions, immediate environment, and subjective health status.

3. Conclusion and recommendations

This chapter contributes to the existing literature by showing that housing quality is a specific determinant of suicide risk, independently from other demographic and socioeconomic individual characteristics, subjective health, years spent in the housing, and the municipality deprivation level. More specifically, the results present housing quality as a significant determinant in suicide risk, with relative importance that is more visible than other socioeconomic characteristics such as occupational status or educational attainment. They show that the relation between living environment and suicide risk is more substantial for young and middle-aged adults. On the contrary, I cannot conclude that neighbourhood characteristics are associated with suicide risk or

can influence the relationship between housing conditions and suicide. If the importance of housing in physical health was already known, findings highlight its role as a factor in mental health. They encourage all policies that guarantee everyone the right to good-quality housing, such as access to essential items, energetical renovations, and maintenance of the installations. They finally suggest that policies and improvements at the neighbourhood level cannot replace renovations at the level of housing.

Takeaway message from Chapter 6

❖ This study aims at estimating the relation between living environment - in terms of housing comfort and neighbourhood quality –and the risk of suicide, thanks to a comprehensive set of housing- and neighbourhood-related indicators.

❖ As a first contribution, we could show that better housing conditions are associated with a lower risk of suicide, for both men and women, after controlling for demographic and socioeconomic individual characteristics, as well as by subjective health, the number of years spent in the housing and the deprivation level of the municipality.

❖ To control for the confounding effect of mental health, a sub-sample of the population, including only individuals who declared healthy or very healthy, was selected. For women, the relationship between housing and suicide is partially mediated by subjective health. An association between neighbourhood satisfaction and suicide risk could only be retrieved from the results for men or women when they had declared a good health status in 2001.

❖ This study is the first to rank living environment quality among suicide predictors. It shows that housing quality is one crucial determinant of suicide, especially for younger and middle-aged adults.

CHAPTER 7

RESIDENTIAL MOBILITY, LIFE COURSE AND SUICIDE IN BELGIUM: IS IT ALL ABOUT CONTEXT?[6]

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[6] This chapter is still under review and was presented at the 3rd *International Conference for Migrations and Mobilities* at Saint-Andrews University, Scotland, in 2022, and to the *19th Divorce network conference* in 2022, at the M. University in Brno, Czech Republic.

I. INTRODUCTION

Many studies on separations and divorces showed that union dissolutions are highly associated with suicide (Bruce & Kim, 1992a; Heikkinen et al., 1993a; Okada & Samreth, 2013). In Belgium, the number of divorces per 1,000 marriages has risen over the last decades (Eurostat, 2021). Consequently, the demand for housing increased, making it difficult for recently separated individuals and parents to find a decent and affordable place, especially in post-separation economic loss (Biotteau et al., 2019a; Feijten, 2005).

However, even if residential mobility and union transitions go hand in hand, there is little knowledge about the link between internal migration and suicide risk. Studies on residential changes and suicide are still missing. So far, scientific literature has highlighted that residential changes were very challenging life changes that could be associated with mental health struggles (Oishi, 2010; Oishi & Schimmack, 2010). According to the context, the consequences of a move on individual trajectories and life satisfaction can be completely different (Choi & Oishi, 2020), varying according to the anticipation of the move, its emergency, the financial constraints, and the intensity of the changes it implies.

This study investigates the relationship between residential mobility within Belgium and the risk of suicide in the working-age population. In a life-course approach, I unravel the possible determinants of this relation, focusing on the partnership-related context of the move and the life stage (younger, middle-aged, and older working-aged populations) during which it happens. Finally, I put forward the specific case of mobility - or immobility – in the context of union dissolution. This research benefits from high-quality administrative datasets, including the Belgian National Register, 2001 and 2011 Census, and death certificates, covering the whole population registered in Belgium between 2008 and 2015 and following it through an event history analysis methodology.

II. LITERATURE REVIEW

1. Mobility and life course

a. Partnership history and mobility

Life course events, such as partnership transitions, parenthood, job losses or professional changes, and residential mobility, often happen hand in hand. A residential move in the context of union dissolution is a challenging situation. After separation, deciding who moves and who stays in the previously shared place is complex and can rely on economic and contextual factors. In Belgium, the legal framework does not encourage any party to leave or stay in the shared place. According to a *cost-benefit approach*, we can assume that if one is not a homeowner or has insufficient financial means to afford common housing costs, they will likely move (Mulder & Malmberg, 2011; Mulder & Wagner, 2010). Beyond that, the decision of who moves and who stays in the previously shared place masks the decision process of the separation itself. Even though there are no inflexible rules, we can assume that the person who decides to break up is likely to be the person who moves out of the shared place because they are more ready to leave the relationship or because they plan to join a new partner (Kolodziej-Zaleska & Przybyla-Basista, 2020; Symoens et al., 2013). Women tend to initiate separations more often than men (Hewitt et al., 2006). Studies in Belgium confirmed women's higher risk of moving after separation, especially among the lower-educated ex-couples (Theunis et al., 2018). Among those contextual elements, reconstructing a new partnership in the years after the union dissolution matters in the relationship between mobility and mental health. It can indicate that the individual in a new relationship is ready to move on from the past relationship. In such a context, mobility appears not only as the consequence of the separation but also and mainly as the first step of a new life chapter and a new union formation.

On the other hand, mobility can also mark the start of cohabitation and the first step of a new union. This facet of mobility is less studied (Brandén & Haandrikman, 2019). A recent Swedish investigation using Register data in 1991-2008 also indicates that, in opposite-sex couples, women

were more prone to join their male partner (at their residence or in their place of living), especially if the distance between them was marked before the cohabitation (Brandén & Haandrikman, 2019). This result is still visible even after controlling for the partners' resources and income and seems to be explained by the valorisation of the man's professional trajectory (Brandén & Haandrikman, 2019; Cooke, 2008). Within existing couples, mobility also exists and is often associated with the evolution of family life, such as marriage or pregnancy (Michielin & Mulder, 2008). In general, the mobility of a couple is associated with more positive outcomes for men than for women, as the man's professional career often triggers the couple's mobility (Brandén, 2014; Cooke, 2008).

Belgium has presented higher divorce rates than the EU average since the early 1980s (Figure 7.1). In 2019, the country counted 50.7 divorces per 100 marriages (Eurostat, 2021). But contrary to other European countries, the number of divorces tended to decrease in Belgium over the last decades (Eurostat, 2021). This also reflects a higher selectivity of marital unions (Figure 7.2) and increased non-marital cohabitation and age at first marriage (Statistics Belgium, 2020). The dissolution of non-marital cohabitations is not registered in official statistics, but survey data suggests that cohabitations are less stable than marriages (G. Andersson et al., 2017a).

Figure 7.1 - Crude divorce rates in European countries, 2010
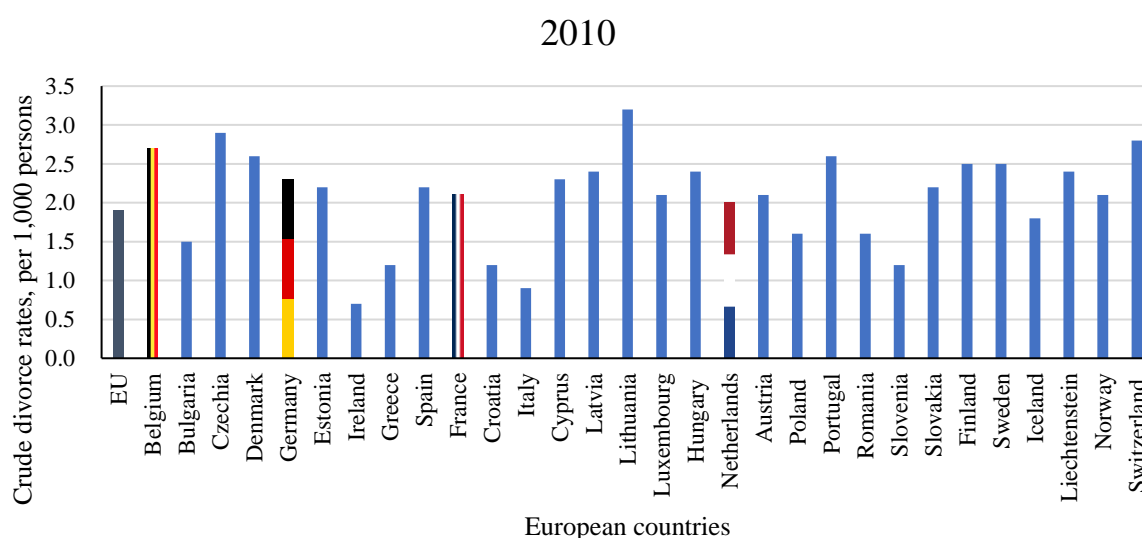
Source: Eurostat (online data code: demo_ndivind).

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Figure 7.2 - Crude marriage rate in European countries, 2010

2010
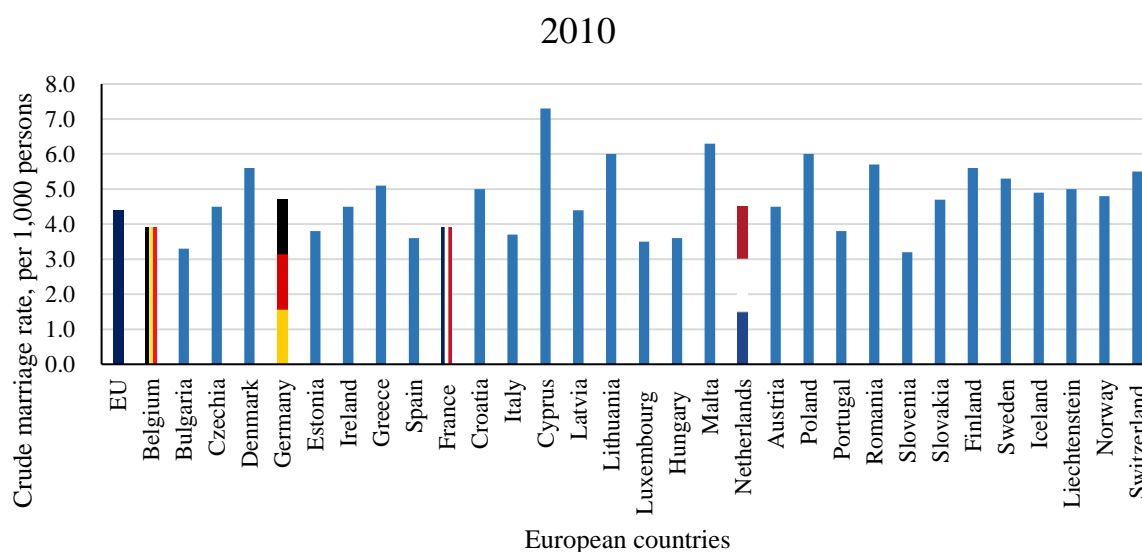
Source: Eurostat (online data code: demo_nind).

b. Age and mobility

Life events do not carry the same social significance at different ages. Young adults are the most mobile population, partially explained by these shorter and more numerous unions, but also related to education and economic constraints (A. Bernard et al., 2014). In their 20ies and 30ies, young adults are in a period of experimentation, where cohabiting partnerships are used as transitory periods between parental home and a long-lasting commitment to a marriage or the building of a family (A. Bernard et al., 2014; Bulloch et al., 2017; Sassler, 2010).

Situations are different for middle-aged, at the peak of their professional development, and older adults who approach (pre-) retirement, aged 55 and older. Adults in their 40ies and 50ies are traditionally expected to be settled down (Kohli & Künemund, 2005). Still, they are the likeliest to go through divorce and separation. These adverse life events can lead them to mobility patterns they did not expect or want, making them unsatisfied with their housing careers and challenging them to find a new residential equilibrium (Coulter & Van Ham, 2013; Koo et al., 2017). This is why middle-aged adults in their 40ies and 50ies are an age group that deserves more specific attention in terms of studies about life course.

Older adults are even more vulnerable than middle-aged adults facing union dissolution: the (upcoming) end of professional activity is accompanied by a loss of material resources, a restriction of the social network, and possible health issues (Lin & Brown, 2020). Nonetheless, older adults present more resilience facing adverse life events than younger populations, as their years of experience give them better emotional regulation. A study showed that older adults presented fewer depressive symptoms than more youthful adults facing persistent economic hardship (Mirowsky & Ross, 1992; Perrig-Chiello et al., 2015). "Grey" divorces, or separations at ages 50 and more, have been on the rise for the last decades (Brown & Lin, 2012): this can be not only explained by the general weakening norm of marriage and long-term relationships – that need to fulfil personal needs first – but also the longer life expectancy (Brown & Lin, 2012). A longer life means more time to grow, change, and drift apart from a partner and no time to waste in unsatisfactory relationships (Wu & Schimmele, 2007). Apart from separation-driven moves, mobility at older ages tends to be more frequent around preretirement or retirement, as professional obligations disappear at that time. Also, the triggers of mobility for this population are more related to personal life events, family members' situation (children having themselves children, etc.), the health situation of the older person, and unsatisfactory or inappropriate housing conditions (Begley & Chan, 2022; de Jong & Brouwer, 2012; Hansen & Gottschalk, 2006).

2. Residential mobility as a determinant of mental health?

In this section, due to a lack of references linking internal migration and suicide, we will extend the literature review to other mental health outcomes, such as depression, mental illnesses, and self-assessed life satisfaction.

According to the literature, residential mobility is associated with mixed consequences on mental health, depending on its context and motivation (Choi & Oishi, 2020; Oishi & Schimmack, 2010). On the one hand, mobility is an essential asset for individuals' development. It can create new professional and personal opportunities by giving more job possibilities (especially for men: Mulder

and Van Ham, 2005), improving interpersonal skills, enlarging the social network (Oishi, 2010), and bringing one closer to non-resident family members (Mulder, 2018; Mulder and Wagner, 2010). Also, places carry symbols and memories, including traumatic elements (Trigg, 2009), and mobility can help move on from the past. On the other hand, according to the *familiarity-liking theory*, moving and adapting to a new environment requires individuals to leave their comfort zone and change their habits and lifestyle (Magdol, 2002; Oishi & Talhelm, 2012). It can imply a break in social ties, a disruption in belonging to a neighbourhood and being socially included. The damaging effect can be reduced if one disposes of high social capital not tied to the place of living, a high income, and a mobility history (Mellor & Edelmann, 1988; Oishi, 2010; Stanley et al., 2012).

Residential mobility is a growing interest in public health and social sciences (Choi & Oishi, 2020). Still, to our knowledge, there is very little empirical literature about the relationship between residential relocation and mental health. Some previous articles highlighted the negative relationship between mobility and good physical health. In a Dutch study, internal migrants reported more health issues than non-migrants (Verheij et al., 1998). In a more recent Australian study, middle-aged women who relocated within the countries presented a higher risk of chronic illness than their counterparts who did not move. Both men and women had more contact with a specialised doctor when they were internal migrants (Larson et al., 2004). But very little is known regarding the psychological implications of mobility. Studies on home eviction showed the detrimental impact of this forced move on adults' and children's mental health (Vásquez-Vera et al., 2017). A qualitative study conducted in Dusseldorf could show that migrants were generally less happy than locals (Hendriks et al., 2016). This result is interpreted based on daily life activities: migrants tend to be less integrated into a social network and thus less involved in activities that promote well-being, health, and mental health (Hendriks et al., 2016). A Chinese work confirmed this conclusion and the idea that internally mobile individuals are likelier to feel isolated and unsatisfied by their immediate social environment (Liu et al., 2017). A recent Australian article (G. A. Wood et al., 2023) recalled the lack of research on this relation. It showed that the association

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between residential mobility and mental health was highly related to the economic context of the move, the ability to afford the housing, and the load of the credits, as well as the tenure transitions: moving to accede homeownership was associated with positive mental health outcomes, unlike moving in a context of homeownership loss (G. A. Wood et al., 2023).

3. Mobility in the context of union dissolution

There is already extensive theoretical and empirical literature on the negative relation between union dissolutions and mental health. In the early 1990s, psychiatric theories explained that increased psychological distress often accompanies separation (Booth & Amato, 1991). Empirical studies confirmed that the levels of mental health started to decrease before a marital or non-marital union dissolution, as shown by longitudinal studies in several contexts (US: Rhoades et al., 2011; Sweden: Switek and Easterlin, 2018; Norway: Næss et al., 2015), and with several measures of mental health (in terms of antipsychotics consumption rates: Metsä-Simola and Martikainen, 2014; in terms of depression: Tosi and van den Broek, 2020; in terms of suicide: Evans et al., 2016). A study in New Haven (US) confirmed that marital disruption was associated with an increased risk of a first depressive episode (Bruce & Kim, 1992a).

A separation is a synonym of short-term and long-term changes in one's life and habits, which can impact well-being and life satisfaction. Among them, we can cite the loss of resources, the new configuration of the family links – including the custody of children, the relation with the in-laws and the familiar friends, and the change of residence and living conditions. The factors that explain the loss of well-being after a union dissolution differ between men and women. Men are more vulnerable to short-term consequences of union dissolutions – such as the loss of social support – than women (Leopold, 2018b). In the longer term, women have to face a higher risk of poverty and single motherhood, which can have multiple consequences on their lives and be detrimental to their mental health for a longer time (Conejero, Olié, Calati, et al., 2018a; Fernquist & Cutright, 1998; Leopold, 2018b; Stack, 1982b). Low partnership quality and the threat of separation can lead

to an anticipation effect (a decrease in well-being that starts before the split is enacted) and long-term effects that can happen years after the relationship ends. Long-term effects are likely gendered, as women suffer more from long-term consequences than men (Leopold, 2018b). Entering a new cohabiting union can be associated with a socioeconomic improvement for divorced and separated individuals, especially for women (Dewilde & Uunk, 2008).

Mobility in the context of separation is a specific type of move characterised by adverse outcomes. First, the new residence is often found in the context of an emergency and has fewer resources. It might be a temporary option (Feijten & Van Ham, 2007), such as moving in (at least temporarily) with a friend, a parent, or a sibling (Feijten & Van Ham, 2007). It can generally be considered as a relatively unwanted or forced migration: following the conflicts and the life-changing decision to dissolve a cohabitation, some distance between the newly separated partners is an immediate need, and an individual has to move while they did not intend to move, for the majority of them (De Groot et al., 2011). This lack of coherence between the intentions and the reality of the life course can trigger frustration and low life satisfaction (Oishi & Schimmack, 2010; C. Warner & Sharp, 2016).

Second, individuals who separate can see a loss in their housing conditions and homeowner status (Lersch & Vidal, 2014). The ex-partners with more financial resources tend to leave the previously shared residence less often, as well as the parent who keeps the primary custody of the children (Mulder & Wagner, 2010). The living environment is increasingly studied as a determinant of mental health. Homeownership is associated with a lower risk of suicide (Damiens & Schnor, 2022), a higher level of housing stability (Fowler et al., 2015; Vásquez-Vera et al., 2017), housing comfort (Jiang et al., 2021; J. H. Lee, 2022; Singh et al., 2019a) and a better-quality neighbourhood, in terms of air quality (Gladka et al., 2018; Heo et al., 2021), amenities (Cairns et al., 2017; Rabe & Taylor, 2010) or social link (Cairns et al., 2017; Liu et al., 2017).

Third, due to the possibly conflictual climate surrounding a union dissolution and the redefinition of the family unit, separation-driven moves can damage a person's social network and trigger social isolation (Coulter & Van Ham, 2013; Heikkinen et al., 1993a; Oishi, 2010). Previous studies based on network analyses suggested that mobility led to high spatial dispersion of personal relations but can be counterbalanced by more transitory local ties (Viry, 2012). However, this capacity to draw a local social network depends on personality traits, such as extraversion and interpersonal skills (Oishi, 2010). For parents, moving can be detrimental to their relationship with their children, especially for the parent with no custody of the minor children or a custody arrangement that does not encourage their relationship with their children (Ferrari et al., 2019).

III.   RESEARCH QUESTIONS

Very little is known about the relationship between residential mobility and suicide risk. This gap was already put forward in recent scientific literature (Choi & Oishi, 2020; Morris et al., 2018). One first contribution of our chapter is to investigate this relation. Residential mobility can be associated with positive outcomes, such as professional or interpersonal development and access to homeownership. However, previous (mainly qualitative) studies highlighted the loss of physical health and psychological well-being for mobile populations and internal migrants (Hendriks et al., 2016; Liu et al., 2017; G. A. Wood et al., 2023). **As a first hypothesis, we assume that mobility is associated with a higher risk of suicide than immobility.**

A second contribution of our work is to investigate some explanatory factors of this relation. Several types of events can trigger mobility for working-aged populations. Compared to any other event, union dissolution is associated with a higher risk of suicide and a loss of well-being (Bruce & Kim, 1992a; R. Evans et al., 2016). Also, we know that mobilities in the frame of a relationship, in the case of union formations or the mobility of a formed couple – are often made to the detriment of women in opposite-sex relationships (Brandén, 2014; Cooke, 2008). **As a second**

hypothesis, we assume that the relation between mobility and suicide risk depends on the move's partnership-related context. We presume that mobilities in the context of union dissolution are associated with higher suicide risk than immobility. On the contrary, we assume that mobility in the context of union formation or no union change is associated with a higher suicide risk for women only.

To go further in this approach, we want to distinguish the effect of mobility from the already well-documented relationship between union dissolution and suicide risk. To do so, it is interesting to focus on whether moving out or staying in the previously shared place can affect the relationship between separation and suicide. **As a third hypothesis, we assume that, in the context of union dissolution, moving will be associated with a higher risk of suicide than staying in the previously shared place.**

Some life-course approaches often assume that age is more a proxy of life stage and life events than an explanatory factor *per se*. Younger adults pursue partnerships with less selectivity and flexibility (Norona et al., 2017) than middle-aged adults, who are looking for longer-term engagements, leading to stable relationships or marriage (Sassler, 2010), and more immobility (Coulter & Van Ham, 2013). Older adults (aged 55 and older) were shown to present fewer negative consequences after disruptive life events, as years lived gave them better coping mechanisms and more emotional control (Lin & Brown, 2020; Mirowsky & Ross, 1992; Perrig-Chiello et al., 2015). **As a fourth hypothesis, we assume that for middle-aged adults aged 40 to 54, mobility is associated with a higher risk of suicide than immobility. At the same time, this association is less visible for younger and older populations.**

IV. DATA & METHOD

1. Datasets

The datasets used in this chapter result from the coupling of several pseudo-anonymised administrative databases. First, information about mortality causes is provided by the death certificates. They present the underlying, immediate, and intermediate causes of death following the 10th International Classification of Diseases (ICD). Second, the National Register gives information about people's demographics, place of residence, household configuration on January 1st, and residence or household composition changes during the year. It also delivers the exact dates of the moves, as declared by the citizen and the municipalities of departure and arrival. Crossing these elements allows for reconstructing partnership and residential trajectories by observing the cohabitations and the residential moves. Third, socioeconomic information, including educational attainment, socioprofesionnal status, housing tenure, and municipal multiple deprivation index (Otavova et al., 2023), is derived from the 2011 Belgian Census, the first register-based Census in Belgium and the most recent census available for research.

2. Analytical sample.

Our sample covers the whole population registered in Belgium for at least one year between January 1st, 2008, and January 1st, 2015. In the first sample, I concentrate on the adult population aged 20 to 64: we excluded the young and the older population due to the specificity of their suicide determinants. Contrary to working-aged people, older adults are more exposed to extreme isolation as they generally no longer work, are less frequently exposed to friend and family relationships, and have less independence in their moves. Similarly, health problems are more prevalent. For young people under 20, as they most often live with their parents, and their mobility patterns depend on the latter, I preferred excluding them. Our primary analytical sample includes N= 3,637,761 men and N= 3,608,979 women.

A second analytical sample is developed to answer the third hypothesis, which only concerns the population in a marital or non-marital union and is susceptible to separation. I thus restrict our sample to the population in partnership at the beginning of the observation and people who enter a partnership between 2008 and 2015. This second analytical sample includes about 60% of the first sample: N= 2,220,767 and N= 2,325,092 women. Among them, the population who separated counts N= 373,791 men and N= 350,269 women.

3. Variables

a. Suicide

Suicide is considered all types of intentional self-harm that led to death, i.e., all deaths categorised as X60 to X84 and Y87.0-Y87.2 according to the 10th ICD, whether this cause is declared immediate, initial, initial, or intermediate. The definition of suicide here includes all self-intended deaths with relative certainty. During the observation period and for the 25- to 64-year-old population, 29,025 deaths, including 2,944 suicides for men, and 18,643 deaths, including 1,165 suicides for women.

b. Union dissolution

Before precising union dissolutions, we must note that unions are defined by marital or cohabiting relationships that include only situations in which two unrelated opposite-sex adults live together with no other unrelated adult, with an age difference of 15 years at most. Couples who do not share the same address are not considered. I measure separation by looking at the household identifiers given by the National Register and the civil status of the individuals. I define separation through physical separation. Nothing changes if the two partners still have the same household identifier. On the contrary, if at least one of the partners changes household identifiers and the two partners have different household identifiers, the couple no longer shares the same accommodation, likely due to separation. In case of a divorce, most individuals stop living together before a divorce is declared. Still, the individuals live together in very few cases (less than 0,01%).

c. Mobility

We define mobility by any registered change of residence. In Belgium, updating the residence address at the municipal offices is mandatory. This information is necessary for all other administrative procedures (e.g., using a bank account, getting refunded for healthcare), so we can assume that the data is reliable. Our definition includes changing residences within the same municipality. Mobility in the context of union dissolution is defined as any move happening from the moment of the separation until six months after the breakup: we assume that a move happening within the six months after the break is very likely to have been decided at the separation, but material contingencies (selling or leaving the housing, making arrangements for children) did not allow individuals to move out of the previously shared place immediately. During the observation period, people can move several times; after each internal move, people re-enter the risk of moving as long as they are registered in Belgium.

Among the more than 5 million individuals aged 20 to 64, we observe that about two-thirds (67%) have not moved during the observation period, while 22% have moved once and 10% twice or more. The share (58%) of the population in a relationship on January 1st, 2008 – at the beginning of the observation – is even less mobile: 71% of them have not moved during the observation period. And among the 14% of this second sample who separated between 2009 and 2015, mobility is more common: 51% of the sample have moved once, and 20% twice or more.

d. Covariates

In our models, we control for age. Suicide risk is the most important for middle-aged adults (in their 40s-50s), especially compared to other causes of death at this age. Specific analyses present the interaction between mobility and life stages defined by large age groups: 20- to 39-year-old, 40- to 54-year-old, and 55- to 64-year-old populations. Models also control for other demographics, such as the household composition of the individual. This includes the marital or relationship status (single, married, unmarried relationship) and the parental status (living with children, not living

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with children) right after the change of status (after the possible mobility or separation). A collective category includes people living in institutions, such as the military, religious or medical home. The civil status before the move was considered to limit the risk of autocorrelation between civil status and the partnership context of a move. Our models also include the region of residence after the move, as we assume that the cultural and socioeconomic differences between Flanders, Wallonia, and Brussels-capital regions can affect partnership and mobility dynamics, mental health policies, and resources to face suicidal thoughts or behaviours. Indeed, Flanders presents a higher marriage rate[7], and marriages are more stable than nonmarital unions (Andersson, et al., 2017). Nationality can impact partnership histories and mental health trajectories. On the one hand, international migration is associated with better health status, as biases are visible among this population: migrants must be healthy to relocate abroad. They might return to their homeland if they encounter health issues (Deboosere & Gadeyne, 2005a).

Regarding socioeconomic characteristics, I controlled for educational attainment, occupational status, and housing tenure, which are information we only get through the census. This means that the situation at the moment of the census might not be the same at the observation moment. For the population aged 30 and more, most individuals' educational attainment and occupational status are stable. This differs for younger adults aged 20 to 29, finishing their studies and entering active life. In addition, education and occupation are associated with life course trajectories. More comprehensive education, a more stable professional life, and a better income are associated with more stability for the rest of life, more stable unions, and fewer life disruptions (e.g., Kaplan & Herbst, 2015). Also, low education is related to higher suicide risk for men, and unemployment or poor working conditions are detrimental to mental health. Homeownership was also associated with a lower risk of suicide (Damiens, Schnor, 2022). It must be noted that homeownership, measured at the moment of the Census, highly depends on mobility before the Census; mobility in

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[7] In 2012, out of 42,198 marriages of Belgian residents, 60% of them were pronounced in Flanders, 28% in Wallonia, 10% in Brussels and 2% abroad (Statbel, 2022a).

a context of union dissolution right before the census might decrease the chance of being an owner in 2011. A last covariate covers the socioeconomic characteristics of the municipalities of residence and their possible evolution in case of mobility. The Belgian Index of Multiple Deprivation (BIMD) was established by Otavova et al. (2023) and represents a multidimensional measure of the socioeconomic level of the municipality based on several scales related to housing, employment, education, income, or crime (Otavova et al., 2023). It is based on the 2011 census. Using maximum likelihood, a synthetic score was established, to rank municipalities based on their level of deprivation, and divide them into deciles of municipalities, the first decile being the 10% of the Belgian communes that are the most deprived. After a move, this variable represents the deprivation level of the municipality of arrival. It was added to the model, in addition to an indicator evaluating whether the individual went through a stagnation, a rise, or a decrease of the municipal index of multiple deprivations. The two latter are defined by a positive or negative change of at least two deciles. In case of no mobility, no change of municipality, a move between two municipalities that belong to the same deciles, or a difference inferior to 2 deciles, we assigned a stagnation of the BIMD. We must note that this indicator does not integrate the possible changes in the deprivation level of the municipalities that could happen over time and represent the situation in 2011.

4. Event history analysis

Event history analysis helps control individuals' exposure time before an event occurs. Individuals become at risk when they appear in the National Register, i.e., whether they are domiciliated for at least a year in a Belgian municipality or at the beginning of the observation. The primary outcome is death by suicide. Apart from suicide, other censoring events are then considered, such as death from other causes, international outmigration, or deregistration for unqualified reasons. I allowed left-censors: individuals not registered in Belgium in 2008 can enter (or re-enter) observation once they register in a municipality. I use Cox proportional hazard models to estimate the risk of suicide

for the population living in Belgium. Predicted relative hazards of suicide are calculated to investigate the interaction of mobility status and context with different age groups (20-39, 40-54, 55-64).

Some robustness checks are conducted. I consider a competing risk to suicide, that is, death from another cause. For adults aged 20 to 64, mortality is very low to relatively low, increasing with age. Causes of death for younger adults are often associated with external causes, which can be interrelated (e.g., drug-related or alcohol-related accidents, than are life-threatening behaviours). Assuming that suicide and other causes of death are independent might be problematic. A Fine-Gray subdistribution hazard models help to estimate the risk of suicide while controlling for the possibility of dying from another cause.

V.   RESULTS

1. Descriptive results

As the knowledge about the relationship between mobility and suicide is limited, a description of the phenomenon can help understand the relations at stake. First, we see the patterns of separation and mobility by age among our interest population, that is, the residents of Belgium in 2008-2015 (Figure 7.3).

Figure 7.3 – Proportion of the population aged 20 to 64 who moved by age at least once in 2008-2015 within Belgium.

Migration proportion

Mobility patterns in Belgium for the 20- to 64-year-old population confirms the trends generally observed. Young adults in their 20ies present increasing and very high mobility proportions, with more than 50% of the people who will move at least once during the observation period (Figure 7.3). From age 30, this share regularly declines until the mid-60ies, reaching 18% at age 64. Mobility patterns for both sexes are very close, with slightly higher mobility for young women and a somewhat inferior mobility rate for women in their 30ies up to their 50ies.

Figure 7.4 – Share of the 20- to 64-year-old population living in Belgium who separated at least once in 2008-2015 and share of the separated individuals who moved out within the six months after the separation, by age.

A/ Separation proportion

Mobility at separation
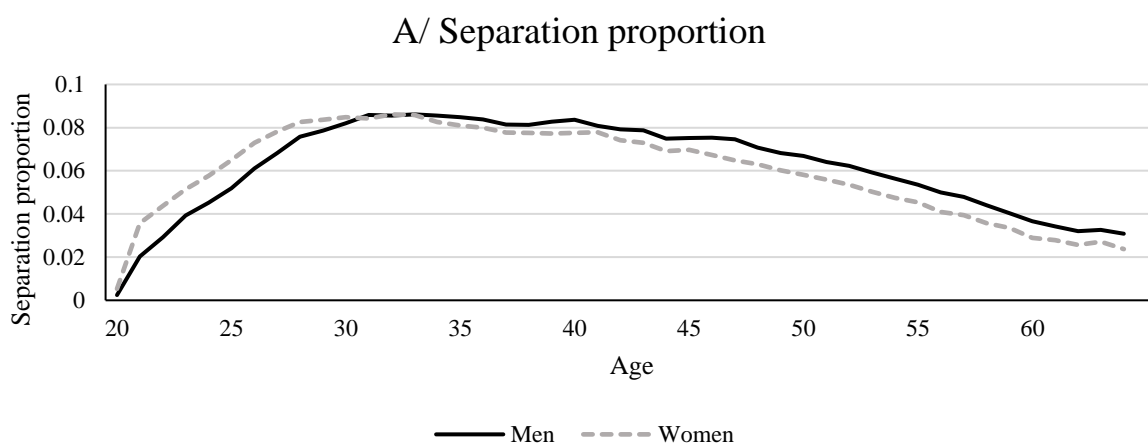
Note: At age 25, we estimate that 5% of men and 6% of women will go through at least one separation during the 2008 to 2015 observation period. Among those separations, at age 25, we observe that 63% of men and 71% of women will move out (and move in somewhere else in Belgium) within six months after the separation.

Source: Belgium National Register 2008-2015, Author's calculations. N= 2,220,767 and N= 2,325,092 (in a marital or non-marital relation) were observed for 7 years for A/ and N= 373,791 men who separated and N= 350,269 women who separated for B/.

Similarly, separation proportions follow the general trends we observe in the literature. The separation proportion drastically rises in emerging adulthood, peaking at 30. It remains high during the 30ies et slowly decreases during the 40ies, declining more dramatically in the 50ies to reach a low point in the 60ies, with a share of 3% for men and 2% for women at age 64 (Figure 7.4-A). We notice that female separation trends are higher than men's in early adulthood and lower than

men's from 30, to remain lower until age 64. This can be explained by the age gap within couples, where women are generally younger than their partners.

Regarding mobility behaviours after separation, younger adults tend to move more often at separation than older adults (Figure 7.4-B). This can be related to housing tenure according to age. In Belgium, personal homeownership (that excludes homeownership of the parental housing) is low before 30, then rises to reach a proportion of 70% at age 40. Sex-wise, young women tend to be more mobile at separation than men before the age of 40, and trends are opposite from the age of 40.

We can also observe the suicide trends for the populations according to their life events.

Figure 7.5 - Suicide rates of the 20 to 64-year-old population living in Belgium in 2008-2015 for the general population (total) and the population who separated at least once during the observation period.
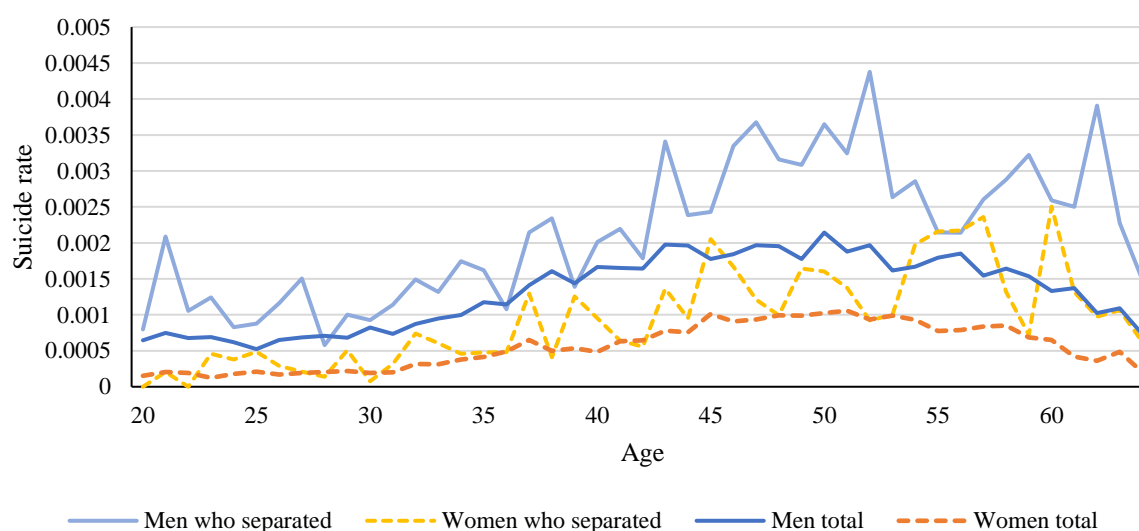
Note: At age 25, we observe a suicide rate of 5 per 100,000 for men and 2 per 100,000 for women. For men aged 25 who separated during the observation period, this suicide rate reaches 9 per 100,000, while for women aged 25 who separated, it reaches 5 per 100,000.

Source: Belgium National Register and death certificates, 2008-2015, author's calculations. N= 3,637,761 men and N= 3,608,979 women (total population) observed for 7 years, including N= 2,220,767 and N= 2,325,092 (in a marital or non-marital relation).

For the general population aged 20 to 64, suicide risk is low in young adulthood, increases progressively, peaks around age 50 (at 21 per 100,000 for men and 10 per 100,000 for women), and decreases until the late 50ies and early 60ies (Figure 7.5). The suicide rate is higher for men than for women of all ages. For men and women who separated at least once during the observation period, rates of suicide are higher than for the general population. We observe the same distribution over age, with a peak of suicide risk for the men who separated around the 50ies (more precisely at age 52, with a suicide rate of 43 per 100,000) and later for women (at age 57, with a suicide rate at 24 per 100,000).

Figure 7.6 - Suicide rates of the 20- to 64-year-old population living in Belgium in 2008-2015 for the general population (total) and those who moved (within Belgium) at least once during the observation period.
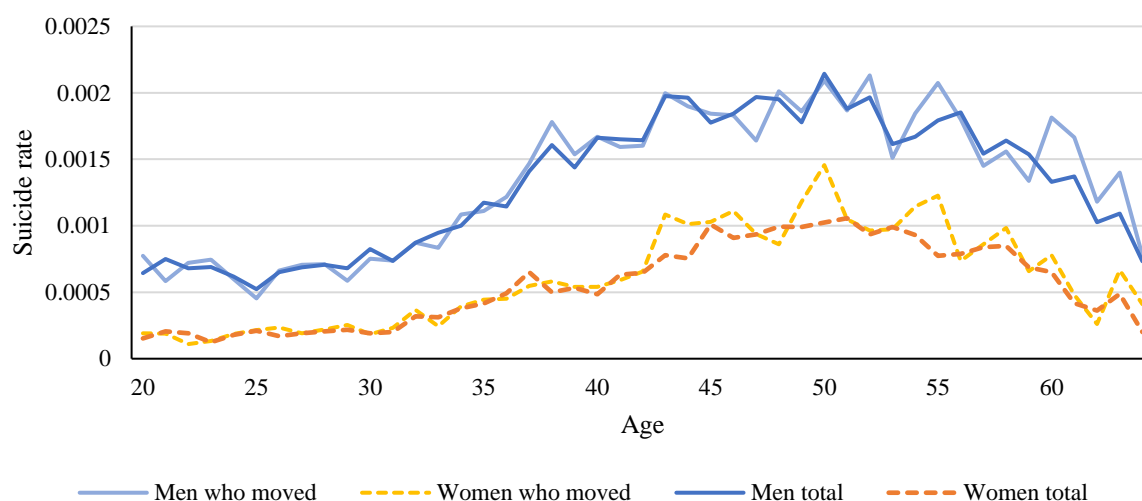
Note: at age 25, women present a suicide rate of 2 per 100,000, no matter whether they moved or not during the observation period.

Source: Belgium National Register and death certificates, 2008-2015, author's calculations. N= 3,637,761 men and N= 3,608,979 women (total population) observed for 7 years.

Regarding internal migration, we can see that individuals who migrate follow suicide trends similar to the general population (Figure 7.6). For women aged 40 to 55, suicide trends are slightly higher for mobile individuals, while for men, this somewhat higher suicide rate for mobile individuals shows up later in late, from age 55.

2. Mobility and suicide

Table 7.1 presents the results of the Cox Proportional hazard models according to the mobility status during the observation period (moved at least once or did not move) of the individuals.

Table 7.1 - Hazard ratios of suicide (cox proportional hazard models) and 95% confidence intervals of men and women (aged 20 to 64), according to mobility status.

