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What Should We Care For?
A Comparative Analysis of the Social Care Needs of Ageing Populations

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Doctoral Thesis Submitted to Obtain the Degree of Doctor in Demography

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Abstract

From being a neglected dimension of societies, we now face what some call a 'care crisis', emphasising its urgency, while others describe it as a 'care revolution', highlighting its potential opportunities. These changes result, among other factors, from the challenges posed by population ageing and the increasing care needs that older individuals are expected to place on social institutions. This dissertation empirically studies these care needs by emphasising the relevance of testing some of our assumptions about their emergence due to the experience of chronic conditions and limitations in performing daily activities. Care needs are explored here through diverse methodological approaches that underline the complex relationship between curing and caring demands. Based on a shared definition of care needs, the thesis offers cross-country comparisons and a gender-sensitive analysis to gain a nuanced perspective on the consequences that ageing might have on social care needs and their linkage to healthcare needs, here defined through the experience of (multi)morbidity. At the same time, it stresses the importance of integrating these two dimensions. To do so, this thesis is composed of five chapters. The first chapter provides an Introduction, presenting the theoretical framework. The second chapter describes and explains unmet care needs in twelve European countries with different social care regimes. The third proposes a combined measure of healthcare needs, understood as multimorbidity, and social care needs to estimate the years of life expectancy with care needs in five Ibero-American countries. The fourth uses sequence analysis techniques to explore complex trajectories from the onset of chronic conditions and the emergence of social care needs in ten European countries. Finally, the fifth chapter introduces the Conclusions, summarising the main findings and their implications in the analysis of these needs. Results from this diverse analysis emphasise social factors differences in the occurrence of healthcare needs, understood as having chronic conditions, and social care needs, based on experiencing limitations for moving or performing Basic Activities of Daily Living, that are principally related, but not exclusively, to countries' specific characteristics, gender, age and socioeconomic status. Instead of framing the care needs of older individuals as a negative consequence of ageing, it is stated that having a better understanding of these healthcare and social care needs is an opportunity to reimagine care provision more democratically.

Keywords: Social care needs, Multimorbidity, Cross-country comparisons, Europe, Latin America

Resum

De ser una dimensió descuidada de les societats, ara ens trobem davant el que alguns anomenen una "crisi de les cures", destacant-ne la urgència, mentre que altres la descriuen com una "revolució de les cures", destacant les seves potencials oportunitats. Aquests canvis són el resultat, entre altres factors, dels reptes que planteja l'envelliment de la població i les creixents necessitats d'atenció que s'espera que les persones grans generin a les institucions socials. Aquesta tesi estudia empíricament aquestes necessitats de cures destacant la rellevància de posar a prova algunes de les nostres hipòtesis sobre la seva aparició a causa de l'experiència de condicions cròniques i limitacions per a la realització de les activitats diàries. Les necessitats de cura s'exploren aquí mitjançant diversos enfocaments metodològics que subratllen la complexa relació entre la curació i les demandes de cura. A partir d'una definició compartida de necessitats de cures, es fa una comparació entre països, així com una anàlisi sensible al gènere per obtenir una perspectiva matisada de les conseqüències que l'envelliment de la població podria tenir sobre les necessitats d'atenció social i la seva vinculació amb les necessitats de serveis sanitarisdefinides a través de l'experiència de la (multi)morbiditat. Al mateix temps la tesi destaca la importància d'integrar aquestes dues dimensions. Per fer-ho, aquesta tesi està composta per cinc capítols. El primer capítol ofereix una Introducció, que presenta el marc teòric. El segon capítol descriu i explica les necessitats de cures no cobertes en dotze països europeus amb diferents règims de cura social. El tercer proposa una mesura combinada de les necessitats de serveis sanitaris, instrumentalitzades com a presència de multimorbiditat, i les necessitats de cura social per estimar els anys d'esperança de vida viscuts amb aquestes dues necessitats en cinc països iberoamericans. El quart utilitza tècniques d'anàlisi de seqüències per explorar trajectòries complexes des del sorgiment de malalties cròniques i l'aparició de necessitats de cura social en deu països europeus. Finalment, el cinquè capítol introdueix les Conclusions, resumint els principals resultats i les seves implicacions en l'anàlisi d'aquestes necessitats. Els resultats d'aquesta diverses anàlisis posen l'accent en les diferències de factors socials en la demanda de necessitats de serveis sanitarisi la presència de necessitats de cura social, basades en experimentar limitacions per moure's o realitzar Activitats Bàsiques de la Vida Diària, que estan relacionades principalment, però no exclusivament, amb les característiques específiques dels països, el gènere, l'edat i l'estat socioeconòmic. En lloc d'enquadrar les necessitats d'atenció de les persones grans com a conseqüència negativa de l'envelliment de la població, s'afirma que tenir una millor comprensió d'aquestes necessitats assistencials i socials és una oportunitat per reimaginar les prestacions de cures de manera més democràtica.

Paraules clau: Necessitats de cura social, Multimorbiditat, Comparacions entre països, Europa, Amèrica Llatina

Resumen

De ser una dimensión desatendida de las sociedades, ahora nos enfrentamos a lo que algunos llaman una “crisis de los cuidados”, enfatizando su urgencia, mientras que otros la describen como una “revolución de los cuidados”, destacando sus oportunidades potenciales. Estos cambios son el resultado, entre otros factores, de los desafíos que plantea el envejecimiento de la población y las crecientes necesidades de cuidado que se espera que las personas mayores generen en las instituciones sociales. Esta disertación estudia empíricamente estas necesidades de cuidado, enfatizando la relevancia de poner a prueba algunos de nuestros supuestos sobre su surgimiento debido a la experiencia de condiciones crónicas y limitaciones para el desempeño de las actividades diarias. Las necesidades de cuidado se exploran aquí a través de diversos enfoques metodológicos que subrayan la compleja relación entre las demandas de curar y cuidar. Basada en una definición compartida de necesidades de cuidado, la tesis ofrece comparaciones entre países y un análisis sensible al género para obtener una perspectiva matizada sobre las consecuencias que el envejecimiento de la población podría tener en las necesidades de cuidado social y su vínculo con las necesidades de atención médica, aquí definidas a través de la experiencia de (multi)morbilidad. Al mismo tiempo, destaca la importancia de integrar estas dos dimensiones. Para ello, esta tesis se compone de cinco capítulos. El primer capítulo proporciona una Introducción, presentando el marco teórico. El segundo capítulo describe y explica las necesidades de cuidados insatisfechas en doce países europeos con diferentes regímenes de cuidado social. El tercero propone una medida combinada de las necesidades sanitarias, entendidas como multimorbilidad, y las necesidades de cuidado social para estimar los años de esperanza de vida con necesidades de cuidados en cinco países iberoamericanos. El cuarto utiliza técnicas de análisis de secuencia para explorar trayectorias complejas desde la aparición de enfermedades crónicas y el surgimiento de necesidades de cuidado social en diez países europeos. Finalmente, el quinto capítulo introduce las Conclusiones, resumiendo los principales hallazgos y sus implicaciones en el análisis de estas necesidades.Los resultados de estos diversos análisis enfatizan las diferencias de factores sociales en la ocurrencia de necesidades de salud, entendidas como tener condiciones crónicas, y necesidades de cuidado social, basadas en experimentar limitaciones para moverse o realizar actividades básicas de la vida diaria, que se

relacionan principalmente, pero no exclusivamente, con las características específicas de los países, el género, la edad y el estatus socioeconómico.. En lugar de enmarcar las necesidades de cuidado de las personas mayores como una consecuencia negativa del envejecimiento de la población, se afirma que tener una mejor comprensión de estas necesidades de atención en salud y cuidado social es una oportunidad para reimaginar la prestación de cuidado de manera más democrática.

Palabras clave: Necesidades de atención social, Multimorbilidad, Comparaciones entre países, Europa, América Latina

After almost a year of caring for a life so fragile that she couldn't speak up for herself, my mom saw hers go in August 2011. This thesis is for Claudia, my mother, Adriana, my cousin, and all the women who cared for Martha Lucía, my grandmother.

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I am deeply inspired by your wise and brave hearts!

Preface

Demographers frequently consider populations as sets of individuals whose aggregation constitutes a whole to be described, measured, and studied. People within a population are typically connected by shared characteristics, such as being part of a cohort, living in a particular territory, or being part of a group defined by race, class, gender, or sexual identity. However, populations are more than the summation of individuals; social mechanisms that affect and shape demographic trends keep us together. There is something in the substratum of our life together: as humans, we need to be cared for to survive from the very beginning of our lives. Despite prevailing ideologies that equate independence and individualism with freedom, the reality is that in no economy, social division of labour, or democracy, can we do it all by ourselves, as we depend on others' care and support. Therefore, social care plays a crucial role in maintaining societies and populations.

Nevertheless, societies usually take social care for granted; we assume it is given rather than arranged. More importantly, we forget that it should be organised according to specific demographic demands. In her book about Caring democracy, Joan Tronto puts care back in the middle of democracy: "There is no universally equal solution to the problem of care needs. Indeed, care often seems to be highly non-democratic, especially if one presumes that care professionals know more than care receivers about the best way to care. Or, if one presumes that care receivers are dependent on others, it seems difficult to return to a framework that presumes that people are independent" (2013, p. 10). The following pages of this dissertation are aligned with these perspectives on care and democracy in two main ways. First, I recognise the importance of social care for demographic analysis, as something that challenges democracy nowadays, which extends beyond population ageing, and supposes the quest for local (or at least country-specific) solutions. Second, I emphasise the importance of understanding older individuals' needs and unmet needs for social care, avoiding previous assumptions about what ageing implies for their health, dependency, disability, or experience of limitations, also by highlighting how these needs are shaped by gender. Instead of assuming the relationship between chronic conditions and disability as a mechanical one, resulting from the limitations emerging from the experience of chronic conditions, I tried to show its complexity by exploring it through different approaches.

Three essays, referring to analytical studies, compose the core of this thesis, seeking to contribute to debates about social care needs and provide a more nuanced perspective of how population ageing, alongside gender and country differences, shapes them. There isn't a perfect formula to

respond to the needs of older individuals. However, healthcare and social care systems should be better integrated and tailored to guarantee older individuals' rights and well-being by accounting for their specific needs. This idea can be found throughout these essays, underscoring the importance of cross-country and gender comparisons when exploring specific needs and consequences emerging from ageing. The results presented here are aligned with a general recommendation, a mantra in the literature about inclusive and equitable healthcare and social care provision: *we should better understand individuals' needs to respond to them*.

This doctoral dissertation was conducted during my three years of enrollment in the Demography program, which I formally started in October of 2022 at Universitat Autònoma de Barcelona. However, some of the ideas presented here, especially those referring to unmet care needs, were partially developed between 2021-2022 while I was attending the European Doctoral School of Demography (EDSD), sponsored by the Centre d'Estudis Demogràfics (CED). My doctoral research was supported by the Spanish Ministry of Science and Innovation [PRE2021-09779] through the CED, a member of the CERCA group under the Catalan regional government (Generalitat de Catalunya). This pre-doctoral contract also allowed me to undertake a research stay in the Núcleo de Estudos de População Elza Berquó (NEPO) at Universidade Estadual de Campinas (UNICAMP), which was crucial for the estimations of life expectancy with care needs, as presented in the third chapter of this dissertation. Additionally, I received funding from the R & D projects COMORHEALTHSES [PID2020-113934RB-I00] and WELLHEALTHFAM [PID2023-152779OB-I00], both led by Dr. Jeroen Spijker and Dr. Elisenda Rentería, whose novel demographic research has advanced the study of wellbeing, health, multimorbidity and social care needs among older individuals.

Contents

List of tables and figures

1. Introduction

Population ageing is usually framed as a challenge due to the expected needs that older individuals might pose to social institutions. Nevertheless, this process could also be seen as an opportunity to reimagine them according to our specific needs (Rechel et al., 2013). Social care provision is particularly in the spotlight due to the increasing shares of older individuals within populations (Christensen et al., 2009). From being an invisible and neglected dimension of society, we are facing what some authors have called a care crisis (Parkes, 2021) or a care revolution (Tronto, 2013), which implies putting old and current ways of caring under the microscope. Ongoing transformations in care provision have revealed the protagonist role that it plays in the existence of society itself and the power it holds for democratic societies (Fisher & Tronto, 1990). At the same time, these changes have shown social inequalities arising from current care arrangements, power relationships that shape its provision, and finally, the disproportionate burden of care assumed by families and women within families in the absence of robust social care systems (Kröger et al., 2019; Rechel et al., 2009; Uccheddu et al., 2019).

Demographic research has notably contributed to a better understanding of how fertility, morbidity, mortality, and migration trends shape social care demand and supply (Bauernschuster et al., 2016; Scott, 2021; Spijker et al., 2022; Williams, 2010). However, much of this work has been rooted in different assumptions about ageing that might not hold. The primary assumption states that ageing at the population level is necessarily followed by the increase of multimorbidity and dependency, and therefore of social care needs, something that has been discussed by analysis of the complex relationship between mortality and morbidity (Fries, 2002; Gruenberg, 1977; Manton, 1982; Vaupel, 2010). Secondly, it is assumed that there will be a shortage in the care supply due to the second demographic transition and the increment of older individuals without children and other living family members able to provide care, or for instance of couples simultaneously experiencing social care needs without any other available source of informal care (Cantor, 1991; Krakowiak, 2020; Lesthaeghe, 2014; Spijker et al., 2022; Tennstedt et al., 1993), hitherto supposing that all older individuals' will, in fact, need social care as they age. Thirdly, economic analysis of healthcare and social care expenditures in ageing societies usually projects that governments won't be able to pay for these services' increasing costs (Blawat et al., 2020; Breyer & Lorenz, 2021; Kasteridis et al., 2014). A fourth common supposition is based on dependency rates, which use the proportion of

older individuals (either at 60+ or 65+) as a key indicator to predict, from a demographic perspective, a population's ability to meet future social care demands. At the same time, a branch of the literature has empirically tested the underlying idea that population ageing directly translates to higher social care demands. Rather than assuming social care "needs" based solely on age, this research focuses on assessing the actual needs of older individuals (Bień et al., 2013; Spijker et al., 2022; Tesch-Römer & Wahl, 2016; Vlachantoni et al., 2011).