	Men			Women		
	HR	IC95%		HR	IC95%	
Migration (ref. No)	1.31	1.22	1.41	1.44	1.29	1.62
Age group (ref. 20-24)						
25-29	0.77	0.68	0.88	0.81	0.63	1.03
30-34	0.94	0.83	1.07	1.15	0.91	1.45
35-39	1.22	1.09	1.38	1.71	1.38	2.12
40-44	1.39	1.24	1.56	1.93	1.57	2.37
45-49	1.20	1.07	1.34	2.33	1.91	2.84
50-54	1.01	0.89	1.13	1.83	1.49	2.24
55-59	0.68	0.60	0.78	1.06	0.85	1.33
60-64	1.01	0.85	1.20	1.36	1.01	1.83
Separation during the observation period	1.79	1.64	1.95	1.76	1.53	2.03
Living with children	0.95	0.90	1.01	0.75	0.68	0.82
Region (ref. Flanders)						
Wallonia	1.17	1.09	1.26	1.11	0.99	1.25
Brussels	0.71	0.62	0.81	0.80	0.66	0.97
Nationality (ref. Belgian)						
Other European	0.69	0.60	0.78	0.51	0.40	0.64
Non-European	0.24	0.18	0.33	0.14	0.08	0.27
Educational level (ref. Pimary)						
Lower Secondary	1.29	1.16	1.42	1.58	1.32	1.88
Upper Secondary	1.11	1.00	1.23	1.54	1.30	1.83
Higher	0.71	0.64	0.80	1.45	1.21	1.75
Unknown	0.84	0.72	0.97	1.19	0.93	1.52
Occupational status (ref. Unemployed)						
Inactive	1.46	1.30	1.64	1.63	1.36	1.96
Employed	0.87	0.78	0.98	0.82	0.68	0.99
Liberal	1.05	0.92	1.20	0.99	0.76	1.28

Unknown	0.57	*0.41*	*0.78*	0.60	*0.32*	*1.16*
Housing tenure (ref. Tenant)						
Owner	0.73	*0.68*	*0.78*	0.69	*0.63*	*0.76*
Unknown	0.73	*0.60*	*0.88*	0.92	*0.68*	*1.25*
Deciles of multiple deprivations (ref. 1st)						
2nd	1.10	*0.99*	*1.21*	1.08	*0.92*	*1.27*
3rd	1.13	*1.00*	*1.26*	0.91	*0.75*	*1.09*
4th	1.11	*0.98*	*1.24*	1.05	*0.87*	*1.26*
5th	1.16	*1.02*	*1.31*	0.93	*0.76*	*1.14*
6th	1.15	*1.01*	*1.30*	1.05	*0.86*	*1.27*
7th	1.15	*1.00*	*1.32*	0.90	*0.71*	*1.13*
8th	1.17	*1.03*	*1.33*	0.95	*0.77*	*1.18*
9th	1.12	*0.98*	*1.29*	0.98	*0.78*	*1.23*
10th	1.03	*0.89*	*1.20*	1.06	*0.84*	*1.33*
Evolution of deciles						
Rise	1.05	*0.92*	*1.21*	0.84	*0.66*	*1.07*
Loss	1.16	*1.01*	*1.32*	0.85	*0.67*	*1.08*
Unknown	1.98	*0.94*	*4.19*	7.69	*1.91*	*31.00*
Log-likelihood	-70342.72			-26778.32		

Source: Belgian National Register, death certificates (2008-2015), Census 2011, author's calculations. N= 3,637,761 men and N= 3,608,979 women (total population) observed for 7 years.

Individuals who moved during the observation period presented a higher suicide hazard (+31% for men, +44% for women) than those who did not (Table 7.1). This confirms our first hypothesis. Middle-aged adults present a higher suicide hazard than younger and older age groups. Parenthood is associated with lower suicide risk only for women. In terms of other characteristics, living in the Brussels region and being a foreigner are associated with lower hazards of suicide. Compared to a low educational level, having a higher education is associated with a lower suicide risk for men and a higher suicide risk for women. Being unemployed is associated with higher suicide risks than being employed but lower than being inactive. Homeowners are associated with lower suicide risks than tenants. The deciles of municipality deprivation level are not associated with suicide risk. Still, the decrease in the municipality index of multiple deprivations during a move is associated with a slightly higher suicide risk than its stagnation for men only. This result remains after controlling for the competing risk of dying from another cause (Appendix, table A7.1).

Figure 7.7 presents the relative hazard ratio of suicide for the interaction between the moving status and large age groups (20-39; 40-54; 55-64-year-old).

Figure 7.7 – Predicted relative hazard ratio of suicide for A) Men and B) Women according to residential mobility for large age groups (20-39; 40-54; 55-64)

A/Men

B/ Women
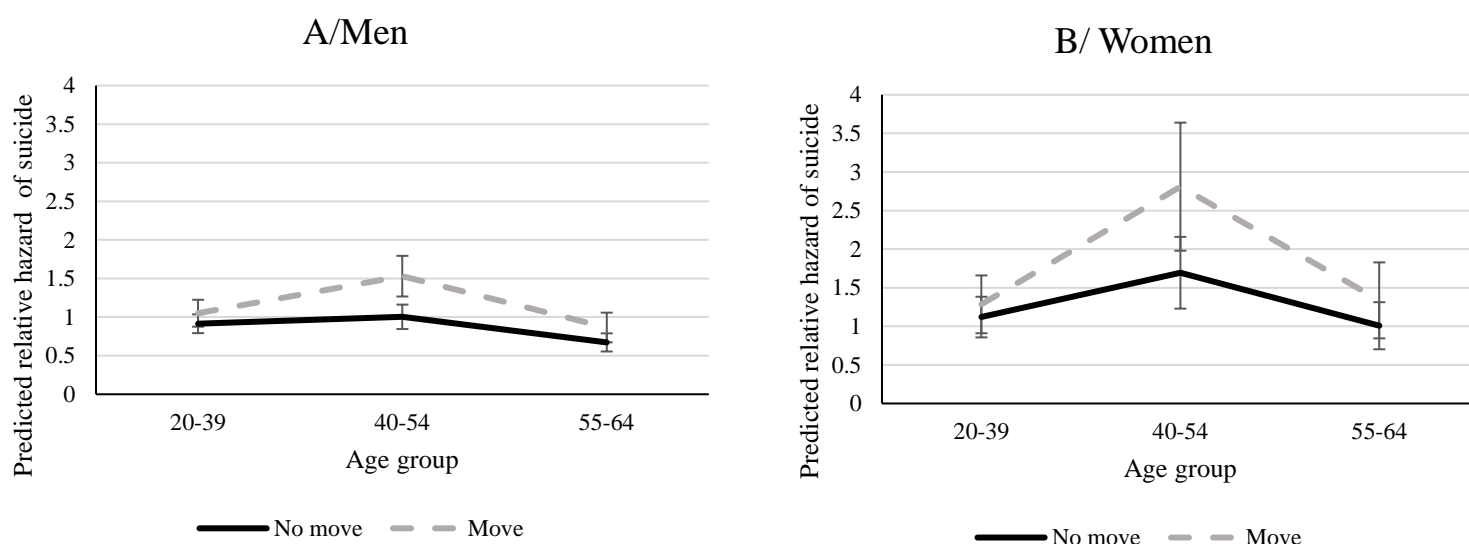
Note: Models control for parental status, separation over the period, region of residence, nationality, education level, occupational status, housing tenure, BIMD and change of BIMD.

Source : Belgian National Register, death certificates (2008-2015), Census 2011, author's calculations. N= 3,637,761 men and N= 3,608,979 women (total population) observed for 7 years.

The relation between mobility and suicide risk differs according to the life stage (Figure 7.7). Interactions between large age groups and mobility indicate that mobility is associated with higher suicide risk, especially for middle-aged adults aged 40-54. The gap according to moving status is minimal for younger and older ages. This follows the idea of our fourth hypothesis: the middle-aged population (40 to 54) seems more sensitive to residential mobility regarding suicide hazards compared to younger and older age groups.

3. Mobility, partnership context and suicide

Table 7.2 displays the results of a Cox proportional hazard model on the risk of suicide, including a variable differentiating the moves according to their context regarding partnership transitions.

Table 7.2 - Hazard ratios of suicide (cox proportional hazard models) and 95% confidence intervals of men and women aged 20 to 65, according to mobility status and the context of the move.

	Men			Women		
	HR	*IC95%*		HR	*IC95%*	
Migration (ref. No)						
Migration, union change	1.38	*1.27*	*1.48*	1.46	*1.29*	*1.65*
Migration, union dissolution	1.62	*1.41*	*1.86*	2.19	*1.79*	*2.69*
Migration, union formation	0.91	*0.79*	*1.05*	0.86	*0.67*	*1.11*
Age group (ref. 20-24)						
25-29	0.82	*0.72*	*0.94*	0.90	*0.70*	*1.16*
30-34	1.03	*0.90*	*1.17*	1.33	*1.04*	*1.69*
35-39	1.39	*1.22*	*1.57*	2.00	*1.60*	*2.51*
40-44	1.62	*1.44*	*1.84*	2.26	*1.81*	*2.83*
45-49	1.41	*1.24*	*1.60*	2.77	*2.23*	*3.45*
50-54	1.21	*1.06*	*1.39*	2.22	*1.77*	*2.79*
55-59	0.84	*0.72*	*0.97*	1.31	*1.03*	*1.68*
60-64	1.29	*1.07*	*1.56*	1.68	*1.22*	*2.32*
Separation during the observation period	0.98	*0.92*	*1.04*	0.78	*0.71*	*0.86*
Civil status (ref. Married)						
Unmarried	1.26	*1.15*	*1.38*	1.20	*1.03*	*1.41*
Divorced	1.25	*1.14*	*1.38*	1.67	*1.47*	*1.89*
Widow·er	1.16	*0.82*	*1.63*	1.14	*0.86*	*1.50*
Separated	1.90	*1.64*	*2.20*	2.05	*1.58*	*2.66*
Single	1.31	*1.21*	*1.43*	1.56	*1.36*	*1.80*
Region (ref. Flanders)						
Wallonia	1.17	*1.09*	*1.26*	1.10	*0.98*	*1.24*
Brussels	0.71	*0.62*	*0.80*	0.79	*0.65*	*0.96*
Nationality (ref. Belgian)						
Other European	0.69	*0.61*	*0.79*	0.52	*0.41*	*0.66*
Non-European	0.26	*0.19*	*0.36*	0.16	*0.08*	*0.30*
Educational level (ref. Pimary)						
Lower Secondary	1.29	*1.17*	*1.43*	1.58	*1.32*	*1.88*
Upper Secondary	1.11	*1.01*	*1.23*	1.51	*1.27*	*1.80*
Higher	0.72	*0.64*	*0.80*	1.41	*1.17*	*1.70*
Unknown	0.84	*0.73*	*0.97*	1.16	*0.91*	*1.49*

Occupational status (ref. Unemployed)						
Inactive	1.45	*1.29*	*1.63*	1.73	*1.44*	*2.08*
Employed	0.90	*0.81*	*1.01*	0.87	*0.72*	*1.05*
Liberal	1.10	*0.96*	*1.25*	1.07	*0.82*	*1.38*
Unknown	0.59	*0.43*	*0.81*	0.63	*0.33*	*1.21*
Housing tenure (ref. Tenant)						
Owner	0.75	*0.70*	*0.80*	0.76	*0.69*	*0.84*
Unknown	0.70	*0.58*	*0.85*	0.90	*0.66*	*1.22*
Deciles of multiple deprivations (ref. 1st)						
2nd	1.09	*0.98*	*1.20*	1.08	*0.92*	*1.27*
3rd	1.12	*1.00*	*1.25*	0.91	*0.75*	*1.10*
4th	1.10	*0.98*	*1.23*	1.07	*0.89*	*1.28*
5th	1.15	*1.01*	*1.30*	0.94	*0.77*	*1.15*
6th	1.14	*1.01*	*1.29*	1.06	*0.87*	*1.29*
7th	1.14	*0.99*	*1.31*	0.92	*0.73*	*1.15*
8th	1.16	*1.02*	*1.33*	0.97	*0.78*	*1.20*
9th	1.11	*0.96*	*1.28*	1.00	*0.80*	*1.25*
10th	1.02	*0.88*	*1.18*	1.07	*0.85*	*1.34*
Evolution of deciles						
Rise	1.06	*0.92*	*1.21*	0.84	*0.66*	*1.07*
Loss	1.16	*1.02*	*1.33*	0.85	*0.67*	*1.07*
Unknown	1.84	*0.87*	*3.88*	7.26	*1.80*	*29.28*
Log-likelihood	-70338.019			-26735.084		

Source: Belgian National Register, death certificates (2008-2015), Census 2011, author's calculations. N= 3,637,761 men and N= 3,608,979 women (total population) observed for 7 years

The positive relation between union dissolutions and suicide risk is visible in these results (Table 7.2), as mobility in the context of union dissolution is associated with a dramatically higher suicide risk than no mobility (+62% for men, +119% for women). On the other hand, mobility in the context of union formation is related to a lower risk of suicide than no mobility. Still, the effect strength of this relation is weak. Finally, a move with no apparent union change, i.e., when the single individual moves to another place or when an existing couple moves to another place, is associated with a higher suicide risk compared to no mobility (+38% for men, +46% for women), which is an unexpected finding.

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Compared to marital unions, all other types of civil status are associated with higher suicide risk, except widowhood, for both men and women. For other covariates, the previous comments are still valid. This result remains after controlling for the competing risk of dying from another cause (Appendix, table A7.2).

Figure 7.8 represents the predicted relative hazard of suicide for the interaction between the mobility status and context and the age groups.

Figure 7.8 - Predicted relative hazard ratio of suicide for a) men and b) women according to residential mobility and context for large age groups (20-39; 40-54; 55-64)
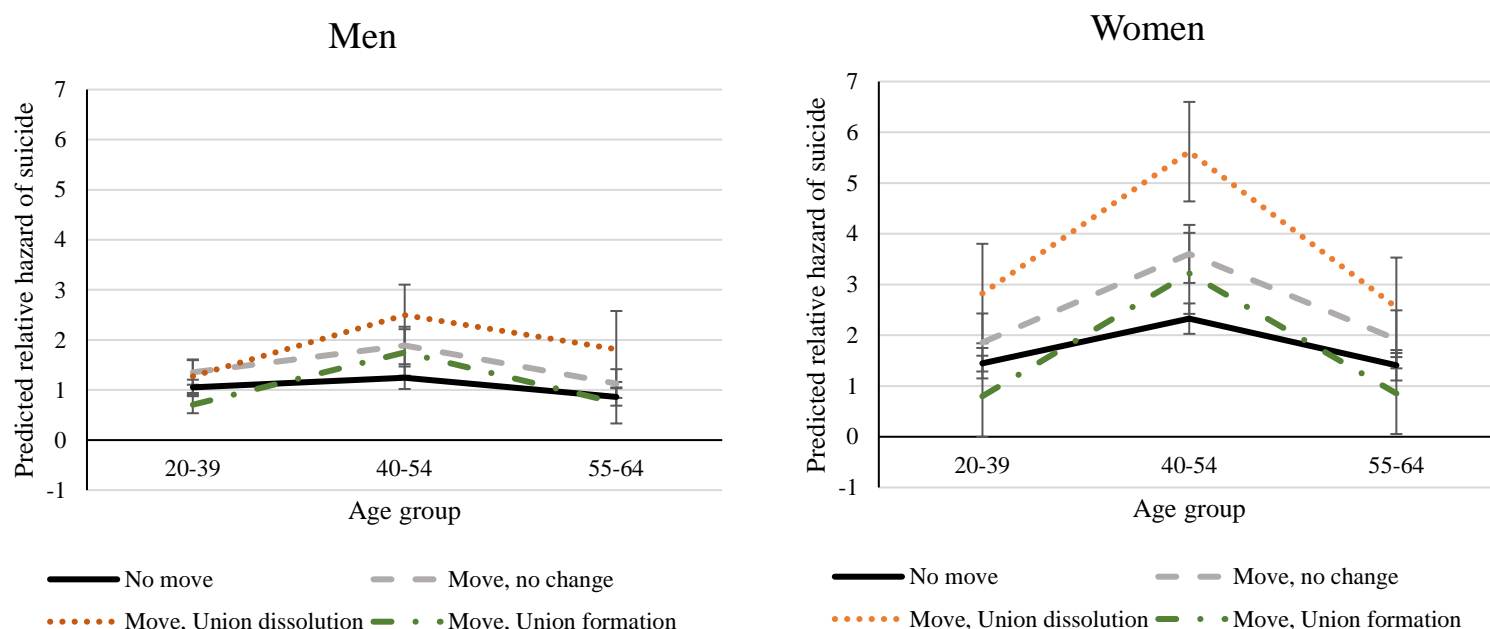
Note: Models control for parental status, marital situation, region of residence, nationality, education level, occupational status, housing tenure, BIMD and change of BIMD.

Source : Belgian National Register, death certificates (2008-2015), Census 2011, author's calculations. N= 3,637,761 men and N= 3,608,979 women (total population) observed for 7 years

The relation between the context of the move and suicide risk also differs according to life stage (Figure 7.8). Mobility in the context of union dissolution is related to the highest suicide hazards for all age categories, except for men aged 20 to 39. For them, there is no apparent difference in suicide risk between mobility and immobility, no matter the context of the move. For men aged 40-54 and 55-64, mobility in the context of union dissolution is associated with higher predicted

relative hazards of suicide than other mobility patterns. For middle-aged adults (aged 40-54), immobility is associated with the lowest predicted suicide hazard.

For women, mobility in the context of union dissolution is always associated with a higher risk of suicide, and immobility is associated with the lowest suicide risk for the middle-aged category. For younger and older groups, mobility in a context of union formation is associated with the lowest suicide hazards, unlike middle-aged women, who face relatively high suicide risk when they move – no matter the context – compared to immobility.

4. Mobility in the context of union dissolution and suicide

Table 7.3 presents the results of the Cox proportional hazard models for the population in a union during the 2008-2015 period, who will possibly go through a separation during this period. We distinguish whether the individual moves at the moment of the separation (at the moment or within six months) or stays in the previously shared residence more than six months after the breakup.

Table 7.3 - Hazard ratios of suicide (cox proportional hazard models) and 95% confidence intervals of men and women in a marital or nonmarital union, aged 20 to 64, according to the separation and mobility status at the moment of the separation.

	Men			Women		
	HR	*IC95%*		HR	*IC95%*	
Separation (ref. No)						
Separation, no mobility	2.25	*1.96*	*2.57*	2.13	*1.68*	*2.70*
Separation, mobility	1.92	*1.67*	*2.21*	2.61	*2.13*	*3.19*
Age group (ref. 20-24)						
25-29	0.73	*0.55*	*0.96*	0.78	*0.52*	*1.17*
30-34	0.86	*0.66*	*1.12*	1.07	*0.72*	*1.57*
35-39	1.15	*0.89*	*1.49*	1.61	*1.11*	*2.34*
40-44	1.25	*0.97*	*1.62*	1.85	*1.28*	*2.66*
45-49	1.08	*0.83*	*1.39*	2.38	*1.67*	*3.39*
50-54	0.88	*0.68*	*1.14*	1.77	*1.24*	*2.53*
55-59	0.62	*0.48*	*0.81*	1.04	*0.72*	*1.51*
60-64	1.17	*0.87*	*1.59*	1.20	*0.73*	*1.95*
Separation during the observation period	1.08	*0.99*	*1.17*	0.72	*0.63*	*0.81*

Region (ref. Flanders)						
Wallonia	1.29	*1.18*	*1.42*	1.19	*1.03*	*1.38*
Brussels	0.67	*0.55*	*0.81*	0.63	*0.46*	*0.86*
Nationality (ref. Belgian)						
Other European	0.65	*0.55*	*0.78*	0.61	*0.45*	*0.83*
Non-European	0.28	*0.18*	*0.44*	0.17	*0.07*	*0.42*
Educational level (ref. Pimary)						
Lower Secondary	1.17	*1.02*	*1.34*	1.31	*1.05*	*1.65*
Upper Secondary	1.05	*0.92*	*1.20*	1.32	*1.05*	*1.65*
Higher	0.64	*0.55*	*0.75*	1.30	*1.03*	*1.65*
Unknown	0.85	*0.69*	*1.04*	1.14	*0.82*	*1.60*
Occupational status (ref. Unemployed)						
Inactive	1.36	*1.14*	*1.63*	1.43	*1.09*	*1.87*
Employed	0.98	*0.83*	*1.16*	0.84	*0.64*	*1.10*
Liberal	1.15	*0.96*	*1.39*	0.96	*0.68*	*1.35*
Unknown	0.70	*0.49*	*1.02*	0.82	*0.40*	*1.66*
Housing tenure (ref. Tenant)						
Owner	0.73	*0.67*	*0.79*	0.73	*0.64*	*0.84*
Unknown	0.66	*0.47*	*0.93*	0.78	*0.47*	*1.29*
Deciles of multiple deprivations (ref. 1st)						
2nd	1.02	*0.89*	*1.18*	1.32	*1.05*	*1.64*
3rd	1.17	*1.01*	*1.36*	1.13	*0.88*	*1.46*
4th	1.07	*0.91*	*1.25*	1.19	*0.93*	*1.53*
5th	1.16	*0.98*	*1.36*	1.05	*0.80*	*1.38*
6th	1.09	*0.92*	*1.29*	1.19	*0.91*	*1.55*
7th	1.14	*0.95*	*1.36*	1.09	*0.81*	*1.46*
8th	1.13	*0.95*	*1.34*	1.09	*0.83*	*1.44*
9th	1.10	*0.91*	*1.31*	1.09	*0.81*	*1.46*
10th	1.04	*0.86*	*1.26*	1.28	*0.95*	*1.72*
Evolution of deciles						
Rise	1.27	*1.08*	*1.51*	1.09	*0.81*	*1.46*
Loss	1.45	*1.22*	*1.72*	1.35	*1.03*	*1.78*
Unknown	2.98	*1.11*	*8.01*	32.50	*8.04*	*131.30*
Log-likelihood	-38471.69			-14964.98		

Source : Belgium National Register and death certificates, 2008-2015, Census 2011, author's calculations. N= 2,220,767 and N= 2,325,092 (in a marital or non-marital relation).

Separation is associated with a higher suicide risk than no separation during observation (Table

7.3). When comparing the mobility trajectories of the separated individuals, we can see very gender-

specific differences. There is a lower suicide hazard for men who leave the previously shared place, while for women, staying is associated with lower suicide risk. For the other covariates, minimal differences are to be noticed compared to previous models. This result remains after controlling for the competing risk of dying from another cause (Appendix, table A7.3). It is to be noted that the confidence intervals that surround these hazard ratios are large. Their overlapping reaches 46% for men, and 56% for women; which is more than the 20% threshold defined in Chapter 4 (page 95). Nonetheless, the difference between the estimates is larger than 5 percentage points.

Figure 8.9 - Predicted related hazard of suicide for men and women in a marital or nonmarital relationship, aged 20 to 64, according to their separation status and mobility at the time of separation.

Men   Women

Legend: No separation — Separation, staying — Separation, moving
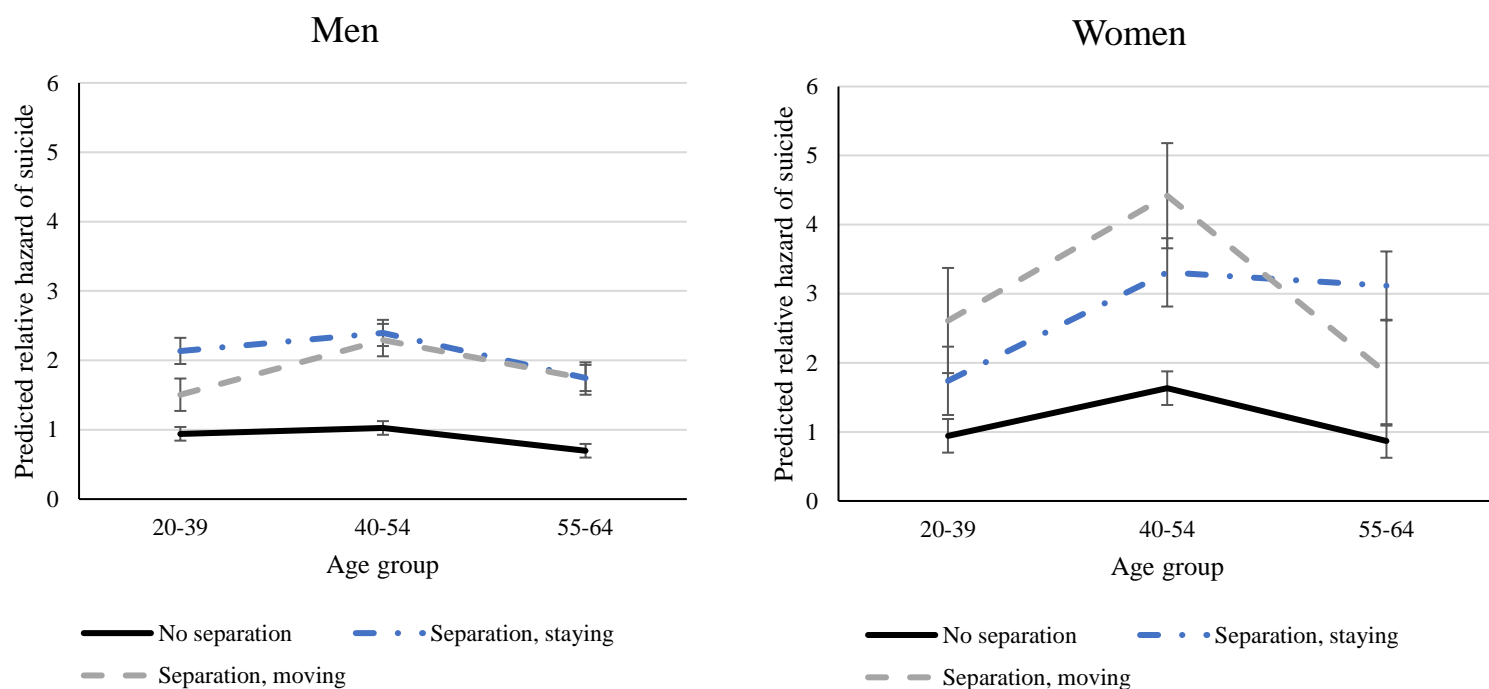
Note: Models control for parental status, region of residence, nationality, education level, occupational status, housing tenure, BIMD and change of BIMD.

Source: Belgium National Register and death certificates, 2008-2015, Census 2011, author's calculations. N= 2,220,767 and N= 2,325,092 (in a marital or non-marital relation).

The interaction between large age groups and separation and mobility status present gender-specific trends (Figure 7.9). For men aged 20 to 39, moving in the context of union dissolution is associated with a lower suicide hazard than staying in the previously shared place after the

separation. For men aged 40 and above, the difference in relative hazards of suicide between those who move and those who stay after a breakup is not visible. For women, the situation depends on the life stage. For women aged 20 to 39 and 40-54, staying in the previously shared accommodation after the separation is associated with lower predicted suicide hazard than moving in the six months after the breakup. For women aged 55 to 64, it is the opposite: staying is associated with a higher suicide hazard than moving at the moment of the separation. For both sexes, the suicide hazard gap between separation and no separation is the largest for the 40 to 54 age groups. Effects presented in this paragraph can be considered as strong, as confidence intervals overlapping is lower than 20% for most categories. Only for women aged 20-39, the confidence intervals that surround the estimate for those who move covers 22% of the confidence intervals that surround the estimate for those who do not move. For women aged 40-54, it is only 14%.

VI. DISCUSSION

1. Interpretation

The objective of this article was to investigate the relationship between residential mobility and suicide risk in Belgium for adults aged 20- to 64- year-old, and some explanatory factors of this relation. Thanks to Belgian administrative data – the National Register, the 2011 Census, and the death certificates – the article covers Belgium's entire registered population from January 1st, 2008, to January 1st, 2015. All internal migrations and partnership transitions were considered, as well as all deaths related to suicide. Using event history analysis, I follow individuals through time. I control for the time spent under the risk of suicide and the possibility of leaving the observation by dying from another cause, leaving the country, or disappearing from the register. The models included a series of individuals' characteristics, such as parental status, nationality, region of residence, educational attainment, occupational status, and housing tenure, but also a proxy for the gain or loss of socioeconomic characteristics of the municipality of residence.

a. First hypothesis: mobility and suicide risk

Through event history analysis, results show that mobility is associated with a higher risk of suicide than immobility. **This confirms our first hypothesis** and suggests that a residential change is positively associated with suicide risk. It corroborates previous studies showing decreased mental health outcomes for internal migrants (Hendriks et al., 2016; Liu et al., 2017). Indeed, according to the familiarity-liking theory, individuals are attached to habits and regularities. When the latter is broken or disturbed, individuals' well-being and psychological state can be negatively impacted (Magdol, 2002; Oishi & Talhelm, 2012). In addition, mobile individuals are more at risk of social isolation and withdrawal, at least temporarily. This loss of social ties can be long-lasting, especially for introverted personalities (Oishi, 2010). It can be more detrimental for populations who base their network on close relations and the neighbourhood (Stanley et al., 2012). Moreover, mobility for the working-age population often reveals changes in other life dimensions. According to the life-course approach, a housing career depends on housing-related choices (such as access to homeownership, search for a better geographical location or housing quality…) and life events (W. A. Clark, 2013). The modifications of household composition, the partnership transitions, and the professional evolution are significant factors in one's decision, or obligation, to change accommodations. Especially some of these life events are associated with higher suicide risk, such as union dissolutions.

b. Second hypothesis: the context of the move and suicide

Results confirm that mobility in the context of union dissolution is associated with a higher risk of suicide and that moves in the context of union formation are not. **I also find that mobilities in a context of no union change are associated with higher suicide risk than immobility, which is unexpected**.

On the one hand, the relationship between separation-driven moves and suicide is easily understood. It implies finding another accommodation in an emergency. The first housing after

the separation can be temporary, low-quality, or inappropriate to the individual's needs, preferences, or financial means. The partner who moves can also consider this mobility forced (De Groot et al., 2011) under pressure to quit the shared place, which can be detrimental to mental health (Oishi & Talhelm, 2012; Vásquez-Vera et al., 2017; C. Warner & Sharp, 2016). Especially in Belgium, the housing market is characterised by a low supply and is said to be static, as it does not adapt quickly to the demand (van der Heijden et al., 2011). This is problematic in the context of more frequent union dissolutions that require dividing the household into at least two units (Biotteau et al., 2019b; Feijten & Van Ham, 2007).

I expected other contexts of mobility (for a union formation or no union change) to present gender specificities, as the literature showed that they were often decided to the detriment of the woman and to protect the man's professional trajectory in opposite-sex couples (Brandén, 2014; Cooke, 2008). Here, findings show that both men and women present no higher suicide risk when they move to form a union than when they do not move. Contrary to other moves, those in the context of union formation are associated with higher social links within the household. Individuals in a union are shown to behave more healthily regarding consumption, physical activity, and relation to healthcare services (Brazeau & Lewis, 2021; M. A. Lewis et al., 2006; Meyler et al., 2007). They are also more informed about health and can find better-coping mechanisms than unpartnered individuals.

Contrary to our expectations, moves with no union change (single individuals remain single, couples remain intact) are associated with higher suicide risks than immobility for both sexes. Residential mobility is a challenging life event that triggers temporary social isolation, demanding changes and adaptation skills. It is more or less difficult for individuals according to their social context, resources, and personality traits (Coulter & Van Ham, 2013; Oishi, 2010). In addition, if a move implies that one individual is highly unsatisfied by the new situation, which could more often be the case for women in opposite-sex relations (Cooke, 2008), this might deteriorate not only this

individual's well-being but also their partner's (Meyler et al., 2007) and the overall wellbeing within the relationship. Even if the man's career is privileged in mobility decisions within a household, this does not mean that his partner's struggles will not affect his mental health. Finally, the higher suicide risk associated with the moves without partnership change can also be induced by the low mobility of this population category. Our descriptive analyses and literature estimate that mobility is rare among single individuals or people in stable relationships (Kulu et al., 2021b). In this context, the familiarity-liking theory can also explain that this life change can be hefty on mental health for people not used to moving. This population can have low resources to face demanding life adaptations (Oishi, 2010).

c. Third hypothesis: mobility in the context of union dissolution

In the context of union dissolution, we can see gender-specific trends. According to our estimates, women present a higher suicide risk when moving than staying in previously shared accommodation. Conversely, men are associated with higher suicide risks when they stay rather than when they leave the place they used to share with their ex-partner. As previously mentioned, residential mobility is challenging for the newly separated or divorced, even more when accompanied by decreased finances and resources at the household level. It is more often the case for women (Leopold, 2018b). The consequences of separation for women increase their risk of poverty and single motherhood (Fernquist & Cutright, 1998; Leopold, 2018b). This can lead to a loss in housing conditions and neighbourhood satisfaction, related to adverse mental health outcomes such as a higher risk of depression (G. W. Evans et al., 2003; Singh et al., 2019a). For women, staying in the previously shared place might protect them from housing instability, from a considerable loss of housing conditions associated with a move, and let them keep the family unit as intact as possible. On the contrary, men especially face a (temporary) reduction in their social support system (Leopold, 2018b). But in the longer run, men are likelier than women to enter a new union after a separation (Wu & Schimmele, 2007).

However, results must be taken with caution. Despite a gap of at least 5 percentage-points between the estimates, the effect strength of the relationships is weakened by large confidence intervals that overlap to a higher extent than the threshold defined in the methodological section (See chapter 4, page 95). The effect is too weak to come to a firm conclusion about the advantage or disadvantages of mobility facing suicide mortality for men or women. It does **not allow us to confirm our third hypothesis.** This absence of a clear association between mobility and suicide mortality in the context of union dissolution is interpretable through the double consequences of mobility on wellbeing. Movers often lack social support and less social integration than locals (Hendriks et al., 2016). This is particularly detrimental in the context of fragility, the end of a relationship. But on the other hand, mobility can also bring advantages and new opportunities (Mulder, 2018; Mulder & Van Ham, 2005; Trigg, 2009). First, it allows one to physically disconnect from the ending relationship and start a new chapter in one's life. Indeed, places are attached to feelings, and leaving can sometimes help overcome traumatic experiences (Trigg, 2009). Second, mobility is positively associated with many outcomes, especially professional life and income (Mulder & Van Ham, 2005). Focusing on other achievements can be a coping mechanism for the newly separated.

In many cases, the person who leaves the shared housing might also be the one who decides to leave the relationship (Mulder & Wagner, 2010). In such a situation, mobility is not as forced as when the partner undergoes a separation they did not choose. Children's custody is also essential in mobility decisions during a union dissolution. To fully understand the implications of mobility in the context of union dissolution on one's mental health and well-being, it is essential to understand the context of the separation, a piece of information that is hard to find in administrative datasets. Future studies, mainly qualitative studies, should focus on how individuals experience separation-driven moves and how they can impact their psychological, material, and social well-being.

d. Fourth hypothesis: mobility over the life stages and suicide

The relationship between mobility and mental health differs according to life stages. I divided the population into three age categories: young adults (20-39), middle-aged adults (40-54), and older adults (55-64). Middle-aged categories present the highest excess mortality due to suicide when mobile, compared to immobile, for all contexts of moves. Contrarily, for younger and older adults, mobility in the context of union dissolution is associated with higher suicide risks. In contrast, other types of mobility were close to immobility regarding suicide risks. Middle-aged adults are more attached to stability and immobility (Coulter & Van Ham, 2013): mobility in this life stage might indicate a disruption in their life course and their quest for long-term relationships, career stability and access to homeownership.

Moreover, gender specificities are observed. On the one hand, younger men present higher suicide hazards when staying in a shared place than moving. This is also the case for older women. In the two cases, staying can imply that the individual is responsible for the home because they own it or are particularly attached to it for practical or emotional reasons. This can mean that the one who keeps the housing must take care of its becoming, whether by continuing a renovation or maintenance project that was started together, taking on the financial obligations over the place, or organising its sale or rental. Young men and older women appear to be more negatively concerned about this situation regarding suicide risk. For young men, who are likelier than their female counterparts to meet a new partner (Kreidl & Hubatková, 2017; Wu & Schimmele, 2007) and become a homeowner of another place in the future (Mikolai & Kulu, 2018), this former place can be an obstacle to move on. For older women (aged 55-64), who are a category of the population that is already highly occupied by caretaking for older and younger generations (K. L. Evans et al., 2016), we can add that the logistics and maintenance of a (too) large housing can be particularly demanding.

For men aged 40-54 and 55-64, the differences between moving and staying in a context of union dissolution are not visible when it comes to suicide risk. For younger women, estimates show that moving is associated with higher risks of suicide than staying. This can be parallel with the higher risk of poverty for separated and divorced women (Fernquist & Cutright, 1998; Leopold, 2018b), which can have long-term consequences. Staying might give at least security and a form of stability for newly separated women. Studies in Belgium confirmed women's higher risk of moving after separation, especially among the lower-educated ex-couples (Theunis et al., 2018). We can then assume that women who remain are more privileged than those who move. Moreover, mobile women are likelier to have initiated the separation (Hewitt et al., 2006; Kolodziej-Zaleska & Przybyla-Basista, 2020; Symoens et al., 2013), to have anticipated it and suffered from unsatisfactory relations in the years before the separation. This poor-quality situation might have consequences after the union dissolution and the physical separation. According to the threshold defined in Chapter 4 (page 95), the effect of the relationships studied in this fourth hypothesis are strong enough to be considered as socially significant, as the overlapping of the confidence intervals is at most 20%. There is nonetheless an exception for younger women, whose results must be taken with more caution.

2. Methodological reflections and limitations

The use of administrative data to treat these questions offers many methodological advantages. We cover the whole interest population and can accede information about many aspects of their life, including their residential course, partnership transitions, and causes of death. However, other elements cannot be considered with such data. First, we consider only couples living in the same residence and define separation as a cohabitation's end. This condition excludes all separations that were not registered. Especially in the context of union dissolution, having more insight into the negotiations over the separation, in terms of the division of the goods and of the children's custody, would help understand what factors are at stake when it comes to the relationship between union

dissolution and suicide, and the role of housing in the association. For instance, we can question how the former housing can anchor the relationship between the separated parents and the children; or how cooperation or conflicts between the ex-spouses can make learning to live alone in the previously shared housing easier or harder. Our models include children in the household after the possible move and/or separation. This information reveals the administrative reality of the children's custody, the parents whose address is declared the children's principal residence. It can foreshadow which parent is legally responsible for the children but does not indicate the real custody arrangement. However, it does not help distinguish between parents who have partial custody of their children, parents who have no custody, parents of adult children and childless individuals. Thanks to register data, and more precisely, the intergenerational information it provides, it is possible to reconstruct family courses and, more specifically, how custody arrangements can impact the mobility patterns of individuals after a separation and their consequences on suicide mortality. Future quantitative or qualitative studies would help cover this topic.

A significant limitation in our work is the impossibility of ruling out a selection bias according to which individuals with a predisposition to poor mental health outcomes would be both more at risk of suicide and higher risk of instability in the other dimension of their life, including in terms of personal relationships and housing career. No causal relation can be drawn from our conclusions. However, an alternative model presented in the appendix allows to control for all-cause mortality. Indeed, individuals diagnosed with mental illnesses show a higher rate of suicide than the general population, but also a higher rate of all-cause mortality and mainly external causes of mortality, including accidents and self-harming behaviours that did not directly intend to result in a death (Hällgren et al., 2019; Walker et al., 2015). Using a Fine-Gray sub-distribution hazard model, I replicated the models controlling for a competing risk to suicide, that is, death from other causes. The main results are robust to this alternative specification (Appendix, Tables A7.1 to A7.3). Comparing the two models lets us think that mortality due to suicide and mortality related

to other causes are independent. This check might also indicate that results are not biased by an excess representation of individuals suffering from mental disorders –at a high risk of all-cause mortality - among the suicides we study.

Finally, our apprehension about the socioeconomic circumstances of the move could be more extensive. I only have information on a time-constant variable – educational level – and a broad definition of socio-professional status – a typology that gathers many realities in the same categories, such as "employed" or "inactive". The absence of measurement of the income variation at the household and individual level would help a) reconstruct the professional and material context of the move and b) quantify the financial consequences of union dissolution. More knowledge about the socioeconomic context of the residential change would give many answers about how this move was negotiated between the individuals, what it implied regarding their economic possibilities and autonomy, and how it changed their means of subsistence. Of course, income strongly determines mental health (Gresenz et al., 2001) and suicide risk (Mäki & Martikainen, 2008). It is a possible confounder in the relationship between mobilities – especially in the context of union dissolution – and suicide mortality that we can only approximate through education and socio-professional status.

3. Conclusion and opening comment on international migration

This is the first register-based study investigating the relationship between residential moves and suicide risk. If mobility is a frequent event, often linked to other life changes, its implications on mental health and suicide have been very little studied. First, I show that mobility in a context of no union change is associated with higher suicide risk for both men and women. This is unexpected, as the literature suggests that mobilities are often more detrimental to women's lives and careers than men's. Also, I highlight the high vulnerability of middle-aged individuals aged 40 to 54: they present the highest risk of suicide when they move, especially in the context of union

dissolution. Public action should target mental health policies on this population, which appears to be particularly sensitive to life course disruptions, including residential mobilities.

To go one step further in reflecting on the relationship between mobility and suicide, it is interesting to extend and compare these results with another type of move: international migration. It is well-known that international migrants present lower mortality risks than the native population (Aldridge et al., 2018; Deboosere & Gadeyne, 2005a) and lower suicide risks (Spallek et al., 2015). However, other studies show that international migrants have more mental health illnesses, such as post-traumatic disorders or anxiety disorders (Schininá & Zanghellini, 2021), and higher risks of suicidal behaviours (Bursztein Lipsicas et al., 2012) than the native population even though scientific literature is not univocal about this (Forte et al., 2018). One central element that can link my results on internal migration with international migration is the concept of the intention of the move. It was shown that forced mobility is associated with a significant loss in well-being (Siriwardhana & Stewart, 2013) and a higher risk of suicide attempts (Aizik-Reebs et al., 2022). Even if international migration can often be considered as a solution to accede better living conditions via professional opportunities, more security, and getting closer to loved ones or partners, it is also often the result of very poor living conditions or unbearable hazards (from an economic, climatic, social, sanitary point of view) in the origin countries (Kashyap & Joscelyne, 2020). Similarly, I show in this chapter that internal migration is more often associated with an increased suicide risk when forced by external events, such as separation or the will to advantage a partner's career. I recommend future research to investigate the consequences of international or internal migrations on mental health with a specific focus on the willingness to move. I suggest examining how mobility might constrain individuals and be an obstacle in realising what they consider a good life, according to their original plans, the respect of their roots and their preferences regarding residence.

Takeaway message from Chapter 7

❖ Our study investigates, for the first time, the relationship between residential moves and suicide. As residential mobility often goes hand in hand with partnership transitions, this study focuses on the union context of the move.

❖ Findings show mobility is associated with a higher suicide risk than immobility. Mobility in separation is associated with a higher risk of suicide than immobility, whereas mobility in the context of union formation is not. Contrary to our expectations, moves with no union change (single individuals remain single, couples remain intact) were associated with higher suicide risks than immobility.

❖ Middle-aged adults (40-54) show the highest excess mortality due to suicide when mobile, compared to immobile. Also, this observation remains for all types of moves

CHAPTER 8

MOVING OUT AND MOVING ON: THE IMPACT OF MOBILITY IN THE CONTEXT OF UNION DISSOLUTION ON ANTIDEPRESSANT INTAKE IN BELGIUM[8]

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[8] This chapter was co-written with Professor Christine Schnor and Dr Didier Willaert in collaboration with the Socialist Health Insurance Funds from Belgium. This chapter is still under review and was presented at the 19th Divorce Network Conference in 2021.

VII. INTRODUCTION

Suicide mortality is the most extreme mental health outcome. Before suicide comes several other mental health indicators, from life satisfaction to depression risk, from ill-being symptoms to mental health care treatments. One specific indicator is the intake of antidepressants. Antidepressants are prescription drugs commonly used to treat depression and depressive symptoms. Their relationship with suicide mortality is complex. Many studies show that antidepressant consumption is associated with lower suicide risks. In the US, a comparison between the counties and within the counties (to account for differences in mental healthcare policies and resources) showed that higher consumption of antidepressants was associated with lower suicide risk (Gibbons et al., 2005). In Europe, countries where antidepressant intake has increased over the last decades, present a more visible decrease in suicide rates (Gusmão et al., 2013). However, there is a debate over the role of antidepressant intake on suicide mortality. Many specialists call for a cautious interpretation of this association (Isacsson et al., 2010). First, antidepressants exist in multiple forms. According to the molecule type, the effects on depression and suicide differ (Courtet & Lopez-Castroman, 2017; Rihmer & Akiskal, 2006). For instance, among young populations, using some types of antidepressants increases suicide mortality (Courtet & Lopez-Castroman, 2017). Second, antidepressants might also indicate better professional support in case of mental health issues and more resources to face depressive symptoms (Gibbons et al., 2005). The antidepressant intake would then be an intermediate variable in the relationship between better quality mental healthcare and decreased suicide mortality.

This chapter has two aims. First, it discusses the relationship between residential mobility and mental health with another less extreme indicator than suicide. The association between internal migration and mental health has been very little studied, and an extension to other indicators gives another perspective to this research. Second, this chapter's objective is to reflect on the use of

suicide as a mental health indicator. What does it imply to use suicide mortality as a mental health outcome rather than an indicator that intervenes earlier in the depressive and suicidal process, such as antidepressant intake?

VIII. BACKGROUND

1. Anticipation and consequences of union dissolution on mental health

A separation is a synonym of short-term and long-term changes in one's life and habits, which can impact well-being and life satisfaction. Among them, the loss of resources, the new configuration of the family links – including the custody of children, the relation with the in-laws and the familiar friends, and the change of residence and living conditions. Low partnership quality and the threat of separation can lead to an anticipation effect (a decrease in well-being that starts before the union dissolution is enacted) and long-term effects that can occur years after the relationship ends. Long-term effects are likely gendered, as women suffer more from long-term consequences than men (Leopold, 2018b). Entering a new cohabiting union can be associated with a socioeconomic improvement for divorced and separated individuals, especially for women (Dewilde & Uunk, 2008).

The factors that explain the loss of well-being after a union dissolution differ between men and women. Men are more vulnerable to short-term consequences of union dissolutions – such as the loss of social support – than women (Leopold, 2018b). In the longer term, women have to face a higher risk of poverty and single motherhood, which can have multiple consequences on their lives and be detrimental to their mental health for a longer time (Conejero, Olié, Calati, et al., 2018a; Fernquist & Cutright, 1998; Leopold, 2018b; Stack, 1982b).

2. *Mobility in the context of union dissolution*

As stated in Chapter 7, residential relocation is very little studied as a determinant of the mental health struggles post-separation. Nonetheless, the housing change is worth exploring among all the difficulties and psychological struggles that can happen during a union dissolution. First, the context of a post-separation move is far from ideal. The new residence is often found in a context of emergency and fewer resources and might be a temporary option (Feijten & Van Ham, 2007). Compared to other move types, individuals can expect to lose some housing quality and homeownership status (Lersch & Vidal, 2014). Poor quality and unstable housing are detrimental to mental health, as it questions one's trust in the future, self-esteem, and social relations (Y. Bernard, 1998; G. W. Evans et al., 2003; Magdol, 2002; McCormick et al., 2012; Oishi & Schimmack, 2010; Shklovski et al., 2006; Stokols et al., 1983). Then, due to the possibly conflictual climate that surrounds a union dissolution and the redefinition of the family unit, separation-driven moves can damage the social network of a person and trigger social isolation (Heikkinen et al., 1993a): for parents, moving can be detrimental to the relationship with the children, especially for the parent who has no custody of the minor children or a custody arrangement that does not encourage their link with their children (Ferrari et al., 2019). Right after separation, the decision of who moves and who stays in the previously shared place is complex information that can rely on economic and contextual factors. In Belgium, the legal framework does not encourage any party to leave or stay in the shared place. However, studies in Belgium confirmed women's higher risk of moving after separation, especially among the lower-educated ex-couples (Theunis et al., 2018). In a context of a fast repartnership, a move appears as the first step of a new life chapter, marking the start of a new union.

3. *Measuring mental health with antidepressant intake*

Some qualitative studies suggest a negative association between internal migration and well-being. Still, to our knowledge, well-being measures were mainly self-reported and based on an

appreciation of happiness and life satisfaction. On the opposite, in research on the relationship between separation and well-being, very diverse ways to measure mental health are suggested, such as depressive symptoms (Tosi & van den Broek, 2020), antidepressant consumption (Metsä-Simola & Martikainen, 2014) and suicidal behaviours and mortality (Lorant, Kunst, Huisman, Bopp, Mackenbach, et al., 2005; Øien-Ødegaard et al., 2021).

The use of antidepressants to measure depression is commonly used in studies focusing on mental health (Eriksson et al., 2004; Frandsen et al., 2016). This indicator represents both positive and negative aspects. On the one hand, it quantifies and objectively measures mental health struggles and a depressive state. In Belgium, an antidepressant is prescribed by general practitioners, psychiatrists, or any other specialised doctor, to treat mainly depressive conditions, anxiety, burn-out, and, more rarely, migraines and muscular pain (Boutsen et al., 2015; Cascade et al., 2007). One condition for depression to be diagnosed is to present depressive symptoms for at least two continuous weeks, which makes a difference between sadness and depression (*Depression*, s. d.). In Belgium, this type of treatment is reimbursed by health insurance. Adhesion to health insurance is compulsory and affordable for a considerable part of the population living in Belgium.

On the other hand, antidepressant intake as a measure might lead to underestimating depression. It requires many steps: seeking medical help, getting diagnosed, and getting a prescription for antidepressants, as well as treatment adherence (Anderson & Roy, 2013). The use of antidepressants can thus be interpreted as the lower bound of depression prevalence. It was shown to underestimate depression among specific populations, especially in the case of non-adherence to treatments (Fried & Nesse, 2015; Uher et al., 2012). Studies suggest that antidepressant consumption varies according to individuals' characteristics, independently from their depressive symptoms. A report by the socialist health insurance fund (Solidaris) showed that in 2012, 27% of the suicide attempt survivors who were hospitalised had not contacted a doctor or psychiatrist during the last three months before their attempt (Boutsen et al., 2015). Seeking mental healthcare

depends on many factors. Men tend to open up less about their mental health issues and seek less medical help (Payne et al., 2008b; Van der Heyden et al., 2009b). Within Belgium, lower social strata consume more antidepressants than higher social strata (Gisle et al., 2018). On the one hand, the more disadvantaged population suffer more from depressive states than more advantaged ones (Freeman et al., 2016; Zimmerman & Katon, 2005). Also, when facing depressive symptoms, the latter have more financial resources to rely on other solutions, such as psychotherapies (Hilvert-Bruce et al., 2012). Personal beliefs about mental health medication and cultural background, as well as social relations – such as the antidepressant consumption of close family and friends – can impact individual adherence to treatment (Anderson & Roy, 2013; Chakraborty et al., 2009; Garfield et al., 2004; Ho et al., 2017), especially in a context of controversy about mental health medication effectiveness and side effects (Healy & Whitaker, 2003; Isacsson et al., 2005).

IX. RESEARCH QUESTIONS AND HYPOTHESES

Some qualitative studies suggest a negative association between internal migration and life satisfaction. Still, to our knowledge, no previous study investigated how residential mobility can interfere with the relationship between union dissolution and antidepressant treatment. **In the first hypothesis, we assume that individuals who leave the shared accommodation after the separation present higher antidepressant increases than individuals who stay in the previously shared place.**

In addition, men and women face different consequences after a separation. Women are likelier to initiate the separation (Hewitt et al., 2006), move out of the previously shared place more often, and have more unstable housing paths after a split (Ferrari et al., 2019). Men often struggle with short-term obstacles related to loss of social support, while women tend to suffer longer from social and economic difficulties (Ferrari et al., 2019; Leopold, 2018b). **As a second hypothesis, we assume that results could differ for men and women. Women who leave the housing**

would present a higher antidepressant consumption before the breakup, as they anticipate the imminent union dissolution and the subsequent move and life changes. **After the separation, we assume men show a higher antidepressant intake when they move than when they stay,** as moving would trigger a higher risk of isolation and loss of social support.

However, the context of the separation and the move can mitigate the relationship. Repartnering in the years after the union dissolution indicates that the post-separation moves may be triggered by the physical separation and the project of entering a new cohabitation. In addition, repartnerhsip tends to protect individuals, especially women, from socioeconomic loss. **As a third hypothesis, we assume that moving in the context of union dissolution is associated with lower antidepressant consumption when the individual repartners than when they move without entering a new partnership. We assume this advantage of repartnership to be even more visible for women,** who are more protected from post-separation socioeconomic losses if they live with a new partner.

X.   DATA AND METHODS

1. Data

To answer those questions, it is possible to rely on health insurance data from *Solidaris* for medical information, which can be merged with the National Register, which provides information about partnership transitions and residential relocations. More specifically, we use population panel data on individuals living in Belgium and affiliated with the Socialist Health Insurance Fund (Solidaris, SHIF)[9]. Our sample includes marital and non-marital couples together on January 1st, 2009, and went through a union dissolution between 2009 and 2018: 33,101 men and 34,947 women[10] (Table 1). Using the National Register's civil status information and household configuration, we can

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[9] https://www.solidaris.be/
[10] Number of men and women differ because of the age restriction.

directly identify marital couples. For non-marital couples, we rely on several assumptions, such as having only two opposite-sex adults aged 16 and above living in the same household, with an age difference lower than 15 years between them. These assumptions exclude same-sex couples and couples with a significant age gap. Still, their consistency is supported by external validation: the applied definition captures more than 90% of the non-married partnerships that were self-declared in the Generations and Gender survey conducted in 2009 in Belgium (Lodewijckx & Deboosere, 2011b). We only considered couples affiliated with *Solidaris* in 2009 to get information about the partner. This condition is also necessary to identify couples and eventually their separation. We exclude couples where one member left the observation before 2018 by moving abroad, dying, or changing health insurance to keep the sample balanced. Finally, we restrict our observation to the population aged 20 to 54 in 2009 –who will turn 30 to 64 at the end of the observation period – as the intake of antidepressants among younger or older persons is mainly influenced by specific factors. For instance, the use of antidepressants among children and teenagers is controversial in psychiatric studies and practice, as the determinants of mental health for young people are even more diverse than for adults (Korenblum, 2004; Morrison & Schwartz, 2014). Antidepressants are often prescribed to elderly individuals, especially in cases of mobility loss or cognitive diseases (Doraiswamy et al., 2003; Karkare et al., 2011).

This dataset is particularly adapted to answer our questions. It enables us to cover individuals before, during, and after a union dissolution, following their inter-municipal relocations and their variation in antidepressant intake over the years. However, they present some limitations that need to be addressed, but this dataset still needs to be adapted for our objectives.

First, we cannot measure intra-municipal moves, only changes in municipalities. This implies that we do not capture all moves, particularly the very short-distance ones, that are particularly common for parents sharing custody (Dewilde & Uunk, 2008). Belgium counts less than 600 municipalities, with an average of 50 km² of area each. This might bias our study by only capturing the moves that

strongly negatively impact mental health and individuals who change their habits, including healthcare services.

Second, the population covered by Solidaris is not representative of the total Belgian population. In Belgium, the health system is based on the obligation for each resident to adhere to a health insurance fund. Health insurance funds cover health-related costs (in terms of therapeutic or diagnostic actions, medical interventions, hospitalisations, or treatments) to a large extent (D'hoore & Stordeur, 2004). Historical, socioeconomic, and cultural factors led to several social movements, such as trade unions, youth, and religious communities. Health insurances are the continuity of these movements and are divided into three large pillars: Christian, socialist, and liberal health insurance (Faniel & Gobin, 1992). Individuals also have free choice between several health insurance companies with close membership fees. Individuals will feel closer to individual health insurance according to their position in society, beliefs or values, or family history. This means every health insurance will cover a different population with different demographic and socioeconomic characteristics. Solidaris covers less than a third of the Belgian population (about 3 200 000 members in 2018, i.e., 28% of the population), with a significant representation of the Walloon population living in the southern French-speaking region of the country (1 300 000 Walloon members in 2018, i.e. 38% of the Walloon population). Compared to the general population in Belgium, our sample is often in nonmarital unions and childless or not living with their children. This might indicate a higher risk of separation, as non-marital unions are less stable than marriages (G. Andersson et al., 2017b). Our sample has a higher chance of increased reimbursement, which shows the higher socioeconomic precariousness of the Solidaris population, which is a factor of higher depression prevalence (Freeman et al., 2016; Zimmerman & Katon, 2005).

2. How to measure mental health?

Our data includes all deliveries of antidepressants (reimbursed by the health insurance) in public pharmacies. From this, the yearly Defined Daily Doses (DDD), the assumed average maintenance dose per day for a drug used for adults (Sinnott et al., 2016), can be calculated. To differentiate a clinical depression from other pathologies requiring a prescription shorter than three months, we define a threshold of at least 90 DDD. This 90 DDD threshold is the adequate minimum duration of treatment of depression to feel better and avoid relapses (Hirschfeld, 2001; Moustgaard et al., 2014). Our outcome variable is thus dichotomous, distinguishing between 0 to 89 DDD and 90 DDD and more. In robustness checks, we also tested variations of the antidepressant consumption in DDD without any threshold.

3. How to measure separation?

We measure separation by looking at the household identifiers. We assume that if the two partners still have the same household identifier, nothing changes in the relationship between years t and t+1. On the contrary, if at least one of the partners changes household identifiers and the two partners have different household identifiers, the couple is separated and no longer shares the same accommodation. As one of our objectives is to investigate the timing of union dissolution, a categorical variable distinguishes 1) two years and more before the separation; 2) the year before the separation; 3) the year of the separation; 4) the year following the separation year; and 5) two years and more after the separation. Here, we can only consider the first separation of the individual in the observation period. The household composition variable allows us to estimate the individual's civil and parental status. Still, after this first relationship, we do not have any information about the characteristics of the possible new partner if they are affiliated with another insurance. Using this variable, we estimate that about 24.6% of men and 22.3% of women from our sample will repartner before the end of our observation period.

4. The moderator effect of mobility

Our second objective is to examine whether the effect of separation on mental health is moderated by residential mobility. A residential move is a change of the municipality of residence between years t and t+1, recoded in a dichotomous variable. The relation between separation and mental health according to the mobility status during the separation year is studied using different approaches. A) First, in a time-varying approach, the individual who relocates is assigned to the "mover" category only from the moment of the separation; B) Second, we take an anticipatory time-constant approach, in which an internal migrant individual is assigned to the "mover" category throughout the whole observation period – both before and after the separation – to evaluate possible anticipation effects: we question the possibility that a future (and anticipated) mobility could increase antidepressants before the separation; C) we investigate the role of repartnership in the relation, by distinguishing four trajectories after the separation: i) individuals who did not move during separation year (t) and who do not repartner; ii) individuals who did not move in year t but repartnered; iii) individuals who moved in year t and did not repartner; iv) individuals who moved in year t and repartnered. This allows us to know more about the context of the move.

5. Covariates

The database includes a range of characteristics for each individual, gathered on January 1st of each year.

a. Time-constant covariate

First, we distinguish men and women, as mental health problems, medication consumption and effects of separation on (mental) health differ by gender (Payne et al., 2008b; Van der Heyden et al., 2009b).

b. Time-varying covariates

All time-varying covariates are measured on the January 1ˢᵗ that precedes the separation. We treat age as a continuous variable. We also include geographic information regarding the region of residence: Flanders, Brussels-Capital Region, and Wallonia. The regions differ regarding mental health policies, with regional budgets and authorities managing mental healthcare. Then, the household type variable is based on the household composition (Van Imhoff & Keilman, 1992) and allows estimation of the individual's marital and parental status, which matters for mental health (Graham, 2015b; Rhoades et al., 2011). The available socioeconomic information is also included. We know that a lower socioeconomic category is associated with a higher risk of mental health issues and tends to decrease the likelihood of taking up therapy without medication (F. Z. Ahmad & Ismail, 1988; Wei et al., 2005). When the household's income is low enough or based on social benefits, they are automatically entitled to an increased healthcare reimbursement: a dichotomous variable indicates whether the individual benefits from this increased reimbursement. Access to this status does not depend on healthcare expenses and is attributed automatically based on the declared income of the household. As it is known that unemployment is closely related to mental health (Artazcoz et al., 2004a), we also used information on the number of days worked over the year as a proxy for employment status. One is considered unemployed and receiving unemployment benefits if the number of days worked is below 150 per year (less than six months). We account for the possibility of these six months overlapping two calendar years. Moreover, studies suggest that physical and psychological pain are interrelated (Conejero, Olié, Calati, et al., 2018a). The general health status is measured by counting the number of days that an employee received sickness or invalidity benefits. We consider individuals in a disability state if their days with sickness or invalidity benefits exceed 150 working days a year.

We also account for the antidepressant consumption of the (ex-)partner, as it can influence one's openness to mental health medication and adherence to the treatment (Dupre and Meadows,

2007[11]). As both the members of the couple are affiliated with Solidaris, this information is directly available. We account for changes in primary antidepressant prescribers between two consecutive years. This is important as a residential move may lead to a change in medical doctor(s). The patient may be less open about their mental health problems to a new healthcare professional or may get a new diagnosis, which can impact the treatment. Finally, the distance of the move is added to the models through a categorical variable, distinguishing whether the distance between the centroids of departure and arrival municipalities was (a) lower than or equal to, or (b) higher than 16 kilometres. In Belgium, we can consider that 16 km is the threshold to define long-distance moves, as 16 km is the radius of the largest municipality in terms of area (Tournai). All these variables are time-varying, but some are likelier to vary in time (unemployment days, marital status, region of residence, and parental status to a lesser extent) than others (sex does not change, increased reimbursement, low variation of prescribers).

6. Methods

The variation in antidepressant intake might depend on observed and unobserved characteristics of the individuals, such as mental illnesses, genetic predispositions, or other health issues. To estimate the depression risk in the context of panel data, we chose to run random-effect logistic models that are presented as the logarithm of the odds of depression (7):

$$\ln \frac{P([AD \geq 90DDD]_{it} = 1)}{P([AD \geq 90DDD]_{it} = 0)} = \alpha_i + \beta X_{it} + u_{it} \tag{7}$$

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[11] Nonetheless, being in a relationship does not mean a systematic lower consumption of mental health medication. It can also increase the individual's antidepressants intake in two ways: by giving healthier habits, such as seeking for help in case of physical and/or mental issues, which can lead one's access to mental health medication (Dupre & Meadows, 2007); by dedramatizing the consumption of such medicine when the partner already relies on such medicine.

Where i is each individual (from 1 to N), t is time in years, α_i is the individual random specific effect, β_{it} is a vector of parameters to be estimated, X_{it} is a vector of explanatory variables (including union dissolution, residential mobility and the interaction of both), and u_{it} is the disturbance/error term following a normal distribution. We estimate logistic regression models, as the risk of the yearly antidepressant intake being 90DDD and above (0/1) is a binary variable. α_i is not directly observable. It can be considered as constant parameters (with fixed-effect logistic regression models) and as random parameters that are allowed to vary (with random-effect logistic regression models). We decide to model random-effect regression models, as fixed-effect models do not estimate time-constant variables (Bell et al., 2019; Halaby, 2004). Above that, we cannot assume that individual-specific effects are correlated with the predictors (predictors cannot capture the whole within-effect).

Interaction results will be presented in predicted probabilities of depression (8):

$$P_{[AD \geq 90DDD]} = \frac{e^{\alpha_i + \beta_{it}X_{it}}}{1 + e^{\alpha_i + \beta_{it}X_{it}}} \tag{8}$$

for each vector X_{it} of explanatory variables (including union dissolution, residential mobility and the interaction of both).

We conduct robustness checks to test other models' specifications. First, linear regression models based on Ordinary Least Squares (OLS) are performed by using, instead of the depression risk, the number of DDD antidepressants consumed over a year. These model results are presented in Figures A8.1-A8.2 and display the predicted number of antidepressants DDD consumed during the separation steps and according to the mobility status at the time of the separation. Second, Poisson regression models are estimated (Figures A8.3-A8.4), as antidepressant intake remains rare (Cai et al., 2010). Results of the Poisson models are expressed in incidence rates (in our case, the incidence rates of depression for the populations who separate and move and for the people who separate and do not move). Finally, we reproduce the random-effect logistic regression models

only on couples whose partners had not consumed any antidepressant in 2008, right before the observation period (Figures A8.5-A8.6). This subsample counts 30,983 men and 30,509 women, i.e., 89% of the analytical sample. This check allows to keep individuals with no mental health issues that lead to mental healthcare support and medication. In addition to random-effect – that controls for the initial level of antidepressant intake before the separation -this specificity helps examine predisposition to chronic depression may influence our results.

XI. ANALYSIS

1. Descriptive part

In 2009, 12% of the members of Solidaris consumed at least 1 DDD of antidepressants, and 7% of the population had an antidepressant intake of 90 DDD or more (Figure 8.1). This percentage increased over the observation period while remaining lower for men (8% with a consumption of at least 1DDD in 2018) than for women (14% in 2018). The difference between men and women is noticeable when comparing their couple trajectories from 2009 to 2018. Here, we gather all the individuals who separated during the observation and calculate their consumption year after year, even before they separated. Less than 10% of men who separated or divorced during the observation period consumed more than 90 DDD of antidepressants in 2018, compared to 19% of the women in the same situation.

Figure 8.1 - Proportion of men and women whose antidepressant intake is at least 90DDD per year, year 2009 to year 2018.
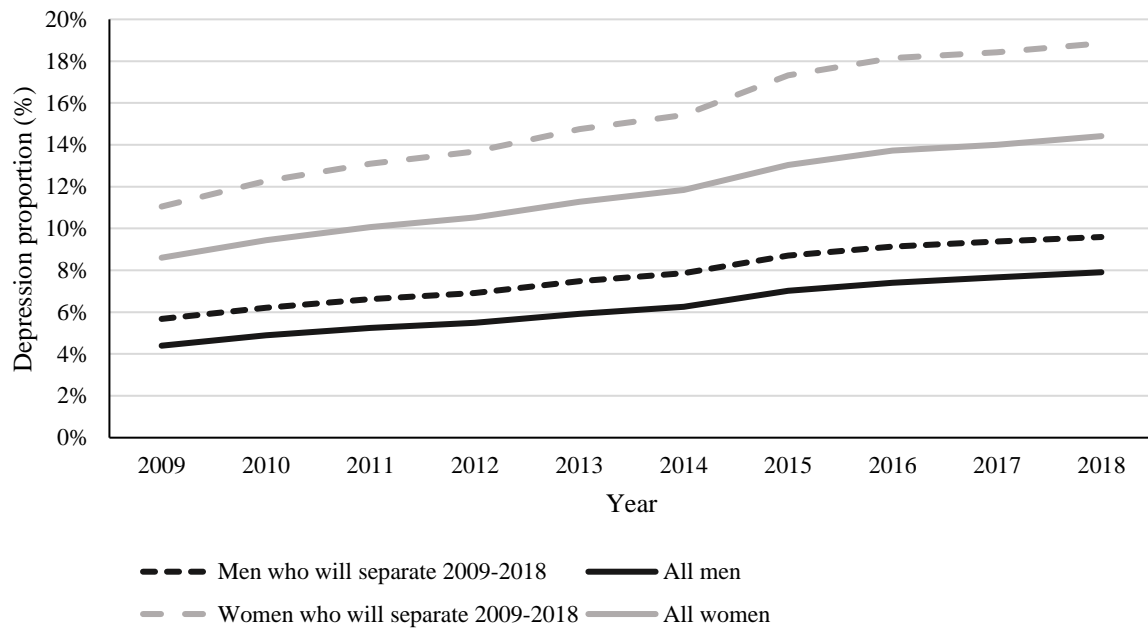
Our sample includes 33,101 men and 34,947 women who went through a separation in the observation period and are followed over nine years, resulting in 612,432 person-years. Table 8.1 shows the sample's characteristics at the observation's beginning. It distinguishes individuals who will move at *t* (year of separation) and those who will not move at *t*. Most of our sample is in a marital union before separating. Most of them also have children. Most of our population lives in Wallonia at the beginning of the observation period. Between 12 to 14% of our sample was unemployed in 2009, and a tiny percentage could not work then. About 10% of our sample can access increased reimbursement due to low income. There are very few differences in characteristics at the beginning of the observation period between people who will move during the separation year b) and people who will not move or move but not change municipalities of residence c).

Table 8.1- Sample characteristics of the analytical sample (intact heterosexual couples in 2009 who will separate in 2009-2018, formed by two Solidaris

members) at the beginning of the observation period (01/01/2009) and according to mobility status during the separation year, in numbers and percentage.

a/ MEN

	a) **TOTAL**	b) *Moved at t*	c) *No move at t*
Total	**33,101**	9,345 28.23%	23,756 71.77%
Living in a marital union	16,745 *50.59%*	4,699 *50.28%*	12,046 *50.71%*
Living in a non-marital union	13,473 *40.70%*	3,815 *40.82%*	2,658 *80.18%*
Living with children	7,725 *23.34%*	2,193 *23.47%*	5,532 *23.29%*
Childless or not living with children	22,493 *67.95%*	6,321 *67.64%*	16,172 *68.08%*
Flanders	14,890 *44.98%*	3,953 *42.30%*	10,937 *43.20%*
Wallonia	14,956 *45.18%*	4,100 *43.87%*	10,856 *47.90%*
Brussels	3,255 *9.83%*	1,292 *13.83%*	1,963 *8.26%*
Unemployment	4,135 *12.49%*	1,148 *12.28%*	2,987 *12.57%*
Incapacity	379 *1.14%*	88 *0.94%*	291 *1.22%*
Increased reimbursement	3,085 *9.32%*	883 *9.45%*	2,202 *9.27%*

b/ WOMEN

	a) **TOTAL**	b) *Moved at t*	c) *No move at t*
Total	**34,947**	9,991 28.59%	24,956 71.41%
Living in a marital union	18,186 *52.04%*	4,728 *47.32%*	13,458 *53.93%*
Living in a non-marital union	13,776 *39.42%*	4,362 *43.66%*	9,414 *37.72%*
Living with children	7,991 *22.87%*	2,783 *27.86%*	5,208 *20.87%*
Childless or not living with children	23,971 *68.59%*	6,307 *63.13%*	17,664 *70.78%*
Flanders	15,805	4,430	11,375

	45.23%	*44.34%*	*45.58%*
Wallonia	15,692	4,549	11,143
	44.90%	*45.53%*	*44.65%*
Brussels	3,450	1,012	2,438
	9.87%	*10.13%*	*9.77%*
Unemployment	4,911	1,312	3,599
	14.05%	*13.13%*	*14.42%*
Incapacity	528	156	372
	1.51%	*1.56%*	*1.49%*
Increased reimbursement	3,779	859	2,920
	10.81%	*8.60%*	*11.70%*

Source: Belgian socialist health insurance fund, authors' calculations.

Other time-varying covariates are added to the models. One of them is the change of prescribers between two consecutive years. Among the moves in 2009, about 5% of the men and 9% of the women changed prescribers. Also, we add the distance of the move. In 2010 and 2015, 32% of the moves between municipalities will cover a distance of at least 16 km. These numbers are consistent over the years.

2. Analytical part

All analyses are conducted on our primary sample: individuals aged 20 to 54 in 2009 who were part of an intact opposite-sex couple in 2009 and will split up from 2009-2018. Table 8.2 presents the results of random-effect logistic regression models in the odds ratio of antidepressant intake of 90DDD or more for men and women. Model 1 includes the separation timing indicator (2 years and more before, 1 year before, year of separation, 1 year after, 2 years and more after). Model 2 includes this separation indicator and the mobility status during the separation year. Model 1 shows an apparent increase in depression risk (antidepressant consumption) during the year before the separation compared to the previous years. This anticipation effect of the break is visible for both men and women after controlling for observable and unobservable individual characteristics. The antidepressant consumption peaks during the year of the separation and decreases after the breakup, especially for men who reach the baseline depression level. For women, even two years and more after the split, the antidepressant intake remains higher than two years or more before

the separation. Model 2 includes both separation and mobility indicators. The odds of an antidepressant intake of 90DDD and more over separation steps remain identical even after controlling for the moves during the separation year. There is no clear association between a move during the separation year and medication use for men and women.

Table 8.2- Random-effect logistic regression on the risk of having an antidepressant intake over 90 DDD (0/1) for men and women, expressed in odds ratio.

| | Men | | Women | |
	Model 1	Model 2	Model 1	Model 2
N	49,930	49,930	52,786	52,786
Separation period				
2 years and more before separation	1.00	1.00	1.00	1.00
1 year before separation (t-1)	1.63	1.63	1.58	1.58
	[1.52-1.75]	[1.52-1.75]	[1.51-1.68]	[1.51-1.68]
Year of separation (t)	1.80	1.80	1.84	1.82
	[1.67-1.95]	[1.65-1.95]	[1.73-1.95]	[1.71-1.93]
1 year after separation (t+1)	1.13	1.13	1.46	1.45
	[1.04-1.22]	[1.03-1.22]	[1.38-1.55]	[1.37-1.54]
2 years and more after separation	0.99	0.99	1.22	1.21
	[0.92-1.06]	[0.93-1.76]	[1.16-1.30]	[1.14-1.29]
Residential move at t		1.01		1.02
		[0.94-1.08]		[0.98-1.08]

Control for age, region of residence, increased reimbursement (proxy of low socioeconomic status), parent of resident children (vs childless or parent of non-resident children), in a married or non-married relation (vs. living without a partner), work incapacity (more than 150 days of sickness or disability benefits a year), unemployment (more than 150 days of unemployment a year), antidepressant consumption of the partner, change of antidepressant prescriber, distance of move.

Full models are in Appendix (A-1)

Source: Belgian socialist health insurance fund, authors' calculations.

a. First hypothesis

In Figures 8.2 to 8.4, we investigate the variation of the predicted probability of an antidepressant intake of 90 DDD and above, before, during, and after union dissolution, according to men's and women's mobility status in the year after the separation. In Figure 8.2, we consider the mobility status as time-varying and assign individuals to the "move" category from the year of the separation and after if they moved in the separation year. After the separation year, men and women who did not make an inter-municipal move during the separation year present a slightly higher antidepressant intake during this specific year. For the following years, no differences are to be noted. All these results show very low effect strengths, with overlapping confidence intervals, which does not allow us to conclude our first hypothesis.

Figure 8.2 - Predicted probability of antidepressant intake being 90DDD+ a year (based on random-effect logistic regression models) according to the mobility status of the individual at the time of separation (t). The mobility status during the year of separation (t) is attributed during this separation year (not before).
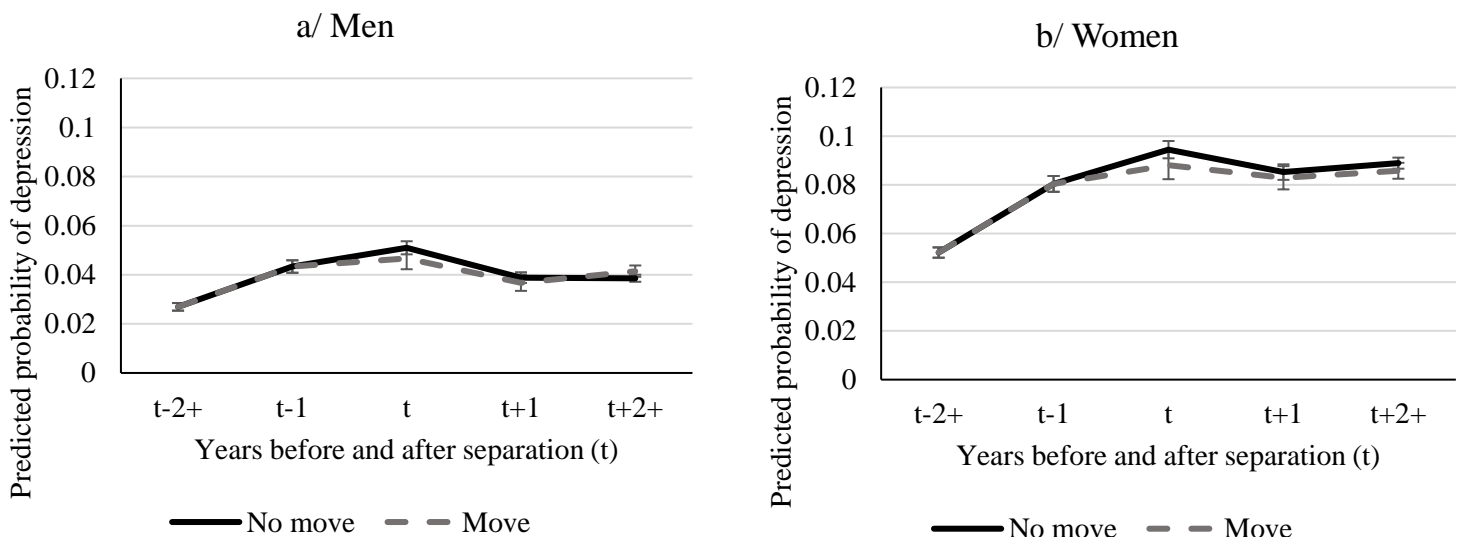
Model controls for age, region of residence, increased reimbursement (proxy of low socioeconomic status), parenthood, couple configuration, work incapacity, unemployment, antidepressant consumption of the partner, change of antidepressant prescriber, and distance of the move.

Note: N=33,101 men and 34,947 women who separated during the observation period of 9 years

b. Second hypothesis

In Figure 8.3, we assign the mobility status in the separation year for the whole observation period. Women who moved during the separation year show a higher antidepressant intake the year before and a convergence in depression risk from the year of the separation. This goes in the direction of our second hypothesis and confirms the gender-specificity of the relation. We can confirm that women who will move anticipate the break and present an increased antidepressant intake in the years before. After the breakup, moving or staying in the previously shared residence does not differ much for women or men. We expected men who moved to present a higher antidepressant intake than those who stayed, but our results do not confirm this idea.

Figure 8.3 - Predicted probability of antidepressant intake being 90DDD+ a year (based on random-effect logistic regression models) according to the mobility status of the individual at the time of the separation (t). The mobility status during the separation year (t) is attributed to the whole period (before and after the separation).
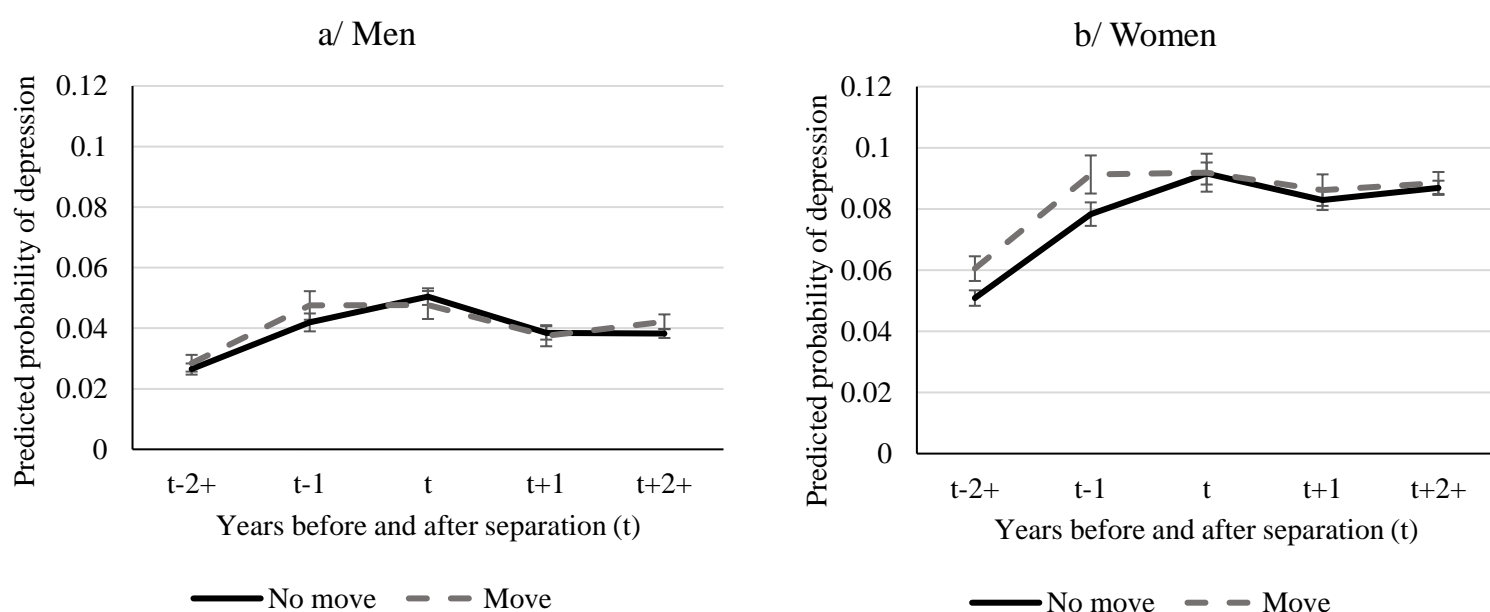
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Model controls for age, region of residence, increased reimbursement (proxy of low socioeconomic status), parenthood, couple configuration, work incapacity, unemployment, antidepressant consumption of the partner, change of antidepressant prescriber, and distance of the move.

Note: N=33,101 men and 34,947 women who separated during the observation period of 9 years

Note bis: Full models and tables of the predicted probabilities are in Appendix (Table A4 and A5)

Source: Belgian socialist health insurance funds, authors' calculations.

c. Third hypothesis

Figure 8.4 shows the distinction between the individuals who will repartner after their separation and those who remain single. Men do not present much difference in medication use according to their moving status and repartnership trajectories after union dissolution. Women who find a new partner two years after the separation show a lower risk of antidepressant consumption, especially when they moved and repartnered in the same year. In the following year, women who are in a new relationship present lower medication use, no matter whether they moved or not. This confirms our third hypothesis: for women, moving in a context of separation and immediate repartnership is associated with lower intake than moving in a context of separation with no new partner. In the longer run, we can also confirm that repartnership is related to less antidepressant use for women, no matter the mobility pattern at the moment of the separation.