I aim to contribute to this research by exploring through cross-country comparisons and gender specific analyses how these social care needs change from one population to another, vary between men and women, and also differ by the socio-demographic indicators that I included in some of the analyses presented here. By doing so, I emphasise that measuring needs rather than supposing them, as the inevitable result of getting old, is a better approach to respond to the current and future social care demands, especially when adapting our societies to guarantee older individuals' well-being. To do so, I highlight the relevance of understanding these social care needs and exploring their complex linkage with healthcare needs. This involves avoiding a mechanical idea or an assumed increase in social care needs as a result of ageing or the consequence of the emergence of a disease, which will allow us to explore some alternative scenarios of its onset. This linkage is explored in this thesis mainly through its co-occurrence, even though this relationship could be approached in many other ways. Here, healthcare needs are approached through the concept of (multi)morbidity, which refers to the experience of chronic conditions. Even though in many cases the experience of (multi)morbidity translates into increasing social care needs, in this thesis I aim to show that this association does not always occur, at the same time that I underline that these healthcare needs arising from multimorbidity imply a variety of implications on social care needs. Meanwhile, social care needs are approached as the experience of limitations for moving or performing basic and instrumental activities of daily living, which will probably imply the need for someone else's support.

There is no magic recipe for responding to transformations resulting from demographic change. However, understanding needs is part of a broader effort that we can make to adjust and design tailor-made care policies that can improve not only older individuals' lives but also our societies. In this thesis, social care needs are explored in different ways, using both cross-sectional and longitudinal data, as well as classic (descriptive statistics and regression models) and more novel methods (sequence analysis and healthy life expectancy indicators combining states of social care and multimorbidity) for understanding population trends. Based on a common definition of social

care needs, this work studies them through three analyses comparing some European and Latin American countries and exploring the gender differences in each one of them. Despite the differences in the countries included in each one of the analytical chapters and how I operationalised older adults' healthcare and social care needs, these three analyses are interwoven by some shared aspects aiming to examine gender and cross-country differences in the relationship between healthcare needs, multimorbidity, and social care needs arising from facing certain limitations. The general framework used for these analyses is presented in this Introduction. Firstly, I explain why healthcare needs associated with (multi)morbidity and social care needs should be studied from a demographic perspective, followed by the main objectives orienting this thesis. Secondly, I provide the general methodological aspects, including information about the data and the methods used. Finally, at the end of this Introduction, I offer a detailed outline of the three analytical chapters that compose this thesis, as well as the aspects presented in the Conclusions. By approaching social care needs in different countries, I aim to contribute to the evidence about how we can prepare for the ongoing and future ageing process and how thinking about social care from a demographic perspective contributes to current debates about caring.

1.2 Curing and caring as a demographic question

Demographers have previously approached healthcare needs, associated with (multi)morbidity and social care needs, arising from limitations in performing basic Activities of Daily Living (ADL) and Instrumental Activities of Daily Living (IADL), in many ways. Much of the current literature about life expectancy and mortality emphasises that morbidity, the experience of chronic conditions, and healthy life expectancy (measured through GALI, self-rated health or disability free) are important dimensions of population outcomes and demographic trends (Robine et al., 2009; Vaupel, 2010). At the same time, research on social care needs has also addressed the measurement of unmet needs and undermet needs for social care (Tesch-Römer & Wahl, 2016). This literature has shown how gains in life expectancy and population ageing raise questions about older adults' needs, which social factors explain these, and how different social and policy arrangements approach them (Ariaans et al., 2021; Ashokkumar et al., 2012; Breyer et al., 2010; Lam et al., 2024; Ophir & Polos, 2022; Pickard et al., 2007; Shen & Payne, 2023; Spijker & Zueras, 2020). These questions are related to individuals' well-being during the further years they are living due to gains in life expectancy, which in turn are related to changes in their healthcare needs and social care needs. Throughout this dissertation, I refer to this as a switch from curing to caring. This highlights how, during ageing processes, curing diseases is not always possible. Therefore, most interventions

should be oriented towards caring, which here implies delivering healthcare services as well as to provide social care or support.

However, the relationship between healthcare needs rising from (multi)morbidity and social care needs remains barely analysed in this literature and is often assumed rather than critically examined (Simpson et al., 2023). In general, there is a supposed causal relationship or linear path between becoming older, experiencing health deterioration, developing a chronic condition that may later be accompanied by others, and the emergence of limitations for performing ADL and IADL, which are related to disability, dependency and, consequently, the need for social care and support (Madero-Cabib et al., 2022); this lineal pathway is rarely contested. Nevertheless, in recent years, several scholars have explored the complex relationship between health problems associated with multimorbidity and social care needs (Simpson et al., 2022; Spiers, 2019) and much of this literature is particularly focused on projecting the future demand and costs of healthcare and social care services (Kingston et al., 2018; Nepal et al., 2011; Wittenberg & Hu, 2015). From a demographic perspective, studying this relationship adds another layer to current debates about life expectancy and healthy life expectancy by demonstrating that commonly used indicators of mortality compression or expansion are not comprehensively capturing how ongoing transformations —ranging from technological medical development to new geriatric approaches— might imply another kind of linkage between healthcare and social care needs. Notwithstanding, there is a gap in the literature on the subject regarding cross-country and gender differences that might emerge in the relationship between chronic conditions and the emergence of limitations or disability.

While previous studies on life expectancy and healthy life expectancy clearly emphasise the differences due to gender, countries and regions of the world, the question about how individuals live increased years due to gains in life expectancy calls for adding another dimension to our debates about morbidity and mortality (Lam et al., 2024; Shen & Payne, 2023). This means combining measures of social care and support with multimorbidity indicators when we analyse the quality of life related to life expectancy improvements. Moreover, this perspective affects not only the demographic discussion about healthy life expectancy but also long-term debates about the burden of diseases and the red herring hypothesis, which emphasises that the unaffordable costs of healthcare needs are not being fuelled by population ageing (Breyer & Lorenz, 2021; Skirbekk et al., 2022; Spijker, 2023; Zweifel, 2022). By studying social care needs, I also tried to illustrate how the complex relationship between healthcare needs, emerging from chronic conditions facing

limitations, implies: on one hand, rethinking what we understand as the burden of disease, highlighting that the experience of diseases might vary from one individual to another; on the other hand, emphasising that the consequences and outcomes of diseases do not always lead to a profound deterioration in quality of life, and vary between men and women and across countries.

Moreover, the assumption that population ageing translates into increasing social and healthcare demands, something that welfare systems and policies cannot take on is questioned by a branch of literature exploring the linkage between healthcare and social care needs (Brown & Menec, 2019; Kuluski et al., 2017; McGilton et al., 2018). Findings from this research have highlighted that even though biological ageing often comes with health deterioration and dependency, this is not true for all individuals, and the relationship between healthcare and social care needs is much more complex (Simpson et al., 2023). Nevertheless, evidence on the subject exploring the specific differences between men and women, as well as how this occurs at the country level, shaped by specific policies, is still scarce. For instance, we still should analyse more comprehensively how healthcare needs associated to chronic conditions translates into the experience of limitations for ADL and IADL, meaning the emergence of social care needs (Cezard et al., 2021), and how this might differ by gender and how this is defined at the national level by specific policies and health trends.

1.2.1 Operationalising healthcare needs associated with (multi)morbidity and social care needs

For consistently studying healthcare and social care needs, in this thesis, I have operationalised them based on previous studies. Therefore, the used variables worked as proxies of these needs. On the one hand, I used the experience of chronic conditions as an indicator of healthcare needs, which is aligned with evidence about long-term care and healthcare utilisation costs (Blawat et al., 2020; Kasteridis et al., 2014). Furthermore, the third and fourth chapters refer to two different categories of healthcare needs: morbidity, here defined as the experience of one chronic condition, and multimorbidity, understood as having more than one chronic condition. This division between morbidity and multimorbidity was done based on evidence regarding differences in the healthcare needs of individuals who have two or more chronic conditions (Calderón-Larrañaga et al., 2017; Marengoni et al., 2009, 2011). In the second chapter, there is no specific variable accounting for multimorbidity. However, the analysis accounted for the experience of at least one chronic condition and self-rated health, an indicator proven to be a robust measure of individuals' health (Kananen

et al., 2021). The conditions included in the third and fourth chapters varied due to the categories' availability in the used surveys. Further details are provided in the methodological section of each chapter.

The definition of social care needs was based on previous literature, defining them as the experience of limitations for performing daily activities essential to individuals' lives (Vlachantoni, 2019; Vlachantoni et al., 2011). These limitations are categorised into Activities of Daily Living (ADL), Instrumental Activities of Daily Living (IADL), and mobility-related tasks. The specific limitations included in the analysis varied depending on data availability, but they referred to basic activities like getting into or out of bed or being able to deal with one's medication. More detailed information about the included limitations can also be found in each chapter. Nevertheless, it is important to mention that there is no agreement regarding which ADL and IADL should be included, nor on whether mobility limitations should be considered as social care needs. The decision to classify any limitation in these areas as a social care need was based on the idea that individuals facing them probably need someone else's support to perform these tasks (Maplethorpe et al., 2015). Furthermore, I conducted sensitivity checks to decide whether to include or not mobility-related tasks as limitations, getting similar results.

Nevertheless, two main issues arise from how I operationalised these variables. The first is the assumption that experiencing a limitation directly translates into a need. When referring to social care needs, it is possible that individuals facing limitations do not need to perform the specific task because someone else is already doing it for them, for instance, cooking or buying groceries. Still, if this is the case, social care needs do exist and are already being met. The second limitation is that these measures do not account for the severity of the social care needs, as other research has been able to do (Lefèvre et al., 2014; Spijker & Zueras, 2020; Warner et al., 2011). In this regard, some previous studies have analysed its severity by grouping the number of limitations, as done in the second chapter. However, this wasn't done in the other chapters because severity was considered by including chronic conditions and multimorbidity. Finally, it is worth mentioning that the experience of these needs might vary across countries, given the diverse ways healthcare and social care systems approach them. Still, it is relevant to keep in mind that the linkage between healthcare and social care needs is importantly shaped by social structures that, alongside underlying mortality, morbidity, and disability patterns, vary from one country to another and are the result of specific configurations of welfare states, healthcare systems, and social care regimes. Hence, cross-country comparisons are informative when analysing them.

1.2.2 Cross-country comparisons of healthcare and social care needs

Variations of morbidity and mortality trends across countries have been a frequent subject of demographic analysis (Bień et al., 2013; Macinko et al., 2019; Souza et al., 2021; Welsh et al., 2021). Many demographic methods have been developed to disentangle the factors underlying cross-country variability regarding indicators like life expectancy and healthy life expectancy (Horiuchi et al., 2008; Robine et al., 2009; Sullivan, 1971). Explaining differences between countries has been the focus of much of the literature about mortality, health, and disease. In this sense, different theories have been behind these cross-country and regional comparisons. I used three main theories as a framework for understanding differences regarding healthcare and social care needs, as well as the changing relationship between them. These theories are the Demographic transition (Caldwell, 1976), the Epidemiological transition (Omran, 1998), and the Health transition (Frenk et al., 1991). In general, these theories complement each other as they refer to interwoven processes. For instance, reductions in infant mortality described by the first demographic transition are related to epidemiological changes described by the second stage of the epidemiological transition, which was only possible worldwide due to improvements in the determinants of health at the individual and structural level, including, among other things, advances of sewage systems, vaccination programs, and coverage expansion of healthcare systems, as explained by the health transition.

Despite their heuristic power, some critics of these theories have been raised due to their inability to refer to non-Western scenarios (Alvarez et al., 2020; Calazans & Queiroz, 2020; Frenk et al., 1991; Mercer, 2018). Among the limitations of the standard versions of these theories, their linear and evolutionary logic has been pointed out as the main one, especially when they put the Western experience as the reference pathway for transitions in the Global South. However, empirical evidence from Latin America, Africa, and Asia shows that the stages described by these transitions have not followed the same path in the same way by the Global North countries (Frenk et al., 1991; Phoon, 1989; Stower, 2019). Even though the first demographic transition has been experienced widely, findings regarding the epidemiological transition and the health transition in Latin America underscore heterogeneous panoramas (Borges, 2017; Gómez Dantés et al., 2011; Gómez-Dantés et al., 2016). For instance, since the 1980s, scholars have pointed out that the epidemiological transition is deeply related to the broader process of the health transition and that in non-Western countries, this has been characterised by polarisation, stage overlapping, and counter-transitions,

explained by persistent inequalities both between and within countries and regions (Frenk et al., 1991).

While the analyses presented in this thesis's second and fourth chapters align well with the classic postulates about these transitions when referring to Europe, the third chapter empirically challenges the evolutionary assumption behind them. There are two main intentions behind providing cross-country comparisons of Ibero-American countries: firstly, to show that differences in the way that the transitions have occurred are not the result of Latin American countries' inability to fit the European process, rather than the outcome of diverse epidemiological and mortality trends that generates a heterogenous scenario with effects on their healthcare and social care needs. Additionally, and most importantly, the consequences of ageing regarding these healthcare and social care needs are not the same for all countries, and therefore, when defining policies for this specific demographic challenge, we should account for their particularities. Furthermore, the second and the fourth chapters highlight that country differences in Europe exist and are significant, calling our attention to the need to keep exploring why some countries, regardless of having a shared history in the demographic, epidemiological, and health transition, have better outcomes than others and the need to seek more evidence regarding positive or successful experiences in preventing and meeting social care needs.

Differences between countries might be explained by their specific healthcare and social care systems configurations, along with their integration (or lack thereof). The integration of healthcare and social care systems refers to their joint capacity to approach individuals' needs from a holistic perspective, which implies not only dealing with the symptoms of chronic conditions but also with the consequences they might have on individuals' lives. In the second chapter, I emphasise that these are partially explained by diverse social care regimes (Pfau-Effinger, 2005). There is no agreement on the typology of social care regimes, nor on which is the care regime of each country (Ariaans et al., 2021; Damiani et al., 2011). Nonetheless, the literature on the subject recognises a spectrum between countries that usually rely on family-provided care, characteristic of Southern European countries (Hrast et al., 2020), to those that are more focused on publicly or privately funded care provision, as seen in Nordic European countries (Kröger et al., 2019). Cross-country comparisons of social care regimes are more common in Europe than in Latin America. However, while the former region is more heterogeneous despite being centred around welfare state policies (Pfau-Effinger, 2005), countries in the latter region are characterised by different forms of family-centred care provision, largely due to their fragile welfare states (Guimarães & Hirata, 2020).

Another dimension of cross-country differences is explained by the diverse levels of integration between healthcare and social care systems, which might shape different outcomes regarding multimorbidity and social care needs. Even though policymakers and empirical evidence call for enhancing the integration between these two systems (Dambha-Miller et al., 2021), this varies widely from one country to another, despite the existence of similar care regimes (Bień et al., 2013; Krakowiak, 2020; Moberg, 2021). The third and fourth chapters are less focused on understanding these differences than the second one. However, they draw attention to the importance of responding to the needs of the older population by understanding them within their specific context, and to try to identify why some countries achieve better outcomes than others. Furthermore, two other factors or health determinants that are included throughout the analyses presented here are gender and age.

1.2.3 Age and gender as determinants of healthcare and social care needs

When studying healthcare needs emerging from multimorbidity and social care needs related to facing limitations, age and gender are particularly relevant as health determinants because of the higher dependency and multimorbidity rates expected at older ages (Kingston et al., 2017; Marengoni et al., 2009), and due to persistent differences between men and women in their mortality, morbidity and disability patterns (Jackson et al., 2015; Oksuzyan et al., 2010; Zarulli et al., 2018). Regarding age groups, it is worth mentioning that in the thesis, the cut-off points for including individuals in specific analytical samples were defined as 50+, 60+, and 65+; the reasons behind these different starting ages were data availability or the specific studied phenomenon. For instance, in the second chapter, 65+ was chosen as the starting age because the analysis focused on individuals expected to be experiencing social care needs, which become significant from age 65 onwards. Meanwhile, in the third chapter, 60+ was used due to data availability across all included data sources. Finally, in the fourth chapter, I included adults aged 50+ to explore different trajectories in the experience of at least one chronic condition, which typically develops before age 60.

The age variable was generally analysed through age groups, and, when possible, I grouped individuals by quinquennial ages. Due to smaller sample sizes, decennial age groups were created in the third chapter. As expected, it would be better to provide analysis by single years. However, when using data from surveys, it is difficult to avoid age grouping due to sample size limitations, especially when other categories such as gender and states of (multi)morbidity and social care

needs are included for comparative analysis. Moreover, for the oldest age group, the upper limit was generally set either at 80+ or 85+. The decision on which of these two cut-off points to use varied in each chapter again due to differences in sample sizes. Even though demographic research on population ageing has called attention to the importance of mortality and morbidity trends occurring within the broad 80+ age group (Strozza et al., 2020), when it comes to nationally representative samples, the information is also affected by small sample size and selection bias caused by the institutionalisation of individuals at these older ages. Therefore, when defining these last age groups, several tests were conducted in each of the analyses to find the most reliable way to close the analysed ages.

Likewise, gender was a key variable in the studies presented here. In general, as a category of analysis, it was helpful to identify women's and men's experiences regarding healthcare needs related to chronic conditions and social care needs, as well as differences between them. I used the term gender instead of sex because there is an agreement that in these analyses, the differences between men and women are widely explained by social aspects rather than biological ones (Mauvais-Jarvis et al., 2020). However, this is an open debate within demography and beyond it (Butler, 1990; Fausto-Sterling, 2000), especially when combining survey data that ask respondents directly about how they identify themselves, with data from mortality registers that are usually based on sex determined by medical practitioners. Nevertheless, the core reason for including gender as a central variable in each one of the chapters is the fact that previous evidence has shown important differences in the ageing consequences for men and women (Crimmins et al., 2011; Oksuzyan et al., 2010). Most of this literature refers to the health survival-paradox hypothesis that emphasises that, almost worldwide, women have higher life expectancies than men but tend to live more years in poor health (Oksuzyan et al., 2010; Van Oyen et al., 2013; Zarulli et al., 2018). Gender differences shape life trajectories, risk accumulation, and exposure, and, therefore, are a crucial aspect to understanding differences in life expectancy and healthy life expectancy, and discussing morbidity expansion or compression, furthermore, these are deeply affected by socio-cultural contexts.

Gender differences are also critical in understanding the ongoing debate between morbidity compression and expansion. While some argue that longer life expectancies experienced by women are accompanied by prolonged periods of ill health (morbidity expansion), others suggest that medical advancements and improved disease management are enabling individuals to live longer with fewer disabling conditions (morbidity compression or dynamic equilibrium). Evidence

from Shen and Payne (2023) suggests that although morbidity is expanding, its impact on disability is diminishing, particularly for higher-educated individuals, which aligns with the dynamic equilibrium model. However, men are more likely to stay disability-free despite experiencing chronic conditions when compared to women. Conversely, Lam et al. (2024) highlight stark educational and cross-national inequalities in multimorbid life expectancy, reinforcing the persistence of morbidity expansion in certain populations. Nevertheless, these authors also found that women tend to spend less time without chronic conditions than men, and that the experience of chronic conditions starts to accumulate earlier in women's lives, which translates to longer periods with these when compared to men. These perspectives underscore the importance of considering gendered experiences in health and ageing, as women, despite their longevity advantage, tend to experience greater periods of multimorbidity and disability than men.

Additionally, research regarding social care needs has also emphasised differences between men and women. For instance, and aligned with the health survival-paradox, women seem to have more limitations and live longer with these than men. These differences are widely explained due to the gender gap in life expectancy and healthy life expectancy (Crimmins et al., 2019; Oksuzyan et al., 2010). However, when it comes to analysing social care needs, it is also important to consider the social differences that are attached to recognising one's limitations or disabilities, as well as the lack of received support. Women may be more prone to seek healthcare and social care (Höhn et al., 2020). Likewise, the gendered division of labour has also negatively impacted women's health and social care needs (Young & Grundy, 2008). Even though this can vary from one social care regime to another, evidence from very different countries has shown that women are the most common social care providers, both formal and informal (Félix-Vega et al., 2024; Vicente et al., 2022), and that the burden of this work usually has adverse effects on their health (Bom & Stöckel, 2021; Rentería et al., 2023; Uccheddu et al., 2019; Zueras & Grundy, 2024). Also, being the primary social care providers within families exposes them to unmet social care needs when they must be cared for by others and compete for scarce resources. Lastly, it is worth mentioning that in some of the analyses presented here, other variables were included to understand the experience of healthcare associated with multimorbidity and social care needs. These variables referred to different dimensions of individuals' lives, including socioeconomic status, measured by education level and housing tenure, and care availability, measured through living arrangements, as other research has emphasised its power for explaining care needs (Spijker & Zueras, 2020; Vlachantoni, 2019).

1.3 Objectives

The main objective of this thesis is to examine healthcare needs related to multimorbidity and social care needs, arising from facing limitations, among older individuals in countries at different stages of the ageing process, emphasising the gender differences in the experience of these needs. This overarching goal is addressed through the following three secondary objectives:

- To analyse cross-country differences that emerge in the analysis of healthcare needs and social care needs and their relationship with various micro and macro-level factors.
- To identify how gender explains the differences in the experience and trajectories of healthcare and social care needs.
- To apply demographic and other statistical methods for measuring and analysing healthcare needs and social care needs as indicators of the challenges faced by ageing populations.

1.4 Materials and methods

In this section, I provide an overview of the most relevant methodological aspects of the analyses presented in the core of this thesis (chapters two to four). However, it is important to note that each analytical chapter includes its own methodological section, which provides further details regarding sample composition and the specific methods used. Broadly, this thesis used a range of methods that span from descriptive statistics to inferential, cluster, and sequence analysis. These methods also combine both cross-sectional with longitudinal analyses. By doing so, I tried to provide a diverse overview of how social care needs and their relationship with healthcare needs associated with multimorbidity can be studied. These different methodological designs and cross-country comparisons required the use of specific data sources, which are schematically described below.

1.4.1 Data and comparative analyses

Two main data sources were used in the analyses presented here: surveys and mortality data. Surveys on ageing, which are available in countries from different regions, were used to obtain information on healthcare needs related to the experience of chronic conditions and social care needs emerging from facing limitations for moving and performing ADL and IADL, age, gender, and other sociodemographic variables. These surveys are usually nationally representative of older adults living in non-institutionalised households. Since the beginning of the 21st century, this kind of data has been collected, given the relevance of population ageing for both social research and

policymakers. Their questionnaires usually include sections related to health, limitations, well-being, care, and, in some cases, retirement. One of their main advantages is that they are generally harmonised *ex-ante*, even though wording for included questions, as well as response options, might vary from one country to another.

For European countries, the data used comes from the Survey of Health, Ageing and Retirement in Europe (SHARE), which is a longitudinal survey conducted every two years in 27 European countries and Israel. The SHARE provides *ex-ante* harmonised data for all the included countries, and its unit of analysis is individuals aged 50 and older and their partners living in private households; it also allows longitudinal analysis and contains information regarding the death of included participants over time (Bergmann et al., 2019; Börsch-Supan, 2022). In the case of the included Latin American countries, the following three surveys were used: the Brazilian Longitudinal Study of Ageing (ELSI) (Lima-Costa et al., 2018), the Mexican Aging and Health Study (MHAS) (Wong et al., 2023) and the Colombian Study of Health, Wellbeing, and Ageing (SABE) (Ortega Lenis & Mendez, 2019). These surveys share some common qualities with SHARE regarding the topics they address and the included questions. However, while the ELSI and the MHAS collect longitudinal data, SABE provides only cross-sectional data. The selection of these surveys for the analysis was based on data availability by country and period after screening for similar population-based surveys within the region (see Table A1.1 from the Appendix for more information). Even though these surveys are comparable to the SHARE, they have particularities that imply a harmonisation process to use them in cross-country comparisons. Further details are provided in the Research Design section of the third chapter.

For the third chapter, mortality data from different sources were also used. For the two European countries included in the analysis (Spain and Portugal), I obtained data from the Human Mortality Database (HMD) (Barbieri et al., 2015). In the Latin American countries (Brazil, Colombia, and Mexico), mortality data were sourced from their official statistical departments (respectively IBGE, DANE and CONAPO, by their Spanish abbreviations). As previously mentioned, there are some advantages to conducting cross-country comparative analysis when assessing healthcare needs due to multimorbidity and social care needs emerging from facing limitations. Nevertheless, there are some challenges related to data harmonisation and the use of self-reported measures. These challenges are particularly relevant when it comes to analysing chronic conditions, which here serve as proxies of healthcare needs. The conditions included in European and Ibero-American surveys differ, and variations in access to healthcare systems can impact the likelihood of diagnosis

of these conditions, particularly among vulnerable populations. This potential bias can also affect the reporting of limitations used to measure social care needs, since the perception of limitations might vary across cultures, and limitations may not be perceived as such when enough support for dealing with them is already being provided.

1.4.2 Methodological approaches

The three analytical chapters that compose this thesis are based on different methodological approaches. For the second and third chapters, descriptive measures of social care needs were used. Moreover, the third chapter also includes a measure of the Years of Life Expectancy with Care Needs (YLCN) estimated using Sullivan's Method (1971) and a decomposition of the gender gap in healthy life expectancy by states combining healthcare needs associated to multimorbidity and social care needs through Horiuchi's et al. method (2008). Finally, the fourth chapter uses sequence analysis to explore trajectories of healthcare needs emerging from the experience of chronic conditions and social care needs (Billari, 2001). Inferential methods, referring to logistic regressions and multinomial regression models, are also used in the second and fourth chapters to explore the different sociodemographic factors that might explain the experience of diverse trajectories of healthcare needs and social care needs, as well as of unmet social care needs. These different methodological approaches aim to show diverse dimensions of these needs.

Furthermore, when combining cross-country analysis (second and third chapters) with longitudinal ones (fourth chapter), this thesis aims to capture the dynamic nature of social care needs and how they change over time (Vlachantoni et al., 2022). Despite the limitations of cross-sectional analysis in showing this dynamic character, they provide useful insights into the prevalence of these needs and offer a perspective on future scenarios that account for regional and country-specific needs. At the same time, they highlight key aspects to consider when adapting healthcare and social care systems to meet older individuals' needs. To guarantee that cross-country comparisons hold, some sensitivity checks were done (particularly for the second and third chapters). When needed, other types of tests were conducted to contrast different measures of social care needs (for the second and third chapters) and ways of building distance matrices for measuring sequences' similarity when creating trajectories of healthcare needs emerging from multimorbidity and social care needs (for the fourth chapter). Further details about these tests can be found in each of the analyses.

1.5 Outline of what can be found in the core chapters

Aside from this Introduction, the dissertation is composed of three analytical chapters that are followed by the Conclusions, summarising the main results as well as the limitations, implications, and policy recommendations derived from the analysis. The first analytical chapter, titled "Cared and Uncared Populations" measures unmet care needs in twelve European countries characterised by different social care regimes that are grouped as "Mediterranean", "Western", "Nordic" and "Eastern", referring to the different ways in which formal and informal care provision is arranged, based on previous evidence (Kröger et al., 2019; Pfau-Effinger, 2005). This analysis aims to emphasise that, regardless of the diversity of formal and informal care arrangements in the region, they are still unable to meet the care needs of all. The second analytical chapter, named "Between Curing and Caring", proposes a combined measure of healthcare needs associated with multimorbidity and social care needs emerging from ADL and IADL. Based on previous debates about morbidity compression and expansion (Lam et al., 2024; Shen & Payne, 2023), I suggest that healthy life expectancy indicators should be complemented by also accounting for social care needs and that these measures vary from one country to another, which is evident when comparing five Ibero-American countries. Finally, the third analytical chapter, called "From Curing to Caring," explores the complex trajectories from the onset of chronic conditions and the emergence of healthcare needs due to multimorbidity and social care needs related to facing limitations for moving and performing ADL and IADL in ten European countries. Even though we usually think about ageing as a linear path from disease to deterioration and the need for social support, these trajectories are more complex (Madero-Cabib et al., 2022). In this chapter, I identified four different trajectories and pathways that are also explained by individuals' sociodemographic characteristics and cross-country variations. Overall, this thesis makes a case for the necessity of having a better understanding, based on empirical data rather than assumptions, of the healthcare needs emerging from multimorbidity and social care needs of older individuals within ageing populations, and how these are shaped by national contexts, gender differences, and other determinants.

2. Cared and Uncared Populations: Understanding Unmet Care Needs of Older Adults (65+) Across Different Social Care Systems in Europe[1]

Abstract

Population care needs are dynamic. They change throughout individuals' life courses and are related to the population structure. These needs are particularly demanding due to population ageing and may vary depending on how societies cope with them. This study explored the unmet social care needs of individuals in twelve European countries with different social care systems. Data used came from the seventh wave of the Survey of Health, Ageing and Retirement in Europe (SHARE) to conduct a cross-sectional study of individuals aged 65 and over with care needs (*n* = 7136). Unmet care needs were measured from an absolute approach. We fitted binomial regression models to explain the relative importance of individuals' characteristics, health status and different social care systems on unmet needs. The absolute measure shows that 53.02% of the analytical sample faced unmet care needs as they reported limitations and did not receive help. The prevalence of unmet care needs is higher for men than women and for younger than older individuals. Furthermore, we found that individuals living in Mediterranean social care systems have the highest prevalence of these unmet needs. This analysis contributes to the ongoing debate about the challenges posed by ageing populations and their relationship with care.