Figure 8.4 - Predicted probabilities of antidepressant intake being 90DDD+ a year (based on logistic regression models) according to the mobility status of the individual at the moment of the separation (t) and the following year, and according to the repartnership status. The mobility status during the separation year (t) and the year after the separation is attributed from this separation.
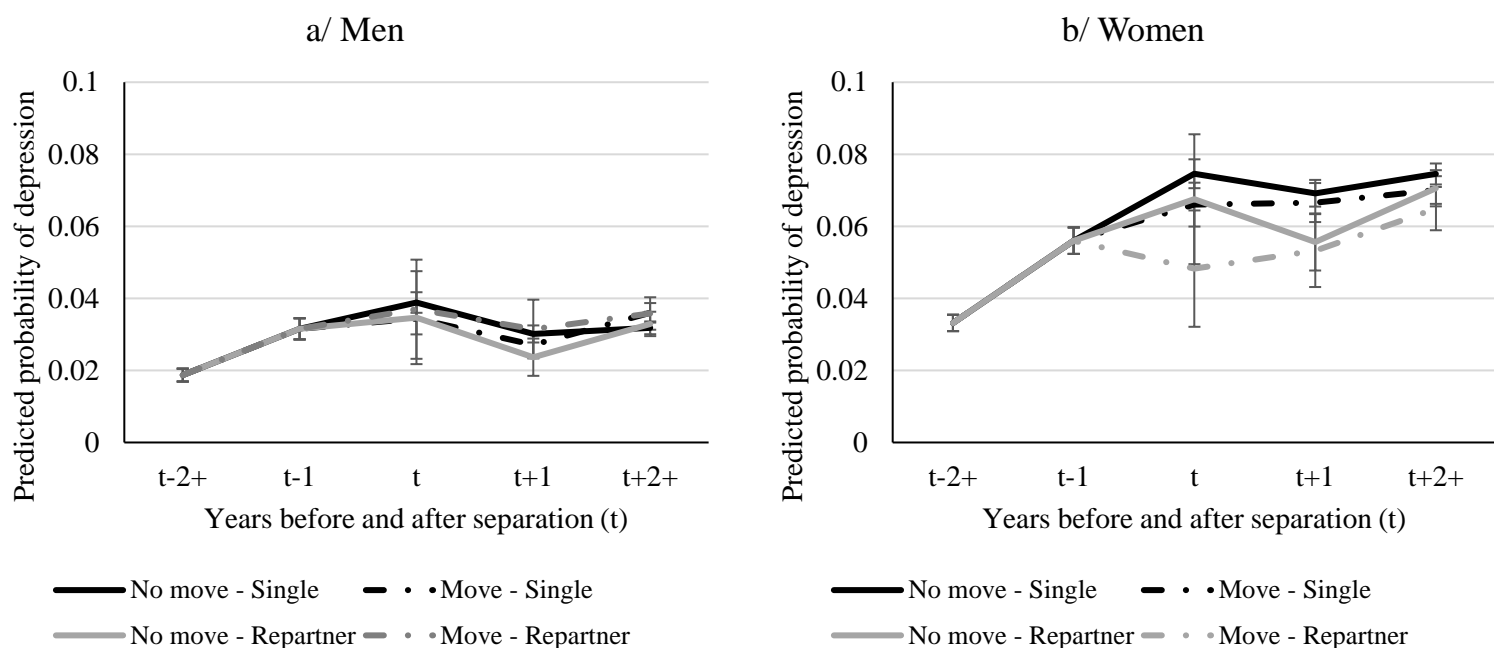
| | a/ Men | | | | | | b/ Women | | | | |

Model controls for age, region of residence, increased reimbursement (proxy of low socioeconomic status), parenthood, couple configuration, work incapacity, unemployment, antidepressant consumption of the partner, change of antidepressant prescriber, and distance of the move.

Note: N=33,101 men; and 34,947 women who separated during the observation period of 9 years.

Note bis: Full models and tables of the predicted probabilities are in Appendix (Table A6 and A7)

Source: Belgian socialist health insurance fund, authors' calculations.

d. Robustness checks

For hypotheses 1 and 2 – for which results are not expected –robustness checks were conducted to test the methodological choices. First, we estimated the predicted margins of antidepressant intake in DDD without any threshold for individuals who moved or did not move in the year of separation according to the steps in the union dissolution process with linear regression models (Appendix - Figures A8.1 and A8.2). Second, we conducted Poisson regression models – appropriate for rare events (Cai et al., 2010) – allowing us to calculate the incidence rate ratio of depression, defined by the threshold of 90 DDD and more per year (Appendix, Figures A8.3 and A8.4). Previous observations for hypotheses 1 and 2 remain robust to these alternative specifications in the two cases.

Third, we considered only couples whose partners consumed no antidepressants in 2008 (Figures 8.5 & 8.6). The objective was to remove all couples in which there is at least one individual who already consumed antidepressants and may suffer from chronic mental health issues, and thus to see whether a selectivity effect drives the results according to which poorer mental health would lead to less stability both in terms of partnership and housing career. These checks support previous results, including women's anticipatory higher antidepressant consumption in the years before separation when they move out of the shared place than when they keep the housing (Figure A8.6 – b). However, we also see that women who did not consume any antidepressant in 2008 present a lower medication use after they separated and moved (compared to staying). In addition, Figure A5 shows that the predicted probability for individuals to consume antidepressants at the beginning of the observation remains high two and more years after the separation for both men and women, no matter whether they leave or stay in the shared municipality of residence.

XII. DISCUSSION

1. Interpretations

This study investigates the role of residential mobility in the negative relationship between union dissolutions and mental health. Drawing data from the socialist health insurance fund Solidaris, we use a sample of couples affiliated with Solidaris, intact on January 1st, 2009, and separated in the 2009-2018 period. We conducted random-effect logistic regression models to estimate the probability of an antidepressant intake of at least 90 DDD per year. Compared to the period of two and more years before the separation, the likelihood of medication use starts to increase in the year before the union dissolution, is the highest during the separation year, and then decreases again (Table 8.2). Men reach pre-separation levels, whereas women present a higher probability of antidepressant use at two years and more after separation than two or more years before the split.

We observe that differences in antidepressant intake between persons who moved and did not move in the year of separation are minimal **(H1 is not confirmed)**. Residential mobility is undoubtedly a stressful and demanding time for the newly separated or divorced. First, it is – in most cases – a relatively forced move, made in an emergency and with pressure to find a convenient place as soon as possible after deciding to separate. Second, separation is accompanied by decreased resources at the household level. This can lead to a loss in housing conditions and neighbourhood satisfaction, related to adverse mental health outcomes such as a higher risk of depression (G. W. Evans et al., 2003; Singh et al., 2019a). Third, if movers often lack social support and less social integration than locals (Hendriks et al., 2016), this is particularly detrimental in the context of fragility, which is the end of a relationship. Facing such a stressful and painful life event, the geographical distance can be an obstacle to the help of friends and family and a marker of the distance with the children. We observe these results considering only inter-municipal moves that are supposed to be the most challenging, leading to a reconfiguration of social networks and habits. Based on municipality changes, this definition of mobility does not overestimate the mental healthcare consequences of mobility in the context of union dissolution.

But mobility can also bring advantages and new opportunities (Mulder, 2018; Mulder & Van Ham, 2005; Trigg, 2009). First, it allows one to physically disconnect from the ending relationship and start a new chapter in one's life. Indeed, places are attached to feelings, and leaving can sometimes help overcome traumatic experiences (Trigg, 2009). Second, mobility is positively associated with many outcomes, especially professional life and income (Mulder & Van Ham, 2005). Focusing on other achievements can be a coping mechanism for the newly separated. Third, the person who leaves the shared housing might also be the one who decided to leave the relationship. In such a situation, the mobility is not forced. To fully understand the implications of mobility in the context of union dissolution on one's medication use and well-being, it is essential also to understand the context of the separation, which is information hard to find in administrative datasets. Future

studies, mainly qualitative studies, should focus on how individuals experience separation-driven moves and how they can impact their psychological, material, and social well-being.

We include a double approach with time-constant and time-varying mobility indicators in the separation year. This allows us to focus on possible anticipatory effects and to confirm a gender specificity in the relation between mobility in the context of union dissolution and antidepressant intake **(H2 is confirmed).** Women who moved at the time of separation present a higher probability of medication intake during the observation period. This result points to a possible anticipation of the split. Women often initiate the separation (Hewitt et al., 2006), and persons who initiate the separation are likelier to move (Mulder & Wagner, 2010). In such a context, we can assume that women who move out of the shared accommodation in the separation year are also more likely to have a mental state decrease before the separation and suffer from a poor-quality partnership. For instance, psychologically or physically abusive relationship victims suffer more from depression and distress and consume more antidepressants (Ruiz-Pérez & Plazaola-Castaño, 2005). Women with fewer economic means might also be afraid of separation as they know they will not be financially able to stay in the shared place, which can impact their happiness within the couple and after the breakup, as well as their power of decision in the separation (Aizer, 2010; Chesley, 2011; Malone et al., 2010). Another explanation relies on a selectivity process: poor mental health can lead to a more unstable life course (Afifi et al., 2006; Booth & Amato, 1991; Butterworth & Rodgers, 2008; Wade & Pevalin, 2004). Women predisposed to poor mental health would show a higher risk of being mobile at the moment of the separation. This result also applies to women with did not consume antidepressants in 2008 (Appendix – Table A8.6).

Findings point to an (mostly unconscious) anticipation effect of union dissolution concerning antidepressant consumption and a gendered difference regarding the duration: we identify a longer-term effect for women. For men, the impact of a union dissolution is limited to the separation year and the first following year. This can be explained by the fact that the consequences of separation

among women tend to impact multiple parts of their lives, such as their risk of poverty and single motherhood (Fernquist & Cutright, 1998; Leopold, 2018b). On the contrary, men especially face a (temporary) reduction in their social support system (Leopold, 2018b). The specific operationalisation of mental health in this study could have impacted our results. We expected men to present a higher intake of antidepressants when they change residences at the moment of the separation. We assumed they may encounter more mental health struggles and have less social support and related coping mechanisms to face this challenging life event. The findings do not prove this. The fast decrease in medication use among men might also be related to the fact that they seek less health care, especially when not partnered (Dykstra & Keizer, 2009b; Payne et al., 2008b). Men present less healthy behaviour and less adherence to healthcare when unpartnered or separated than when they have a partner (K. Williams & Umberson, 2004).

This gender specificity of the relation is confirmed by the analysis distinguishing individuals who entered a new relationship in the years following the separation from those who remained single. While men show little differences in antidepressant intake according to this variable, women who enter a new relationship during the separation year show a lower risk of consumption, especially if they leave the previously shared place at this moment **(H3 is confirmed for women**). This might indicate that women in a new relationship can suffer less from the negative impact of separation, especially when the move during the separation year happens in the context of a new partnership formation, compared to women who remain single. First, a particular share of women might have started their new relationship before or after the first separation, reducing the emotional suffering caused by the union dissolution (Crosier et al., 2007). Then, a new partnership might reduce the economic hardship related to the separation (Dziak et al., 2010; Leopold, 2018b). For women, a breakup is likelier to be associated with losing socioeconomic means and resources. A new partnership will decrease this risk by raising the resources and income at the household level. Finally, a selective process might also lead women with better mental health outcomes to start a new relationship faster (Wu & Hart, 2002). This beneficial effect is less visible for men, which the

relationship between men and healthcare might explain. Men in a relationship can also consume more antidepressants when surrounded or in a relationship where healthy habits are encouraged (Hughes & Waite, 2009; Wu & Hart, 2002).

2. Limitations and methodological considerations

We could rely on a large-scale longitudinal dataset with information on medication use, population characteristics, partnership transitions, and residential mobilities from the National Register. This dataset presents some limitations. First, our sample is limited to the members of Solidaris and, more specifically, couples in which both partners are members of this health insurance fund. This sample can be considered biased compared to the general population. In Belgium, health insurance choices are based on family-related preferences, values, and self-defined societal positions (D'hoore & Stordeur, 2004; Faniel & Gobin, 1992). Compared to the Belgian population, members of the socialist health insurance fund are, on average more deprived – as shown by a higher number of persons with increased reimbursement (see Appendix – Table A8.14). The couples in our sample are also more often unmarried and childless, associated with higher partnership instability (Musick & Michelmore, 2018).

The choice of antidepressants as a proxy for mental health is used in the specialised literature. Sadness and grief are standard mechanisms in a context such as a union dissolution. Using a medical and quantifiable tool, such as antidepressant intake, removes subjective assessment risk. The results of a well-being scale or a list of psychological symptoms would highly depend on the context of the study – the time since the separation, the conflicts between the ex-partners at the moment of the interview – while antidepressant intake summarises a situation and gives an objective measurement, based on a doctor's diagnosis. However, antidepressant consumption is not systematically an indicator of poor mental health. Seeking medical help and being diagnosed and treated with mental health medication indicates that the person is mentally strong enough to realise

their mental struggles and find a solution. This indicator of antidepressant intake does not capture many mental health issues and depressive states.

Another element worth mentioning is the absence of distinction we made between marital and non-marital unions. Compared to cohabiting relationships, the determinants of marriage are related to socioeconomic characteristics. Women with low educational attainment have less stable partnership and family trajectories; they are likelier to enter cohabiting relationships early in life and tend less to transition to marriage. When they do, they have a higher divorce risk (Lundberg et al., 2016).

Our models account for individuals' characteristics such as age, sex, household composition, and region of residence. They also includ unemployment, financial precariousness, and work incapacity, which are determinants of an individual's well-being and mental health medication use (Conejero, Olié, Calati, et al., 2018a; Lersch & Vidal, 2014). Nevertheless, other elements are relevant in the relationship between separation, mobility, and mental healthcare and are not considered in our models. We control for increased reimbursement offered to low-income individuals, used in previous studies as a relevant proxy for socioeconomic status (Van den Bosch et al., 2013). Still, we have little knowledge of the population's deprivation level or variation in earnings. A limitation of this study is that standard socioeconomic indicators, such as educational attainment or income, are lacking in our database. Controlling for this information would possibly disclose a more negative impact of union dissolution on men's mental health (Feijten, 2005; Wyder et al., 2009). However, the use of random-effect models helped to control for individuals' specificity and unobserved characteristics, such as biological determinants or cultural background.

3. Contribution

Despite some limitations, this insurance-based panel data is a real asset in observing medication use during life course events, such as union dissolutions. Our article presents two essential contributions to literature. First, it highlights the complex relationship between separation-driven

mobility and antidepressant intake and the advantages and disadvantages of staying in the previous residence rather than moving out. It calls for a more in-depth analysis of the contextual elements of the relationship dissolution that could be associated with the moving decision, such as who initiates the separation, personal resources, income, and the conflicts about the children's custody and the divisions of goods. Second, it contributes to a better understanding of the gender-specific consequences of separations and separation-driven residential mobility on mental health. Our findings suggest that women who leave the shared place face lower mental health before the separation. This highlights the detrimental impact of low-quality relationships on women's mental health and their anticipation of separation and relocation, especially when women suffer long-term economic losses after a divorce or separation.

These conclusions encourage direct actions. We recommend that public policies support individuals at two moments. First, at the moment of the separation. Low-quality relationships are detrimental to mental health, and policies should help individuals find and afford a new residence adapted to their and their family's needs. Services of relocation for women leaving a difficult (or even abusive) relationship should be encouraged. Second, in the long run, after the separation. For women especially, divorce or separation is a social and economic fragility time. We can see that repartnering is often considered a protective factor against poverty and income decrease for women. Policies should offer an alternative to this by supporting independent single mothers and newly separated women quickly after the separation and in the longer run. Finally, this article recalls that men consume fewer antidepressants than women in a society where men are likelier to end due to suicide, especially after separating or divorcing (Bruce & Kim, 1992a; Payne et al., 2008b). Policies and societal debate about men's mental health should target a change of mentalities and behaviours and help men seek medical or psychological help to open up about their inner struggles.

Takeaway message from Chapter 8

❖ This research investigates depression risks before, during and after separation and whether they vary according to mobility in the year of the separation.

❖ The dataset gathers information on 20 to 64-year-old individuals affiliated with the Belgian socialist health insurance fund – the largest public health insurance fund in French-speaking Belgium – and who lived in marital or non-marital opposite-sex partnerships in 2008 and separated between 2009 to 2018 (N=68,048).

❖ We use antidepressant consumption ($>= 90$ defined daily doses per year) to proxy for depression risk and conducted random-effect logistic regression models.

❖ Controlling for observed and unobserved individuals' characteristics, findings show that, compared to two years and more before the union dissolution, the depression risk increase in the year before separation, peak in the year of the separation, and then decrease but remain high, especially for women. Mobility during the year and/or the year following the separation is not associated with decreased or increased depression risk.

❖ Women who move during their separation year have a higher risk of depression than women who stay in the previously shared place. This result is robust even after considering other model specificities and working on the population who did not consume antidepressants in 2008, i.e. the year before the observation started.

❖ Repartnership is associated with lower depression risk for women, especially if they leave the shared place.

CHAPTER 9

GENERAL CONCLUSIONS

This thesis investigated the relationship between the residential context and suicide risk in Belgium among the working-age population using Belgian population data. More specifically, after presenting the existing literature on suicide determinants and the role of the environment in inequalities of suicide and offering the Belgian and European context, it covers three main empirical topics.

1. Main contributions of this work

First, Christine Schnor and I evaluated the relationship between housing tenure and suicide risk. Tenants appear to suffer from "status syndrome" (Marmot, 2004a) when looking at the specific populations that have higher suicide risks when they are tenants compared to homeowners. Middle-aged adults, married men, unpartnered women, and adults living with children are at a notably higher risk of suicide when they are tenants. This chapter contributes to the current knowledge by highlighting the differences in the relationship between housing tenure and suicide risk and using social status theory to interpret them. Homeownership is not only financial security but also a standard to be achieved by most people during their lifetime (Hiscock et al., 2001). In a country like Belgium, where homeownership is widespread and beneficial, remaining a tenant can hide a more unstable life course, with adverse life events such as a separation or a chaotic professional career and socioeconomic precariousness. It is also a synonym for going against the typical Belgian norm of acceding homeownership at a certain age and under certain family circumstances that also vary for men and women. Even if the mentality is evolving in the Belgian norms, married men remain the household's breadwinners, and unpartnered women are already transgressing some social expectations.

In Chapter 6, I could highlight the importance of living in suitable environmental conditions on suicide risk. I evaluated, for the first time to my knowledge, the association between the living environment and suicide through an extensive series of housing- and neighbourhood-related indicators, and I observed the variations in this relationship over the life course for both men and

women. To control for a possible selection bias – poor mental health is the first determinant of suicide but can also impact people's socioeconomic achievement and possibilities regarding housing and residential location – I reiterated the analyses on the population who declared a good or excellent physical and mental health situation. This chapter contributes to the current understanding by showing that better housing conditions are associated with lower suicide risk. This relation is partially mediated by subjective health status for women only. I also show that neighbourhood satisfaction is related to lower suicide risk only for the healthy population. Findings confirm previous results – only shown on children's mental health scales (Rollings et al., 2017) – indicating that a good neighbourhood does not buffer the relationship between poor housing conditions and high suicide risks. Finally, the pseudo-partial correlation helped measure the relative importance of housing on suicide compared to other predictors and treat suicide mortality with an unusual approach.

Chapter 7 investigated the relationship between residential mobility and suicide risk, focusing on the partnership context of the move. Findings show a higher risk of suicide related to mobility, especially in the context of union dissolution or no union changes. Only mobilities in the context of union formations are associated with lower suicide risk than no mobility. Moves with no union change are surprisingly associated with higher suicide risks for both sexes. Mobility is a difficult life change that demands adaptation skills, the creation of new social links, and a new composition of habits and everyday life. It can also hide other life changes not captured by our dataset. To our knowledge, this study is the first one on the relationship between residential mobility and suicide risk. We also contribute to understanding its gender specificities and variation over the life course. More specifically, in the context of union dissolution, moving out of the previously shared place seems to be associated with a higher suicide risk than staying for women, while it is the opposite for men. The negative consequences of a union dissolution are often longer-term and more dramatic for women (Leopold, 2018a), especially in terms of poverty risk, and housing instability can intensify this situation. Still, these interpretations must be taken with nuance, given their

relatively weak effect strengths, that are lower than the thresholds defined in the methodological section of this thesis (see Chapter 4). I also show that middle-aged categories are at the highest risk of suicide when they move compared to when they do not. For younger adults, mobility is an expected behaviour part of the personal, professional experimentations typical at these ages. For older adults, mobility is also possibly less detrimental to other aspects of life, such as the professional trajectory, and can benefit the family links. Inversely, middle-aged adults are the ones who suffer the most from one change in their life course: a modification in one aspect of their lives can have repercussions on all other dimensions (W. A. Clark, 2013; W. W. A. Clark & Dieleman, 1996).

2. A life-course and social status approach

This thesis confirms previous theories and empirical works surrounding suicide determinants. The transgression of some norms might be related to other contradictions of the norms through a partnership transition or other changes in the personal or professional trajectory that disrupt one's socioeconomic and environmental evolution. In such a context, the residential path reveals another challenging event, a disappointing life situation from which the person cannot escape. The *learned helplessness theory* confirms that a dissatisfactory situation in which one feels trapped is a strong determinant of suicide. Furthermore, just like Durkheim at the beginning of the XXth century (Durkheim, 1897) and like researchers in psychiatry a century later (Joiner, 2005; J. M. G. Williams & Williams, 1997a), our findings and interpretations show that the interpersonal and social links integration to a community and its rules and values also matter in the relation between the residential career and suicide risk. Some different social norms and expectations surround the level of environmental quality to achieve and mobility patterns to follow according to an individual's life stage, household configuration, and gender. Society defines goals, such as homeownership, housing and neighbourhood good conditions, and low mobility. The residential context then becomes a mirror of people's integration into their community and conformity towards society's regulation,

social norms, and expectations values. Housing is the home – the shelter from the outside world – but also one of the lenses society uses to judge a person and their achievement. According to the social status theory (Marmot, 2004a), social inequalities in health and well-being depend not only on absolute situations but also on relative achievements compared to the expectations of society.

Especially, heavy and constraining norms surround Belgium's housing system. For decades, housing policies in Belgium have led individuals to opt for homeownership and long-term settling (De Decker et al., 2017; Goossens & Lammertyn, 1982; Meeus & De Decker, 2015). Residence changes – to adapt one's housing to their family and personal situation – are costly (Meeus & De Decker, 2015). This implies two elements. First, individuals are expected to accede homeownership as early as possible, limit their mobility, and prefer to modify their housing rather than move. Second, households living in precarious situations and poor housing conditions might find it even more challenging to change residences and get better environmental quality. Transgressing these residential norms is thus financially difficult but less expected and socially accepted. Not acceding homeownership, or being mobile, might hide socioeconomic precariousness or other life events that require residential instability. For middle-aged adults in their 40ies and 50ies who are supposed to have reached their highest socioeconomic situation and to be settled and responsible for other family members, not respecting the injunctions of residential stability might result in mental health consequences. Our results show that, at this life stage, the differentials in suicide risks according to housing tenure, living environment quality and residential mobility are the largest. Not only is this rejection of residential norms costly and aggravates socioeconomic vulnerability, but they can also lead to a negative appreciation of the individual compared to their peers. This downward comparison would be the hardest during middle adulthood, where family life and professional career are most demanding (W. W. A. Clark & Dieleman, 1996; Shiner et al., 2009). It is also plausible that disparities in living environment can reflect differences in other socioeconomic achievements in terms of education, occupational status and income levels.

3. Using suicide as an outcome: reflections and limitations

In addition to this study using suicide as an outcome, Chapter 8 (co-written with Christine Schnor and Didier Willaert) focuses on the association between residential mobility in union dissolution and antidepressant consumption. This study, based on the population affiliated with the Belgian Socialist health insurance fund, *Solidaris*, does not allow us to find the same associations as in Chapter 7. We cannot show any difference in antidepressant consumption between men and women who stay in the previously shared place or leave after the union dissolution. However, this chapter contributes to the existing literature by showing a higher consumption of antidepressants in the years before the union dissolution for women who will separate and leave the place. This higher consumption of mental health medication before the separation can be explained by a relationship deterioration or by women's dissatisfaction with their life and couple, leading them to start a separation and leave the housing. This study also shows that repartnering in the years after separation is associated with lower consumption of antidepressants, especially for women. However, this study's outcome, antidepressant consumption, is related to many biases, from the self-awareness of the depressive symptoms and the decision to seek mental healthcare to the diagnosis, medication prescription, and treatment adherence. We know that many other factors can impact antidepressant consumption. For instance, women tend to consume more antidepressants as they have fewer issues discussing their problems with a professional. People with higher socioeconomic status tend to go more often to therapy and consume fewer antidepressants than more deprived populations. Among people with suicidal behaviours, a third had previously sought help from mental healthcare professionals. We observe that antidepressant intake is not ideal for measuring poor mental health. On the contrary, seeking medical help and support indicates a first step towards better mental health or managing depressive symptoms.

We can also question the indicator of suicide mortality. What do we measure thanks to suicide? Indeed, not the complex and broad notion of mental health. Many biases are at stake: when facing negative feelings, one has many ways to react. For those who attempted suicide, studies observed

a tendency to be more violent and impulsive than depressive people who had not attempted suicide (McGirr et al., 2008; R. C. O'Connor & Nock, 2014). Also, some predispositions or personality traits, partially explained by previous experiences and cognitive functioning, can demonstrate that some people will see suicide as a possible exit while others will not (Mann et al., 1999; Olié et al., 2015; Richard-Devantoy et al., 2014). Then, many biases appear at the moment of the suicide attempt: the choice of the method, the circumstances of the attempt, maybe the degree of intention to die, and some random elements will change the outcome of the action and lead to a completed suicide (R. C. O'Connor & Nock, 2014). However, the associations observed between housing conditions and mental health are, for most of them, also visible through suicide mortality. If suicide does not capture mental health, the living environment determinants of mental well-being are very close to those that predict suicide mortality.

Also, we can discuss how we operationalised suicide mortality. In all our analyses, we considered the causes of death defined as self-harm with a clear intent to die (X60 to X84 and Y87.0-Y87.2 in the ICD-10). Alternative definitions of suicide, including possible self-harm with unknown intent to die or indirect causes of suicide (mortality related to alcohol and drug consumption), were considered. When considering deaths with unknown intent (Y10-Y34 in the ICD-10) – that look like suicides but in which the intention to die was not certified -the results remain close, mainly due to the small numbers of such deaths (about 30 a year). On the other hand, the number of alcohol[12] and drug-related[13] mortality is almost as high as suicides (nearly 5,000 drug- and alcohol-related deaths in 2002-2006, for 7,159 suicides), which does not allow us to compare the two types – direct and indirect – of suicides. Our way of measuring suicide is used in most literature and is the one that best captures the definition of the Operational Criteria for the Determination of Suicide (Rosenberg et al., 1988). Some alternative methodological choices helped control for the competitive aspect of other causes of death: multinomial logistic regressions in Chapter 5 and Fine-

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[12] In ICD-10 : F11-16, F18-19, X40-44, X60-64, X85, Y10-14
[13] E24.4, F10, G31.2, G62.1, G71.1, I42.6, K29.2, K70, K85.2, K86, Q86, R78, X45, X65, Y15.

Gray sub-distribution hazard models in Chapters 6 and 7. Our results are robust to these changes in specifications. Moreover, in this thesis, the primary methods of suicide were not studied. Men tend to choose more lethal methods of suicide. Even though we attempt this exercise throughout the thesis, gender differences in suicide "methods" make it challenging to compare men and women directly, hence results that are split by gender (Callanan & Davis, 2012). In addition to the present study, an analysis of the relationship between the residential context and suicide attempts (no matter the outcome of this attempt) would help us understand how the lethality of the methods of suicide can bias the associations observed in this thesis, and how the means of suicide can select the population who died due to suicide.

4. Residential context as a primary predictor: reflections and limitations

Also, discussing the use of the living environment and housing conditions is possible. In this thesis, we claim that housing conditions, homeownership, and residential mobility reflect certain socioeconomic achievements but also a specific dimension in one's life comfort and determinant in well-being. In other words, are we measuring socioeconomic inequalities in suicide mortality via the residential context? Not only. All our results control for educational attainment and occupation, two central socioeconomic situation measures. Some of our results also control for deprivation at the municipality level and remain robust. Above that, previous literature already highlighted the relationship between residential conditions and socioeconomic status and showed that the two elements are not always synonyms (Damiens, 2020; Emelianoff, 2010). Deprived households do not always live in the worst-quality housing; inversely, advantaged households do not always occupy the best-quality accommodation. A loss of housing quality is increasingly socially diverse due to a higher risk of disruptions in the life course of educated and higher-earning populations.

However, is it desirable to separate the different dimensions of the experience of life? Housing conditions and residential mobility are intrinsically embedded in the life course of the individual,

their personal and professional achievements or unexpected turns, their previous circumstances and plans for the future, their financial possibilities, their social anchors, and the persons they meet. The residence reflects many other dimensions, and I do not claim to isolate it. Still, we can highlight that the residential course – in terms of quality and mobility – is not only a mirror of other circumstances, as it is often considered in the literature. It is also a specific predictor, catalysing social and economic inequalities in suicide mortality (Emelianoff, 2010; Lejeune et al., 2016). Its impact varies over the life course and according to gender and circumstances. One of the roles of housing is to be a space of control and security when the outside world seems impossible to predict. High-quality housing and surroundings, homeownership, and residential stability appear as significant factors of suicide.

One area for improvement of our work is the impossibility of following residential quality and conditions. Our dataset only allows us to get housing and neighbourhood-related information at the census in 2001 and 2011. We assume the situation at the census represents the usual experience of the individuals. Our methodological framework account for this flaw, explicitly focusing on the time spent since the census through event history analysis and short exposure time. Still, an analysis of the changes in housing conditions through time would have been beneficial to understand the mechanisms of the relation. An intercensal analysis was considered but not conducted because of the nature of the data available in Belgium. The 2001 census is an excellent data source containing hundreds of indicators not found elsewhere on the living environment, subjective health, parental leaves, and working conditions. Since then, this has been the only data source to compete with this dated and understudied census. The next census, conducted in 2011, is based on registers. To get information about housing, researchers can only rely on a minimal series of indicators (such as the presence of a bathroom, central heating, the number of rooms per inhabitant of the housing, housing tenure, and the type of building). Information comes from the cadastral register, which only received the declared renovations or constructions, that is, the changes requiring a specific building permit. For most modifications in the housing (such as adding central heating to the

dwelling), no such license is obligatory, which makes us doubt the quality of the 2011 census and the possibility of comparing it with the 2001 census, which directly questions individuals and their experiences through an extensive series of questions.

Finally, the definition of the living environment omits many other aspects of environmental inequalities. People spend a significant amount of time at home but an even larger share of time outside of home, at work, on public transport and outdoors. If the residential context matters, accounting for broader environmental inequalities – such as inequalities in comfort and security at the workplace – would draw a more comprehensive portrait of the individuals' experience. Also, other environmental aspects – related to pollution, climate change, and exposure to hazardous substances – were not approached here but could be the object of future research.

5. What about now? Some perspectives on the housing market in Belgium and the future of the relationship

A shortage of available housing marks the current situation of the housing market in Belgium for an increasing number of households and exploding prices. Low-income households are the first victims of this double phenomenon. The social housing market is not strong enough in Belgium to help more precarious individuals find affordable and good-quality homes for their families. The pandemic of Covid-19 and the subsequent measures that requested families to stay at home highlighted the issues of the current housing system in many countries, including Belgium. This period of our recent lives was a challenge for mental health, especially for the youngest populations (Rens et al., 2021). Among the determinants of mental health and well-being during the pandemic, the place of residence was involved in the differences in the level of anxiety between individuals because it represents the individuals' quality of life and the comfort in which they had to go through the quarantine (Rotărescu et al., 2021). Individuals living in separate houses with access to a garden or outdoor areas had better mental health outcomes than those living in low-rise or high-rise buildings without access to green spaces (Akbari et al., 2021; Keller et al., 2022). In addition to the

immediate mental health outcomes, overcrowded housing was associated with a higher risk of Covid-19 transmission and subsequent deaths (Alidadi & Sharifi, 2022). The relationship between housing and mental health also evolved around the economic consequences of the Covid-19 crisis. Many individuals lost their job, got indebted and saw their projects disrupted due to the pandemic (Englert et al., 2022). Adding to that, another crisis, the energetical turmoil related to the Ukraine war, increased prices in all sectors, including the housing market. As previously stated, in 2020-2022, the costs increased drastically: only in two years, the real estate prices have increased by 15% (Statbel, 2023c). The tensions between Ukraine and Russia also led European countries to stop the energy trading with Russia, triggering a rarely high inflation and increase in gas and electricity prices (The Brussels Times, 2022). This rise in prices amplified existing socioeconomic inequalities, especially regarding housing and energetical comfort. All criteria are gathered to increase social inequalities, and housing represents a source of stress and anxiety for individuals with financial difficulties, which can lead them to feel trapped in a situation they cannot control. As already discussed, those are ingredients of suicidal behaviours.

To these social inequalities in housing in Belgium comes another problem: climate change and its consequences on mental health. Even though Belgium is not a place where climate change is the most violently visible, the population witnesses environmental modifications, air quality, and disruption of the usual cycle of the seasons, as well as violent floods in some cities. In Belgium e, the question of sustainable practices to reduce pollution and damage to nature is discussed and implemented. The Researchers defined the phenomenon of "eco-anxiety" to qualify the consequences of climate change and environmental hazards on mental health (Clayton, 2020). This anxiety is caused not only by the actual natural issues but also by how authorities and civil society approach the problem or do not approach it (Clayton, 2020; Heeren et al., 2022; Soutar & Wand, 2022). More importantly, managing the ecological crisis is often presented as an individual responsibility. Individuals are asked to sort out their waste, use better energy, replace cars or planes with trains and buses, and reduce their carbon footprint. This leads individuals to carry an

overwhelming load and to forget the role of public institutions, as climate change is an ecological but also a social and collective issue that needs solid directions and political responses to be solved (Clayton, 2020). This includes the practices that surround the place of residence. A residence is increasingly requested to integrate sustainable practices, especially in its energetical aspect. Regions encourage the renovations of the existing dwellings and the construction of more durable homes that respect the environment and integrate renewable energy with solar power panels and more effective isolation (Wallonie Energie SPW, 2020). However, in Belgium, low-income households have little control over their energetical capacities, and many suffer from energetical poverty and many other deprivations (Bartiaux et al., 2018). In parallel, Belgian policies must reduce the country's carbon footprint while solving inequalities in access to decent heating, insulation and aeration of all dwellings. This dilemma leads some municipalities to construct energetically sustainable social housing (Goies et al., 2023), but these initiatives remain few. To understand the current relationship between the residential environment and mental health – and, by extension, suicide – it is essential to realise that the dilemmas faced by institutions are the same as those encountered by individuals (Clayton, 2020). Households must reflect on their impact on nature and climate change while ensuring their comfort without endangering their present and future financial capacities. Populations are responsible for individual and collective issues, and their mental health can suffer from this mental load that society and they impose on themselves (Clayton, 2020).

6. One step further for research on suicide

Our research allows us to conclude on some understudied determinants of suicide: the living environment and the residential course. However, it also highlights other elements that can guide future research on suicide mortality and social inequalities in health and mortality.

First, Belgium presents a higher age-standardised rate of suicide than other Western European countries. In Chapter 2, I tried to understand this specificity through three approaches: a Belgian culture of interiorising mental health problems; difficulties in getting professional help due to a low

number of psychiatrists and mental healthcare centres in Belgium; a high-quality registration of causes of death in Belgium. The high-quality dataset used in this thesis, which includes death certificates, is a real asset in understanding the residential determinants of suicide. Especially when studying a specific cause of death such as suicide, exhaustive register data allow us to draw reliable statistical analyses around those rare events and reconstruct a comprehensive context surrounding them. Research on suicide mortality requires systematic and reliable data collection, with solid verification mechanisms surrounding declaring the causes of death and avoiding uncertainties. In Belgium, corrections of the inconsistencies and double verifications were implemented to reduce inconsistencies in mortality statistics (Renard et al., 2014).

Without comparable data, studying and comparing suicide mortality in several countries can be very difficult. In addition to the existence of reliable information on the cause of death, it would call for a similar mental health context. It is possible to cite the differences between the Netherlands and Belgium, already presented in Chapter 2: the Netherlands tend to learn earlier in life the importance of talking about psychological struggles and seeking help, while in Belgium, individuals are requested to find solutions on their own (Reynders et al., 2014). Suicide is not a cause of death like others. It carries a social stigma. It is associated with religious and cultural condemnation and highlights the failure of an individual's support system. In European countries where suicide rates are the lowest, it is also more challenging to talk about suicide openly (Schomerus et al., 2015). In Belgium, suicide-related stigma was mainly self-inflicted: suicide survivors presented more difficulties talking about suicide than people without a suicidal past (Reynders et al., 2015).

The multiple disparities in suicide apprehension between contexts, but also the quality differences in suicide statistics, make it difficult to fully understand why Belgium is so specific in terms of suicide mortality and to compare it with other countries. However, our analysis of the residential context highlights that the Belgian system seems more rigid than others. As it exists, the Belgian system requires individuals to make very long-term decisions, and any path change during life is

costly. Most individuals are homeowners at a relatively young age; residential mobility is rare. In such a context, very little space is given to changes in plans, mistakes, accidents and experimentation in general. Without trying to extrapolate this state of mind to all areas of life in Belgium, this particularity in the housing system already puts much pressure on individuals who need to adapt, consequently, their income, professional life, personal life and family trajectories to this demand for stability. I expect that similar findings about the relationship between residential context and suicide as what was found in Belgium would also be observed in countries or regions with high rigidity in the housing norms and policies, such as a high homeownership rate, or a high cost at mobility.

Belgium is also specific due to its high feminine suicide rates compared to other countries. Again, the international comparison is difficult, but our analysis confirms the surprisingly positive association between instruction level and suicide mortality for women only. Lorant et al. (2019) have already presented this result. Higher suicide rates for women with tertiary education, compared to primary education, can be understood by the multiplicity of their roles. Adult women with higher education are expected to take advantage of this degree and get involved in a demanding career while sometimes taking care of their children, being a partner or a spouse, having older parents in charge and managing the housework and other household activities. Belgium was the country where parental burnout was theorised (Mikolajczak & Roskam, 2018), and it is particularly prevalent (Roskam et al., 2021). Parental burnout can be defined as chronic and overwhelming stress that individuals can associate with their parental role (Mikolajczak et al., 2021). In Belgium, the welfare regime can be considered a hybrid system between a conservatist and a social-democratic system, offering a generous social system (childcare, eldercare…) but also encouraging men and women to have full-time careers (Kammer et al., 2012; Orloff, 2002). This might have stronger repercussions on women in a country where women spend about 50% more time than men taking care of the housework (Van Tienoven et al., 2023). Multiplying women's

roles and responsibilities at home and the workplace can harm their mental health, as discussed in the context of the Covid-19 pandemic (Aldossari & Chaudhry, 2021).

7. Methodological limitations

a. The absence of a causal relation

One methodological limitation of this work is the difficulty in clarifying the causal link between the residential context and suicide risk. Figure 9.1 represents a directed acyclic graph of the relationships studied in the thesis. It gathers the principal independent variables related to housing tenure, living environment and residential mobility, and suicide mortality, our primary outcome. It also includes the different confounders of the relation, that are, the demographics, the family course, the region of residence – and what it implies in terms of policies and context – but also socioeconomic status and mental health. This causal diagram highlights that the four types of confounders need to be adjusted to identify a causal effect.

Figure 9.1– Direct Acyclic Graph (DAG) of the relationship between the residential context (housing tenure, housing conditions, neighbourhood quality, residential mobility) and suicide mortality.
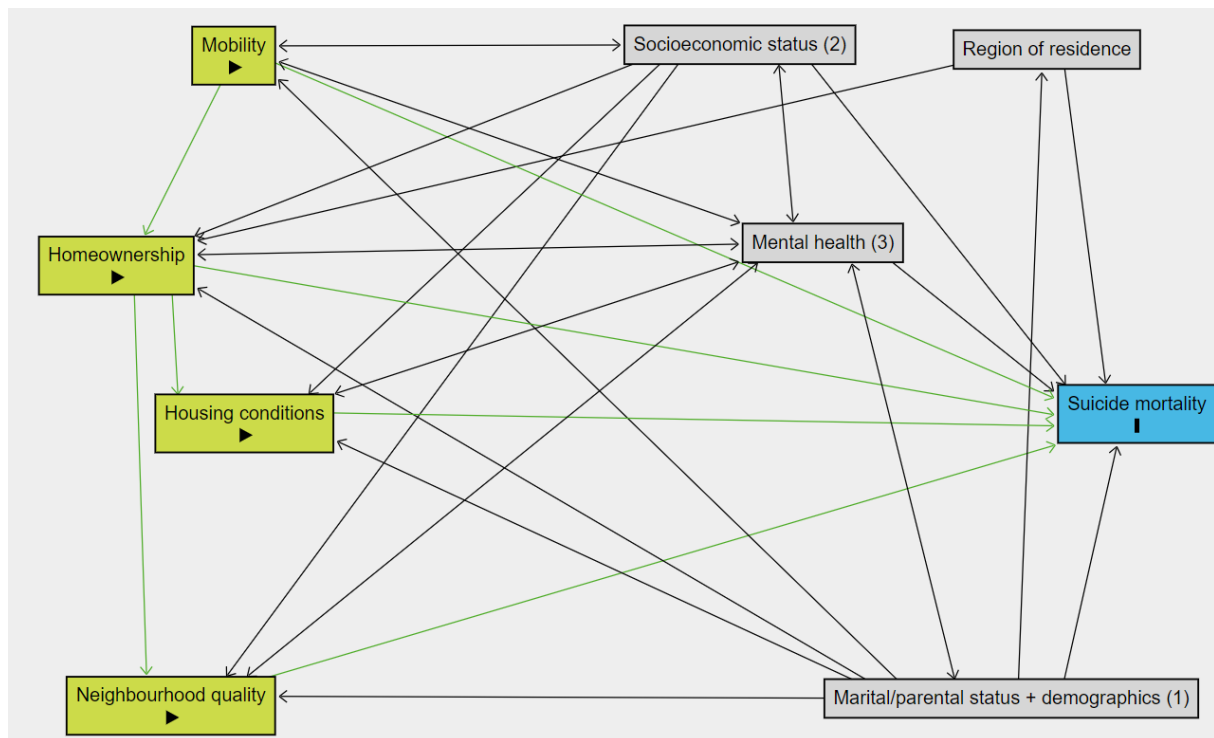
Note: The graph was computed with DAGitty v3.1. (1) Demographics gather nationality, age, and gender. (2) Socioeconomic status includes educational attainment, socio-professional status, income, or wealth information. (3) In empirical chapters, subjective health is used as a proxy for mental health.