Keyword: Social care systems; Ageing; Unmet care needs; Care provision; Europe

2.1 Background

Care is a basic need of human beings throughout their life. As anthropological and philosophical work has suggested, care constitutes individuals' personhood (Buch, 2015) and acts as the foundation of society itself (Fisher & Tronto, 1990). The most paradoxical aspect of care, however, is that it is usually recognised because of the lack of it. People usually feel they are not receiving enough care when they stop being cared for or when new care needs emerge. Furthermore, demographic dynamics fundamentally impact social care demand and supply (Spijker et al., 2022). For instance, care needs are not the same between populations in the earlier stages of the demographic transition, characterised by high fertility rates where children take up most of the care and the social services, in comparison with those in the fourth stage of the transition that are facing

[1] A similar version of this chapter was coauthored with Dr. Pilar Zueras and was published as: Calderón-Jaramillo, M., Zueras, P. Cared and uncared populations: understanding unmet care needs of older adults (65+) across different social care systems in Europe. Eur J Ageing 20, 11 (2023). https://doi.org/10.1007/s10433-023-00760-3

population ageing processes and challenges regarding caring for older people (Bom & Stöckel, 2021; Rechel et al., 2013). European countries are forerunners in this fourth stage of the demographic transition that will affect many countries worldwide (Vaupel & Kistowski, 2008). Therefore, Europe is a critical scenario for understanding population ageing effects on care provision, policies, and welfare systems. Previous literature has highlighted that care is affected by its gendered provision, as it is mainly given by women for most of their lives, a trend that only changes at oldest ages when husbands are the main providers (Schmid et al., 2012; Uccheddu et al., 2019; Young & Grundy, 2008); the central role played by the family and informal care provision, regardless the social care system in which it takes place (Pickard et al., 2007; Tennstedt et al., 1993); and new changes in the design and use of social services aimed to provide long-term care and adapting them to the challenges posed by ageing populations (Cantor, 1991; Davey, 2017; Spijker & Zueras, 2020).

Some authors have suggested that we are facing a care crisis driven by demographic dynamics leading to population ageing and changes in family trajectories, household units, and social and economic transformations (Pérez Orozco, 2006). Discussions about care provision have also underlined how it is affected by policy changes (Pfau-Effinger, 2005) and social perceptions about ageing and support that usually shape specific care systems to help people with disabilities and those facing limitations in daily life. However, in many societies, some individuals are not receiving the support they need and are facing unmet care needs that can negatively affect their health, well-being, and life expectancy. In this article, we aim to analyse the unmet care needs experienced by people aged 65 and over within twelve European countries. We examined the socio demographic characteristics of middle-age and older adults with care needs and estimated the prevalence of unmet care needs in the following social care systems: the Mediterranean, characterised by family-based care provision; the Nordic, where care provision is strongly linked to welfare-state services; the Western, where care provision is articulated between informal and formal care provision, also including the participation of private providers; and, the Eastern, which used to be based on 'familialist' care provision but has undergone various transformations since the fall of the Berlin Wall.

2.1.1 Different typologies for understanding social care systems

Social care is conceptualised as the coexistence of informal and formal care activities that address three primary needs: socialisation, activities of daily living and personal needs related to severe disability (Cantor, 1991). The differences between social care systems are related mainly to how

informal and formal care are organised. For example, family-centred systems rely primarily on informal care, whereas welfare-state-centred systems emphasise the availability of formal care through its provision by people who are not relatives. Theoretically, the configuration of social care systems relates to values (Pfau-Effinger, 2005), ancient family systems (Reher, 1998), religion (Damiani et al., 2011), and the structural socioeconomic context (Ariaans et al., 2021) that have shaped care provision itself as well as public policies related to it. The starting point for exploring unmet care needs is the recognition that social care systems may fail to provide universal coverage, access, and funding for individuals' care needs. This idea also emphasises that the relationship between formal and informal care provision is not always virtuous, that the availability of one of these types of care does not guarantee the availability of the other, and access to both does not necessarily lead to all care needs being met. For example, there may be times of the day when the individuals have no one to help them, or certain tasks for which they do not get the help they need.

The literature on social care systems mainly focuses on childcare and infants' care needs; meanwhile, the one referred to care for the older population is based on different typologies. These have been built according to theoretical or empirical perspectives. The theoretical approach focuses on the configuration of the welfare state within Europe, where care systems fall on the spectrum of family-centred care (Hrast et al., 2020) and social care services directly or indirectly provided by the welfare state (Bergmark et al., 2000; Pfau-Effinger, 2005). This theoretical framework refers especially to service provision and articulation between informal and formal care provision. On the other hand, the empirical approach has constructed different typologies of social care systems using statistical methods such as clustering and principal components analysis. Previous evidence has focused on OECD, high-income and middle-income countries and has emphasised diverse aspects of care provision like service availability, public expenditure, care demand, performance, and regulation (Ariaans et al., 2021; Damiani et al., 2011). Despite the importance of this approach, one of its main limitations is that the demographic dynamics in care provision remain barely explored. Furthermore, there is no consensus on which aspects or dimensions should be included when constructing typologies of social care regimes. These may vary from one country to another, not only due to the specific care needs faced by their populations but also because of the very different historical pathways by which these systems were configured.

In this article, we focused on the theoretical typology to explore unmet care needs in countries where social care systems have been shaped by a long-term history of their social policy. In Europe, social care systems were driven by the integration of women into the labour market at the end of

the twentieth century. Before, social care provision relied mainly on kin-related women. This change implied a formalisation of social care provision, which occurred at different intensities in each country and involved diverse ways in which informal and formal care providers were arranged (Pfau-Effinger, 2005). Our theoretical definition is based on the level of involvement expected from families or governments to provide social care. The spectrum ranges between family-centred and government-centred care provision. With some nuances, Southern European countries, like Spain, can be identified as examples of the former care regime (Spijker et al., 2022), whereas Nordic countries, like Sweden, are more aligned with the latter (Kröger et al., 2019). However, there are many countries in which care is arranged in-between. For instance, Eastern countries are undergoing transformations aimed at increasing government support for care provision, although such support often remains precarious (Krakowiak, 2020). Meanwhile, Western European countries have been more prone to combine informal and formal care depending on the severity needs and the family's capacity to provide care, even though they are still very family-centred when compared to the Nordic care regimes (Kaschowitz & Brandt, 2017).

2.1.2 Measuring unmet care needs

Underlying the measurement of unmet care needs is the discussion about social care services and how informal and formal care are articulated through policies, public institutions, households, and families (Broese van Groenou & De Boer, 2016; Uccheddu et al., 2019). However, research on this topic has stressed the challenges of measuring unmet care needs among the ageing population (Allen et al., 2014; Bień et al., 2013; Dunatchik et al., 2019; Stein et al., 2020). These difficulties, by and large, occur because surveys do not usually include enough information about care provision and the quality of care received. Consequently, its analysis should be done through indirect estimations based on questions about experiencing functional limitations that affect the performance of daily life activities.

Evidence on the subject has identified different dimensions of these functional limitations and distinguishes between mobility, Activities of Daily Living (ADL) and Instrumental Activities of Daily Living (IADL) (Ćwirlej-Sozańska et al., 2019; Mlinac & Feng, 2016; Wolinsky et al., 2011). The definition used here is based on previous work by Vlachantoni's et al (2011), where unmet care needs from an absolute approach refer to the type and amount of support received by someone who reports functional limitations (mobility, ADL and IADL) and is, consequently, assumed to require help but does not report receiving it. Previous evidence has shown the importance of demographic and socioeconomic circumstances on people's needs and unmet care needs and has

emphasised that socioeconomic variables like housing tenure and education level may explain the experience of unmet needs (Maplethorpe et al., 2015; Vlachantoni, 2019). It has also called attention to the relationship between unmet needs, health conditions (McGilton et al., 2018), and types of limitations faced (Mlinac & Feng, 2016).

In this article, we explore two hypotheses about the unmet care needs of people over 65 based on previous literature. Firstly, due to women's greater longevity and likelihood of being widowed and living alone (Delbès et al., 2006), as well as the fact that those with the worst health and financial circumstances have less access to care provision outside the home (Dupraz et al., 2020), we hypothesised that women in the older age group, in poor health and with low educational attainment (Momtaz et al., 2012), would be most likely to face unmet needs (Hypothesis A). Second, in terms of issues related to the functioning of social care systems, there are concerns about the availability of informal care provision and its limits in meeting the increasing demand for care (Pickard et al., 2007; Tennstedt et al., 1993). Hence, we hypothesised that the propensity to have unmet care needs would be higher among middle-aged and older adults living in countries with family-centred social care systems (Mediterranean) than in countries with other types of state participation (Hypothesis B).

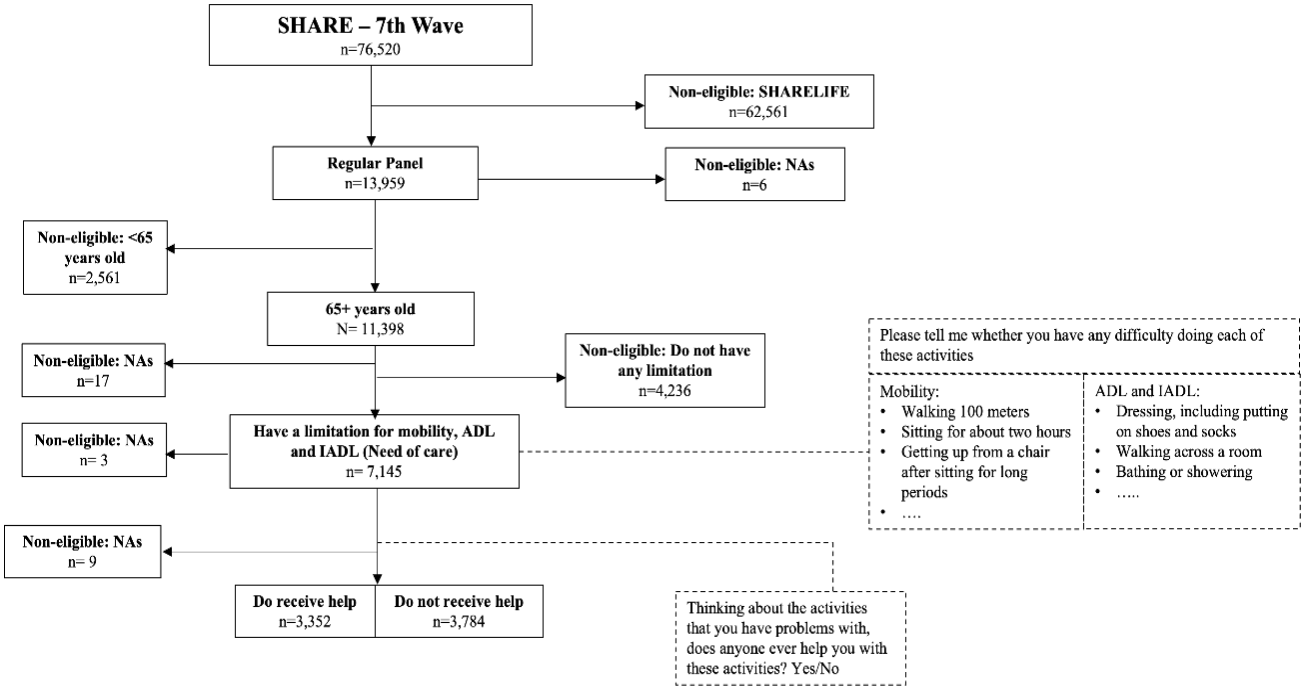
2.2 Data and methods

2.2.1 Data

This cross-sectional study uses data from the seventh wave of the Survey of Health, Ageing and Retirement in Europe (SHARE), collected in 2017 (Börsch-Supan, 2022). The SHARE provides harmonised longitudinal data through eighth waves about individuals aged 50 and older, and their partners, from 28 participant countries (27 European countries plus Israel). The eighth wave of SHARE, with more recent data, is currently available, but was collected during the COVID-19 pandemic when many changes in older adults' lives and care provision at the household level took place (Lebrasseur et al., 2021). In the seventh wave, the module about physical health included questions about functional limitations and care received by individuals (Börsch-Supan et al., 2013). However, the relevant questions for this study were not available in all countries. We selected 12 countries based on the availability of the studied variables concerning facing limitations in daily life and receiving help (or not) for coping with these limitations. The analytical sample was composed of individuals who reported having limitations in performing at least one activity related to moving, ADL or IADL. Figure 2.1 includes the flowchart and questions to illustrate the selection process of

the analytical sample. The selected sample was of 7,136 individuals with complete information for the questions about facing any of the previously mentioned limitations and care received.

Figure 2.1. Flow chart for the selection of the analytical sample



Note*:* ADL: Activities of Daily Living; IADL: Instrumental Activities of Daily Living.
Source: Survey of Health Ageing and Retirement in Europe - SHARE, seventh wave (2017)

2.2.2 Analytical strategy

The analysis of unmet care needs consisted of two steps. Firstly, we measured the percentage of people with absolute unmet care needs by type of limitation and analysed these measures by age, gender, and social care system. Secondly, we conducted a multivariate analysis regressing the binary dependent variable of absolute unmet need for social care (0 = received care; 1 = did not receive care) considering socio-demographic and health variables: gender, age group, educational level, marital status, housing tenure, living arrangements, self-rated health, chronic disease, and type of limitations. These variables are ex ante harmonised through the SHARE, which are also harmonised with similar surveys from other countries like the ELSA (England) and the HRS (US) (Börsch-Supan, 2017). The variables are measured indirectly through individuals' responses and were selected based on available evidence on unmet care needs, in particular on Vlachantoni's previous study of England, with data from the ELSA (2019). Finally, given the purpose of this study, the variable accounting for the European countries' clusters by social care systems was also included.

Regression models were built using a forward method and were aligned with the two hypotheses. Model one included the individuals' demographic and socioeconomic variables, and the second model added the macro variable identifying the social care system. Model three again considered individuals' socio-demographic characteristics and included information on the limitation type, to better understand its relationship with unmet care needs. Model four added all the health variables, and model five adjusted for having children as an indicator of potential availability of care outside the household. Finally, model six included all the previous variables and, again, the social care system of the country of residence.

2.2.3 Variables

As mentioned above, the dependent variable was the absolute unmet need for social care, measured through the question related to help received by individuals reporting any mobility, ADL and IADL limitation. Participants were asked about these limitations through two questions referring to twenty-five activities, ten for mobility and fifteen combining ADL (six limitations) and IADL (nine limitations). For mobility limitations, the question was: "Please look at card 36. Please tell me whether you have any difficulty doing each of the everyday activities on this card. Exclude any difficulties that you expect to last less than three months."[2] On the other hand, for measuring ADL and IADL, the survey asked: "Please tell me if you have any difficulty with these activities because of a physical, mental, emotional or memory problem. Again, exclude any difficulties you expect to last less than three months."[3] In addition, for those who report having problems with any of these activities, the survey includes the following question: "Thinking about the activities that you have problems with, does anyone ever help you with these activities?".

Independent variables were included as follows. Age was aggregated into three categories (65–74, 75–84 and 85+); the education level was harmonised through ISCED 1997 classification and grouped into low (until primary school), mid (secondary education), and high education (college

[2]Mobility activities on card 36 included: i) Walking 100 m; ii) Sitting for about two hours; iii) Getting up from a chair after sitting for long periods; iv) Climbing several flights of stairs without resting; v) Climbing one flight of stairs without resting; vi) Stopping, kneeling, or crouching; vii) Reaching or extending your arms above shoulder level; viii) Pulling or pushing large objects like a living room chair; ix) Lifting or carrying weights over 10 pounds/5 kilos, like a heavy bag of groceries; and x) Picking up a small coin from a table.

[3]The ADL and IADL activities asked about were: i) Dressing, including putting on shoes and socks; ii) Walking across a room; iii) Bathing or showering; iv) Eating, such as cutting up your food; v) Getting in or out of bed; vi) Using the toilet, including getting up or down; vii) Using a map to figure out how to get around in a strange place; viii) Preparing a hot meal; ix) Shopping for groceries; x) Making telephone calls; xi) Taking medications; xii) Doing work around the house or garden; xiii) Managing money, such as paying bills and keeping track of expenses; xiv) Leaving the house independently and accessing transportation services; and xv) Doing personal laundry. Activities from i to vi refer to ADL, while from vii to xv are related to IADL.

and above); even though ISCED 2011 is also included in the SHARE, this variable presented higher proportions of missing values than the ISCED 1997. Housing tenure was also regrouped into three categories: (i) owner, (ii) tenant and (iii) other; this last category includes members of a cooperative, subtenant and rent-free. The variables of level of education and housing were included to assess socio-economic status (SES). Although income would be a more accurate indicator of socio-economic status, it is less informative of SES over the life course, particularly for individuals over 65 years old, than educational attainment.

Self-rated health was treated as binary, distinguishing between good health (excellent, very good or good) and poor health (fair or poor self-rated health). Besides, given the information available, we followed the approach used by Spijker and Zueras (2020) and combined the type of functional limitations to create a variable that captures the degree of severity depending on the type of the reported limitations: (i) facing only mobility limitations (for those who reported any mobility limitation but no limitations in performing IADL and ADL), (ii) those who reported limitations in one ADL and/or any IADL, (iii) those who reported limitations in two or more ADL. Even though the Global Activity Limitation Indicator (GALI) has been validated as a severity measure and is also included in the SHARE, it does not provide detailed information about the type of limitation faced by individuals, moreover, how it is included in the questionnaire does not allow to directly linked it with the used measure of unmet care needs.

Table 2.1 Descriptive statistics of the analytical sample by social care system

	Mediterranean		**Eastern**		**Western**		**Nordic**		**Total sample**	
	n=2662	%	n=1160	%	n=2364	%	n=950	%	n=7136	%
Age group										
65-69	543	20.4	289	24.9	511	21.6	170	17.9	1513	21.2
70-74	588	22.1	301	25.9	497	21.0	226	23.8	1612	22.6
75-79	569	21.4	225	19.4	465	19.7	195	20.5	1454	20.4
80-84	510	19.2	183	15.8	406	17.2	160	16.8	1259	17.6
85+	452	17.0	162	14.0	485	20.5	199	20.9	1298	18.2
Gender										
Women	1616	60.7	726	62.6	1460	61.8	615	64.7	4417	61.9
Type of limitation										
Only mobility	1456	54.7	627	54.1	1223	51.7	508	53.5	3814	53.4
One ADL and/or any IADL	852	32.0	356	30.7	873	36.9	327	34.4	2408	33.7
Two or more ADL	354	13.3	177	15.3	268	11.3	115	12.1	914	12.8

Note: ADL: Activities of Daily Living; IADL: Instrumental Activities of Daily Living.
Source: Survey of Health Ageing and Retirement in Europe, seventh wave (2017).

Finally, countries were grouped into four theoretical regions according to their social care system, following a welfare-state configurations typology (Pfau-Effinger, 2005). The Mediterranean social care system includes Spain, Greece, and Italy; the Nordic one considers Sweden and Denmark; the Western care system has Germany, France, Austria, Switzerland, and Belgium; and the Eastern one is composed of the Czech Republic and Poland. Table 2.1 displays the composition of the analytical sample by age, gender, and type of limitations by the social care system.

2.2.4 Sensitivity analysis

We conducted an alternative analysis exploring different aggregations of marital status and living arrangements to understand how unmet care needs were related to the availability of potential informal care within households. Marital status was grouped in two different ways. First, we considered three categories: (i) married or with a registered partner, (ii) ever married, and (iii) never married; secondly, four categories distinguishing: (i) married or with a registered partner, (ii) divorced or separated, (iii) never married, and (iv) widowed. However, none of these variables showed significance and were removed to avoid multicollinearity with the living arrangements variable.

We extended the sensitivity analysis by grouping living arrangements in two different ways. In the first place, living arrangements distinguished people (i) living with their partner, either with or without other people, (ii) living alone, and (iii) living with other people but not their partner. Secondly, the categories were grouped as: (i) living alone, (ii) living as a couple, with the partner only, (iii) living with one or more relatives and non-relatives. The results that used the second way of coding living arrangements, by which we considered the availability of care provided by the partner, showed lower statistical significance levels than the first, which were included in the final models.

The severity variable aimed to explore how the number and type of limitations explained the experience of unmet care needs. Before including it, we fit the models with the specific limitations (ADL, IADL, and mobility) and also fitted three different models for individuals with each type of limitation. Results were very similar to those presented here and did not include the number of limitations, which is related to the amount of help needed, so we used the severity variable with the categories described earlier, which considered both the type and number of limitations. Finally, we also analysed results by including countries instead of social care systems, the findings showed the internal coherence of the Mediterranean social care system and the differences within the other groups, especially for the Nordic and Eastern countries.

2.3 Results

We present two types of results: First, the descriptive analysis of the analytical sample focusing on the prevalence of unmet care needs from an absolute approach and the demographic characteristics of those with any of these needs. Second, binomial regression models illustrate how individuals' demographic and economic factors and health status explain the experience of unmet care needs and their relationship with specific social care systems in Europe.

2.3.1 Who needs care?

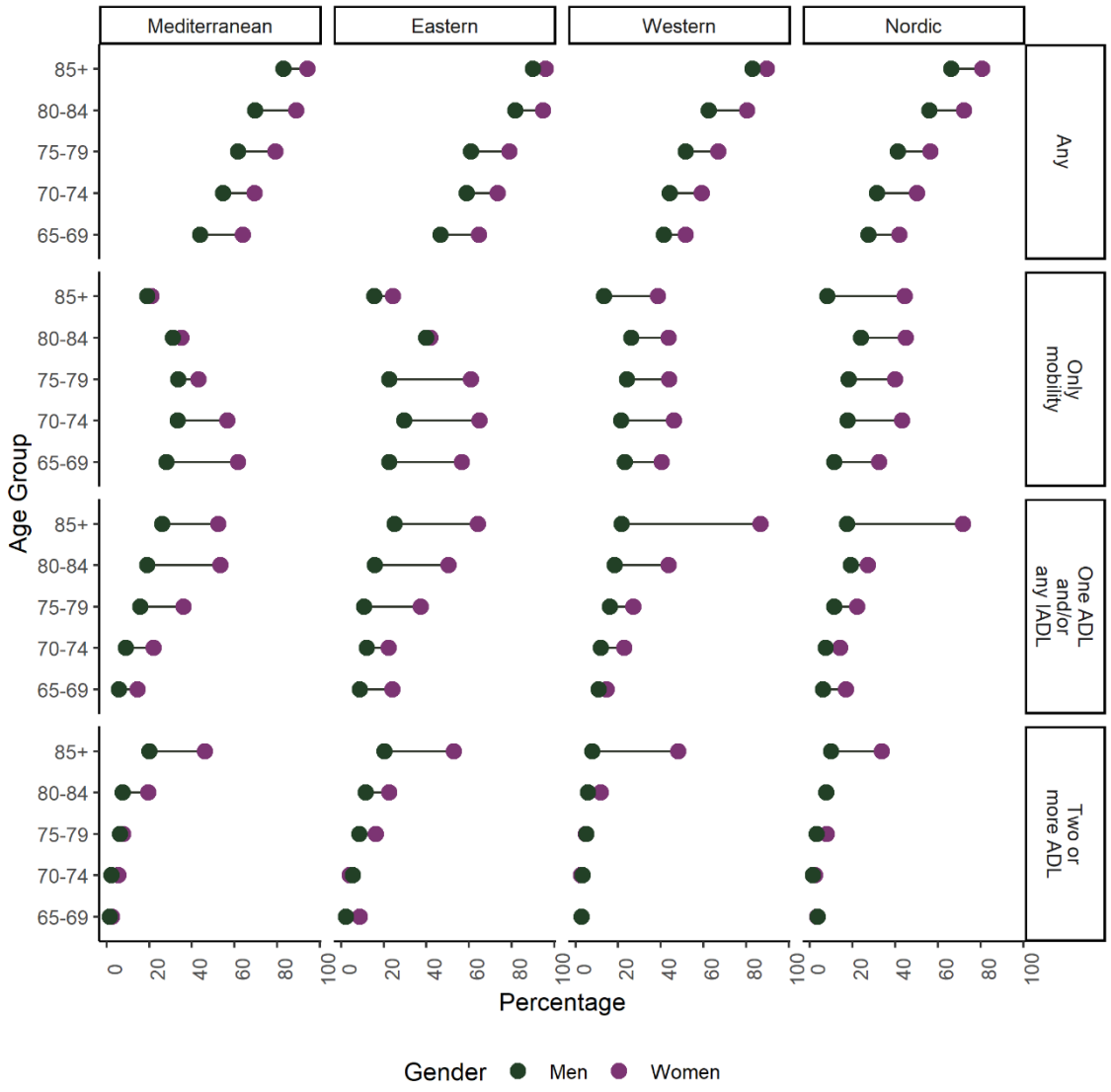
People with any limitation (mobility, ADL and IADL) were considered to be at risk of having unmet care needs. Figure 2.2 presents the prevalence of each type of limitation among women and men by age group and social care system. In the four social care systems analysed, women have more limitations regardless its type (69.67%; CI 68.54–70.80%) than men (53.74%; CI 52.37–55.11%); these percentages are also higher in the Eastern region (70.43%; CI 68.22–72.63%) for individuals with any limitation and for the specific types that were analysed.

As expected, the prevalence of care needs is higher and more severe in older age groups. The most common type of limitation below age 85 is to experience only mobility difficulties, while limitations for performing one ADL and/or any IADL are the most common for those aged 85 and over. Having only mobility limitations shows the highest prevalence across the sample (33.46%, CI 32.60–34.32%), exceeding 15% in all the age-gender combinations. Also, smaller percentages of this population face the other two types of limitations, and differences between men and women regarding the prevalence of limitations related to ADL and IADL are minor in the younger and the oldest age groups. However, the gender gap is larger in the Mediterranean social care system and the Nordic social care systems for people aged 85+.

Relating to the prevalence of unmet care needs, from the absolute approach, 53.03% (CI 51.87–54.18%) of the individuals in the analytical sample (*n* = 7,136) dealt with these. Therefore, more than half of the population who reported at least one limitation didn't receive any help. Figure 2.3 shows the results by social care system, age, gender, and type of limitation. The main trend is that the percentage of people with any limitation experiencing unmet care needs is lower in the older age groups, and, with some exceptions, for the age-gender groups. In general, proportions are higher for men (56.75%; CI 54.90–58.61%) than women (50.73%; CI 49.26–52.21%), even though the latter experience more limitations than the former.