Thanks to Register data, the reconstruction of the family course, the household composition and the region of residence are available for all individuals under study. However, to fully apprehend the causal nature of the relationship between the residential context and suicide, it requires adjusting models for the individual's socioeconomic status and the level of mental health. The latter are flaws in our design to comprehensively apprehend the causality in the relationships we studied.

Measuring socioeconomic characteristics

All our results control for education and occupation at the moment of the census, but we could have added other covariates such as income level. Unfortunately, income information is very limited in the dataset. It is to be noted that the data exists but was not requested in the Causineq project, from which this thesis was dependent data-wise. The income deciles per individual were available in 2000-2003, while the income per household was available for 2006-2018. For the analysis of housing conditions and environmental satisfaction (studied in 2002 and 2002-2006),

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income at the level of the household would be more representative of the dwelling the family can afford. On the contrary, in our analysis of residential mobility (studied in 2008-2015), income at the individual level would have been more insightful, as partnership transitions might play a lot in disposable income variation. I decided to exclude this information because of the difficulty in reconstructing a consistent evolution of the income variable over time. The relationship between income, mental health, and suicide is still poorly understood: some studies argue that low income is associated with higher suicide risk (Agerbo et al., 2001; S.-U. Lee et al., 2017), others contradict this idea (Araya et al., 2003), but income was shown to be a more critical predictor in all-cause mortality than education or occupation (Geyer et al., 2006). Income is the closest socioeconomic information to housing conditions: income immediately purchasing power and the material means a household can invest in their living environment. On the contrary, the different socio-professional statuses we use – inactive, unemployed, employed or liberal – gather very diverse situations. Income at the level of the income might also be more representative of the actual living conditions of the individual than their educational attainment or socio-professional status. This is especially the case for low-educated or inactive whose situation might be compensated by their partner's earnings. Not controlling for income in our analyses might prevent me from controlling for individuals' comprehensive socioeconomic situations. But little is known about suicide mortality. Nonetheless, education and income are strongly correlated (Tamborini et al., 2015; van de Werfhorst, 2011): I believe that controlling by education – an almost time-constant indicator - already captures much information we would find in income, primarily as we work with the working-age population. With information on income, education and occupation, creating a multidimensional index, such as in previous Belgian research (Eggerickx et al., 2018), would help maximise the socioeconomic inequalities and help measure individuals' social situation.

Measuring mental health

On the one hand, mental health status is the primary determinant of suicide. At the same time, it also impacts the quality of the environment, the possibility of homeownership – by playing on

socioeconomic achievement – and the mobility patterns – by reducing mobility or leading people to get closer to their caretakers or being institutionalised. Some robustness checks in this thesis present our results with the population who declared good or excellent health. Our results show that, especially for women, the association between environmental quality and suicide is partially mediated by health status. On the contrary, results do not change for men, which can also be explained by the masculine tendency to under-declare mental health issues. When it comes to neighbourhood satisfaction, on the contrary, the relation only appears when we select populations with good or excellent subjective health. This suggests that respondents' experience of their immediate environment might also depend on their However, there is a lack of information about mental health predisposition, such as depressive symptoms or well-being scales, in most population data, including in Belgium.

On the other hand, another possible confounder is the individual's socioeconomic status. The socioeconomic situation will impact the material possibilities regarding housing quality, tenure, and neighbourhood satisfaction and is associated with suicide risk. However, the literature is not univocal about the relationship between educational attainment and suicide risk. Some studies show that higher educational attainment is related to lower suicide risk (López-Contreras et al., 2019; Lorant et al., 2018; Lorant, Kunst, Huisman, Costa, et al., 2005), while others contradict this idea (Fergusson et al., 2003; Pompili et al., 2013), especially for women in Belgium (Lorant et al., 2021a).

This thesis cannot confirm a causal relationship between residential context and suicide among the working-aged population in Belgium. Still, it highlights an association between some elements – such as being a tenant, living in poor housing conditions and residential mobility – and a higher risk of suicide, especially in some circumstances. It does not prove that housing conditions and changes of residence directly impact suicide risk, but it indicates that residence is one stressor factor that can influence suicide mortality. Going back to the psychiatric theories presented in Chapter 1, the stress-diathesis model explained that suicide was the result of a specific sensitivity, a

predisposition to mental health issues and suicidal behaviours and the existence of negative life events or stressing factors leading fragile individuals to attempt suicide (Mann et al., 1999). The notion of a mortality catalyser was already put forward to interpret the higher mortality of unemployed individuals (Mesrine, 2000). Here, the living environment and the residential course can be seen as catalysers in the suicidal phenomena. Without being proven as a direct cause of suicide, they build a context of mental vulnerability.

b. An intergenerational approach

In addition to annual income – which varies according to household composition and gender role within families, professional trajectories and transitions, and part-time and full-time employment-wealth is another piece of information that could help us understand the role of socioeconomic status in the relationship between the residential context and suicide risk. The literature already highlighted the role of family background in suicide mortality. Parental socioeconomic precariousness is associated with suicidal behaviours and mortality (Fergusson et al., 2000; A. Page et al., 2014). Wealth also includes inherited financial goods, the socioeconomic background through the patrimony of the parents, or their educational achievement. For instance, a large amount of literature put forward the role of parental wealth in access to first-time homeownership (Helderman & Mulder, 2007; Öst, 2012) and even the active parental participation in buying a first housing (H. Lee et al., 2020). The social background of an individual, but also their social network in general, helps a lot in finding the financial and informative resources to find the most suitable and comfortable place to live. The intergenerational transmission of social inequalities in health and mental health is one of my next research steps. It will aim at completing the understanding of the existing literature, already showing that the suicide of a parent is associated with a higher risk of suicidal behaviours for young adults (Kuramoto et al., 2009). Also, the parental life course – including the parent's union dissolution - strongly determines the adult child's suicidal behaviours (Haimi & Lerner, 2016; Wagner et al., 2003). This question is worth studying in the case of suicide

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mortality, but also regarding the implications of housing conditions during childhood on later life suicides. In Belgium, the information about intergenerational links would allow the reconstruction of housing careers for several generations and integrate the socioeconomic background into the individuals' characteristics.

Additionally, considering a more extensive period in the analysis and reconstructing the residential course of several generations would enable us to account for a possible cohort effect on suicide trends. Indeed, we show the vulnerability of individuals in their 40ies and 50ies. Still, we cannot rule out the possibility that this effect has more to do with a generational effect than with the life stage itself. In Belgium, it was shown that the cohort effect was evident in the depression rate, with a higher rate of depression in the younger generations (Brault et al., 2012).

In future research experiences using Finnish register data, my research questions will include the role of intergenerational transmission of housing conditions and homeownership and the link between residential mobility and social mobility on the mortality inequalities within the whole population and among siblings.

c. A few limits in the Belgian administration data

The dataset used in this thesis is very high quality. Despite some limits, such as the lack of variables about the mental health status of the individuals, such information is present in the 2001 census to allow us to draw a precise portrait of Belgium's environmental conditions. The National Register is also a precious source of information to reconstruct people's partnership history and residential trajectories. However, - the devil is in the details – we can regret that some variables have a lot of missing values. Especially when it comes to environmental indicators, many respondents did not give answers to these questions. For other variables, such as education, occupation, and household composition, a category "other" was created to gather the individuals who did not reply to these central questions. We know these non-responses are not random, especially with the high mortality rate of this population. This work contains strategies to overcome this missing information, and I

believe the current and future projects will help understand the characteristics of this population, as well as the reason why they do not reply. Furthermore, we can regret the lack of visibility of nonmarital unions in the Belgian population data. We use a widespread definition to capture the unregistered couples checked through survey data (Lodewijckx & Deboosere, 2011a). Still, it excludes same-sex couples and unions with a significant age gap between the partners. Despite these limitations, I am very grateful for the work conducted by Statistics Belgium and other data providers, whose precise and tremendous work allows researchers to rely on such high-quality and high-scale datasets.

8. *Suggestions and recommendations*

I finally present suggestions and recommendations to two essential actors of the population's well-being: the data providers who allow researchers to measure phenomenon and their determinants and the policy-makers.

First, I advise data providers to improve the Belgian data on socioeconomic inequalities and mental health outcomes. Even if the census is a precious source of information, it represents the only source of population data on individuals' socioeconomic trajectories available for researchers and is available once a decade. I encourage the development of more frequent measures of housing conditions and tenure, educational attainment, occupational status, and income level over time, every five years, for instance. Especially for housing and neighbourhood conditions, I advise measuring this information with more modern, up-to-date, and varied data. For example, measuring the presence of a bathroom in the housing is now a bit obsolete, as only 1% of the accommodation does not have such an essential item. I consider the need for renovations of the windows or the roof as good elements to measure housing conditions. I also suggest questioning individuals about the air quality, the green spaces, and the security they observe in their immediate environment. I propose controlling the housing-related indicators of the register-based census of

2011 or 2021 through a survey, for instance. Finally, I draw attention to a better measurement of nonmarital unions, which are increasingly frequent in Belgium.

Second, I recommend that policymakers consider the living environment as a central place of public action. After some other life course elements, housing represents an essential determinant of suicide. Although it is challenging to provide a straightforward solution to reduce self-harm and suicide in Belgium, policymakers should target better living conditions and more comfort for their population. Reduction of poor-housing conditions, improvement in the immediate environment, access to homeownership and good quality housing, and a more adapted housing market appear to be underestimated determinants of mental health and suicide risk. For instance, Belgium provides fiscal advantages to homeowners but not financial reductions to accede homeownership, and property loans are getting harder to obtain. The static housing system in Belgium is also poorly adjusted to society's higher divorce and singlehood rates. We can regret the lack of inclusivity of the most deprived populations who cannot afford adequate housing. We also shed light on middle-aged adults, who are particularly sensitive to housing tenure and quality. Social support policies often forget this life stage and consider it the most autonomous. However, individuals in their 40ies and 50ies are the most at risk of higher suicide risks, especially when they go through a life accident, disruption, separation, or residential mobility. Even if we encourage policies targeting younger and older populations, middle-aged adults should receive more attention.

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APPENDICES

I. CHAPTER 5

1. Tables

Table A5.1– *Observations and proportion of homeowners according to marital situation and parenthood in population aged 25–69.*

	Men		Women	
	N	% Homeowners	N	% Homeowners
Single	796,185	47.63%	857,055	49.55%
Married couple	1,930,950	80.72%	1,903,863	80.90%
Cohabiting couple	269,179	50.85%	239,952	53.73%
No child at home	1,426,306	58.93%	1,359,062	64.43%
Children at home	1,570,008	78.61%	1,641,808	74.21%
Total population	*2,996,314*		*3,000,870*	

Source: Census of Belgium 2001 data, DEMOBEL; authors' calculations

Table A5.2– *Analysis of variance of suicide rates in 2002 according to subjective health level reported in the 2001 census.*

		ANOVA	
Health status in 2001	Suicide rate in 2002	*F*	*p*-value
Very good	0.0001022		
Good	0.0001765		
Intermediate	0.0003685	197.52	0.000
Bad	0.0009339		
Very bad	0.0010379		

Source: Census of Belgium 2001 and National Register data, death registers, DEMOBEL; authors' calculations

Table A5.3– *Number of suicides and total number of 25 to 69 year-old men and women according to their household composition.*

		Number of suicides	Number of deaths	Total
Men	Married couple	529	9,715	1,930,950
	Unmarried couple	118	1,064	269,179
	No couple	451	6,626	796,185
	Children at home	471	5,005	1,570,008
	No children at home	627	12,400	1,426,306
Women	Married couple	197	4,865	1,903,863
	Unmarried couple	30	499	239,952
	No couple	214	3,969	857,055
	Children at home	173	2,693	1,641,808
	No children at home	268	6,640	1,359,062

Source: Census of Belgium 2001 and National Register data, death registers, DEMOBEL; authors' calculations

		SUICIDE				OTHER			
		Men		Women		Men		Women	
		Model1	Model3	Model1	Model3	Model1	Model3	Model1	Model3
Housing tenure (ref. Owner)									
	Tenant	0.54 [0.41 ; 0.68]	0.25 [0.09 ; 0.40]	0.69 [0.49 ; 0.90]	0.29 [0.06 ; 0.52]	0.63 [0.59 ; 0.66]	0.25 [0.21 ; 0.29]	0.56 [0.51-0.61]	0.17 [0.12 ; 0.23]
	Unknown	0.99 [0.81 ; 1.17]	0.12 [-0.28 ; 0.52]	1.16 [0.89 ; 1.46]	0.4 [-0.22 ; 1.02]	1.07 [1.02 ; 1.12]	0.2 [0.11 ; 0.30]	1.07 [1.00-1.13]	0.14 [0.01 ; 0.28]
Age		0.06 [0.02 ; 0.10]	0.04 [-0.01 ; 0.09]	0.15 [0.08 ; 0.22]	0.13 [0.06 ; 0.21]	0.11 [0.09 ; 0.12]	0.07 [0.06 ; 0.09]	0.14 [0.12-0.16]	0.1 [0.07 ; 0.12]
Age²		0 [0.00 ; 0.00]	0 [0.00 ; 0.00]	0 [0.00 ; 0.00]	0 [0.00 ; 0.00]	0 [0.00 ; 0.00]	0 [0.00 ; 0.00]	0 [0.00-0.00]	0 [0.00 ; 0.00]
Bathroom (ref.yes)									
	No		-0.04 [-0.32 ; 0.23]		0.21 [-0.24 ; 0.65]		0.07 [0.00 ; 0.13]		0.13 [0.04 ; 0.22]
Central heating (ref. yes)									
	No		0 [-0.35 ; 0.14]		0.01 [-0.22 ; 0.24]		0.12 [0.08 ; 0-15]		0.09 [0.04 ; 0.14]
Density of occupation									
			0 [0.00 ; 0.00]		0.01 [0.00 ; 0.01]		0 [0.00 ; 0.00]		0 [0.00 ; 0.01]
Household type (ref. Married w children)									
	Married w/o children		-0.1 [-0.30 ; 0.11]		0.37 [0.06 ; 0.68]		0.02 [-0.02 ; 0.07]		0.06 [-0.01 ; 0.12]
	Cohabitant w children		0.18 [-0.20 ; 0.56]		-0.06 [-0.85 ; 0.73]		-0.09 [-0.24 ; 0.06]		-0.15 [-0.39 ; 0.08]
	Cohabitant w/o children		0.28		-0.02		-0.1		0.03

		[-0.04 ; 0.60]	[-0.68 ; 0.64]	[-0.20 ; 0.01]	[-0.12 ; 0.17]
	Single	0.52	0.89	0.16	-0.02
		[0.29 ; 0.76]	[0.46 ; 1.31]	[0.09 ; 0.24]	[-0.13 ; 0.09]
	Lone-parent	0.32	0.42	0.08	-0.06
		[0.01 ; 0.34]	[-0.02 ; 0.86]	[-0.02 ; 0.18]	[-0.18 ; 0.06]
	Unknown, other	0.09	0.18	0.06	0.11
		[-0.17 ; 0.36]	[-0.29 ; 0.66]	[-0.01 ; 0.11]	[0.00 ; 0.21]
Civil status (ref. Single)					
	Married	0.15	-0.02	-0.22	-0.38
		[-0.05 ; 0.23]	[-0.42 ; 0.38]	[-0.29 ; -0.15]	[-0.48 ; -0.28]
	Widow·er	0.42	0.21	0.08	0.03
		[0.01 ; 0.84]	[-0.24 ; 0.66]	[0.00 ; 0.17]	[-0.13 ; 0.07]
	Divorced	0.27	0.15	0	-0.24
		[0.06 ; 0.49]	[-0.20 ; 0.51]	[-0.06 ; 0.07]	[-0.34 ; -0.15]
	Unknown	0.39	0.16	-0.19	-0.89
		[-0.48 ; 1.27]	[-1.46 ; 1.79]	[-0.48 ; 0.11]	[-1.42 ; -0.37]
Region of residence (ref. Flanders)					
	Wallonia	0.09	0.01	0.04	-0.18
		[-0.05 ; 0.23]	[-0.20 ; 0.23]	[0.00 ; 0.08]	[-0.23 ; -0.13]
	Brussels	-0.22	-0.5	-0.11	-0.12
		[-0.51 ; 0.06]	[-0.90 ; -0.09]	[-0.17 ; -0.04]	[-0.21 ; -0.04]
Area of residence (ref. urban)					
	Suburban	0.04	-0.23	-0.01	-0.03
		[-0.12; 0.20]	[-0.47 ; 0.02]	[-0.05 ; 0.03]	[-0.08 ; 0.03]
	Rural	0.2	-0.15	-0.06	-0.06
		[0.04 ; 0.36]	[-0.40 ; 0.11]	[-0.10 ; 0.02]	[-0.12 ; -0.01]
Nationality (ref. Belgian)					
	European	-0.86	-1.02	-0.31	-0.53
		[-1.20; -0.52]	[-1.66 ; -0.39]	[-0.38 ; -0.24]	[-0.64 ; -0.42]
	Non-European	-1.67	-0.88	-0.42	-0.44
		[-2.49 ; -0.85]	[-1.90 ; 0.15]	[-0.55 ; -0.29]	[-0.62 ; -0.26]
Educational level (ref. Primary or less)					
	Lower Secondary	-0.04	0.21	0	0.05

	[-0.24 ; 0.15]	[-0.12 ; 0.53]	[-0.05 ; 0.05]	[-0.01 ; 0.11]
Higher secondary	-0.1	0.45	0.05	0.15
	[-0.30 ; 0.11]	[0.12 ; 0.79]	[0.00-0.10]	[0.07 ; 0.22]
Higher, tertiary	-0.32	0.72	-0.04	0.08
	[-0.57 ; -0.08]	[0.36 ; 1.08]	[-0.10 ; 0.02]	[0.00 ; 0.17]
Unknown	-0.17	-0.02	0.03	0.06
	[-0.41 ; 0.08]	[-0.42 ; 0.38]	[-0.02 ; 0.08]	[0.00 ; 0.13]
Occupational status (ref. Unemployed)				
Public, permanent	-0.14	-0.03	-0.28	-0.28
	[-0.37 ; 0.10]	[-0.39 ; 0.33]	[-0.37 ; -0.20]	[-0.41 ; -0.16]
Private, permanent	-0.61	-0.5	-0.6	-0.39
	[-0.88 ; -0.34]	[-0.91 ; -0.09]	[-0.69 ; -0.51]	[-0.53 ; -0.26]
Manual, permanent	-0.2	-0.37	-0.46	-0.43
	[-0.41 ; 0.01]	[-0.99 ; 0.25]	[-0.55 ; -0.38]	[-0.63 ; -0.23]
Public, temporary	-1.48	-0.41	-0.16	-0.58
	[-2.87 ; -0.09]	[-1.41 ; 0.59]	[-0.47 ; 0.15]	[-1.00 ; -0.16]
Private, temporary	0.32	0.74	-0.43	-0.58
	[-0.35 ; 0.99]	[-2.14 ; 0.66]	[-0.83 ; -0.04]	[-1.08 ; -0.09]
Manual, temporary	0.46	-1.68	-0.17	-0.62
	[0.05 ; 0.87]	[-3.65 ; 0.29]	[-0.40 ; 0.05]	[-1.02 ; -0.23]
Independent, liberal	-0.14	0.11	-0.37	-0.18
	[-0.40 ; 0.12]	[-0.42 ; 0.63]	[-0.46 ; -0.28]	[-0.36 ; 0.00]
Inactive	0.26	0.02	-0.06	-0.05
	[0.00 ; 0.51]	[-0.33 ; 0.37]	[-0.11 ; -0.01]	[-0.11 ; 0.01]
Unknown	-0.26	0.09	-0.38	-0.28
	[-0.59 ; 0.06]	[-0.39 ; 0.57]	[-0.49 ; -0.26]	[-0.45 ; -0.11]
Subjective health (ref. very good)				
Good	0.56	0.51	0.3	0.48
	[0.35 ; 0.77]	[0.13 ; 0.89]	[0.22 ; 0.38]	[0.36 ; 0.61]

Intermediate	1.14	1.45	1.1	1.54
	[0.91 ; 1.37]	[1.06 ; 1.85]	[1.02 ; 1.18]	[1.41 ; 1.66]
Bad	1.86	2.47	2.09	2.8
	[1.60 ; 2.13]	[2.05 ; 2.89]	[2.01 ; 2.18]	[2.67 ; 2.93]
Very bad	1.78	2.81	2.88	3.79
	[1.39 ; 2.17]	[2.28 ; 3.34]	[2.79 ; 2.97]	[3.65 ; 3.92]
Unknown	0.9	1.39	1.29	1.72
	[0.50 ; 1.31]	[0.80 ; 1.98]	[1.19 ; 1.39]	[1.57 ; 1.87]

Notes: Model 1 controls for age and quadratic term of age; Model 3 controls for Model 1 + household type, region, area of residence, nationality, education, occupational category, presence of a bathroom, presence of central heating, density of occupancy and subjective health.

Notes bis: [a] no response or information about housing tenure; [b] measured through the number of household members per room; [c] collective households, households above 16 persons, flat-sharing.

Sources: Census of Belgium 2001 and National Register data, death registers, DEMOBEL; authors' calculations.

2. Figures

Figure A5.1 – Percentage of owners per age in Belgium, population aged 20–69, 2001.
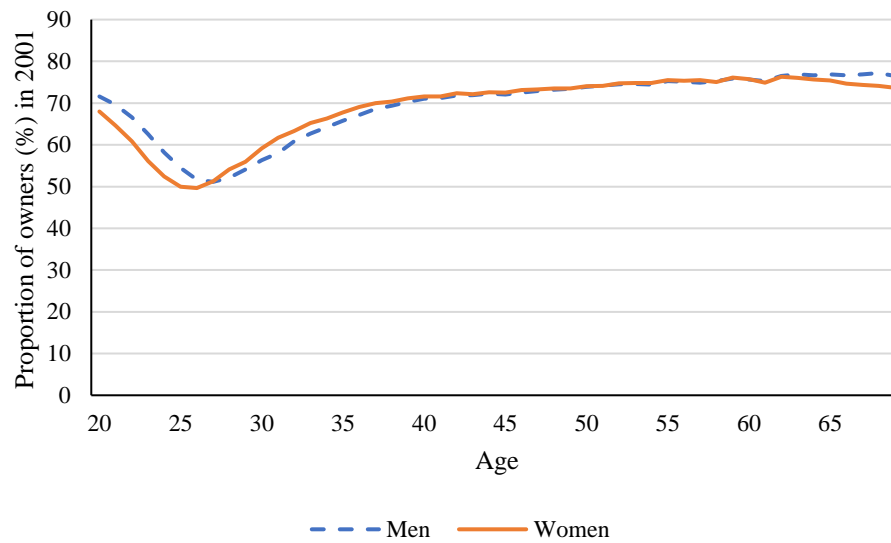
Source: Census of Belgium 2001 data; authors' calculations.

Figure A5.2 – Predicted probabilities of suicide for owners and tenants according to the region of residence.
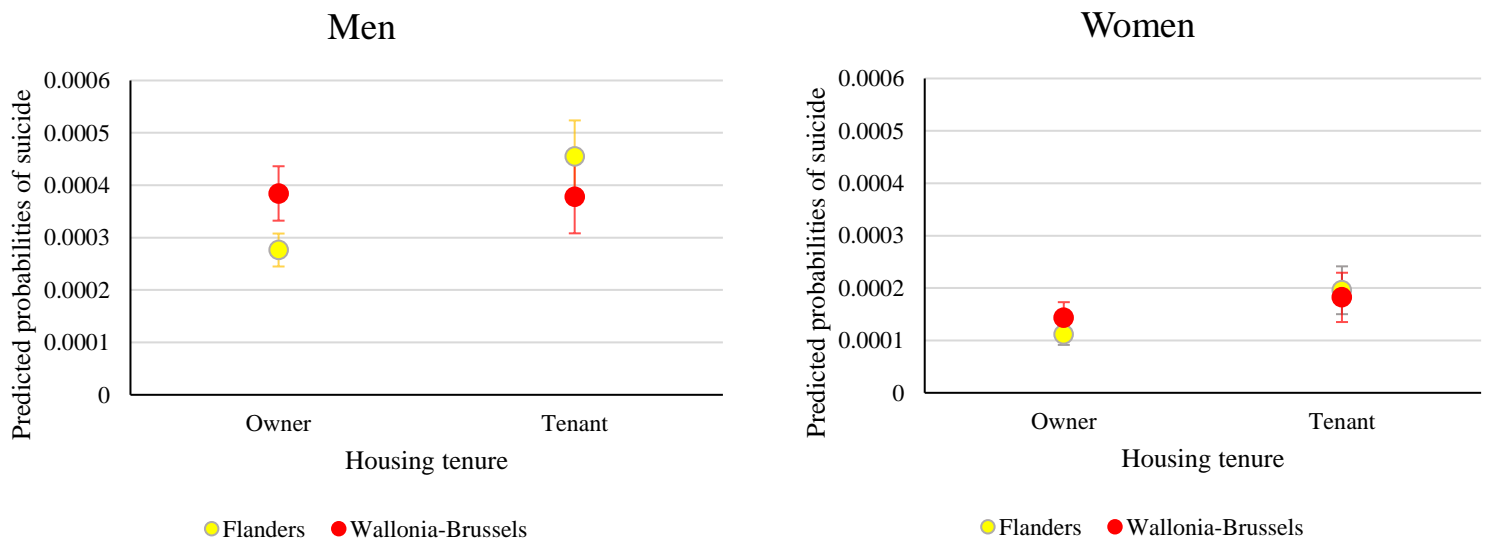
Notes: Model based on Model 2 (controlling for housing quality, household type, nationality, area of residence, educational attainment, and occupational category), including an interaction between housing and region.

Figure A5.3- *Predicted probabilities of suicide in 2002 for owners and tenants according*
to the nationality.
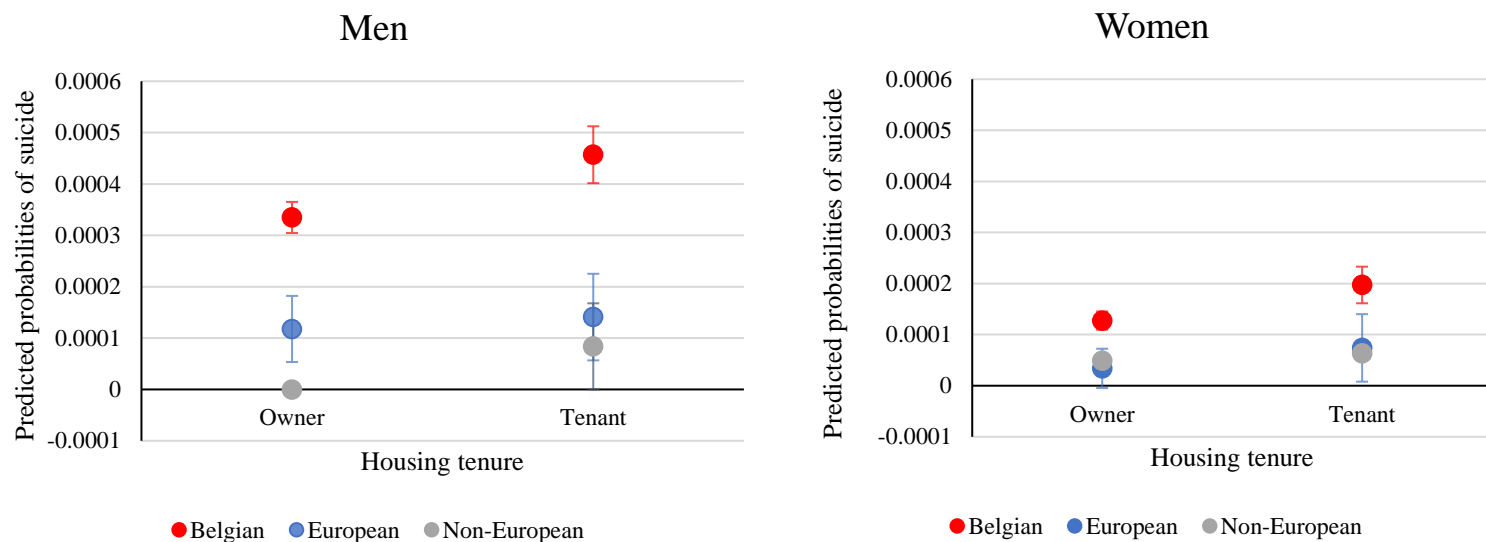
Notes: Model based on Model 2 (controlling for housing quality, household type, region, area of
residence, educational attainment, and occupational category), including an interaction between
housing and nationality.

Source: Census of Belgium 2001 and National Register data, death registers, DEMOBEL; authors'
calculations.

Figure A5.4- Predicted probabilities of suicide in 2002 for owners and tenants according to the educational level.
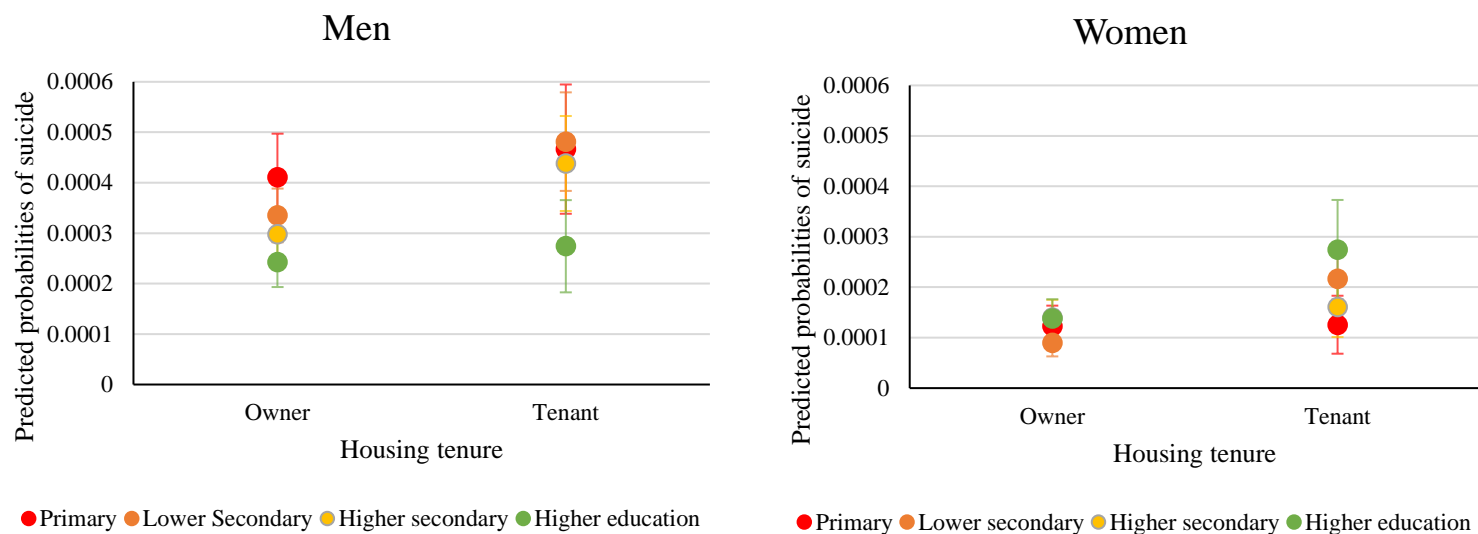
Notes: Model based on Model 2 (controlling for housing quality, household type, nationality, region, area of residence, and occupational category), including an interaction between housing and education.

Source: Census of Belgium 2001 and National Register data, death registers, DEMOBEL; authors' calculations.

Figure A5.5- Predicted probabilities of suicide in 2002 for owners and tenants according to the occupational status.
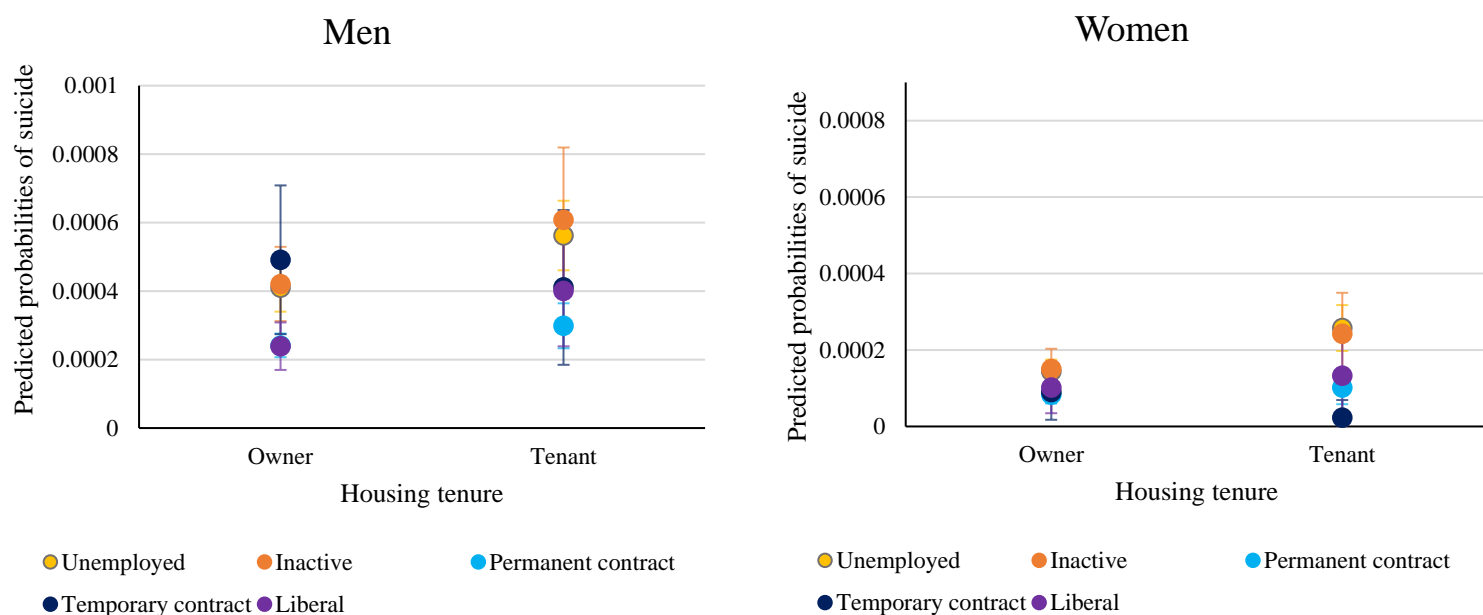
Notes: Model based on Model 2 (controlling for housing quality, household type, nationality, region, area of residence, and educational attainment), including an interaction between housing and occupational status.

Source: Census of Belgium 2001 and National Register data, death registers, DEMOBEL; authors' calculations.

Figure A5.6 - Multinomial logistic regression on the risk to die from another cause than suicide in 2002, predicted probabilities.
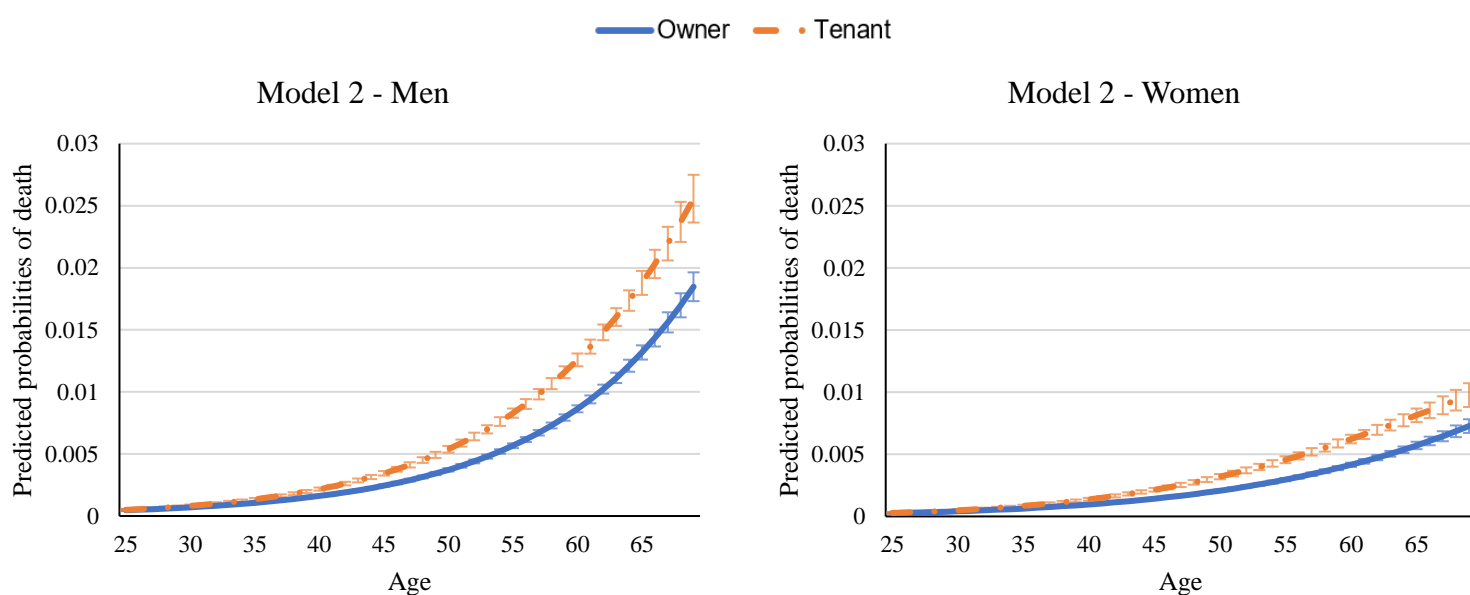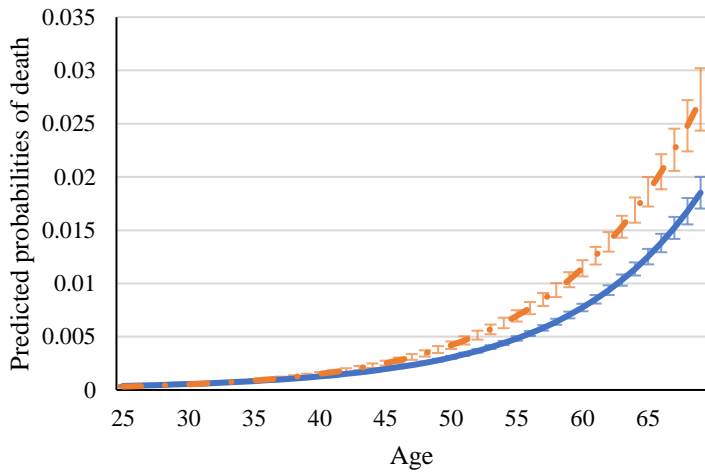
Model 2 - Married men

Model 2 - Married women
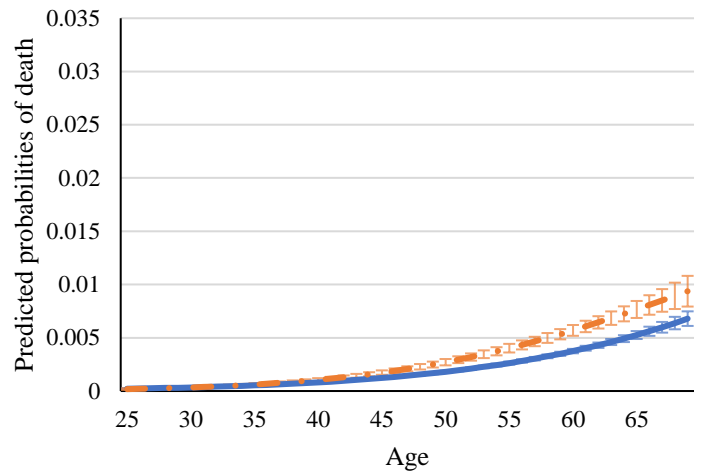
Model 2 - Unmarried men
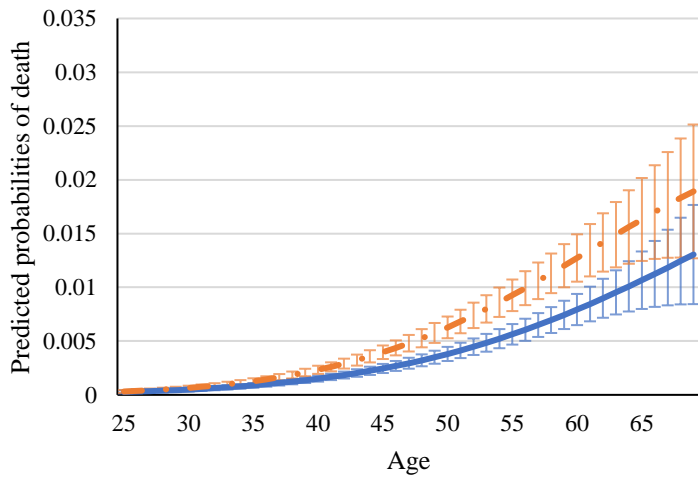
Model 2 - Unmarried women
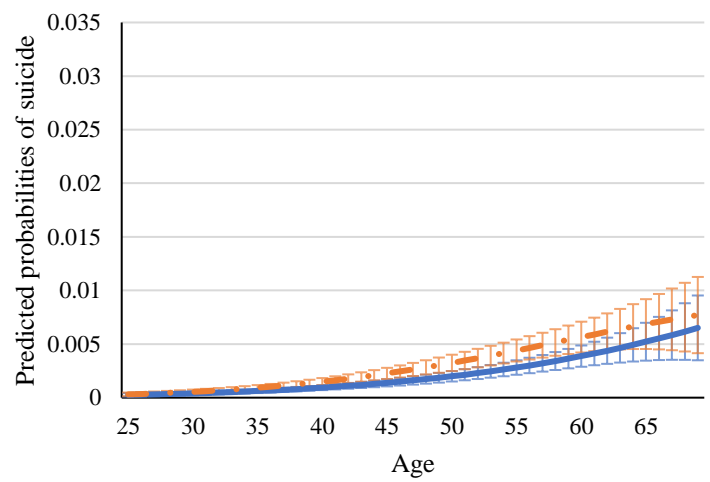
Model 2 - Single men
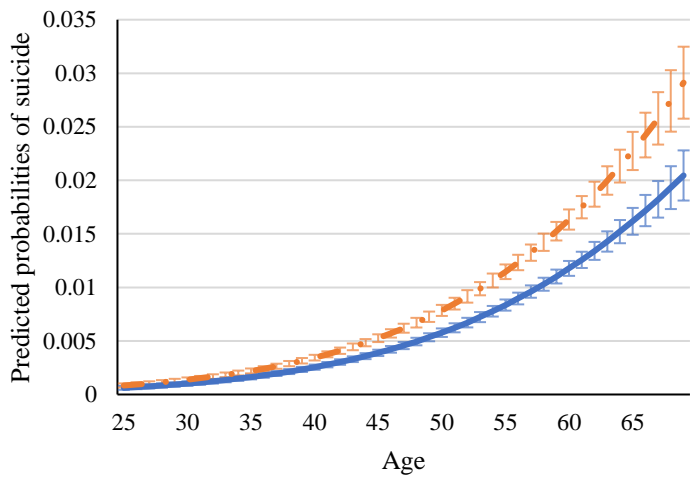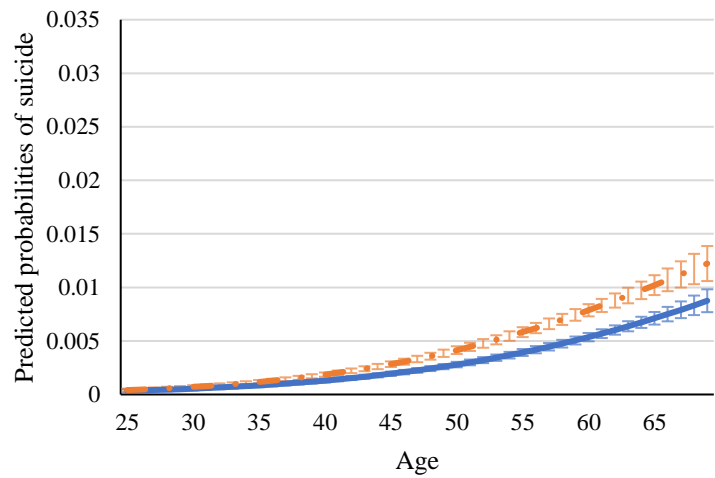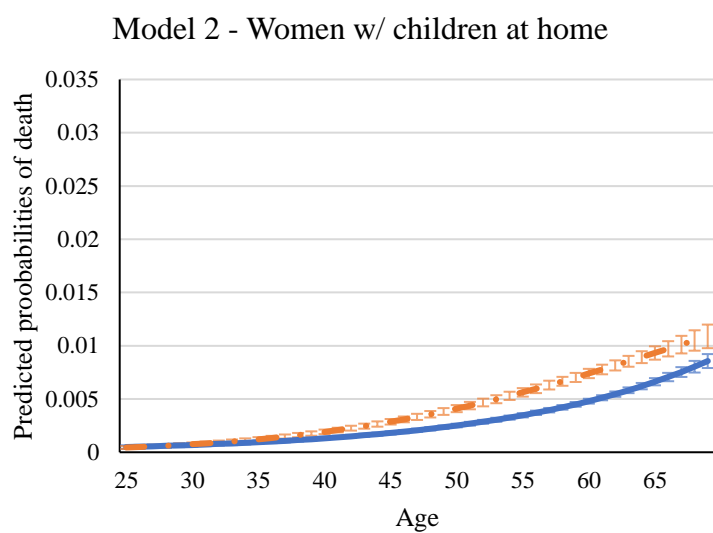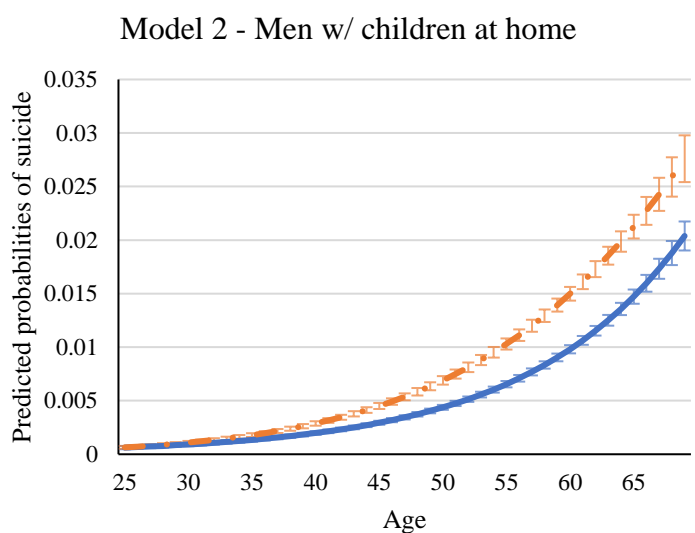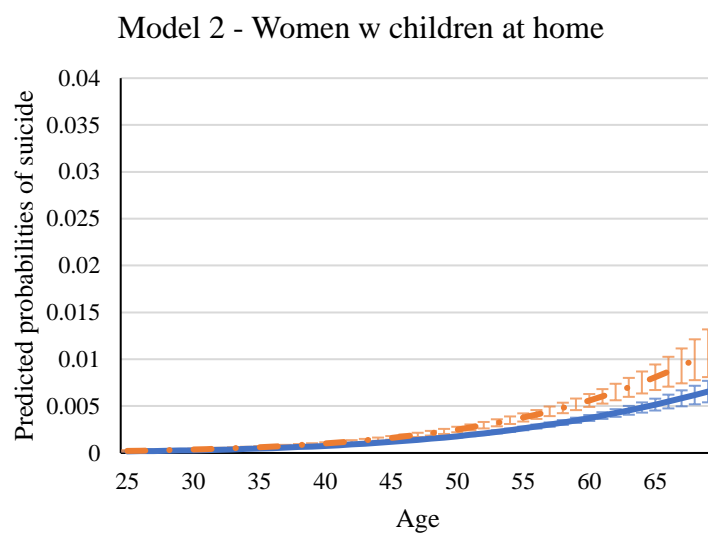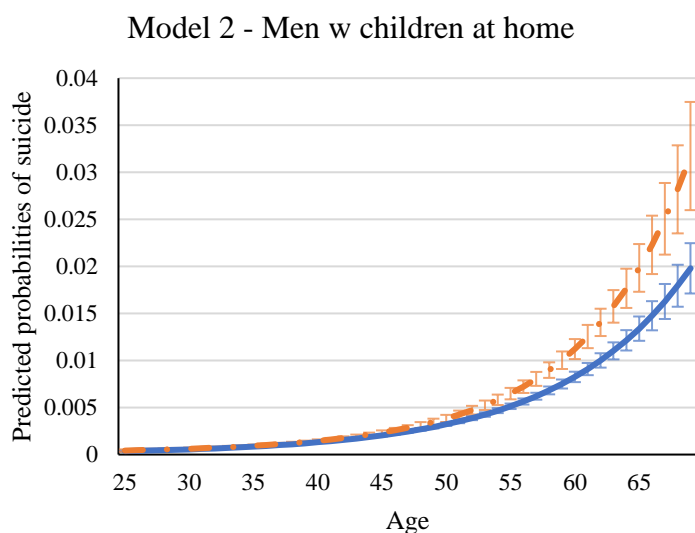
Model 2 - Single women

Model 2 - Men w children at home

Model 2 - Women w children at home

Model 2 - Men w/ children at home

Model 2 - Women w/ children at home

Notes: Model based on Model 2 (controlling for housing quality, household type, nationality, area of residence, educational attainment, and occupational category), including an interaction between housing and region.

Source: Census of Belgium 2001 and National Register data, death registers, DEMOBEL; authors' calculations.

Figures A2 show that, except for unmarried persons, all predicted probabilities of suicide present a higher suicide mortality for tenants, compared to owners, from the fifties. This gap increases until the late sixties. This difference appears earlier, from the early forties, for men and women without children.

3. Methodological appendix

Figure A5.7. Logistic regression on the risk of suicide in 2002 and 2003, predicted probabilities.
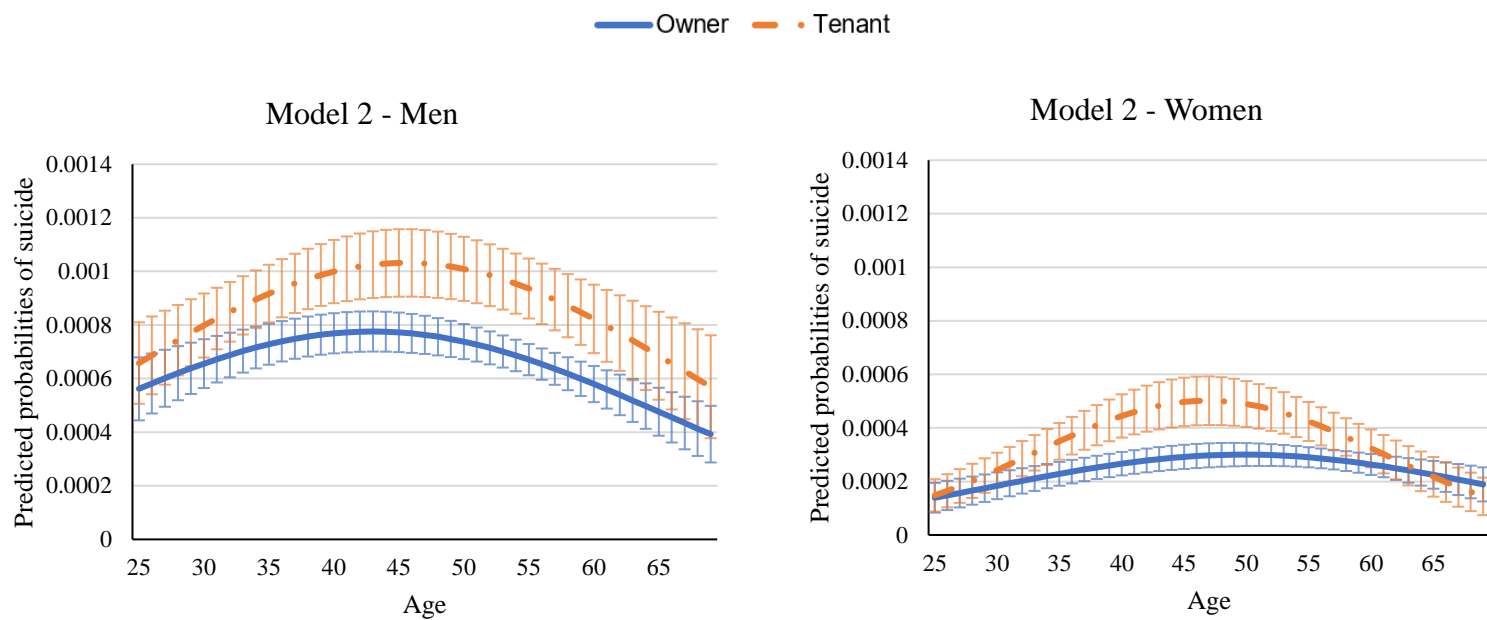
Model 2 - Men w children at home
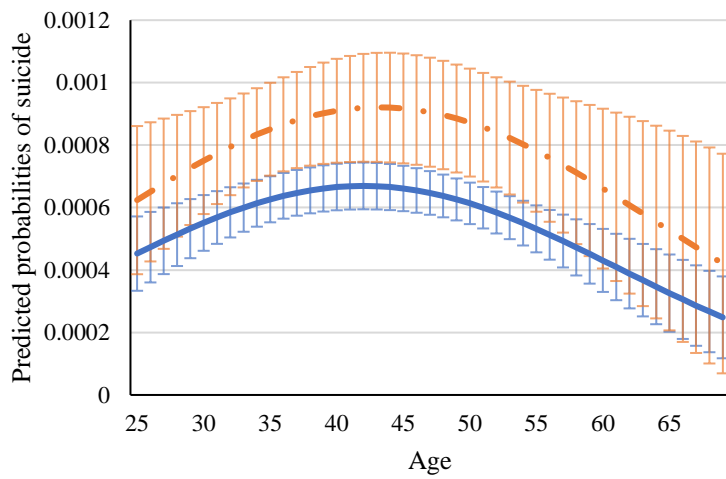
Model 2 - Women w children at home
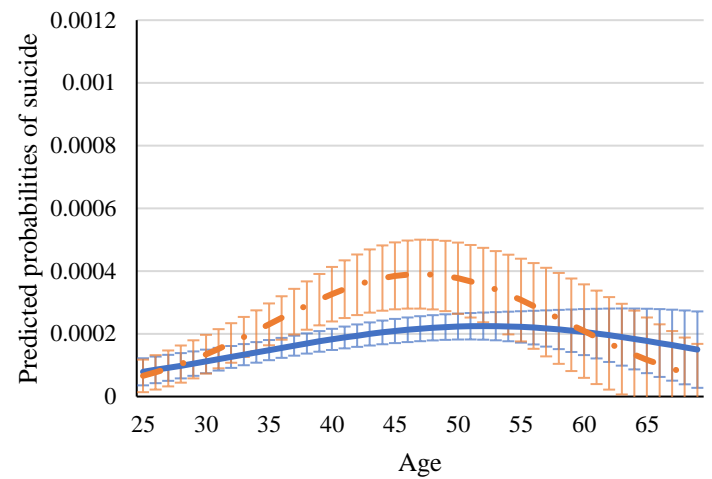
Model 2 - Men w/ children at home
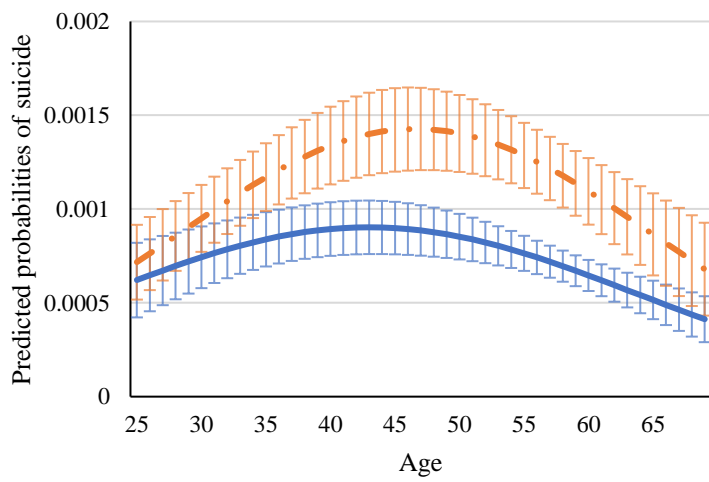
Model 2 - Women w/ children at home

Model 2 - Single men

Model 2 - Single women

Figure A6.8 - *Logistic regression on the risk of suicide in 2002, with age as categorical variable, predicted probabilities.*
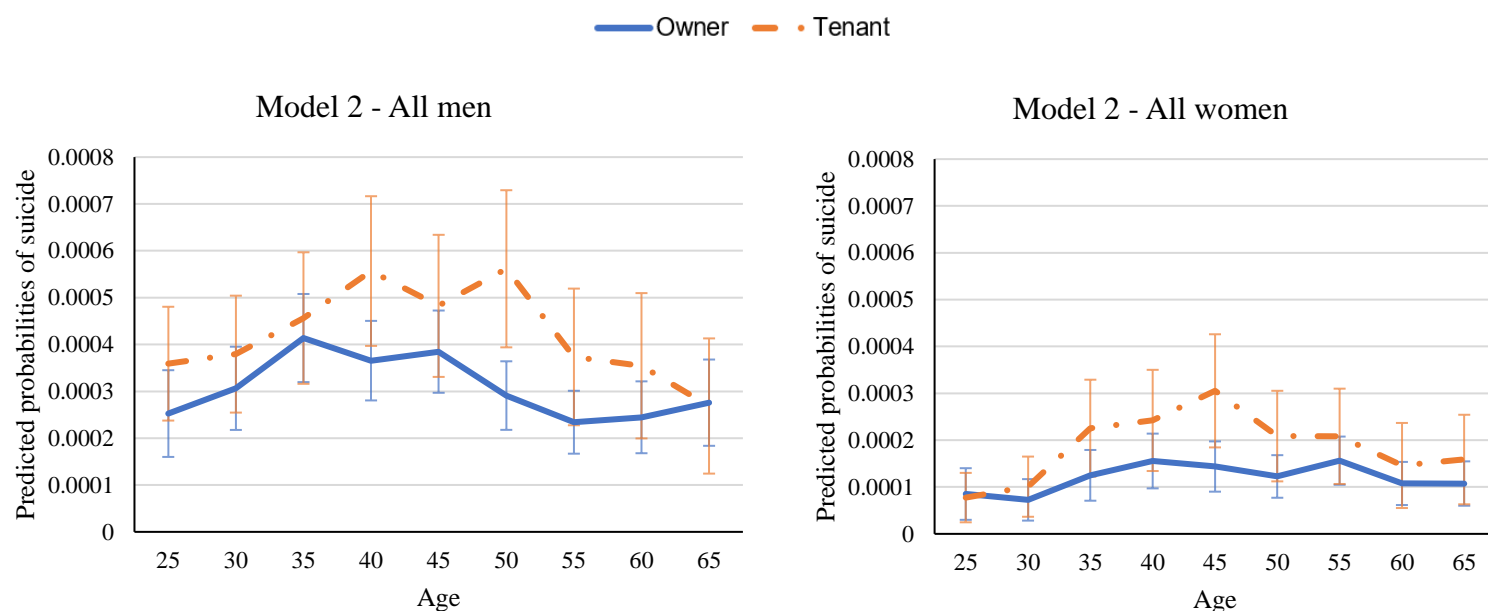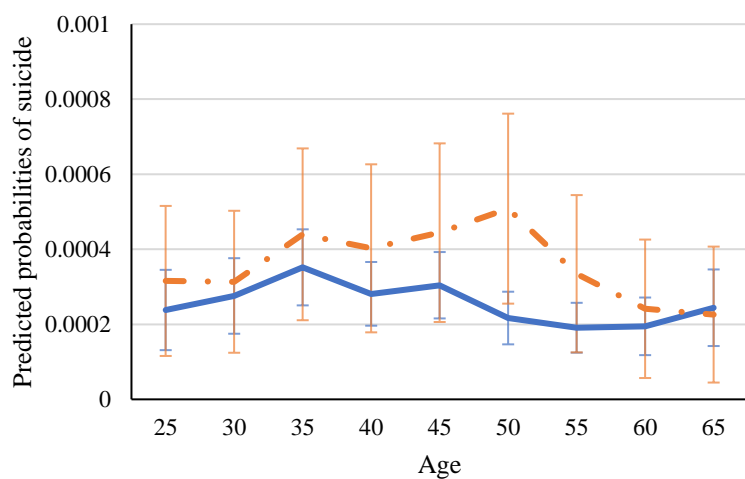
Model 2 - Married men

Model 2 - Married women
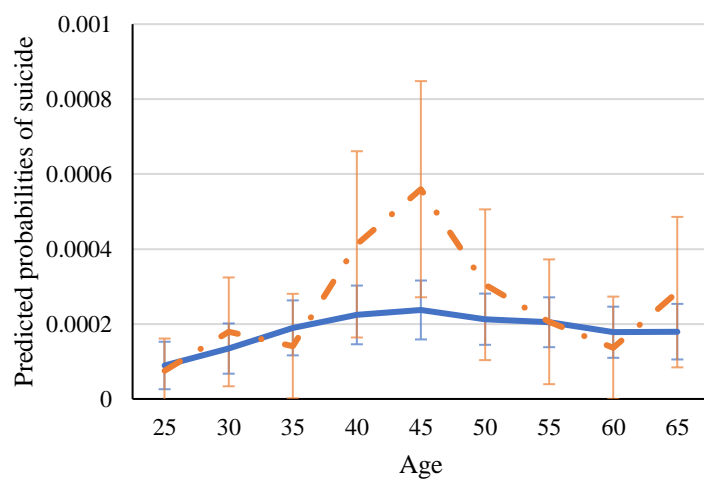
Model 2 - Cohabiting men
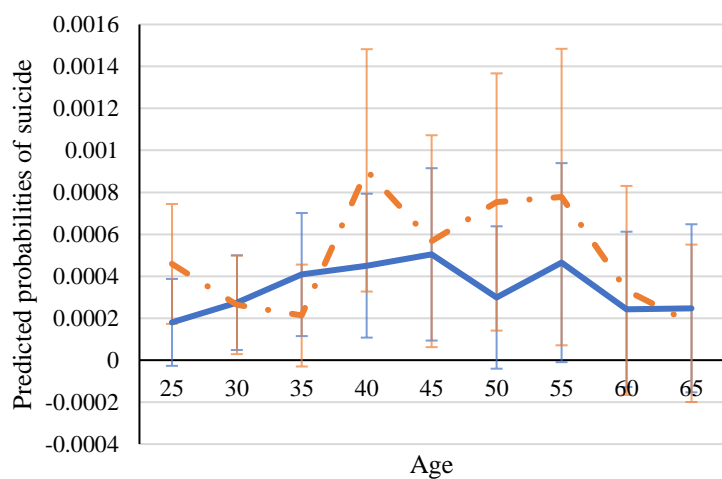
Model 2 - Cohabiting women
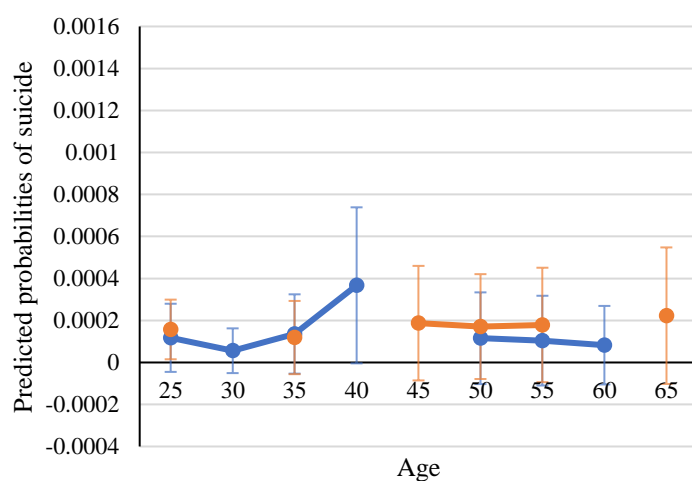
Model 2 - Single men
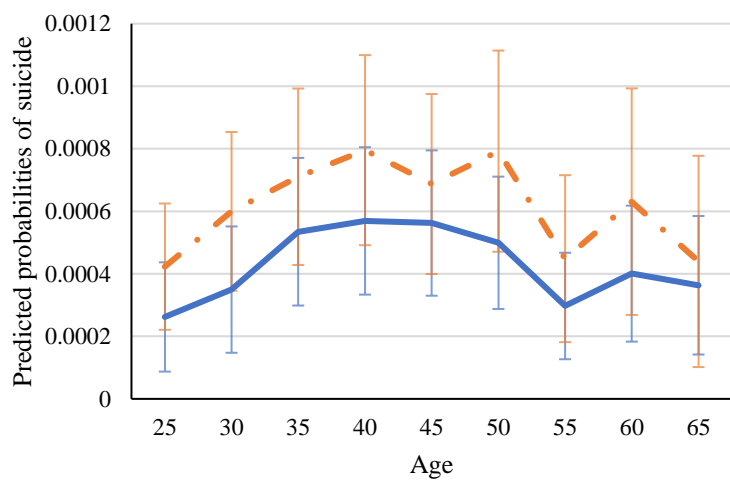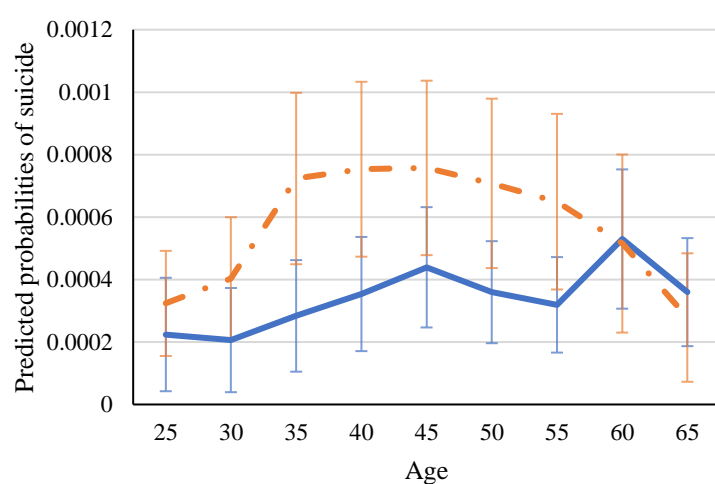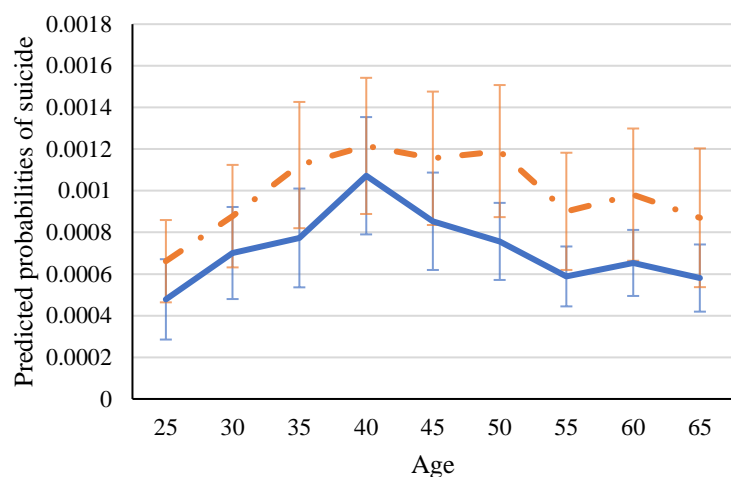
Model 2 - Single women

Model 2 - Men w/ children at home

Model 2 - Women w/ children at home
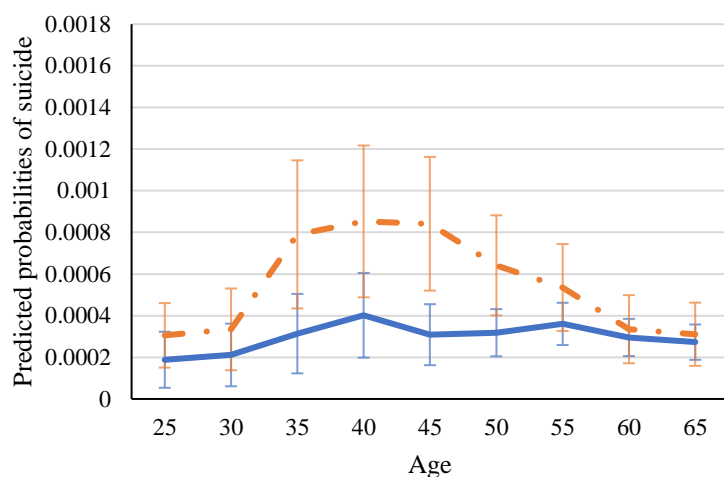
Model 2 - Men w children at home
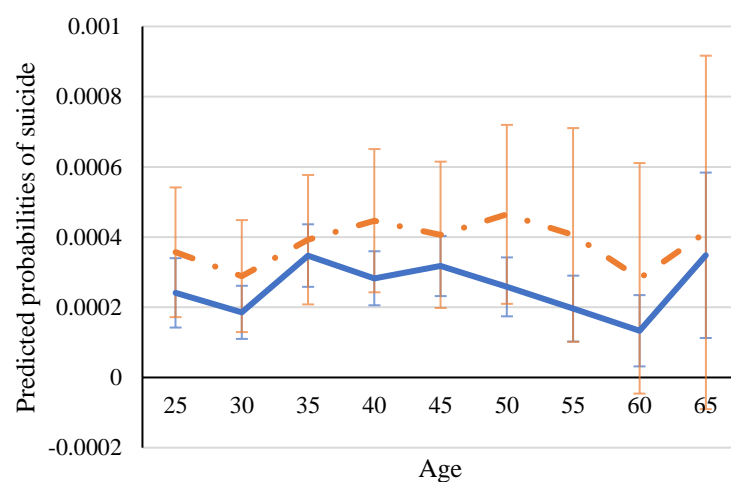
Model 2 - Women w children at home
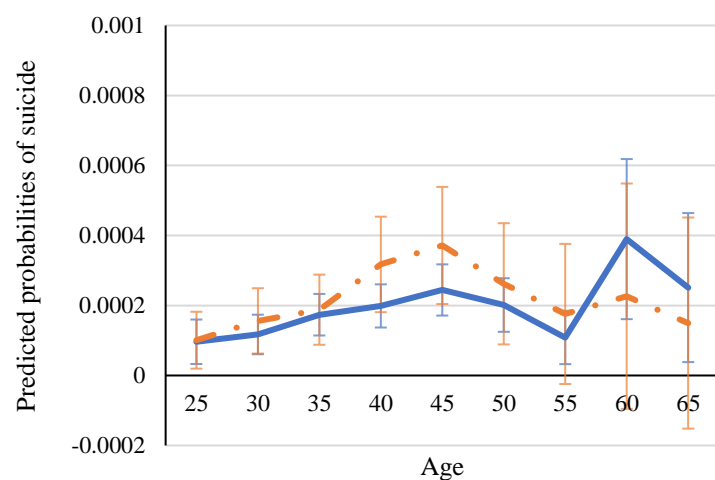
Note: Model 2 controls for age, quadratic term of age, household type, region, area of residence, nationality, education, occupational category, presence of a bathroom, presence of central heating, and density of occupancy.

Source: Census of Belgium 2001 and National Register data, death registers, DEMOBEL; authors' calculations.

II.   CHAPTER 6

1. Description of the variables

Table A6.1 – List of the variables used to create the housing quality score and the weights given to them in the creation of the score.

	Indicator	Coding	Category	Weight
Layout of the housing	Type of buidling	0	Apartment, shared building	1
		1	One-household house	
	Garden	0	Absence	1
		1	Presence	
	Household density	0	Overcrowding (Less than one room per inhabitant)	1
		1	No overcrowding (studio or over 1 room per inhabitant)	
Basic items	Central heating	0	Absence	2
		1	Presence	
	Bathroom	0	No bathroom	2
		1	At least one bathroom within the housing	
Outdoors items	Quality of the roof	0	Need for small or complete renovation	1
		1	No need for renovation	
	Quality of the outside walls	0	Need for small or complete renovation	1
		1	No need for renovation	
	Quality of the pipes	0	Need for small or complete renovation	1
		1	No need for renovation	
Indoor items	Quality of the inside walls	0	Need for small or complete renovation	2
		1	No need for renovation	
	Quality of the electric system	0	Need for small or complete renovation	2
		1	No need for renovation	
	Quality of the window	0	Need for small or complete renovation	2
		1	No need for renovation	
	Double glazing	0	Absence	2
		1	Presence	

Source: Census 2001.

Table A6.1-2 – List of the variables used to create the neighbourhood quality score and the weights given to them in the creation of the score.

	Indicator	Coding	Category	Weight
Close amenities	Esthetic	0	Poorly satisfied	2
		1	Satisfied or very satisfied	
	Cleanness	0	Poorly satisfied	2

		1	Satisfied or very satisfied	
	Tranquility	0	Poorly satisfied	2
		1	Satisfied or very satisfied	
Natural items	Air quality	0	Poorly satisfied	2
		1	Satisfied or very satisfied	
	Green spaces	0	Poorly satisfied	2
		1	Satisfied or very satisfied	
Services	Healthcare services	0	Poorly satisfied	1
		1	Satisfied or very satisfied	
	Administrative services	0	Poorly satisfied	1
		1	Satisfied or very satisfied	
	Social services	0	Poorly satisfied	1
		1	Satisfied or very satisfied	
	Culture and leisures	0	Poorly satisfied	1
		1	Satisfied or very satisfied	

Source: Census 2001.

2. Models without the multiple imputation of the missing values

Table A6.3 – Cox model on the risk of suicide in 2002-2006 expressed in Hazards-ratio and 95% confidence intervals, without the multiple imputation of the missing values.

	Men			Women		
	OR	IC95%		OR	IC95%	
Housing quality (ref. Very high)						
Very low	1.011	0.923	1.107	0.903	0.779	1.048
Low	0.951	0.871	1.038	0.866	0.752	0.997
High	0.881	0.790	0.984	0.762	0.634	0.916
Neighbourhood satisfaction (ref. High)						
Intermediate	0.891	0.815	0.975	0.988	0.857	1.139
Low	1.023	0.947	1.105	1.012	0.891	1.150
Age	0.982	0.979	0.986	0.977	0.971	0.983
Housing tenure (ref. Owner)						
Tenant	1.407	1.297	1.525	1.189	1.041	1.357
Unknown	1.659	1.224	2.248	1.312	0.756	2.277
Household composition (ref. Marital couple, children)						
Marital couple, no children	0.820	0.736	0.915	1.398	1.174	1.666
Non-marital couple, children	1.302	1.110	1.527	0.800	0.545	1.175
Non-marital couple, no children	1.477	1.279	1.706	2.187	1.703	2.808
Single, children	1.503	1.289	1.753	2.297	1.908	2.766
Single, no children	2.388	2.181	2.614	3.211	2.707	3.809
Other	1.121	0.948	1.324	1.419	1.069	1.884
Unknown	2.979	0.959	9.254	9.409	2.339	37.841
Region (ref. Flanders)						
Wallonia	1.018	0.947	1.094	1.005	0.892	1.131
Brussels	0.826	0.728	0.937	0.816	0.663	1.006
Area (ref. Urban)						
Suburban	1.193	1.094	1.301	0.879	0.763	1.012
Rural	1.093	0.996	1.199	0.887	0.762	1.033
Nationality (ref. Belgian)						
Other European	0.526	0.442	0.626	0.526	0.386	0.718
Non-European	0.293	0.179	0.481	0.583	0.318	1.069
Unknown	0.528	0.132	2.116	0.000	0.000	.
Educational level (ref. Primary)						
Lower Secondary	1.118	0.999	1.252	1.088	0.903	1.310
Upper Secondary	0.955	0.849	1.073	1.285	1.062	1.555
Higher	0.741	0.653	0.841	1.329	1.087	1.624

Unknown	0.857	*0.729*	*1.008*	0.915	*0.705*	*1.188*
Occupational status (ref. Unemployed)						
Inactive	0.876	*0.679*	*1.130*	1.225	*0.962*	*1.560*
Employee	0.908	*0.734*	*1.122*	1.028	*0.839*	*1.259*
Liberal	0.976	*0.769*	*1.239*	1.284	*0.949*	*1.735*
Unknown	1.068	*0.847*	*1.347*	0.830	*0.619*	*1.113*
Time spent in the housing (ref. Under 1 year)						
1-2 years	0.819	*0.729*	*0.919*	0.801	*0.661*	*0.971*
3-5 years	0.718	*0.637*	*0.808*	0.656	*0.538*	*0.800*
5 years+	0.672	*0.605*	*0.747*	0.654	*0.549*	*0.778*
Subjective health (ref. Very good)						
Good	1.313	*1.197*	*1.440*	1.712	*1.433*	*2.044*
Intermediate	2.104	*1.885*	*2.347*	3.633	*2.989*	*4.415*
Bad	3.618	*3.147*	*4.158*	8.715	*6.997*	*10.854*
Very bad	4.513	*3.629*	*5.612*	14.213	*10.563*	*19.125*
Unknown	1.613	*1.257*	*2.071*	2.792	*1.914*	*4.073*
Deciles of BIMD (ref. most deprived)						
2	1.085	*0.962*	*1.225*	1.049	*0.858*	*1.281*
3	1.105	*0.957*	*1.276*	1.186	*0.934*	*1.508*
4	1.063	*0.929*	*1.215*	1.378	*1.113*	*1.706*
5	0.957	*0.829*	*1.105*	1.376	*1.098*	*1.723*
6	0.994	*0.855*	*1.155*	1.255	*0.983*	*1.603*
7	0.883	*0.756*	*1.030*	1.192	*0.932*	*1.524*
8	0.994	*0.852*	*1.159*	1.248	*0.968*	*1.609*
9	0.981	*0.839*	*1.147*	1.224	*0.947*	*1.582*
Least deprived	0.973	*0.822*	*1.151*	1.121	*0.846*	*1.487*
Failures	3,622			1,348		
Observations	2,279,672			2,282,802		
Log Likelihood	-51199.055			-18890.578		

Source: Belgian 2001 Census, National register and death certificates (2002-2006), author's calculations.

Note: All individuals with at least 3 missing values in their neighbourhood or housing questions in the 2001 Census were excluded from analysis, that is about 9% compared to Table 2.

Table A6.4 – *Cox model on the risk of suicide in 2002-2006 expressed in Hazards-ratio and 95% confidence intervals, on the population who declared being in good or very good health conditions in 2001, without the multiple imputations of the missing values.*

	Men			Women		
	OR	*IC95%*		OR	*IC95%*	
Housing quality (ref. Very high)						
Very low	0.971	*0.864*	*1.091*	0.868	*0.695*	*1.085*
Low	0.882	*0.789*	*0.986*	0.897	*0.732*	*1.101*
High	0.809	*0.706*	*0.928*	0.848	*0.663*	*1.085*
Neighbourhood satisfaction (ref. High)						
Intermediate	0.862	*0.770*	*0.965*	0.966	*0.790*	*1.183*
Low	0.921	*0.835*	*1.016*	0.901	*0.751*	*1.082*
Age	0.988	*0.983*	*0.992*	0.986	*0.978*	*0.995*
Housing tenure (ref. Owner)						
Tenant	1.462	*1.317*	*1.622*	1.154	*0.947*	*1.407*
Unknown	1.308	*0.820*	*2.086*	1.048	*0.391*	*2.812*
Household composition (ref. Marital couple, children)						
Marital couple, no children	0.822	*0.713*	*0.947*	1.512	*1.185*	*1.929*
Non-marital couple, children	1.340	*1.114*	*1.612*	0.940	*0.596*	*1.483*
Non-marital couple, no children	1.431	*1.189*	*1.722*	2.333	*1.642*	*3.315*
Single, children	1.638	*1.349*	*1.988*	2.668	*2.076*	*3.428*
Single, no children	2.481	*2.213*	*2.782*	3.508	*2.757*	*4.463*
Other	1.218	*0.993*	*1.496*	1.625	*1.103*	*2.394*
Unknown	1.624	*0.228*	*11.547*	10.899	*1.524*	*77.931*
Region (ref. Flanders)						
Wallonia	0.997	*0.910*	*1.092*	0.941	*0.795*	*1.114*
Brussels	0.828	*0.708*	*0.969*	0.669	*0.496*	*0.903*
Area (ref. Urban)						
Suburban	1.206	*1.080*	*1.346*	0.838	*0.686*	*1.023*
Rural	1.171	*1.041*	*1.317*	0.809	*0.650*	*1.007*
Nationality (ref. Belgian)						
Other European	0.539	*0.432*	*0.674*	0.583	*0.379*	*0.895*
Non-European	0.286	*0.148*	*0.554*	0.813	*0.356*	*1.857*
Unknown	0.561	*0.079*	*3.993*	0.000	*.*	*.*
Educational level (ref. Primary)						
Lower Secondary	0.974	*0.833*	*1.139*	0.966	*0.708*	*1.316*
Upper Secondary	0.788	*0.672*	*0.923*	1.185	*0.874*	*1.605*
Higher	0.574	*0.486*	*0.679*	0.986	*0.721*	*1.350*
Unknown	0.909	*0.723*	*1.144*	0.845	*0.524*	*1.361*

Occupational status (ref. Unemployed)						
Inactive	0.802	*0.529*	*1.217*	1.042	*0.696*	*1.559*
Employee	0.817	*0.595*	*1.121*	0.889	*0.660*	*1.196*
Liberal	0.876	*0.622*	*1.234*	1.118	*0.736*	*1.699*
Unknown	0.988	*0.707*	*1.382*	0.821	*0.552*	*1.220*
Time spent in the housing (ref. Under 1 year)						
1-2 years	0.834	*0.722*	*0.963*	0.834	*0.632*	*1.101*
3-5 years	0.719	*0.620*	*0.835*	0.671	*0.504*	*0.894*
5 years+	0.670	*0.586*	*0.766*	0.720	*0.559*	*0.929*
Deciles of BIMD (ref. most deprived)						
2	0.974	*0.831*	*1.143*	0.845	*0.630*	*1.134*
3	1.060	*0.879*	*1.279*	1.124	*0.800*	*1.580*
4	0.969	*0.815*	*1.153*	0.945	*0.688*	*1.300*
5	0.941	*0.785*	*1.128*	1.060	*0.767*	*1.466*
6	0.890	*0.734*	*1.080*	1.143	*0.817*	*1.600*
7	0.816	*0.670*	*0.993*	0.898	*0.634*	*1.271*
8	0.905	*0.745*	*1.101*	0.985	*0.690*	*1.405*
9	0.967	*0.797*	*1.173*	1.002	*0.706*	*1.422*
Least deprived	0.905	*0.733*	*1.119*	0.912	*0.620*	*1.342*
Failures	2,253			668		
Observations	1,754,656			1,712,220		
Log Likelihood	-31392.796			-9326.774		

Source: Belgian 2001 Census, National register and death certificates (2002-2006), author's calculations.