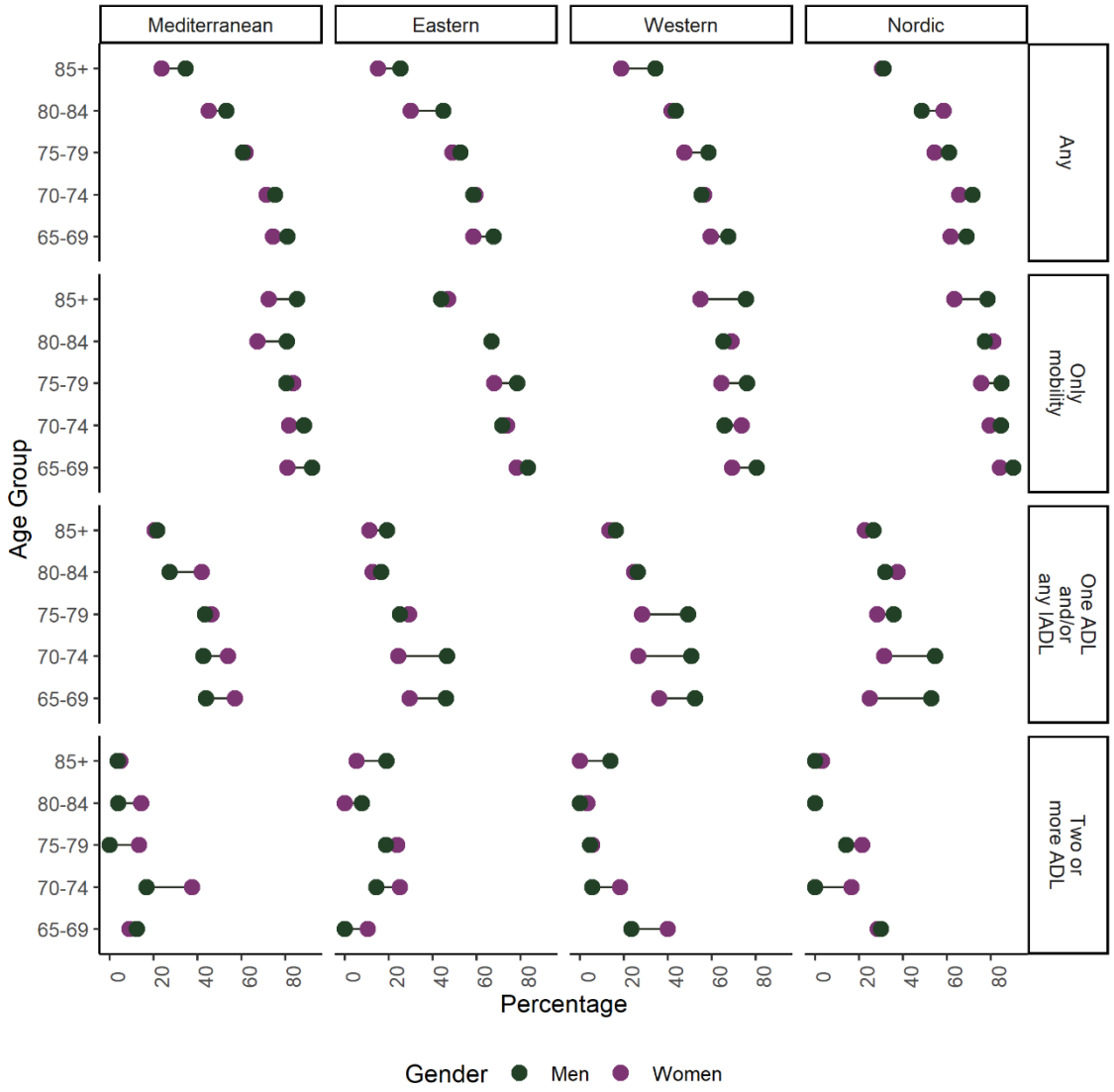
In general, individuals with any limitation from the Mediterranean group have higher percentages of unmet care needs (56.87%; CI 57.00–60.73%), which is also the trend by age-gender combinations, than the other three groups. Moreover, Figure 2.3 shows the relevance of mobility limitations in the experience of this circumstance because the higher percentages of unmet care needs are experienced by people with only mobility limitations. Additionally, the percentages of individuals with unmet care needs that face two or more ADL are lower when compared with the other limitations' types (less than 40% for all the analysed combinations of age and gender groups).

Figure 2.2 Percentage of people 65 + with functional limitations by type of limitation, age, gender, and social care system.



Note: ADL: Activities of Daily Living; IADL: Instrumental Activities of Daily Living; All: presents any type of limitation on these activities.
Source Survey of Health Ageing and Retirement in Europe - SHARE, seventh wave (2017)

Figure 2.3 Percentage of people 65+ facing unmet care needs from an absolute approach by type of limitation, age, gender, and social care system



Note: ADL: Activities of Daily Living; IADL: Instrumental Activities of Daily Living; All: presents any type of limitation on these activities.
Source Survey of Health Ageing and Retirement in Europe - SHARE, seventh wave (2017)

Percentages of unmet care needs also varied across countries. Table 2.2 presents percentages of individuals with unmet care needs for those with any limitations and by type of limitation. Overall, the trend is that more than 30% of the population with any limitation is experiencing unmet care needs. Greece has the highest percentage (68.60%; CI 63.10–68.60%), and the Czech Republic the lowest (31.82%; CI 27.85–35.80%). However, less than 25% of people with two or more ADL limitations experience unmet care needs in all countries. For example, in Czech Republic and Austria, less than the 3% of people that has two or more ADL limitations have unmet needs (respectively 1.51%; CI − 1.43–4.46 and 2.26; CI − 2.33–7.33%), while in France, they are the

10.34% (CI 2.51–18.18%). At the same time, these percentages are higher for people facing one ADL, and/or one or more IADL difficulties, ranging between 14.81% (CI 9.75–19.90%) in the Czech Republic and 42.64% (CI 36.60–48.67%) in Spain.

Table 2.2 Percentage of people 65+ with an unmet care need from an absolute approach by country and type of limitation

Social Care System	Country	Any		Only mobility		One ADL and/or any IADL		Two or more ADL	
		n	%	n	%	n	%	n	%
Mediterranean	Spain	340	49.49 [45.75 – 53.23]	220	80.00 [75.27 – 84.72]	110	42.64 [36.60 – 48.67]	10	6.49 [2.60 – 10.39]
	Greece	750	65.85 [63.09 – 68.60]	599	82.50 [79.74 – 85.27]	144	41.86 [36.65 – 47.07]	7	10.14 [3.02 – 17.27]
	Italy	477	57.06 [53.70 – 60.41]	379	83.30 [79.87 – 86.72]	82	32.80 [26.98 – 38.62]	16	12.21 [6.60 – 17.82]
Western	Germany	179	43.77 [38.96 – 48.57]	150	60.00 [53.93 – 66.07]	27	25.23 [17.00 – 33.46]	2	3.84 [-1.38 – 9.07]
	France	316	57.04 [52.91 – 61.16]	227	81.36 [76.79 – 85.93]	83	38.25 [31.78 – 44.71]	6	10.34 [2.50 – 18.18]
	Belgium	347	42.16 [38.79 – 45.54]	251	67.29 [62.53 – 72.05]	89	25.36 [20.80 – 29.91]	7	7.07 [2.01 – 12.12]
	Austria	153	50.33 [44.70 – 55.95]	125	81.17 [74.99 – 87.34]	27	24.55 [16.50 – 32.58]	1	2.50 [-2.34 – 7.34]
	Switzerland	135	49.27 [43.35 – 51.19]	102	61.08 [53.68 – 68.47]	29	32.95 [23.13 – 42.78]	4	21.05 [2.72 – 39.38]
Nordic	Sweden	309	62.05 [57.79 – 66.31]	243	82.09 [77.73 – 86.46]	60	40.00 [32.16 – 47.84]	6	11.54 [2.85 – 20.22]
	Denmark	212	46.90 [43.30 – 51.50]	163	76.89 [71.21 – 82.56]	44	24.66 [18.49 – 31.22]	5	7.93 [1.26- 14.61]
Eastern	Poland	398	62.97 [59.21 – 66.73]	316	89.27 [86.04 – 92.49]	62	37.13 [29.80 – 44.45]	20	18.01 [10.87 – 25.17]
	Czech Republic	168	31.81 [27.85 – 35.79]	139	50.92 [44.99 – 56.85]	28	14.81 [9.75 – 19.88]	1	1.51 [-1.43 – 4.46]

Note: ADL: Activities of Daily Living; IADL: Instrumental Activities of Daily Living. Confidence intervals, in squared brackets, were estimated based on the z value for 95% confidence (1.96) and standard errors from the analytical sample.
Source: Survey of Health Ageing and Retirement in Europe, seventh wave (2017).

2.3.2 The experience of unmet care needs: individuals vs social care systems

Table 2.3 summarizes the results of six regression models. Similar results were observed between the first two models, which refer mainly to demographic and economic characteristics (model 1) and social care systems (model 2). In models 3 to 6, we observed the importance of health status in explaining unmet care needs, in these models the variables of self-reported health and chronic disease where included and both showed statistical significance ($p < 0.001$) for these coefficients in the three versions of the models. According to the statistics used (Akaike and Bayesian indexes of goodness of fit, AIC and BIC), model 6 had the best fit. It included demographic, economic and health variables, having children (a potential source of care), and social care systems.

Table 2.3 Binomial logistic regressions for estimating unmet care needs in different social care systems.

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
Intercept	0.418***	0.612***	1.298*	1.966***	2.434***	3.650***
	[0.344, 0.507]	[0.493, 0.758]	[1.038, 1.623]	[1.552, 2.492]	[1.782, 3.329]	[2.611, 5.112]
Age						
85+ (Ref.)	1	1	1	1	1	1
65-74	5.555***	5.461***	3.030***	3.127***	3.113***	3.009***
	[4.768, 6.485]	[4.681, 6.385]	[2.545, 3.611]	[2.620, 3.737]	[2.608, 3.720]	[2.517, 3.602]
75-84	2.984***	2.929***	2.029***	2.105***	2.100***	2.032***
	[2.575, 3.465]	[2.525, 3.403]	[1.714, 2.404]	[1.775, 2.500]	[1.771, 2.494]	[1.712, 2.415]
Gender						
Women (Ref.)	1	1	1	1	1	1
Men	1.239***	1.227***	1.366***	1.427***	1.413***	1.410***
	[1.115, 1.378]	[1.103, 1.365]	[1.212, 1.541]	[1.264, 1.612]	[1.251, 1.597]	[1.248, 1.595]
Living arrangements						
Partner in household (Ref.)	1	1	1	1	1	1
Living alone	1.048	1.062	1.322***	1.321***	1.277***	1.302***
	[0.933, 1.178]	[0.945, 1.195]	[1.157, 1.511]	[1.155, 1.513]	[1.112, 1.468]	[1.132, 1.497]
In other arrangements	0.607***	0.596***	0.784*	0.831	0.816+	0.801+
	[0.496, 0.741]	[0.486, 0.729]	[0.622, 0.987]	[0.658, 1.047]	[0.647, 1.030]	[0.633, 1.012]
Housing tenure						
Owner (Ref.)	1	1	1	1	1	1
Tenant	1.002	1.112	1.034	1.082	1.081	1.205*
	[0.863, 1.164]	[0.952, 1.298]	[0.874, 1.225]	[0.912, 1.284]	[0.911, 1.283]	[1.009, 1.440]
Other	0.890	0.985	0.894	0.945	0.953	1.030
	[0.756, 1.047]	[0.834, 1.164]	[0.744, 1.075]	[0.785, 1.138]	[0.792, 1.148]	[0.851, 1.247]
Level of Education						
High (Ref.)	1	1	1	1	1	1
Mid	0.713***	0.716***	0.756***	0.769**	0.772**	0.767**
	[0.622, 0.818]	[0.622, 0.823]	[0.648, 0.882]	[0.657, 0.899]	[0.660, 0.902]	[0.654, 0.900]
Low	0.806**	0.673***	1.064	1.116	1.124	0.931
	[0.700, 0.929]	[0.578, 0.782]	[0.906, 1.250]	[0.948, 1.315]	[0.954, 1.325]	[0.782, 1.108]
Social care system						
Mediterranean (Ref.)		1				1
Nordic		0.745***				0.784*
		[0.629, 0.883]				[0.643, 0.956]
Western		0.559***				0.527***
		[0.491, 0.636]				[0.453, 0.613]
Eastern		0.588***				0.632***

		[0.504, 0.685]				[0.528, 0.756]
Self-reported health						
Good health (Ref.)				1	1	1
Poor health				0.708***	0.707***	0.662***
				[0.626, 0.800]	[0.625, 0.800]	[0.584, 0.750]
Chronic disease				1	1	1
No (Ref.)						
Yes				0.569***	0.570***	0.598***
				[0.500, 0.647]	[0.501, 0.649]	[0.524, 0.682]
Type of limitation						
Only mobility (no ADL nor IADL)			1	1	1	1
One ADL and/or any IADL			0.165***	0.188***	0.187***	0.189***
			[0.146, 0.186]	[0.166, 0.212]	[0.166, 0.211]	[0.167, 0.214]
Two or more ADL			0.039***	0.052***	0.051***	0.051***
			[0.030, 0.049]	[0.040, 0.066]	[0.040, 0.065]	[0.039, 0.065]
Children						
No (Ref.)					1	1
Yes					0.804*	0.807*
					[0.653, 0.990]	[0.653, 0.995]
Num.Obs.	7136	7136	7136	7136	7136	7136
AIC	9187.2	9101.8	7583.7	7436.8	7434.6	7364.0
BIC	9256.0	9191.2	7666.1	7533.1	7537.7	7487.7
F	-4.583.617	-4.537.907	-3.779.830	-3.704.423	-3.702.311	-3.663.999
RMSE	68.272	56.848	148.446	129.183	119.964	99.875

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001.

Note: Odds ratios are reported with their confidence intervals in squared brackets. ADL: Activities of Daily Living; IADL: Instrumental Activities of Daily Living.

Source: Survey of Health Ageing and Retirement in Europe, seventh wave (2017).

In all models, younger people (65–74) presented higher risks of dealing with unmet care needs than the 85+ group, but this difference showed a statistically significant reduction of the odds ratio after adjusting for health status from 8.908 in model 1 to 3.007 in model 6, this reduction is smaller but also noticeable in the age group from 75 to 84 from 4.971 in model 1 to 2.032 (see Table 2.4). Also, men were statistically significant ($p < 0.001$) at higher risk of experiencing that situation than women in all models. The odds of facing unmet care needs differed depending on living arrangements: living with other than the partner reduced the risk of experiencing it (results were statistically significant with different p values for all the models but the fourth one).

The educational attainment showed similar results across models, suggesting that being low- and middle-educated was associated with lower risks of experiencing unmet care needs than higher educated individuals. However, differences for individuals in the lower levels of education became nonsignificant after controlling for health variables (models 3 to 6). Regarding health variables, first, the type of limitation showed that those with ADL and IADL were less at risk of experiencing unmet care needs than those with mobility limitations alone ($p < 0.001$). In this line, individuals with self-reported chronic diseases and poor health were not that exposed to experience unmet care needs

than those without chronic disease and good health ($p < 0.001$). In addition, having children is associated with a more consistent satisfaction of individuals' care needs when compared to those who do not have children ($p < 0.001$).