Note: All individuals with at least 3 missing values in their neighbourhood or housing questions in the 2001 Census were excluded from analysis, that is about 9% compared to Table 3.

3. Relative importance of the predictors

d. Pseudo-partial correlations

Table A6.5 – Pseudo-partial correlations, in absolute numbers, between the predictors and suicide risk (based on a logistic model), for men and women, according to different age groups, and rank of each predictor.

MEN	25-39		40-54		55-69	
	PCP	Rank	PCP	Rank	PCP	Rank
Health	0.0039	1	0.0041	1	0.0027	2
Household composition	0.0024	2	0.0029	2	0.0019	3
Age	0.0019	3	0.0006	7	0.0029	1
Housing quality	0.0018	4	0.0019	4	0.0007	5
Years spent in housing	0.0015	5	0.0022	3	0.0010	4
Region	0.0010	6	0.0010	6	0.0000	8
Homeownership	0.0008	7	0.0013	5	0.0007	6
Neighbourhood satisfaction	0.0008	8	0.0002	9	0.0000	8
Area	0.0008	9	0.0005	8	0.0000	8
Occupation	0.0008	10	0.0001	10	0.0000	8
Nationality	0.0002	11	0.0000	12	0.0000	8
Education	0.0000	12	0.0000	13	0.0002	7
Muncipality IMD	0.0000	13	0.0000	14	0.0000	8

WOMEN	25-39		40-54		55-69	
	PCP	Rank	PCP	Rank	PCP	Rank
Health	0.0032	1	0.0041	1	0.0021	2
Household composition	0.0020	2	0.0022	2	0.0008	5
Age	0.0014	3	0.0000	11	0.0022	1
Housing quality	0.0010	4	0.0014	4	0.0004	7
Nationality	0.0009	5	0.0007	6	0.0011	4
Years spent in housing	0.0008	6	0.0020	3	0.0012	3
Occupation	0.0006	7	0.0008	5	0.0000	9
Homeownership	0.0005	8	0.0004	8	0.0003	8
Region	0.0004	9	0.0000	11	0.0000	9
Area	0.0003	10	0.0003	9	0.0000	9
Neighbourhood satisfaction	0.0000	11	0.0005	7	0.0000	9
Education	0.0000	12	0.0003	9	0.0000	9
Muncipality IMD	0.0000	13	0.0000	11	0.0005	6

Source: 2001 Census, National register and death certificates (2002-2006), author's calculations.

e. Akaike Information Criterion comparisons

Table A6.6 – Comparison of the Akaike Information Criterion (AIC) of the full model, with models deprived from each predictor, percentage of the AIC lost between the models and ranking of the relative importance of each predictor.

MEN	25-39			40-54			55-69		
	AIC of the model without the variable	% AIC lost without the variable	Rank	AIC of the model without the variable	% AIC lost without the variable	Rank	AIC of the model without the variable	% AIC lost without the variable	Rank
Housing quality	44816.71	1.41%	4	55148.79	1.33%	4	24561.23	1.72%	5
Neighbourhood satisfaction	44399.96	0.46%	10	54687.52	0.49%	9	24185.64	0.17%	12
Age	45099.21	2.05%	3	54801.45	0.70%	7	26278.3	8.83%	1
Housing tenure	44602.44	0.92%	7	55017.69	1.09%	5	24477.27	1.37%	6
Household composition	47402.51	7.26%	2	56587.27	3.98%	2	24986.65	3.48%	3
Region	44647.21	1.02%	6	54845.74	0.78%	6	24289.96	0.60%	7
Area	44498.23	0.69%	8	54720.89	0.55%	8	24256.78	0.46%	8
Nationality	44348.94	0.35%	11	54496.44	0.13%	12	24238.94	0.39%	10
Education	44276.41	0.18%	12	54520.58	0.18%	11	24245	0.41%	9
Socioprofessional category	44495.89	0.68%	9	54597.41	0.32%	10	24199.01	0.22%	11
Duration of residence	44754.72	1.27%	5	55897.56	2.71%	3	24801.1	2.72%	4
Subjective health	48616.73	10.00%	1	58417.75	7.34%	1	25180.75	4.29%	2
Municipal IMD	44209.28	0.03%	13	54440.5	0.03%	13	24181.2	0.15%	13
Full model	44195.03			54422.97			24145.53		

WOMEN	25-39			40-54			55-69		
	AIC of the model without the variable	%AIC lost without the variable	Rank	AIC of the model without the variable	%AIC lost without the variable	Rank	AIC of the model without the variable	%AIC lost without the variable	Rank
Housing quality	13215.45	1.32%	4	22936.89	1.92%	4	12867.47	1.59%	5
Neighbourhood satisfaction	13050.08	0.06%	11	22541.77	0.16%	11	12671.25	0.04%	10
Age	13620.02	4.43%	3	22645.57	0.62%	7	13302.23	5.02%	1
Housing tenure	13074.45	0.24%	7	22701.45	0.87%	6	12812.6	1.15%	6
Household composition	13865.24	6.31%	2	23014.41	2.26%	2	12904.74	1.88%	4
Region	13065.55	0.17%	9	54845.74	143.70%	12	12667.23	0.01%	13
Area	13054.04	0.09%	10	22589.4	0.37%	9	12667.45	0.01%	12
Nationality	13213.78	1.31%	5	22612.03	0.47%	8	12699.55	0.26%	7
Education	13049.64	0.05%	12	22545.09	0.17%	10	12690.7	0.19%	9
Socioprofessional category	13070.47	0.21%	8	22707.2	0.89%	5	12669.3	0.02%	11
Duration of residence	13207.13	1.26%	6	22994.66	2.17%	3	13021.4	2.80%	3
Subjective health	14473.78	10.97%	1	24014.26	6.70%	1	13114.65	3.54%	2
Municipal IMD	13043.54	0.01%	13	22511.86	0.03%	13	12694.68	0.22%	8
Full	13042.86			22505.87			12666.39		

Source: 2001 Census, National register and death certificates (2002-2006). Author's calculations.

4. Scoring with Principal component analysis

One objective of Chapter 6 was to use a vast number of variables to estimate housing and neighbourhood quality. Facing many indicators, an index was created thanks to a weighted mean, then divided into population thirds or quartiles. But before choosing this type of indicator, other methods were considered. Among them, the creation of indices thanks to principal component analyses (PCA) was attempted. This method helps to draw a few scores from a more significant number of indicators that are linearly uncorrelated with each other. Usually, components whose eigenvalues are above one – meaning that the variance varied by each element is higher than the variance carried by each indicator - are selected. Another possibility is only to select the first component with the highest eigenvalue and to define it as a housing or neighbourhood quality score. This selection of one component was already used in literature, especially by Krefis et al. (2010), in a study using housing and household characteristics to derivate children's socioeconomic status to study the social inequalities in malaria infection. In this study, the eigenvalue of the selected component was higher than 2.00 and carried about 20% of the variance proportion (Krefis et al., 2010).

We conducted two PCAs, based on the variables in Tables A1 and A2. Based on these analyses, several components could be selected. For the housing components, the first component would represent a weighted mean of the different characteristics, giving, like we did, an important weight to essential elements (central heating, bathroom), the electric system quality, and the indoor features (walls, windows, double glazing). Similarly, the first component gives lower importance to the residence's layout (the type of building, the household density, and the presence of a garden) and some outdoor elements, like the state of the pipes. A better score on this component is associated with better overall housing quality. But for the following components, there is a real difficulty in interpreting what a better score means. For the second component, a better score is related to a worse roof condition but a good state of the pipes, walls, or the presence of central heating. For

the third component, a better score means a worse state of the windows, no double glazing, poor conditions of the walls, and bad electric installations.

For the neighbourhood-related indicators, the same process was followed. The first component is a weighted mean of the different indicators that approximately give the same importance to all indicators. A better score means better satisfaction in terms of neighbourhood characteristics and services. For the second component, a higher score is associated with good satisfaction with the neighbourhood amenities and layout but low satisfaction with the services. The interpretation gets more challenging from the third component as a better score for this component is related to poor aesthetics, cleanliness, and low satisfaction with healthcare services, but similarly good satisfaction about the quietness and the green spaces.

Table A6.7 – Principal component analysis conducted on the housing-related indicators, with eigenvalues and proportion of variance carried by each component.

Variable	Comp1	Comp2	Comp3	Comp4	Comp5	Comp6	Comp7	Comp8	Comp9	Comp10	Comp11	Unexplained
Type of buidling	0.1266	0.3401	0.3247	0.4079	-0.1969	-0.1323	-0.1333	-0.7197	-0.052	0.0158	0.0399	0
Overcrowding	0.0374	0.13	0.1656	0.2865	0.9053	0.1854	0.125	-0.0022	0.0465	0.0204	0.0095	0
Central heating	0.1655	0.3828	0.2272	-0.4353	0.1143	-0.2065	-0.0659	0.0898	-0.2606	-0.6698	0.0183	0
State of roof	0.3584	-0.4364	0.4035	-0.0395	-0.0325	0.0245	0.1158	0.0028	-0.0379	-0.0072	0.0144	0
State of walls	0.357	0.0107	-0.1374	0.05	0.0468	-0.0307	-0.3695	0.0315	0.2554	-0.048	-0.8018	0
Outdoor walls	0.4219	0.0111	-0.4057	0.0975	0.0305	0.0053	0.0628	-0.0361	-0.3541	0.0432	0.1195	0
Pipes	0.1967	0.3415	0.2077	-0.3514	0.0832	-0.3816	-0.0297	0.1615	-0.0146	0.7054	0.0272	0
Windows	0.4219	0.0111	-0.4057	0.0975	0.0305	0.0053	0.0628	-0.0361	-0.3541	0.0432	0.1195	0
Double glazing	0.2213	0.272	-0.1012	-0.0624	-0.1477	0.0477	0.7786	-0.0669	0.4571	-0.0899	-0.1053	0
Bathroom	0.1015	0.2233	0.0963	-0.3504	-0.0984	0.8554	-0.1463	-0.1265	-0.0676	0.1564	0.0029	0
Garden	0.0942	0.314	0.26	0.5357	-0.2892	0.1534	-0.001	0.6451	-0.1189	-0.0211	0.0015	0
Electric system	0.3285	0.0267	-0.108	0.018	0.02	-0.0117	-0.4032	0.0871	0.6168	-0.1182	0.5606	0
Eigenvalue	3.8365	1.51166	1.25163	1.1009	0.973365	0.930108	0.826534	0.728025	0.692678	0.648999	0.4996	0
Share of variance	29.51%	11.63%	9.63%	8.47%	7.49%	7.15%	6.36%	5.60%	5.33%	4.99%	3.84%	0.00%

Source: 2001 Census, National register and death certificates (2002-2006). Author's calculations.

***Table A6.8** – Principal component analysis conducted on the neighbourhood-related indicators, with eigenvalues and proportion of variance carried by each component.*

Variable	Comp1	Comp2	Comp3	Comp4	Comp5	Comp6	Comp7	Comp8	Comp9	Unexplained
Esthetic aspect	0.3261	0.3074	-0.5858	0.0948	0.0111	0.0344	0.6359	0.0154	-0.2027	0
Air quality	0.3345	0.3486	0.3514	-0.3634	-0.0408	-0.0096	-0.1688	0.2899	-0.6299	0
Cleanliness	0.3463	0.3166	-0.4795	0.0166	-0.0763	-0.0172	-0.6919	-0.0508	0.2493	0
Quietness	0.3285	0.3486	0.3985	-0.3381	-0.0359	0.0113	0.2766	-0.2547	0.5955	0
Green spaces	0.3133	0.1594	0.3546	0.787	0.3518	0.0034	-0.0461	-0.0618	-0.0406	0
Healthcare services	0.3148	-0.381	-0.0887	-0.2248	0.5972	0.2069	0.0114	0.4988	0.2212	0
Administrative services	0.3426	-0.3894	0.0115	-0.0584	-0.1406	0.6158	-0.0567	-0.526	-0.2206	0
Social services	0.3379	-0.3818	-0.0378	-0.1266	0.1245	-0.755	-0.0006	-0.3447	-0.1349	0
Cultural services	0.3537	-0.3071	0.0971	0.2346	-0.6895	-0.0785	0.0802	0.4474	0.167	0
Eigenvalue	2.50494	1.87393	0.853526	0.823979	0.684237	0.598983	0.576513	0.542931	0.540959	
Share of variance	0.2783	0.2082	0.0948	0.0916	0.076	0.0666	0.0641	0.0603	0.0601	

Source: 2001 Census, National register and death certificates (2002-2006). Author's calculations.

Only the first component of the housing-related analyses and the two first components of the neighbourhood-related analysis were selected because only they were interpretable. We divided these components into population quantiles (quartiles for the housing-related index and thirds for the neighbourhood-related indices). We used them as predictors of suicide in Cox proportional hazard models, with the same covariates as presented in Tables 2 and 3. Compared to the results based on the weighted means introduced in the main text, effects based on PCA are very similar. We still observe that better housing quality is associated with lower suicide risk for men and women. For men, intermediate and higher satisfaction with the neighbourhood is associated with a 4% lower suicide risk. There is no visible difference in suicide hazard according to the levels of the second neighbourhood-related index. For women, we can see that better housing conditions are associated with lower suicide risks. A high level of satisfaction about the neighbourhood is associated with less than 3% lower suicide risk than a low satisfaction level. We cannot notice a difference in suicide hazard according to the levels of the second neighbourhood-related index.

For healthy populations (who declared a high or very high health status in 2001), men still show a higher risk of suicide when they live in poor housing conditions. An association between lower neighbourhood satisfaction and higher suicide risk appears. There is an 18% lower suicide risk for men who report high satisfaction about their neighbourhood than men with low satisfaction. This confirms the trend observed in Table 3. About the second neighbourhood index, we can see that a better score – a good level of satisfaction with the neighbourhood amenities and characteristics and a low satisfaction about the close services, including the healthcare services – are associated with higher suicide risk. For healthy women, we can still notice that women living in very bad housing conditions (1st quartile) are associated with the highest suicide risk. However, the category with the lowest suicide risk is the quartile living in bad housing conditions (2nd quartile). This result is a bit different from what we found with our previous indicator, but we can still draw the same conclusion. Women's health status confounds the relation between housing conditions and suicide: predisposition to poor health and mental health predicts both poor housing conditions and a higher

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risk of suicide. We also observe similar results for the first neighbourhood index, as observed with our weighted means. A high level of neighbourhood-related satisfaction is associated with an 8% lower suicide risk than a low satisfaction. For the second neighbourhood-related index, we do not see a clear gradient.

Overall, the results found with both methods are very close. In our main text, the weighted mean method was preferred to principal component analysis, as it gives us more control over the interpretation of the scores.

Table A6.9 – Cox model on the risk of suicide in 2002-2006 expressed in Hazards-ratio and 95% confidence intervals, on the total population (on the left) and on the population who declared a healthy status in 2001 (on the right), using the quartiles of scores as defined through principal component analyses.

	General population						Healthy* population					
	Men			Women			Men			Women		
	HR	IC95%		HR	IC95%		HR	IC95%		HR	IC95%	
Housing-related component 1 (ref. Q1-very low)												
Low housing quality	0.928	0.828	1.040	0.892	0.823	0.961	0.921	0.797	1.065	0.768	0.577	1.023
High housing quality	0.892	0.790	1.006	0.748	0.523	0.974	0.857	0.738	0.995	0.906	0.689	1.191
Very high (Q4)	0.874	0.765	0.998	0.791	0.633	0.987	0.799	0.679	0.941	0.900	0.672	1.207
Neighbourhood-related component 1 (ref. T1 - Low)												
Intermediate	0.965	0.858	1.087	1.021	0.840	1.240	0.836	0.719	0.971	0.920	0.699	1.210
High	0.967	0.809	1.157	0.976	0.722	1.320	0.822	0.657	1.030	0.985	0.648	1.499
Neighbourhood-related component 2 (ref. T1 - Low)												
Intermediate	1.037	0.881	1.221	1.099	0.832	1.451	1.028	0.838	1.260	0.899	0.616	1.311
High	0.992	0.877	1.122	1.081	0.883	1.324	1.103	0.792	1.537	1.064	0.799	1.417
Age	0.984	0.979	0.988	0.977	0.969	0.985	0.989	0.983	0.995	0.983	0.971	0.994
Housing tenure (ref. Owner)												
Tenant	1.364	1.219	1.527	1.403	1.164	1.691	1.413	1.224	1.631	1.381	1.047	1.823
Unknown	1.634	1.025	2.606	1.375	0.569	3.325	0.977	0.437	2.183	0.648	0.091	4.622
Household composition (ref. Marital couple, children)												
Marital couple, no children	0.840	0.731	0.965	1.382	1.106	1.726	0.812	0.680	0.969	1.481	1.095	2.003
Non-marital couple, children	1.278	1.025	1.594	0.720	0.417	1.242	1.335	1.041	1.713	0.778	0.407	1.489
Non-marital couple, no children	1.451	1.182	1.780	2.550	1.839	3.534	1.285	0.984	1.677	2.400	1.505	3.829
Single, children	1.698	1.394	2.067	2.459	1.923	3.144	1.770	1.385	2.263	2.639	1.896	3.673

Single, no children	2.715	*2.410*	*3.059*	2.906	*2.289*	*3.690*	2.733	*2.357*	*3.170*	3.349	*2.408*	*4.657*
Other	1.268	*1.029*	*1.562*	1.643	*1.162*	*2.323*	1.330	*1.032*	*1.713*	1.766	*1.102*	*2.833*
Unknown	5.334	*2.993*	*9.504*	10.263	*4.470*	*23.562*	6.926	*2.578*	*18.608*	43.241	*10.571*	*######*
Region (ref. Flanders)												
Wallonia	1.002	*0.915*	*1.098*	1.058	*0.908*	*1.232*	0.967	*0.863*	*1.084*	1.023	*0.829*	*1.262*
Brussels	0.841	*0.722*	*0.980*	0.885	*0.686*	*1.141*	0.893	*0.745*	*1.071*	0.774	*0.548*	*1.092*
Area (ref. Urban)												
Suburban	1.091	*0.984*	*1.210*	0.892	*0.750*	*1.061*	1.085	*0.953*	*1.235*	0.775	*0.609*	*0.986*
Rural	0.991	*0.885*	*1.111*	0.925	*0.766*	*1.117*	1.069	*0.928*	*1.230*	0.849	*0.656*	*1.100*
Nationality (ref. Belgian)												
Other European	0.563	*0.446*	*0.710*	0.504	*0.322*	*0.788*	0.609	*0.457*	*0.812*	0.592	*0.324*	*1.083*
Non-European	0.139	*0.045*	*0.432*	0.354	*0.112*	*1.116*	0.160	*0.040*	*0.644*	0.297	*0.041*	*2.152*
Unknown	0.741	*0.104*	*5.275*	0.000	*.*	*.*	0.000	*0.000*	*.*	0.000	*.*	*.*
Educational level (ref. Primary)												
Lower Secondary	1.094	*0.938*	*1.276*	0.967	*0.753*	*1.242*	0.965	*0.784*	*1.188*	1.028	*0.678*	*1.559*
Upper Secondary	1.000	*0.855*	*1.169*	1.213	*0.942*	*1.563*	0.820	*0.666*	*1.010*	1.195	*0.793*	*1.799*
Higher	0.700	*0.591*	*0.828*	1.140	*0.872*	*1.490*	0.540	*0.434*	*0.672*	1.018	*0.669*	*1.548*
Unknown	0.943	*0.756*	*1.176*	0.830	*0.571*	*1.206*	1.027	*0.758*	*1.392*	0.826	*0.415*	*1.645*
Occupational status (ref. Unemployed)												
Inactive	0.868	*0.599*	*1.257*	1.268	*0.912*	*1.763*	0.661	*0.374*	*1.169*	1.014	*0.595*	*1.728*
Employee	0.945	*0.693*	*1.290*	1.049	*0.799*	*1.378*	0.699	*0.455*	*1.074*	0.857	*0.583*	*1.259*
Liberal	0.948	*0.675*	*1.333*	1.273	*0.854*	*1.898*	0.670	*0.422*	*1.063*	1.184	*0.705*	*1.987*
Unknown	1.123	*0.803*	*1.571*	0.756	*0.499*	*1.145*	0.813	*0.514*	*1.284*	0.662	*0.381*	*1.151*
Time spent in the housing (ref. Under 1 year)												
1-2 years	0.832	*0.705*	*0.983*	0.865	*0.645*	*1.161*	0.872	*0.711*	*1.070*	0.878	*0.583*	*1.322*

3-5 years	0.745	0.631	0.880	0.763	0.570	1.021	0.786	0.641	0.965	0.777	0.518	1.167
5 years+	0.719	0.621	0.833	0.778	0.602	1.007	0.732	0.609	0.880	0.856	0.597	1.230
Subjective health (ref. Very good)	1.294	1.150	1.456	1.572	1.256	1.969						
Good	1.989	1.723	2.295	3.294	2.562	4.235						
Intermediate	3.584	2.978	4.313	7.425	5.542	9.947						
Bad	4.610	3.453	6.154	12.227	8.153	18.337						
Very bad	1.540	1.095	2.167	2.314	1.362	3.933						
Unknown												
Failures	2111			750			1369			398		
Observations	1398141			1365249			1100556			1050632		
Log Likelihood	-28903.225			-10174.052			-18508.647			-5381.8032		

Source: 2001 Census, National register and death certificates (2002-2006). Author's calculations.

Note : the healthy* population is the population who declared a good or very good health status in 2001.

5. Fine-Gray sub-distribution hazard models

Survival analysis aims to follow an individual's life course and events and, more specifically, to investigate the time spent between entering a risk window and the risk occurrence. However, the survival analysis we studied through the Cox models presented in the article does not account for competing risks or events, which are likely to occur before the primary event of interest, and then "prevent" it. One competing risk of suicide is death from another cause. We can think of cases where a poor health status can lead to both premature death and a loss in well-being and life satisfaction and increased suicidal thoughts and behaviours. The Fine-Gray sub-distribution hazard model is usually recommended to estimate the incidence of outcomes over time in the presence of competing risks. In previous analyses, the competing risks were censored, while the Fine-Gray models estimate a cumulative incidence function (CIF). In those models, the hazard rate for suicide at time t is calculated after accounting for all previously occurring event types, which include competing events.

f. Competing risk : suicide or another cause?

Table A6.10 presents the results of the Fine-Gray models. It controls for the risk of a competitive outcome, that is the death from other causes.

Table A6.10 – Fine-Gray subdistribution hazard model on the risk of suicide in 2002-2006 expressed in Hazards-ratio and 95% confidence intervals, with other cause of death as a competitive risk.

	Men			Women		
	SHR	IC95%		SHR	IC95%	
Housing quality (ref. Very high)						
Very low	0.975	0.933	1.015	0.937	0.803	1.055
Low	0.913	0.832	1.004	0.851	0.729	0.961
High	0.815	0.737	0.886	0.741	0.610	0.900
Neighbourhood satisfaction (ref. Low)						
Intermediate	0.897	0.842	0.957	0.997	0.907	1.096
High	0.942	0.861	1.042	0.958	0.837	1.099
Age	0.980	0.971	0.990	0.977	0.972	0.983

Housing tenure (ref. Owner)						
Tenant	1.412	*1.320*	*1.535*	1.275	*1.120*	*1.424*
Unknown	1.375	*1.141*	*1.568*	1.496	*1.078*	*1.820*
Household composition (ref. Marital couple, children)						
Marital couple, no children	1.039	*0.920*	*1.174*	1.773	*1.454*	*2.162*
Non-marital couple, children	1.177	*1.013*	*1.367*	0.736	*0.507*	*1.069*
Non-marital couple, no children	1.260	*1.094*	*1.450*	1.872	*1.460*	*2.401*
Single, children	1.416	*1.217*	*1.648*	1.552	*1.282*	*1.878*
Single, no children	1.937	*1.671*	*2.245*	3.271	*2.423*	*4.417*
Other	1.096	*0.933*	*1.288*	1.373	*1.049*	*1.798*
Unknown	3.826	*1.588*	*9.220*	7.581	*1.877*	*30.610*
Region (ref. Flanders)						
Wallonia	1.013	*0.948*	*1.082*	1.020	*0.918*	*1.134*
Brussels	0.786	*0.702*	*0.879*	0.766	*0.643*	*0.912*
Area (ref. Urban)						
Suburban	1.156	*1.073*	*1.245*	0.886	*0.786*	*0.998*
Rural	1.105	*1.018*	*1.198*	0.912	*0.801*	*1.038*
Nationality (ref. Belgian)						
Other European	0.499	*0.424*	*0.587*	0.444	*0.332*	*0.595*
Non-European	0.232	*0.147*	*0.366*	0.425	*0.243*	*0.744*
Unknown	0.524	*0.169*	*1.629*	0.000	*0.000*	*0.000*
Educational level (ref. Primary)						
Lower Secondary	1.027	*0.925*	*1.140*	0.997	*0.847*	*1.173*
Upper Secondary	0.902	*0.807*	*1.007*	1.127	*0.954*	*1.332*
Higher	0.706	*0.622*	*0.803*	1.203	*1.001*	*1.447*
Unknown	0.977	*0.856*	*1.115*	0.900	*0.725*	*1.119*
Occupational status (ref. Unemployed)						
Inactive	0.864	*0.693*	*1.077*	1.142	*0.921*	*1.415*
Employee	0.910	*0.756*	*1.096*	0.978	*0.814*	*1.174*
Liberal	1.009	*0.817*	*1.247*	1.259	*0.956*	*1.658*
Unknown	1.034	*0.844*	*1.267*	0.849	*0.659*	*1.094*
Time spent in the housing (ref. Under 1 year)						
1-2 years	0.895	*0.815*	*1.016*	0.834	*0.700*	*0.999*
3-5 years	0.771	*0.699*	*0.858*	0.728	*0.618*	*0.831*
5 years+	0.681	*0.630*	*0.798*	0.651	*0.535*	*0.780*
Subjective health (ref. Very good)						
Good	1.409	*1.300*	*1.528*	1.408	*1.151*	*1.712*
Intermediate	2.342	*2.136*	*2.569*	3.074	*2.488*	*3.778*
Bad	4.085	*3.651*	*4.579*	8.104	*6.569*	*9.985*
Very bad	4.710	*3.914*	*5.679*	13.739	*10.525*	*17.957*

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Unknown	1.592	*1.260*	*2.000*	3.071	*2.267*	*4.179*

Failures	4,123	1,573
Observations	2,527,183	2,540,061
Log Likelihood	-54670.327	-21475.812

Source: 2001 Census, National register and death certificates (2002-2006). Author's calculations.

Results in Table A6.10 are very close to those observed in Table 2, at least regarding the relation between the living environment and suicide. We still notice a higher risk of suicide for men and women living in poorer housing conditions, as well as no clear gradient in the relation between neighbourhood satisfaction and suicide risk.

g. Competing risk : mobility

Table A6.11 presents the results of the Fine-Gray models. Compared to our main Cox models, it controls for the risk of a competitive outcome: the change of residence during the observation period. In the previous model, this event was considered a right-censor because it means that the housing and neighbourhood characteristics no longer apply to the individual's current situation.

Table A6.11 – Fine-Gray subdistribution hazard model on the risk of suicide in 2002-2006 expressed in Hazards-ratio and 95% confidence intervals, with mobility as a competitive risk.

	Men			Women		
	SHR	*IC95%*		SHR	*IC95%*	
Housing quality (ref. Very high)						
Very low	0.986	*0.945*	*1.026*	0.960	*0.827*	*1.074*
Low	0.934	*0.854*	*1.028*	0.772	*0.650*	*0.885*
High	0.861	*0.789*	*0.931*	0.718	*0.584*	*0.877*
Neighbourhood satisfaction (ref. Low)						
Intermediate	0.912	*0.857*	*0.972*	0.990	*0.935*	*1.050*
High	0.994	*0.913*	*1.098*	1.001	*0.885*	*1.142*
Age	0.969	*0.960*	*0.979*	0.977	*0.972*	*0.983*
Housing tenure (ref. Owner)						
Tenant	1.287	*1.194*	*1.409*	1.360	*1.205*	*1.509*
Unknown	1.420	*1.187*	*1.613*	1.518	*1.100*	*1.842*

Household composition (ref. Marital couple, children)						
Marital couple, no children	0.896	*0.795*	*1.009*	1.504	*1.240*	*1.825*
Non-marital couple, children	0.950	*0.818*	*1.103*	0.599	*0.412*	*0.869*
Non-marital couple, no children	0.972	*0.846*	*1.117*	1.422	*1.114*	*1.815*
Single, children	1.163	*1.002*	*1.351*	1.190	*0.987*	*1.433*
Single, no children	1.642	*1.418*	*1.902*	2.672	*1.982*	*3.601*
Other	0.937	*0.798*	*1.100*	1.118	*0.855*	*1.463*
Unknown	2.559	*1.062*	*6.166*	5.344	*1.326*	*21.543*
Region (ref. Flanders)						
Wallonia	1.005	*0.940*	*1.074*	1.009	*0.908*	*1.122*
Brussels	0.778	*0.696*	*0.871*	0.758	*0.637*	*0.903*
Area (ref. Urban)						
Suburban	1.171	*1.088*	*1.261*	0.882	*0.783*	*0.994*
Rural	1.120	*1.033*	*1.215*	0.907	*0.797*	*1.032*
Nationality (ref. Belgian)						
Other European	0.455	*0.387*	*0.536*	0.403	*0.301*	*0.541*
Non-European	0.144	*0.092*	*0.227*	0.279	*0.160*	*0.487*
Unknown	0.304	*0.098*	*0.945*	0.000	*0.000*	*0.000*
Educational level (ref. Primary)						
Lower Secondary	1.026	*0.924*	*1.139*	1.000	*0.850*	*1.177*
Upper Secondary	0.916	*0.821*	*1.022*	1.150	*0.974*	*1.358*
Higher	0.704	*0.620*	*0.800*	1.228	*1.022*	*1.476*
Unknown	0.968	*0.848*	*1.104*	0.903	*0.727*	*1.122*
Occupational status (ref. Unemployed)						
Inactive	1.175	*1.023*	*1.350*	1.554	*1.330*	*1.816*
Employee	0.718	*0.624*	*0.825*	0.582	*0.471*	*0.719*
Liberal	0.678	*0.574*	*0.800*	0.762	*0.558*	*1.039*
Unknown	0.730	*0.642*	*0.830*	0.654	*0.539*	*0.794*
Time spent in the housing (ref. Under 1 year)						
1-2 years	0.894	*0.803*	*0.996*	0.922	*0.774*	*1.099*
3-5 years	0.791	*0.708*	*0.884*	0.708	*0.590*	*0.851*
5 years+	1.437	*1.313*	*1.572*	1.417	*1.226*	*1.638*
Subjective health (ref. Very good)						
Good	1.310	*1.201*	*1.430*	1.263	*1.009*	*1.566*
Intermediate	2.642	*2.457*	*2.869*	2.564	*1.978*	*3.268*
Bad	4.460	*4.085*	*4.954*	7.480	*5.946*	*9.370*
Very bad	5.167	*4.371*	*6.136*	12.894	*9.679*	*17.112*
Unknown	1.771	*1.459*	*2.174*	2.530	*1.735*	*3.638*
Failures	4,123			1,573		

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Observations	2,527,183	2,540,061
Log Likelihood	-56060.593	-21987.461

Source: 2001 Census, National register and death certificates (2002-2006). Author's calculations.

Results given in Table A6.11 are very close to those observed in Table 2 regarding the relation between the living environment and suicide. Like in the previous Fine-Gray model, we still notice a higher risk of suicide for men and women living in poorer housing conditions and no clear gradient in the relation between neighbourhood satisfaction and suicide risk. However, the association with other covariates, such as household composition, occupational status, and time spent in the housing, change significantly. For men, being in a non-martial relationship is not associated with a higher risk of suicide compared to being married and living with children. With this model specification, inactive men also show a higher risk of suicide than unemployed men. At the same time, it was not the case before controlling for the alternative outcome, residential mobility. For both men and women, having spent five years and more in the housing before the census is now associated with a higher suicide risk than having spent less than a year. We can assume that moving after a long time in housing can be associated with a life-changing event, such as a union dissolution, hence a high suicide risk.

III. CHAPTER 7

Table A7.1 - Fine-Gray model on the risk of suicide in 2008-2015 expressed in subhazards-ratio and 95% confidence intervals. controlling for the risk of dying from another cause (competing risk).

	Men			Women		
	SHR	*CI95%*		SHR	*CI95%*	
Migration (ref. No)	1.37	*1.28*	*1.46*	1.40	*1.26*	*1.55*
Age group (ref. 20-24)						
25-29	0.78	*0.68*	*0.88*	0.81	*0.63*	*1.03*
30-34	0.93	*0.82*	*1.06*	1.15	*0.92*	*1.45*
35-39	1.21	*1.07*	*1.36*	1.72	*1.39*	*2.12*
40-44	1.38	*1.23*	*1.54*	1.94	*1.58*	*2.38*
45-49	1.18	*1.05*	*1.32*	2.32	*1.90*	*2.83*
50-54	0.99	*0.87*	*1.11*	1.81	*1.47*	*2.22*
55-59	0.67	*0.58*	*0.76*	1.06	*0.85*	*1.32*
60-64	0.98	*0.82*	*1.17*	1.30	*0.96*	*1.76*
Separation during the observation period	1.82	*1.67*	*1.99*	1.78	*1.54*	*2.05*
Living with children	0.96	*0.91*	*1.02*	0.75	*0.68*	*0.82*
Region (ref. Flanders)						
Wallonia	1.12	*1.06*	*1.19*	1.10	*1.00*	*1.21*
Brussels	0.66	*0.59*	*0.75*	0.80	*0.67*	*0.96*
Nationality (ref. Belgian)						
Other European	0.68	*0.59*	*0.77*	0.51	*0.40*	*0.65*
Non-European	0.25	*0.18*	*0.34*	0.15	*0.08*	*0.27*
Educational level (ref. Pimary)						
Lower Secondary	1.29	*1.17*	*1.43*	1.58	*1.33*	*1.89*
Upper Secondary	1.12	*1.01*	*1.24*	1.57	*1.31*	*1.88*
Higher	0.72	*0.64*	*0.81*	1.47	*1.21*	*1.78*
Unknown	0.84	*0.72*	*0.97*	1.19	*0.93*	*1.53*
Occupational status (ref. Unemployed)						
Inactive	1.43	*1.28*	*1.61*	1.68	*1.39*	*2.02*
Employed	0.89	*0.79*	*0.99*	0.84	*0.70*	*1.01*
Liberal	1.07	*0.94*	*1.22*	1.00	*0.77*	*1.29*
Unknown	0.59	*0.43*	*0.81*	0.62	*0.33*	*1.18*

	Men			Women		
Housing tenure (ref. Tenant)						
Owner	0.74	*0.70*	*0.79*	0.70	*0.63*	*0.77*
Unknown	0.75	*0.62*	*0.91*	0.95	*0.70*	*1.29*
Log-likelihood	**-71217.16**			**-27138.10**		

Source: Belgian National Register, death certificates (2008-2015), Census 2011, author's calculations. N= 3,637,761 men and N= 3,608,979 women (total population) observed for 7 years

Table A7.2 - Fine-Gray model on the risk of suicide in 2008-2015, according to the context of the move, expressed in subhazards-ratio and 95% confidence intervals. controlling for the risk of dying from another cause (competing risk).

	Men			Women		
	SHR	CI95%		SHR	CI95%	
Migration (ref. No)						
Mobility, no union change	1.43	*1.33*	*1.54*	1.41	*1.25*	*1.58*
Mobility + union dissolution	1.70	*1.48*	*1.97*	2.15	*1.74*	*2.66*
Mobility + union formation	0.96	*0.84*	*1.11*	0.82	*0.64*	*1.05*
Age group (ref. 20-24)						
25-29	0.82	*0.72*	*0.94*	0.91	*0.71*	*1.16*
30-34	1.02	*0.89*	*1.16*	1.33	*1.04*	*1.69*
35-39	1.36	*1.20*	*1.54*	2.01	*1.60*	*2.51*
40-44	1.60	*1.41*	*1.80*	2.27	*1.83*	*2.83*
45-49	1.38	*1.21*	*1.57*	2.73	*2.20*	*3.40*
50-54	1.18	*1.03*	*1.35*	2.19	*1.74*	*2.74*
55-59	0.81	*0.70*	*0.95*	1.29	*1.02*	*1.65*
60-64	1.24	*1.03*	*1.50*	1.61	*1.16*	*2.21*
Living with children	0.99	*0.93*	*1.06*	0.78	*0.70*	*0.86*
Civil status (ref marital union)						
Nonmarital union	1.27	*1.16*	*1.40*	1.19	*1.01*	*1.39*
Divorced	1.26	*1.14*	*1.38*	1.67	*1.46*	*1.90*
Widow·er	1.14	*0.81*	*1.61*	1.12	*0.85*	*1.48*
Separated	1.88	*1.62*	*2.19*	1.97	*1.51*	*2.57*
Single, unpartnered	1.30	*1.20*	*1.42*	1.56	*1.36*	*1.78*
Region (ref. Flanders)						
Wallonia	1.12	*1.06*	*1.19*	1.08	*0.98*	*1.19*
Brussels	0.66	*0.59*	*0.75*	0.78	*0.66*	*0.94*
Nationality (ref. Belgian)						
Other European	0.69	*0.60*	*0.78*	0.53	*0.41*	*0.66*

	Men			Women		
Non-European	0.27	*0.20*	*0.36*	0.16	*0.08*	*0.30*
Unknown	0.62	*0.15*	*2.52*	0.00	*0.00*	*0.00*
Educational level (ref. Primary)						
Lower Secondary	1.29	*1.17*	*1.43*	1.59	*1.33*	*1.90*
Upper Secondary	1.12	*1.01*	*1.24*	1.55	*1.29*	*1.85*
Higher	0.72	*0.64*	*0.81*	1.44	*1.19*	*1.74*
Unknown	0.84	*0.72*	*0.97*	1.18	*0.92*	*1.51*
Occupational status (ref. Unemployment)						
Inactive	1.42	*1.26*	*1.59*	1.77	*1.47*	*2.14*
Employed	0.91	*0.82*	*1.02*	0.88	*0.73*	*1.07*
Liberal	1.12	*0.98*	*1.27*	1.08	*0.83*	*1.39*
Unknown	0.62	*0.45*	*0.85*	0.65	*0.34*	*1.25*
Housing tenure (ref. Tenant)						
Owner	0.76	*0.71*	*0.81*	0.76	*0.69*	*0.84*
Unknown	0.72	*0.59*	*0.87*	0.93	*0.69*	*1.27*
Log- likelihood	**-71219.03**			**-27095.87**		

Source : Belgian National Register, death certificates (2008-2015), Census 2011, author's calculations. N= 3,637,761 men and N= 3,608,979 women (total population) observed for 7 years

Table A7.3 - Fine-Gray model on the risk of suicide in 2008-2015, of the population in a marital or non-marital union, according to the moving status at the moment of the separation, expressed in subhazards-ratio and 95% confidence intervals. controlling for the risk of dying from another cause (competing risk).

	Men			Women		
	SHR	*CI95%*		SHR	*CI95%*	
Separation (ref. No)						
Separation, no mobility	2.18	*1.90*	*2.50*	2.05	*1.62*	*2.59*
Separation, mobility	2.02	*1.75*	*2.33*	2.73	*2.22*	*3.35*
Age (ref. 20-24)						
25-29	0.73	*0.55*	*0.96*	0.77	*0.51*	*1.16*
30-34	0.84	*0.65*	*1.10*	1.06	*0.71*	*1.57*
35-39	1.12	*0.87*	*1.46*	1.58	*1.08*	*2.30*
40-44	1.21	*0.94*	*1.57*	1.79	*1.24*	*2.59*
45-49	1.04	*0.80*	*1.34*	2.31	*1.61*	*3.31*
50-54	0.83	*0.64*	*1.08*	1.70	*1.18*	*2.44*
55-59	0.57	*0.44*	*0.75*	1.00	*0.69*	*1.47*
60-64	1.07	*0.79*	*1.45*	1.12	*0.68*	*1.85*

Living with children	1.07	*0.99*	*1.17*	0.70	*0.62*	*0.80*
Region (ref. Flanders)						
Wallonia	1.26	*1.17*	*1.36*	1.12	*0.99*	*1.27*
Brussels	0.63	*0.52*	*0.76*	0.59	*0.44*	*0.79*
Nationality (ref. Belgian)						
Other European	0.64	*0.54*	*0.77*	0.60	*0.44*	*0.82*
Non-European	0.27	*0.17*	*0.43*	0.17	*0.07*	*0.42*
Educational level (ref. Primary)						
Lower Secondary	1.19	*1.04*	*1.36*	1.35	*1.07*	*1.70*
Upper Secondary	1.07	*0.93*	*1.22*	1.37	*1.09*	*1.73*
Higher	0.66	*0.56*	*0.76*	1.37	*1.07*	*1.74*
Unknown	0.86	*0.70*	*1.05*	1.19	*0.85*	*1.67*
Occupational status (ref. Unemployed)						
Inactive	1.34	*1.12*	*1.61*	1.49	*1.13*	*1.96*
Employed	0.99	*0.84*	*1.17*	0.87	*0.66*	*1.14*
Liberal	1.18	*0.98*	*1.42*	1.00	*0.71*	*1.40*
Unknown	0.73	*0.51*	*1.06*	0.86	*0.42*	*1.74*
Housing tenure (ref. Tenant)						
Owner	0.72	*0.66*	*0.78*	0.73	*0.63*	*0.83*
Unknown	0.68	*0.49*	*0.95*	0.82	*0.50*	*1.36*
Log-likelihood	**-39014.31**			**-15202.564**		

Source: Belgium National Register and death certificates, 2008-2015, Census 2011, author's calculations. N= 2,220,767 and N= 2,325,092 (in a marital or non-marital relation).