Table 2.4 Comparison between models 1 and 6 (rescaled to the variance)

	Estimate	OR	Std.	Error	z value	Pr(>|z|)
Age						
65-74						
Model 1	2.187	8.908	0.093	23.404	<2.2e-16	***
Model 6	1.101	3.007	0.091	12.049	<2.2e-16	***
Difference	1.085		0.062	17.385	<2.2e-16	***
75-84						
Model 1	1.404	4.071	0.088	157.977	<2.2e-16	***
Model 6	0.709	2.032	0.087	80.729	6,87E-13	***
Difference	0.695		0.057	120.377	<2.2e-16	***
Gender						
Men						
Model 1	0.294	1.342	0.062	47.326	2,22E-03	***
Model 6	0.343	1.409	0.062	54.882	4,06E-05	***
Difference	-0.049		0.034	-14.43	0.149	
Living arrangements						
Living alone						
Model 1	0.108	1.114	0.068	15.784	0.114	
Model 6	0.263	1.301	0.071	37.012	0	***
Difference	-0.155		0.042	-36.778	0	***
In other arrangements						
Model 1	-0.644	0.525	0.118	-54.378	5,39E-05	***
Model 6	-0.221	0.802	0.119	-18.539	0.063	.
Difference	-0.422		0.074	-57.034	1,18E-05	***
Housing Tenure						
Tenant						
Model 1	0.009	1.009	0.087	0.105	0.915	
Model 6	0.186	1.204	0.09	20.602	0.039	
Difference	-0.177		0.053	-33.129	0	*
Other						
Model 1	-0.143	0.867	0.095	-15.067	0.131897	
Model 6	0.029	1.029	0.097	0.3034	0.761593	
Difference	-0.172		0.058	-29.578	0.003099	**
Level of education						
Mid						
Model 1	-0.431	0.650	0.08	-53.516	8,72E-05	***
Model 6	-0.265	0.767	0.081	-32.531	0.001	**
Difference	-0.166		0.042	-39.333	8,38E-02	***
Low						
Model 1	-0.243	0.784	0.083	-29.196	0.003	**
Model 6	-0.071	0.931	0.088	-0.803	0.421	
Difference	-0.171		0.052	-32.761	0.001	**

Source: Survey of Health Ageing and Retirement in Europe - SHARE, seventh wave (2017).

Finally, the models showed that the risk of suffering unmet care needs is lower for individuals in other social care systems than in the Mediterranean. This risk was lower in the final model for the Western region (0.527, $p < 0.001$) and higher in the Nordic region (0.784, $p < 0.05$); however, smaller p values were observed in the Nordic group ($p < 0.001$ vs. $p < 0.05$). Refined analysis, including countries instead of regions, revealed considerable heterogeneity within the analysed social care systems, particularly in the Eastern and Nordic social care systems. In the former, the Czech Republic had lower than expected odds ratios, and in the latter, Sweden's odds ratios were not statistically significantly different from Spain. In contrast, countries in the Mediterranean and Western regions had more homogeneous results (Table 2.5).

Table 2.5 Odd ratios of model 6 using countries instead of grouping by social care systems

Social care system	Country	OR
Mediterranean	Spain (Ref.)	1
	Greece	0.729 [0.570-0.933]
	Italy	0.832 [0.644 – 1.073]
Western	Germany	0.262 [0.190 – 0.361]
	France	0.684 [0.514 – 0.909]
	Belgium	0.298 [0.227 – 0.389]
	Austria	0.494 [0.347 – 0.703]
	Switzerland	0.287 [0.200 – 0.411]
Nordic	Sweden	0.763 [0.560 – 1.039]
	Denmark	0.404 [0.296 – 0.552]
Eastern	Poland	1.353 [1.020 – 1.796]
	Czech Republic	0.149 [0.110 – 0.203]

Note: Confidence intervals are provided in squared brackets.
Source: Survey of Health Ageing and Retirement in Europe, seventh wave (2017).

2.4 Discussion

This study aimed to understand the unmet care needs of people aged 65+ from different social care systems in twelve European countries. Results showed that the most vulnerable individuals (with poor health, chronic disease, older age group, and women) are at lower risk of experiencing unmet care needs, rejecting Hypothesis A. This is consistent with previous evidence from England, which suggested that men were at a higher risk of experiencing these (Vlachantoni, 2019) and that

older people with poor health were more likely to report receiving care (Maplethorpe et al., 2015). These results are probably due to social awareness of the care and social support needed by older people with health problems, indicating the importance of social imaginaries and perceptions about the consequences of ageing on individuals' lives.

In contrast, we observed that people living in countries with Mediterranean social care systems are at a higher risk of having unmet care needs than in other systems, in line with Hypothesis B. The social care systems of these countries are characterised by their reliance on informal care provision by family members (Spijker et al., 2022), which might explain why individuals from these countries are more exposed to unmet care needs due to demographic change that has led to a reduction in kin-related individuals to provide care. Additionally, results show that family-centred systems may face more challenges in meeting individuals' needs due to their dependence on the availability of family members willing and able to provide care (Tennstedt et al., 1993). These may be changing as women's engagement in the labour market increases. For example, a study in Spain showed that the willingness to care for the older family members was lower among women with a high level of education and who did paid work (Zueras et al., 2018). Previous studies have also emphasised that ageing due to demographic changes poses challenges to the availability of informal care because of low fertility rates and increases in the percentage of dependent elders who are childless (Spijker & Zueras, 2020).

Furthermore, these results indicate the diverse approaches within social care systems, as well as the social awareness about the urgent care needs required by older adults. This is particularly evident given that in all the analysed categories of social care systems, some part, even a small portion, of the population facing limitations experienced unmet care needs for social care. Even though the results from the other analysed social care systems were not as coherent as the ones from the Mediterranean countries, formal and informal care provision arrangements in these countries can also be improved. However, it is worth mentioning that the theoretical typology used here can be questioned due to the peculiarities of care arrangements at the country level. For instance, empirical analysis using indicators like long-term care services and expenditures, and legislation about leaves, pointed out other alternatives to differentiated care regimes across Europe (van Damme et al., 2025). Nevertheless, the main contribution of this study is its comparative approach, which is a largely unexplored issue, and our typology is consistent with the fact that differences between care regimes are mainly related to how much it is expected by states that

family members take a role in care provision. Our findings show that unmet care needs change depending on the social care system of the country where older people live.

Despite previous research showing differences in social care systems between regions and countries (Ariaans et al., 2021; Dunatchik et al., 2019; Pfau-Effinger, 2005), to our knowledge, this is the first study comparing unmet care needs between different social care systems. Results spotlighted that the demographic characteristics, like the age group and gender, were associated with unmet care needs, i.e., a higher risk was found for men than women and for younger than older age groups. In line with previous research, findings showed that the type of limitation explained the risk of facing unmet care needs. In our results, individuals with only mobility limitations faced lower risk, meanwhile, others have shown that the chance of suffering from them is more strongly associated with ADL (Vlachantoni, 2019). Living with other people in the household is associated with a lower risk, which may indicate that care is being provided by someone other than the couple, although previous research has shown that partners are still the main informal care providers (Kaschowitz & Brandt, 2017; Uccheddu et al., 2019; Young & Grundy, 2008).

In addition, people who live with someone other than a partner (compared with living alone or with a partner with or without another person) and who are neither owners nor tenants of the house in which they live are less likely to have unmet care needs. Previous evidence on the subject comes from England, where it was estimated that about 55% of older individuals with ADL, 24% of people with an IADL difficulty, and 80% of people with a mobility limitation have unmet care needs based on ELSA (Vlachantoni, 2019). In contrast, this study found lower percentages of unmet care needs by each type of limitation, even for the population with only mobility difficulties, for whom the highest percentage was found in Greece. Nevertheless, these results are not fully comparable as the estimation comes from similar but not equivalent questions and filters in the analysed surveys (Ashokkumar et al., 2012).

However, further research on the relationship between these unmet needs and different social care systems is still needed. Through the sensitivity check of the models, it was visible that there are differences within the groups of Nordic and Eastern countries. In this sense, there is a need to keep theorising social care regimes and systems and their specific characteristics, as well as studying them from an empirical perspective, as some studies have already done (van Damme et al., 2025). The proposed categories are inspired by previous literature and refer to the emergence of social policies and welfare states in each country, but disentangling the details of how social care systems

are crystallised in each country is beyond the scope of this study. Nevertheless, some aspects help to contextualise our findings. For instance, the results for Sweden and Poland may be explained by recent changes in their care policies. In the Swedish case, changes during the last three decades have been orientated towards enhancing voluntary choices and individuals' involvement in their own care; however, these measures are taking place in a context where the second demographic transition may affect the availability of care provision by children and partners (Edlund & Lövgren, 2022; Moberg, 2021). Meanwhile, Poland's history is characterised by an essential differentiation between hospice-palliative care, which emerged in the seventh decade of the last century, and home care (Krakowiak, 2020), gaps between these two ways of care provision may reflect the lower quality of informal care provided in Poland when compared to the other countries (Dobrzyn-Matusiak et al., 2014).

In any case, this study has some limitations related to the sample and the measure of unmet social care needs that we used. The most relevant limitation is posed by the assumption behind measuring unmet care needs, which supposes that individuals facing any limitation, in fact, need help, even though some of them may be able to cope with these limitations without the support of a caregiver. Another limitation comes from the small sample size and lack of representativeness of the analysis by countries, which is why we used groups of countries based on theoretical typologies of social care systems, despite, as previously highlighted, there are internal differences between the countries that are part of the Nordic and the Eastern social care systems. How to construct typologies of social care systems is still an ongoing debate. Previous evidence says that there may be more appropriate criteria than a regional approach (Ariaans et al., 2021; Damiani et al., 2011). Nevertheless, this study based its theoretical typology on previous work about welfare state configuration, which is also useful to understand the European region from a policy perspective (Pfau-Effinger, 2005).

Some relevant aspects come from using SHARE data to measure unmet care needs. While studies based on the ELSA usually ask if someone facing a limitation is receiving the help needed for performing a specific activity (e.g., bathing or eating), the SHARE asks this after all the questions about limitations for performing these activities are asked, which makes it impossible to know the specific activities for which individuals are facing these unmet needs. Likewise, we cannot truly know if the individual needs help to cope with the limitations that s/he is facing. This problem can only be solved by adding a new question in the survey that directly asks if the person needs care

from others to perform these activities.[4] Furthermore, the usage of an ex ante harmonised data source allows comparisons between countries with different values and imaginaries about social care and its provision. Even though these social contexts are not approached in our analysis, it is worth mentioning that they can shape individuals' perceptions of the support received, albeit we focused on the absolute measure of unmet care needs and we did not explore if the help was enough for meeting their needs (relative approach). Still, the main value of this study lies in its comparative nature, which makes it possible to provide an empirical estimate of unmet care needs in twelve countries and to gain insights into the differences between social care systems at the regional level, which may be useful for policy makers interested in care demand and provision in ageing societies.

2.5 Conclusions

Care provision within ageing scenarios poses challenges in assuring people's rights and well-being. This chapter suggests that individuals from older age groups and those in poorer health and worse functioning conditions face negligible risks of experiencing unmet care needs. This scenario could indicate that social care systems meet the most pressing needs: they are reactive but not preventive because they do not consider the future effects of unmet care needs on individuals' morbidity, well-being, and physical and mental health. Also, living arrangements respond to higher needs of care and are effective in supplying at least some of it; despite that, whether this is sufficient or the most appropriate care should also be a matter of investigation. Care is a basic need that changes over the life course and poses challenges to ageing populations, particularly in those societies based on family-centred care provision. More information and research are needed to examine current and future responses to the actual care demands to leave no one behind.

[4] Following the SHARE wording it can be formulated as: "Thinking about the activities that you have problems with, do you need help or support from someone else for performing these activities? Yes/No".

3 Between Curing and Caring: Years of Life Expectancy with Care Needs (YLCN) in Ibero-American countries[5]

Abstract

Unprecedented gains in life expectancy call for a nuanced understanding of morbidity and its consequences on social care needs. Despite the observed worldwide gender gap in life expectancy and healthy life expectancy, we still do not know how the longer years lived by women, when compared to men, are affected by social care needs related to the experience of chronic conditions. This study examines the Years of Life Expectancy with Care Needs and Multimorbidity that individuals are expected to live at age 60, using Sullivan's method (1971), and decomposes, through Horiuchi et al.'s approach (2008), the gender gap in healthy life expectancy by states that combines healthcare and social care needs across five Ibero-American countries (Brazil, Colombia, Mexico, Portugal, and Spain). Results support the health-survival paradox, with women living longer lives and more years in states of multimorbidity. Furthermore, findings also show that women are expected to live on average more years with social care needs than men. They also suggest that differences between Latin-American and European countries are due to their diverse epidemiological and health transitions, which are informative of how these empirically occurred in countries with different demographic trends. The study seeks to contribute to the evidence regarding the diverse consequences of ageing populations.

Key words: Social care needs; Multimorbidity; Healthy life expectancy; Ibero-America; Ageing

3.1 Introduction

Unprecedented gains in life expectancy have, for decades, raised questions about individuals' wellbeing during the additional years that individuals are expected to live (Crimmins, 1984; Robine et al., 2009). The complex relationship between morbidity and mortality has been discussed from both pessimistic and optimistic perspectives. Evidence remains mixed on whether life expectancy improvements are matched by better health outcomes (Vaupel, 2010). Nevertheless, population ageing stresses the necessity of understanding the needs and demands of older individuals. In a scenario of increasing (multi)morbidity, that does not always imply cumulative dependence, healthy and active life expectancy indicators can be refined by incorporating social care needs into their estimations. Previous research has emphasised the gender differences underlying mortality trends and their consequences on healthcare needs for older individuals (Oksuzyan et al., 2010).

[5] This chapter was coauthored with PhD Jeroen Spijker, PhD Elisenda Rentería and PhD Luciana Correia-Álves

Furthermore, gender differences have also been identified regarding social care needs among ageing populations (Vlachantoni, 2019). Nevertheless, the linkage of chronic conditions to the experience of social care needs has been less studied through healthy life expectancy estimations. By using indicators that account for these, we would gain a deeper knowledge of the gender differences related to the need for health and social support. Through comparisons of five Ibero-American countries, this study seeks to measure the Years of Life Expectancy with Care Needs (YLCN) of men and women in different states, which account at the same time for the experience of chronic conditions (multimorbidity) and limitations for performing Basic Activities of Daily Living (ADL) or/and Instrumental Activities of Daily Living (IADL). This comparative analysis across countries aims to emphasise the heterogeneity of older adults' needs and their gendered differences resulting from scenarios that have faced differential transformations regarding their demographic and epidemiological trends, their health transitions related to the burden of disease as well as specific configurations of healthcare and social care systems during the 20th and 21st century.