IV.   CHAPTER 8

Table A8.1 - Random-effect logit regression on the risk of consuming at least 90DDD of antidepressants over a year for men and women, expressed in Odds Ratio.

	Men		Women	
	Model 1	Model 2	Model 1	Model 2
N	49,930	49,930	52,786	52,786
Separation period				
2 years and more before separation	1.00	1.00	1.00	1.00
1 year before separation (t-1)	1.63	1.63	1.58	1.58
	[1.52-1.75]	[1.52-1.75]	[1.51-1.68]	[1.51-1.68]
Year of separation (t)	1.80	1.80	1.84	1.82
	[1.67-1.95]	[1.65-1.95]	[1.73-1.95]	[1.71-1.93]
1 year after separation (t+1)	1.13	1.13	1.46	1.45
	[1.04-1.22]	[1.03-1.22]	[1.38-1.55]	[1.37-1.54]
2 years and more after separation	0.99	0.99	1.22	1.21
	[0.92-1.06]	[0.93-1.76]	[1.16-1.30]	[1.14-1.29]
Residential move at t		1.01		1.02
		[0.94-1.08]		[0.98-1.08]
Age				
	1.06	1.06	1.09	1.09
	[1.05-1.06]	[1.05-1.06]	[1.09-1.10]	[1.09-1.10]
Increased reimbursement				
	1.43	1.43	1.30	1.30
	[1.34-1.52]	[1.34-1.52]	[1.23-1.35]	[1.23-1.35]
Parent of resident children				
	0.96	0.96	1.04	1.04
	[0.90-1.02]	[0.90-1.02]	[1.00-1.08]	[1.00-1.08]
Married or in non-marital relationship				
	0.89	0.89	0.92	0.92
	[0.86-0.92]	[0.86-0.92]	[0.90-0.95]	[0.90-0.95]
Region (ref. Flanders)				
Brussels	0.86	0.86	0.68	0.68
	[0.74-0.98]	[0.74-0.98]	[0.61-0.77]	[0.61-0.77]
Wallonia	1.72	1.72	2.10	2.10
	[1.58-1.86]	[1.58-1.86]	[1.97-2.25]	[1.97-2.25]
Incapacity				
	3.25	3.25	2.86	2.86
	[2.97-3.53]	[2.97-3.53]	[2.69-3.03]	[2.69-3.03]
Unemployment				
	1.03	1.03	1.01	1.01
	[1.90-1.15]	[1.90-1.15]	[0.90-1.14]	[0.90-1.14]
Consumption of the partner				
	1.01	1.01	1.00	1.00

	[1.01-1.01]	[1.01-1.01]	[1.00-1.01]	[1.00-1.01]
Change of prescriber				
	4.81	4.81	2.80	2.80
	[4.62-5.00]	[4.62-5.00]	[2.72-2.89]	[2.72-2.89]
Intercept				
	-8.59	-8.59	-8.95	-8.95

Note: N=33,101 (297,909 person-years); and 34,947 women (314,523 person-years), who separated during the observation period of 9 years.

Source: Belgian socialist health insurance fund, authors' calculations.

Note: Depression is measured by the consumption of at least 90DDD of antidepressant.

1. Hypothesis 1

Table A8.2 - Random-effect logit regression on the risk of consuming at least 90DDD of antidepressants over a year for men and women, expressed in Odds Ratio.

	Men			Women		
	OR	*CI 95%*		OR	*CI95%*	
Timing of the separation x Mobility at the moment of the separation						
(ref. 2 years+ before separation x No move)						
1 year before separation x No move	2.05	*1.82*	*2.30*	2.14	*1.95*	*2.33*
Year of separation x No move	2.77	*2.43*	*3.16*	2.86	*2.59*	*3.17*
Year after separation x No move	1.78	*1.56*	*2.03*	2.37	*2.15*	*2.62*
2 years+ after separation x No move	1.77	*1.57*	*1.98*	2.59	*2.37*	*2.83*
2 years+ before separation x Move	1.11	*0.94*	*1.31*	1.35	*1.18*	*1.53*
1 year before separation x Move	2.51	*2.10*	*3.01*	2.84	*2.46*	*3.28*
Year of separation x Move	2.52	*2.07*	*3.08*	2.88	*2.46*	*3.37*
Year after separation x Move	1.71	*1.42*	*2.06*	2.55	*2.21*	*2.94*
2 years+ after separation x Move	2.06	*1.78*	*2.39*	2.68	*2.39*	*3.01*
Age	1.03	*1.03*	*1.04*	1.05	*1.05*	*1.06*
Preferential fees (ref. No)	1.42	*1.30*	*1.55*	1.26	*1.19*	*1.33*
Have children	0.99	*0.92*	*1.07*	1.12	*1.06*	*1.17*
Couple status (ref. Unpartnered)						
Marital union	0.88	*0.79*	*0.98*	0.84	*0.77*	*0.90*
Non-marital union	0.80	*0.73*	*0.88*	0.85	*0.79*	*0.91*
Region of residence (ref. Flanders)						
Brussels	0.73	*0.63*	*0.86*	0.75	*0.66*	*0.86*
Wallonia	1.46	*1.34*	*1.60*	1.60	*1.49*	*1.72*

Temporary work incapacity	3.23	*2.91*	*3.59*	2.96	*2.75*	*3.19*
Long-term work incapacity	6.82	*6.20*	*7.49*	5.61	*5.24*	*6.01*
Temporary unemployment	0.89	*0.79*	*1.01*	0.97	*0.88*	*1.05*
Long-term unemployment	0.99	*0.86*	*1.14*	0.95	*0.86*	*1.05*
Partner's antidepressants consumption	1.00	*1.00*	*1.00*	1.00	*1.00*	*1.00*
Change of prescriber	9.62	*9.12*	*10.15*	5.05	*4.86*	*5.24*
Distance of the move (ref. No move)						
Under 16 km	1.07	*0.96*	*1.18*	1.07	*0.99*	*1.15*
16km and more	1.00	*0.88*	*1.14*	0.95	*0.85*	*1.06*
Constant	0.00	*0.00*	*0.00*	0.00	*0.00*	*0.00*
Panel-level variance component	1.77	*1.72*	*1.82*	1.89	*1.85*	*1.92*
Standard deviation	2.43	*2.37*	*2.49*	2.57	*2.52*	*2.61*
Proportion of the total variance contributed by the panel-level variance component	0.64	*0.63*	*0.65*	0.67	*0.66*	*0.67*

Note: N=33,101 men and 34,947 women who separated during the observation period of 9 years

Source: Belgian socialist health insurance fund, authors' calculations.

Table A8.3 – Predicted probabilities (PP) of consuming at least 90DDD of antidepressants over a year for men and women, according to whether men and women moved during the separation year or not. Moving status is attributed to the whole period (before and after the separation/mobility).

	Men					
	No move			Move		
	PP	*IC95%*		PP	*IC95%*	
2 years+ before separation	0.027	*0.025*	*0.028*	0.028	*0.026*	*0.031*
Year before separation	0.042	*0.039*	*0.045*	0.048	*0.043*	*0.052*
Year of separation	0.050	*0.048*	*0.053*	0.048	*0.043*	*0.052*
Year after separation	0.038	*0.036*	*0.041*	0.038	*0.034*	*0.041*
2 years+ after separation	0.038	*0.037*	*0.040*	0.042	*0.040*	*0.045*

	Women					
	No move			Move		
	PP	*IC95%*		PP	*IC95%*	
2 years+ before separation	0.051	*0.048*	*0.053*	0.060	*0.056*	*0.065*
Year before separation	0.078	*0.074*	*0.082*	0.091	*0.085*	*0.098*
Year of separation	0.092	*0.088*	*0.095*	0.092	*0.086*	*0.098*
Year after separation	0.083	*0.080*	*0.086*	0.086	*0.081*	*0.091*

	OR	CI 95%		OR	CI 95%	
2 years+ after separation	0.087	*0.085*	*0.089*	0.088	*0.085*	*0.092*

2. Hypothesis 2

Table A8.4 - Random-effect logit regression on the risk of consuming at least 90DDD of antidepressants over a year for men and women, expressed in Odds Ratio.

	Men			Women		
	OR	CI 95%		OR	CI95%	
Timing of the separation x Mobility at the moment of the separation						
(ref. 2 years+ before separation x No move)						
1 year before separation x No move	2.11	*1.91*	*2.33*	2.15	*1.99*	*2.31*
Year of separation x No move	2.76	*2.46*	*3.09*	2.90	*2.66*	*3.17*
Year after separation x No move	1.77	*1.58*	*1.99*	2.39	*2.19*	*2.61*
2 years+ after separation x No move	1.75	*1.58*	*1.93*	2.59	*2.40*	*2.79*
Year of separation x Move	2.38	*2.00*	*2.83*	2.54	*2.22*	*2.91*
Year after separation x Move	1.62	*1.38*	*1.90*	2.27	*2.02*	*2.55*
2 years+ after separation x Move	1.96	*1.74*	*2.22*	2.42	*2.21*	*2.65*
Age	1.03	*1.03*	*1.04*	1.05	*1.05*	*1.06*
Preferential fees (ref. No)	1.42	*1.30*	*1.55*	1.26	*1.19*	*1.34*
Have children	0.99	*0.92*	*1.07*	1.10	*1.05*	*1.15*
Couple	0.90	*0.85*	*0.94*	0.93	*0.90*	*0.96*
Region of residence (ref. Flanders)						
Brussels	0.74	*0.63*	*0.86*	0.75	*0.66*	*0.85*
Wallonia	1.46	*1.34*	*1.60*	1.60	*1.49*	*1.73*
Temporary work incapacity	3.23	*2.91*	*3.59*	2.96	*2.74*	*3.19*
Long-term work incapacity	6.82	*6.20*	*7.49*	5.60	*5.23*	*6.00*
Temporary unemployment	0.89	*0.79*	*1.01*	0.97	*0.89*	*1.06*
Long-term unemployment	0.99	*0.86*	*1.14*	0.95	*0.86*	*1.05*
Partner's antidepressants consumption	1.00	*1.00*	*1.00*	1.00	*1.00*	*1.00*
Change of prescriber	9.62	*9.12*	*10.15*	5.05	*4.86*	*5.24*
Distance of the move (ref. No move)						
Under 16 km	1.07	*0.97*	*1.18*	1.07	*0.99*	*1.15*
16km and more	1.00	*0.88*	*1.14*	0.95	*0.85*	*1.06*
Constant	0.00	*0.00*	*0.00*	0.00	*0.00*	*0.00*
Panel-level variance component	1.77	*1.72*	*1.82*	1.89	*1.85*	*1.92*

Standard deviation	2.43	*2.37*	*2.49*	2.57	2.52	2.61
Proportion of the total variance contributed by the panel-level variance component	0.64	*0.63*	*0.65*	0.67	0.66	0.67

Note: N=33,101 men and 34,947 women who separated during the observation period of 9 years

Source: Belgian socialist health insurance fund, authors' calculations.

Table A8.5 – Predicted probabilities (PP) of consuming at least 90DDD of antidepressants over a year for men and women, according to whether men and women moved during the separation year or not. Moving status is attributed from the year of separation.

	Men					
	No move			Move		
	PP	*IC95%*		PP	*IC95%*	
2 years+ before separation	0.027	*0.025*	*0.028*	0.027	*0.025*	*0.028*
Year before separation	0.043	*0.041*	*0.046*	0.043	*0.041*	*0.046*
Year of separation	0.051	*0.048*	*0.054*	0.047	*0.042*	*0.051*
Year after separation	0.039	*0.037*	*0.041*	0.037	*0.033*	*0.040*
2 years+ after separation	0.039	*0.037*	*0.040*	0.041	*0.039*	*0.044*

	Women					
	No move			Move		
	PP	*IC95%*		PP	*IC95%*	
2 years+ before separation	0.052	*0.050*	*0.054*	0.052	*0.050*	*0.054*
Year before separation	0.080	*0.077*	*0.084*	0.080	*0.077*	*0.084*
Year of separation	0.094	*0.091*	*0.098*	0.088	*0.082*	*0.094*
Year after separation	0.085	*0.082*	*0.088*	0.083	*0.078*	*0.088*
2 years+ after separation	0.089	*0.087*	*0.091*	0.086	*0.083*	*0.089*

Note: N=33,101 men and 34,947 women who separated during the observation period of 9 years

Source: Belgian socialist health insurance fund, authors' calculations.

3. Hypothesis 3

Table A8.6 - Random-effect logit regression on the risk of consuming at least 90DDD of antidepressants over a year for men and women, expressed in Odds Ratio.

	Men			Women		
	OR	*CI 95%*		OR	*CI95%*	
Timing of the separation x Mobility at the moment of the separation						
(ref. 2 years+ before separation)						
1 year before separation	2.16	*1.90*	*2.47*	2.31	*2.09*	*2.56*
Year of separation x No move x Single	2.99	*2.47*	*3.61*	3.79	*3.28*	*4.38*
Year after separation x No move x Single	2.02	*1.66*	*2.45*	3.32	*2.87*	*3.84*

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2 years+ after separation x No move x Single	2.19	*1.83*	*2.62*	3.78	*3.30*	*4.33*
Year of separation x Move x Single	2.47	*1.92*	*3.19*	3.06	*2.52*	*3.72*
Year after separation x Move x Single	1.72	*1.35*	*2.19*	3.11	*2.60*	*3.72*
2 years+ after separation x Move x Single	2.65	*2.17*	*3.23*	3.39	*2.92*	*3.95*
Year of separation x No move x Repartner	2.50	*1.42*	*4.40*	3.18	*2.02*	*5.02*
Year after separation x No move x Repartner	1.41	*1.03*	*1.92*	2.29	*1.82*	*2.88*
2 years+ after separation x No move x Repartner	2.31	*1.99*	*2.68*	3.44	*3.06*	*3.86*
Year of separation x Move x Repartner	2.76	*1.56*	*4.90*	1.81	*1.05*	*3.10*
Year after separation x Move x Repartner	2.16	*1.47*	*3.18*	2.13	*1.56*	*2.89*
2 years+ after separation x Move x Repartner	2.63	*2.18*	*3.17*	2.97	*2.56*	*3.46*
Age	1.03	*1.02*	*1.03*	1.05	*1.04*	*1.05*
Preferential fees (ref. No)	1.39	*1.26*	*1.54*	1.23	*1.15*	*1.31*
Have children	0.98	*0.90*	*1.07*	1.11	*1.05*	*1.18*
Couple	0.90	*0.81*	*0.99*	0.99	*0.91*	*1.07*
Region of residence (ref. Flanders)						
Brussels	0.71	*0.60*	*0.83*	0.77	*0.67*	*0.88*
Wallonia	1.44	*1.31*	*1.58*	1.54	*1.42*	*1.68*
Temporary work incapacity	3.01	*2.67*	*3.39*	2.98	*2.73*	*3.26*
Long-term work incapacity	6.63	*5.96*	*7.39*	5.63	*5.19*	*6.10*
Temporary unemployment	0.85	*0.74*	*0.98*	0.99	*0.89*	*1.10*
Long-term unemployment	0.97	*0.82*	*1.14*	0.89	*0.79*	*1.00*
Partner's antidepressants consumption	1.00	*1.00*	*1.00*	1.00	*1.00*	*1.00*
Change of prescriber	12.99	*12.21*	*13.83*	6.70	*6.40*	*7.01*
Distance of the move (ref. No move)						
Under 16 km	1.04	*0.93*	*1.17*	1.08	*0.99*	*1.18*
16km and more	1.06	*0.91*	*1.23*	0.96	*0.85*	*1.09*
Constant	0.00	*0.00*	*0.00*	0.00	*0.00*	*0.00*
Panel-level variance component	1.63	*1.58*	*1.69*	1.77	*1.73*	*1.81*
Standard deviation	2.26	*2.20*	*2.32*	2.42	*2.37*	*2.47*
Proportion of the total variance contributed by the panel-level variance component	0.61	*0.59*	*0.62*	0.64	*0.63*	*0.65*

Note: N=33,101 men and 34,947 women who separated during the observation period of 9 years

Source: Belgian socialist health insurance fund, authors' calculations.

Table A8.7 – Predicted probabilities (PP) of consuming at least 90DDD of antidepressants over a year for men and women, according to whether men and women moved during the separation year or not, and their partnership status (single or repartnered).

	Men											
	No move - Single			Move - Single			No move - Repartner			Move - Repartner		
	PP	*IC95%*		PP	*IC95%*		PP	*IC95%*		PP	*IC95%*	
2 years+ before separation	0.019	*0.017*	*0.020*	0.019	*0.017*	*0.020*	0.019	*0.017*	*0.020*	0.019	*0.017*	*0.020*
Year before separation	0.032	*0.029*	*0.034*	0.032	*0.029*	*0.034*	0.032	*0.029*	*0.034*	0.032	*0.029*	*0.034*
Year of separation	0.039	*0.036*	*0.042*	0.034	*0.030*	*0.039*	0.035	*0.022*	*0.048*	0.037	*0.023*	*0.051*
Year after separation	0.030	*0.028*	*0.032*	0.027	*0.024*	*0.031*	0.024	*0.018*	*0.029*	0.031	*0.023*	*0.040*
2 years+ after separation	0.032	*0.030*	*0.034*	0.036	*0.033*	*0.039*	0.033	*0.030*	*0.036*	0.036	*0.031*	*0.040*

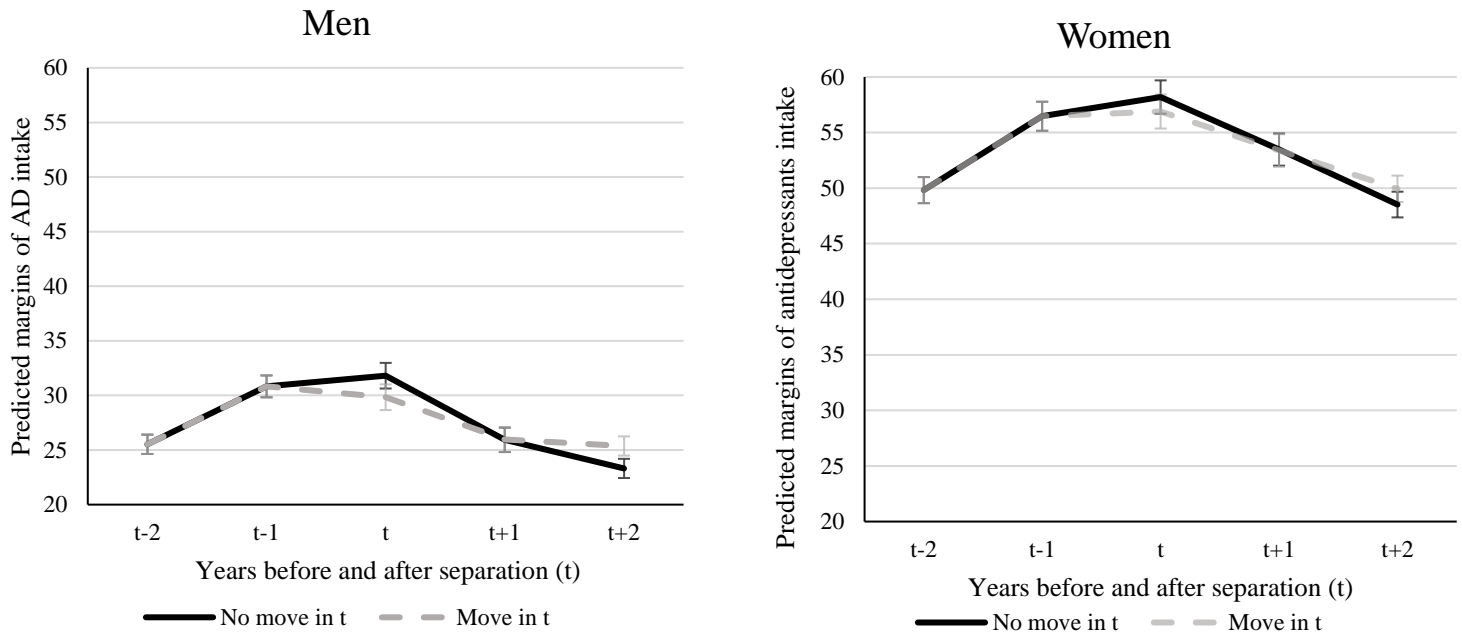|	Women											
	No move - Single			Move - Single			No move - Repartner			Move - Repartner		
	PP	*IC95%*		PP	*IC95%*		PP	*IC95%*		PP	*IC95%*	
2 years+ before separation	0.033	*0.031*	*0.035*	0.033	*0.031*	*0.035*	0.033	*0.031*	*0.035*	0.033	*0.031*	*0.035*
Year before separation	0.056	*0.052*	*0.060*	0.056	*0.052*	*0.060*	0.056	*0.052*	*0.060*	0.056	*0.052*	*0.060*
Year of separation	0.075	*0.071*	*0.079*	0.066	*0.060*	*0.072*	0.068	*0.049*	*0.086*	0.048	*0.032*	*0.064*
Year after separation	0.069	*0.065*	*0.073*	0.067	*0.061*	*0.072*	0.056	*0.048*	*0.064*	0.053	*0.043*	*0.063*
2 years+ after separation	0.075	*0.072*	*0.077*	0.070	*0.066*	*0.074*	0.071	*0.066*	*0.076*	0.065	*0.059*	*0.071*

Note: N=33,101 men and 34,947 women who separated during the observation period of 9 years

Source: Belgian socialist health insurance fund, authors' calculations.

4. Robustness checks – Hypothesis 1

a. OLS models

Figure A8.1 - Predicted margins of antidepressant intake (based on OLS regression models) according to the mobility status of the individual at the moment of the separation (t). The mobility status during the year of separation (t) is attributed from this separation year (not before).
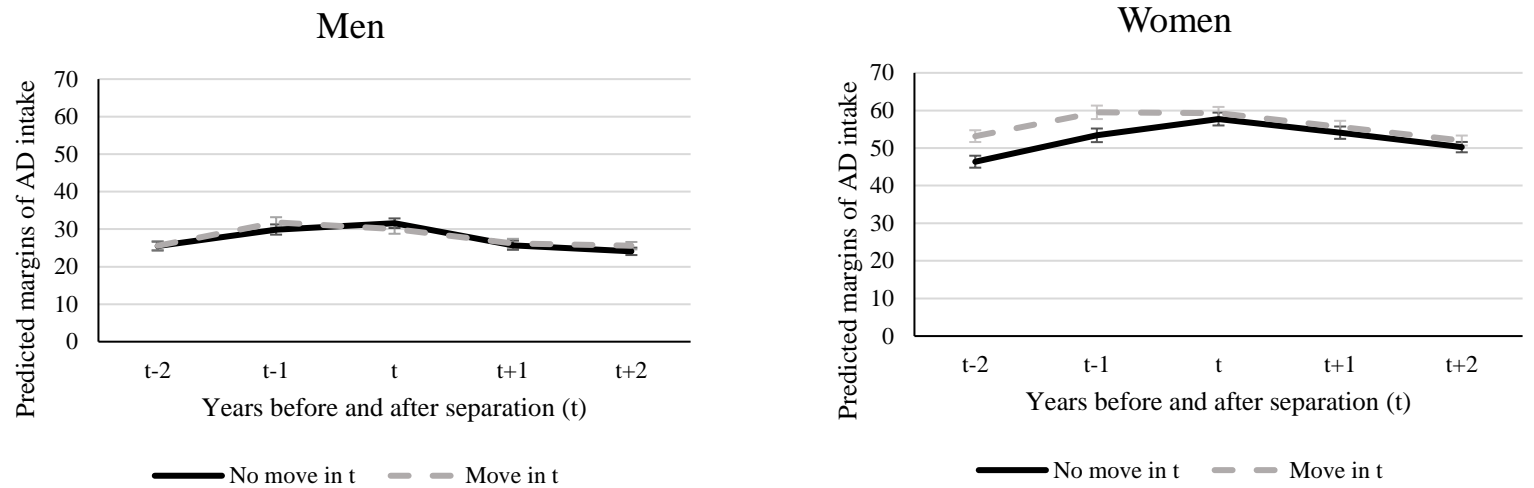

Model controls for age, region of residence, increased reimbursement (proxy of low socioeconomic status), parenthood, couple configuration, work incapacity, unemployment, antidepressant consumption of the partner, change of antidepressant prescriber.

N= 33,101 and 34,947 women observed for 9 years

Source: Belgian socialist health insurance fund, authors' calculations.

Figure A8.2 - Predicted margins of antidepressant intake (based on OLS regression models) according to the mobility status of the individual at the moment of the separation (t). The mobility status during the year of separation (t) is attributed to the whole period (before and after the mobility).
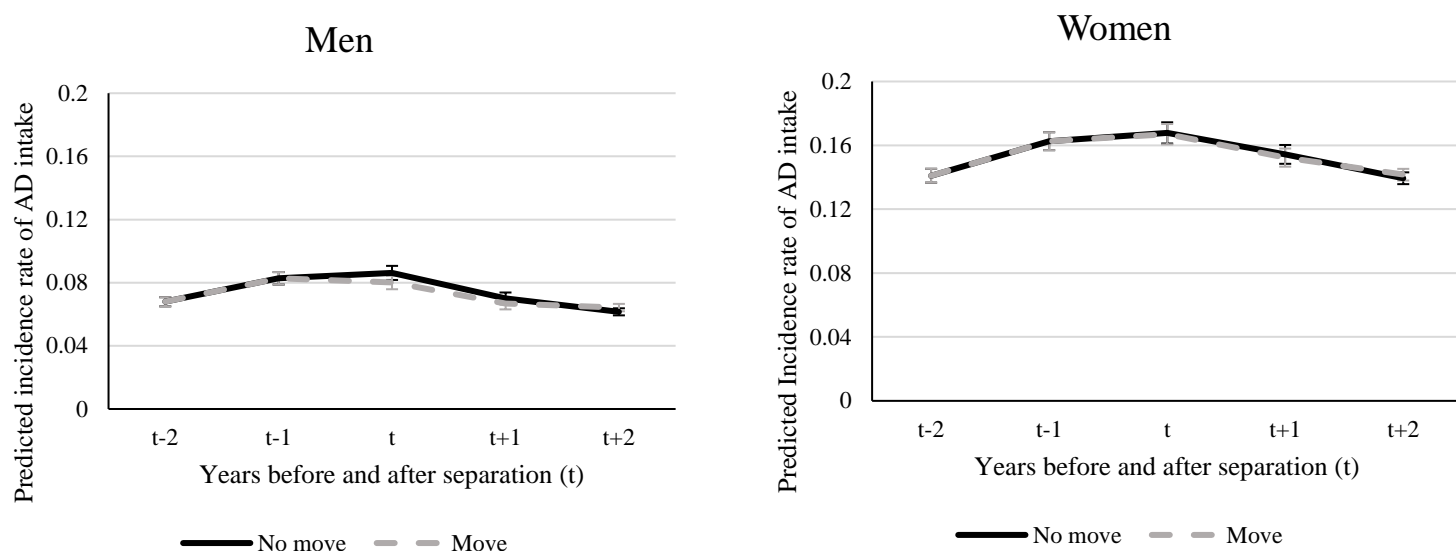
Model controls for age, region of residence, increased reimbursement (proxy of low socioeconomic status), parenthood, couple configuration, work incapacity, unemployment, antidepressant consumption of the partner, change of antidepressant prescriber.

N= 33,101 and 34,947 women observed for 9 years

Source: Belgian socialist health insurance fund, authors' calculations.

b. Poisson models

Figure A8.3 - Predicted incidence rates of depression (based on Poisson regression models) according to the mobility status of the individual at the moment of the separation (t). The mobility status during the year of separation (t) is attributed from this separation year (not before).
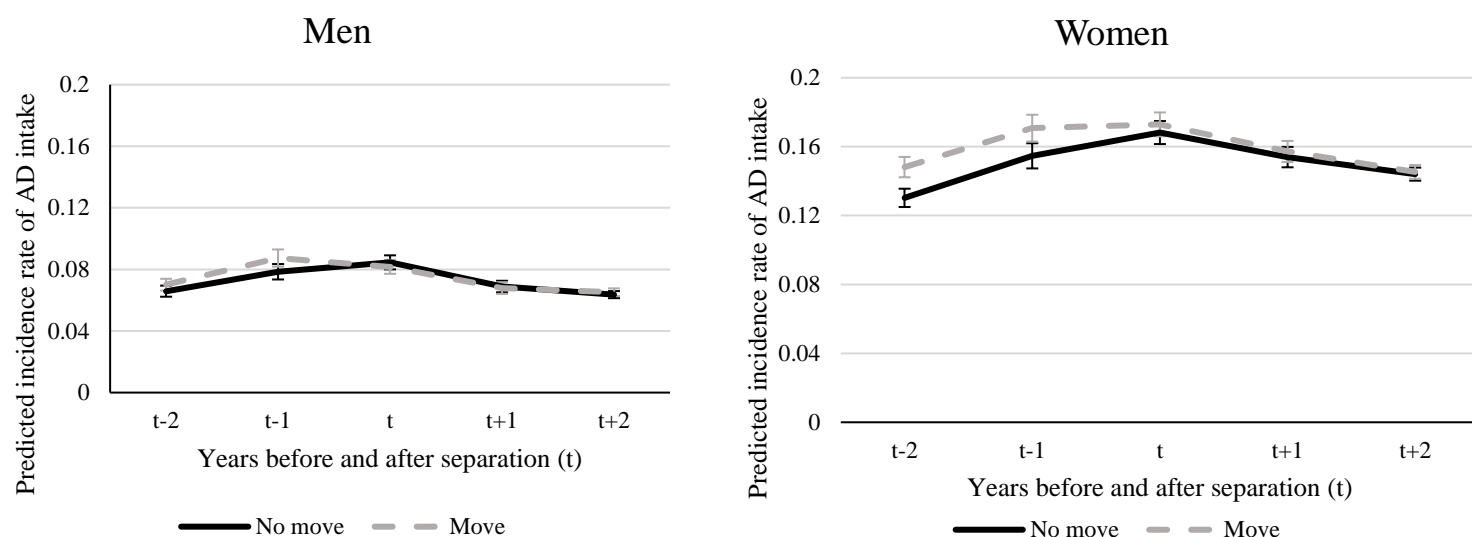
Men

Women

Model controls for age, region of residence, increased reimbursement (proxy of low socioeconomic status), parenthood, couple configuration, work incapacity, unemployment, antidepressant consumption of the partner, change of antidepressant prescriber.

N= 33,101 and 34,947 women observed for 9 years

Source: Belgian socialist health insurance fund, authors' calculations.

Figure A8.4 - Predicted incidence rates of depression (based on Poisson regression models) according to the mobility status of the individual at the moment of the separation (t). The mobility status during the year of separation (t) is attributed during the whole period (before and after the mobility). Source: Belgian socialist health insurance fund.
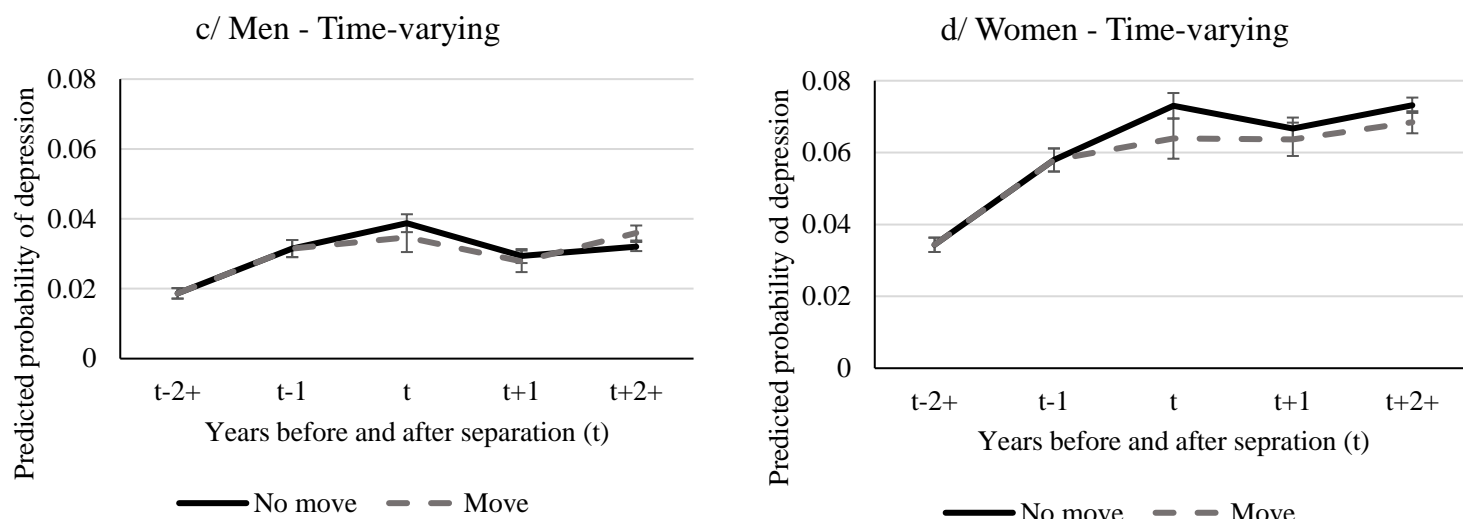
Model controls for age, region of residence, increased reimbursement (proxy of low socioeconomic status), parenthood, couple configuration, work incapacity, unemployment, antidepressant consumption of the partner, change of antidepressant prescriber.

N= 33,101 and 34,947 women observed for 9 years

Source: Belgian socialist health insurance fund, authors' calculations.

6. No consumption at the beginning of observation (in 2008)

Figure A8.5 – Predicted probabilities of a yearly antidepressants intake of at least 90DDD, of men and women who did not consume any antidepressants in 2008 (at the beginning of the observation period), according to their mobility status at the moment of their separation. The moving status is attributed from the moment of the mobility.

Model controls for age, region of residence, increased reimbursement (proxy of low socioeconomic status), parenthood, couple configuration, work incapacity, unemployment, antidepressant consumption of the partner, change of antidepressant prescriber.

N= 30,983 and 30,509 women observed for 9 years

Source: Belgian socialist health insurance fund, authors' calculations.

Figure A8.6 – Predicted probabilities of a yearly antidepressant intake of at least 90DDD, of men and women who did not consume any antidepressants in 2008 (at the beginning of the observation period), according to their mobility status at the moment of their separation. The moving status is attributed during the whole period, before and after the mobility.
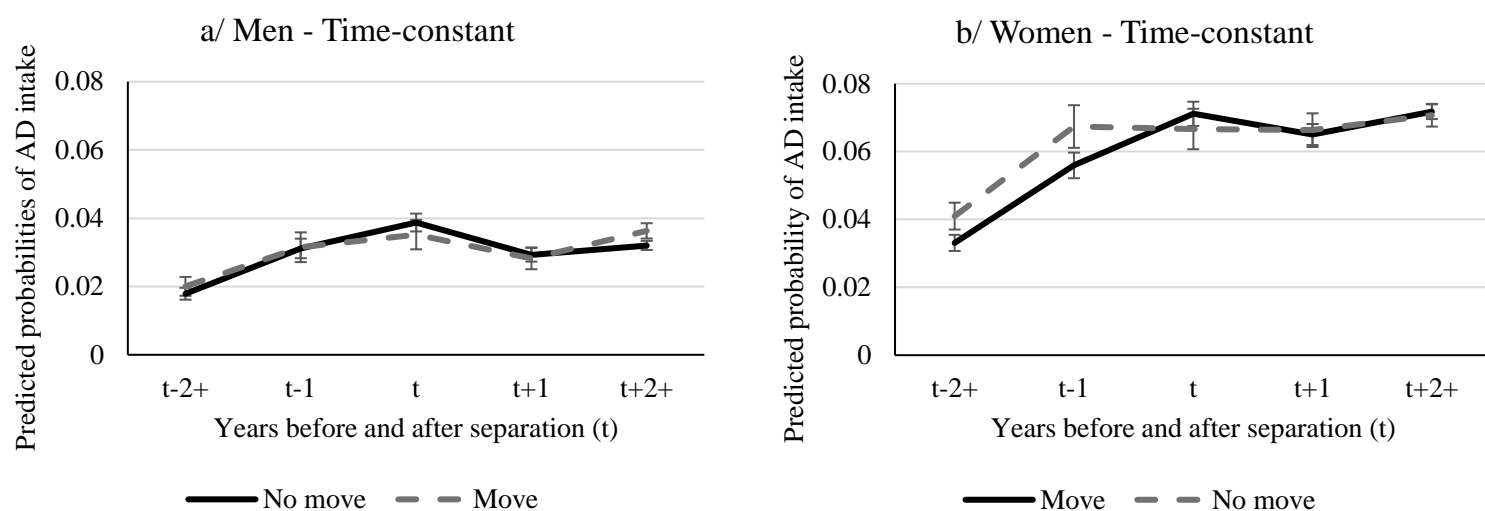

Model controls for age, region of residence, increased reimbursement (proxy of low socioeconomic status), parenthood, couple configuration, work incapacity, unemployment, antidepressant consumption of the partner, change of antidepressant prescriber.

N= 30,983 and 30,509 women observed for 9 years

Source: Belgian socialist health insurance fund, authors' calculations.

7. Additional material

Table A8.8 – Characteristics of the sample population (adults aged 20 to 54 in 2009 and in a relationship in 2009 who will separate in the period 2009-2018), the socialist health insurance (SHI) fund population (all adults aged 20 to 54 in 2009 affiliated to the socialist health insurance fund in 2009) and the Belgian registered population (all adults aged 20 to 54 who are present in the National Register (NR) in 2009).

		Men			Women		
		Sample	SHI population	NR	Sample	SHI population	NR
Region							
	Flanders	43.10%	45.82%	47.37%	43.07%	44.74%	48.85%
	Brussels	9.15%	12.56%	12.00%	9.19%	12.42%	9.33%
	Wallonia	47.75%	41.62%	40.63%	47.75%	42.84%	41.82%
Couple							
	No		59.10%	46.80%		56.18%	40.72%
	Married	55.41%	29.53%	41.97%	56.90%	32.66%	47.12%
	Unmarried	44.59%	11.37%	11.23%	43.10%	11.17%	12.16%
Parenthood							
	No	35.56%	66.98%	57.53%	29.74%	54.95%	48.8%
	Yes	64.44%	33.02%	42.47%	70.26%	45.05%	51.2%
Age							
	20-24	4.37%	12.73%	12.65%	7.40%	12.94%	12.66%
	25-29	12.61%	13.78%	13.14%	16.97%	14.24%	13.38%
	30-34	19.23%	14.16%	13.41%	19.51%	13.86%	13.44%
	35-39	22.18%	15.38%	14.50%	20.18%	14.74%	14.39%
	40-44	20.36%	15.51%	15.43%	16.77%	14.86%	15.20%
	45-49	15.37%	14.65%	15.98%	11.70%	14.97%	15.90%
	50-54	5.89%	13.79%	14.89%	7.46%	14.39%	15.03%
Increased reimbursement							
	No	90.02%	88.81%	87.23%	88.41%	85.33%	84.70%
	Yes	9.98%	11.19%	12.77%[a]	11.59%	14.67%	15.30%[a]
Work incapacity							
	No	98.54%	98.81%		98.00%	98.43%	
	Yes	1.46%	1.19%		2.00%	1.57%	
Unemployment (job seeker for more than half a year)							
	No	87.31%	83.73%		95.63%	82.61%	
	Yes	12.69%	16.27%		4.37%	17.39%	

[a] Source: Institut national d'assurance maladie-invalidité (INAMI); number on December, 31ˢᵗ 2016. Please note that the rate of increased reimbursement has risen by 25% between 2009 and 2017 in the general population (Intermutualistic Agency, s. d.). The numbers are therefore given more for information than for comparison.

In terms of region, the Walloon are slightly overrepresented in the socialist health insurance fund, compared to the Belgian population. The Flemish are underrepresented. However, the sample is particularly present in Wallonia compared to other regions.

Regarding couple configuration, the socialist health insurance fund population is more often single than the general population. Married individuals are underrepresented among the socialist health insurance fund population compared to the Belgians. The Solidaris members have a lower chance of living with children, especially men, than the National Register population. Our sample shows a higher chance of living with children. This was expected as we selected only couples.

The age of the Solidaris population and the Belgian population are somewhat similar. The sample is concentrated on middle-aged adults (aged 30 to 44), with a lower representation of the younger and especially older adults.

The sample shows a lower risk of having an increased reimbursement compared to the overall socialist health insurance fund population, especially for women. This difference seems to be age-related: the proportion of increased reimbursement is higher among the older age categories (Intermutualistic Agency, s. d.)

Work incapacity risk is comparable between the sample and the socialist health insurance fund population. The unemployment risk is slightly higher for the sample population than for the Solidaris population. Job difficulties and transitions can lead to conflicts within the household and financial problems, triggering a separation.