3.1.1 Literature review

Empirical studies have attempted to determine whether current mortality trends are aligned with morbidity patterns described by one of the following three hypotheses: the 'failure of success' (Gruenberg, 1977), the 'compression of morbidity' (Fries, 2002) and the 'dynamic equilibrium' (Manton, 1982). Hence, in recent years, research about the consequences of increasing life expectancy on individuals' lives has shifted from exclusively analysing mortality to complementing it with measures of healthy life expectancy (Saito et al., 2014), which estimates adjusted years of life expectancy lived in good health (generally through morbidity, GALI or self-reported health status) and active life expectancy or disability-free life expectancy (based on certain physical/mental functions) (Beltrán-Sánchez et al., 2015). These indicators provide estimations about how life expectancy is affected not only by mortality, but also by healthy and unhealthy states. However, among their limitations are that they usually have a unidimensional definition of health (either self-perceived, focused on chronic conditions or in functional limitations), but there are few studies combining more than one definition of health or quality of life (Saito et al., 2014). Moreover, when they do focus on functionality (measured through Basic Activities of Daily Living) tend to dismiss the wider spectrum of dependency or social care needs. Finally, when the analyses focus on disability indicators (measured through ADL), the compression of morbidity seems to be an appropriate hypothesis. However, when the focus shifts to health status and chronic conditions,

findings tend to align more with the hypothesis of morbidity expansion (Tesch-Römer & Wahl, 2016).

Consequently, recent literature has highlighted the importance of incorporating a nuanced approach to understanding multimorbidity by estimating, through multistate models, life expectancies of individuals experiencing healthy and unhealthy states alongside disability (Lam et al., 2024; Shen & Payne, 2023). These studies have interpreted facing limitations in performing Basic Activities of Daily Living (ADL) as indicators of disability or inactivity. Following this effort, in this study, we have combined ADL with limitations for performing Instrumental Activities of Daily Living (IADL), which account for social care needs, defined as the experience of limitations in performing ADL and IADL. While ADL refer to basic tasks that individuals need to perform for living, like eating, bathing and getting in or out of bed, IADL are related to actions that are not basic but needed for living an independent life, for instance, buying groceries, handling money or taking medications. Aligned with previous work, in this study, social care needs are conceptualised as facing limitations for performing both ADL and IADL, which provides a measure that is not just focused on severe disability or dependency but also on tasks for which individuals need someone else's support. The used definition has two main qualities: first, it is focused on individuals' own assessment; second, it is useful to identify the type of support an individual might need (Vlachantoni, 2019; Vlachantoni et al., 2011).

The measure of social care needs used is combined with healthcare needs, which are operationalised through (multi)morbidity indicators. Based on previous literature, we define having one chronic condition as morbidity and having more than one chronic condition as multimorbidity (Calderón-Larrañaga et al., 2017). By using a combined indicator of healthcare and social care needs, we aimed to emphasise that the consequences of (multi)morbidity can vary from one individual to another. In doing so, we acknowledge that the same chronic conditions and multimorbidity might have different implications on healthy life expectancy estimations, particularly regarding limitations, independence, disability (Verbrugge et al., 2017), and, ultimately, the need for social care. Therefore, when studying the relationship between morbidity and mortality, it is essential to consider the broader impacts of (multi)morbidity on individuals' lives, incorporating the implications that multimorbidity may or may not have on their daily lives, especially regarding independence and social care needs. At the same time, we account for the fact that advancements in medical technology, the success of preventive healthcare systems, and the promotion of healthy

behaviours may have improved the health outcomes of individuals with chronic conditions, thereby mitigating their adverse effects on disability and quality of life (Head et al., 2021).

Additionally, results on the expansion and the compression of multimorbidity varied from one country to another, given that they might be attributed to several factors, including demographic trends, individuals' conditions and trajectories, and countries' specific pathways within the demographic, epidemiological and health transitions. In this context, the healthy life expectancy literature has shown important variations by country, cohorts, and subpopulations (Saito et al., 2014). These differentials are often explained by the effect that changes in causes of death have had on life expectancy increases, specifically, the epidemiological transition suggests that during the 20th century, deaths from infectious diseases were progressively replaced by those from non-communicable and chronic diseases (Omran, 1998). However, critics of these frameworks argue that not all populations or subpopulations have experienced mortality declines in the same way or at the same pace (Alvarez et al., 2020; Calazans & Queiroz, 2020) and that the dichotomy between chronic conditions and infectious diseases does not hold in practice, as these two types of diseases are related to each other in a complex way (Mercer, 2018). Furthermore, evidence from Latin America has emphasised that the epidemiological transition should be understood as part of a broader process affected by health determinants, including individual characteristics and behaviours (Frenk et al., 1991). These dynamics produce varying consequences across countries, especially in middle- and lower-income countries, as well as across regions within the same country, which might have experienced the transition at different paces (Borges, 2017; Gómez-Dantés et al., 2016). However, research about the consequences of ageing populations on health care systems can benefit from comparative analysis between regions to examine how older adults' healthcare and social care needs are affected by country-level specific trends.

For this analysis, we studied mortality, healthcare, and social care needs in the older population (60+) of Brazil, Colombia, Mexico, Portugal, and Spain during 2015. Two European countries and three Latin American countries were selected. These regions are culturally connected due to the colonisation between the 15th and 19th centuries. However, demographic, epidemiological and health transitions taking place during the 20th century were diverse in these countries, impacting on their population ageing process, as well as their life expectancy and healthy life expectancy trends. While Spain and Portugal can be fitted into Omran's 'Western model', the experience of Brazil, Colombia and Mexico diverge from this traditional model, resulting in a mixed-morbidity scenario and an epidemiological polarisation characterised by i) stage overlapping, ii) counter-

transitions, and iii) prolonged transitions with the coexistence of mortality rates caused by infectious diseases and the increase of mortality due to chronic conditions. Additionally, this mix of mortality causes varies widely between regions and segments of populations within the same country, driven, for example, by social or racial stratification (Frenk et al., 1991; Macinko et al., 2019; Palloni & McEniry, 2007). A comparative analysis of these countries is a way to explore how these diverse pathways shape health and social care needs among ageing populations. However, most studies on social care needs have focused on comparisons within regions with similar care regimes or exclusively on high-income countries. Despite a shared history among Ibero-American countries, demographic analyses rarely include comparisons between them, and few studies bridge countries from the Global North and South (Alvarez et al., 2020; Rueda-Salazar et al., 2021). One reason for avoiding this comparison is that it can be framed as uneven, however, it can also be a heuristic tool to understand how these differential pathways explain differential consequences of population ageing on healthcare and social care needs, as well as their specific relationship with gender differences.

Besides regional disparities, gender differences in life expectancy and healthy life expectancy indicators have been broadly reported and are commonly described through the health-survival paradox (Zarulli et al., 2018) . While women consistently live on average longer than men, a pattern observed in nearly all countries (Austad, 2006), the size of this gender gap varies across countries and changes over time. Additionally, this higher life expectancy among women is accompanied by the observation that women's longer lives are often lived in poorer health states compared to men (Oksuzyan et al., 2010). However, this outcome may vary depending on overall life expectancy and the size of the gender gap. Previous analyses explain these gender differences through inequalities in survival and disparities in the experience of disabilities (Van Oyen et al., 2013). Moreover, other studies have highlighted that women face higher chances of needing social care (Pickard et al., 2007; Uccheddu et al., 2019).

Nevertheless, there is limited knowledge on how the health-survival paradox behaves when applying a multidimensional framework that incorporates (multi)morbidity alongside social care needs, an aspect that forms part of our study aim. Furthermore, cross-country and cross-regional comparisons offer a unique opportunity to explore mortality, morbidity patterns, and how the gender gap might result from different pathways and paces during their epidemiological transitions that, in turn, affect populations' healthcare and social care needs. Therefore, this study aims to explore the trends of health and social care needs among five Ibero-American countries in three ways. First,

by estimating the Years of Life Expectancy with Care Needs (YLCN) that individuals are expected to live with multimorbidity and limitations for performing ADL and IADL after age 60; second, by conducting cross-country comparisons of the YLCN, along with examining gender differences in these indicators; and thirdly, by decomposing the gender gaps in the healthy life expectancy (without a chronic condition) after age 60 into the effects of different (multi)morbidity and social care states.

3.2 Research design

3.2.1 Methodological approach

This study employs a cross-sectional analysis to compare trends in healthcare needs (measured by multimorbidity), social care needs (measured through the experience of limitations), and mortality across five countries. To achieve this, the study integrates indicators of chronic conditions and limitations in performing ADL and IADL as proxies for healthcare and social care needs, with mortality measures, to estimate Years of Life Expectancy with Care Needs (YLCN). The following five states are considered to account for the combination of healthcare and social care needs: A) No chronic condition (with or without social care needs); B) 1 chronic condition without social care needs; C) 1 chronic condition with social care needs; D) 2+ chronic conditions without social care needs; and, E) 2+ chronic conditions with social care needs (see 3.3 section for more details on the measures used). The methodological approach involves three sequential steps: First, the prevalence by state is calculated within the populations. Second, using the previously mentioned prevalences, the Sullivan method (1971) is applied to estimate the YLCN by states. Finally, Horiuchi et al.'s (2008) decomposition method is applied to analyse the gender gap in healthy life expectancy (defined as living without any chronic condition, regardless of the presence or absence of social care needs) at age 60, measuring the contribution of different states to this gap. All results are disaggregated by country, gender, and age group.

3.2.2 Data

Data used to estimate the prevalence of healthcare and social care needs came from four surveys conducted in five Ibero-American countries: ELSI (Brazil), MHAS (Mexico), SABE (Colombia), and SHARE (Portugal and Spain). These surveys share similar objectives, designs, and questions (see Table 3.1 for more details). The analysis focused on data collected in 2015, during which all the surveys were conducted. Although more recent data (2020-2021) were available for all countries, except Colombia, they were excluded due to attrition and selection bias resulting from the data

collection challenges faced during the COVID-19 pandemic, affecting sample size and prevalence estimations, especially in Brazil and Portugal. Each country's samples were weighted according to their specific survey designs. Mortality data, specifically the mortality rates (mx), came from the Human Mortality Database (HMD) for the European countries and from the official national statistics for Brazil (IBGE), Colombia (DANE), and Mexico (CONAPO), which published life tables for 2015. While debates about the quality of mortality data in Latin America persist, the official statistics of the analysed countries have improved over the past decades, resulting in more reliable mortality registries and curated life tables (Gonzaga et al., 2018).

Table 3.1 Analysed surveys technical details

Surveys' Name	Country	Period	Design	Participants' characteristics	Sampling	Representativeness
Estudo Longitudinal da Saúde dos Idosos (ELSI).	Brazil	2015 - 2016 (Onda 1) 2019 - 2021 (Onda 2)	Longitudinal	Community-dwelling adults aged 50 years or older.	Based on selection stages that combined stratification of primary sampling units (municipalities), census tracts, and households.	National
Estudio Nacional de Salud, Bienestar y Envejecimiento (SABE)	Colombia	2015	Cross-sectional	Community-dwelling adults aged 60 years or older.	Sampling based on multiple stages based on clusters and strata for rural and urban areas	National
Mexican Health and Aging Study (MHAS)	Mexico	2001 (Baseline) 2003 2012 2015 2018 2021.	Longitudinal	Community-dwelling adults aged 50 years or older and their spouses/partners regardless of their age	Sample in all the states of the country including urban and rural areas, over-sample in households in the six states that account for 40% of all migrants to the U.S.	National
Survey of Health, Ageing and Retirement in Europe (SHARE)	Spain Portugal, and other 25 European countries and Israel	2004 - 2006 (Wave 1) 2006 - 2010 (Wave 2) 2008 – 2011 (Wave 3) 2011 – 2012 (Wave 4) 2013 (Wave 5) 2015 (Wave 6) 2017 – 2018 (Wave 7) 2019 – 2020 (Wave 8)	Longitudinal	Community-dwelling adults aged 50 years or older and their spouses/partners regardless of their age	Participants are selected if they have their regular domicile in the respective SHARE country. In wave 1 all household members born 1954 or earlier were eligible for an interview, from the second wave sample refreshment was done in all but the third wave.	National and regional for the included European countries

3.2.3 Measures

In this study, healthcare needs are defined as ever having been diagnosed by a doctor with two or more of the following chronic conditions: heart attack, high blood pressure, stroke or cerebral

vascular disease, diabetes, chronic lung diseases, cancer, arthritis, or rheumatism; here morbidity was interpreted as having one chronic condition meanwhile, multimorbidity denoted reporting two or more chronic conditions. Social care needs were operationalised as experiencing at least one limitation in performing ADL or IADL. These limitations include dressing, bathing, eating, getting in or out of bed, using the toilet, shopping for groceries, taking medications or managing money. The chronic conditions and limitations were selected based on availability in all the analysed surveys (see Table A3.1 in the Appendix for further information). To measure social care needs, harmonisation of all surveys was necessary, particularly for the response options from Brazil, Colombia, and Mexico regarding limitations for ADL and IADL. Therefore, we tested different ways of operationalising care needs (see Table 3.2), specifically for Colombia (A and B) and Brazil (A and B), as these surveys included a wider range of response options, making dichotomisation less straightforward. In version A, individuals were classified as experiencing a limitation at various levels of difficulty (e.g., being able to perform a task but with difficulty was considered a limitation). In contrast, version B focused only on whether an individual could or could not perform the activity. The results presented here are based exclusively on version B, as this approach yielded more consistent results with the data from the other analysed countries.

Table 3.2 Different ways for operationalizing facing ADL and IADL limitations according to response options by survey and country

Facing limitations	Brasil_A	Brasil_B	Colombia_A	Colombia_B	Mexico	Spain	Portugal
Yes	Can't do	Can't do	Can't do	Can't do	Yes	Yes	Yes
	Do have some minor difficulty		Can do without help but with difficulty	Need or will need help for doing it	Can't do		
	Do have a major difficulty		Need or will need help doing it				
No	Do not have difficulty	Do not have difficulty	Can do without difficulty or help	Can do without difficulty or help	No	No	No
		Do have some minor difficulty		Can do without help but with difficulty	Doesn't		
		Do have a major difficulty					

Years of Life Expectancy with Care Needs (YLCN) at age 60 were calculated by each state using the Sullivan method (1971). To achieve this, prevalence rates were estimated by decennial age groups from (60-80+), gender, and country. The starting age of analysis was set at 60 years old for two main reasons: first, due to data availability as the Colombian survey used only interviewed

individuals 60+ or older; second, because it was useful to reduce comparison issues arising from differential access to healthcare services among the analysed countries, as Europeans at age 50 might have higher chances of experiencing multimorbidity than Latin Americans due to their better access to primary health care services, an effect that dilutes with increasing age. Decennial abridged life tables, top-truncated at age 80+ for men and women, were used for mortality trends. These 10-year abridged life tables were built from single-year life tables for each country. We also tried to use estimates based on 5-year age groups, but due to the division of states by gender and age groups, the sample sizes in some countries, like Portugal, were too small, resulting in significant variability in prevalence estimates. Similarly, we tried different categorizations of the oldest open age group, at 85+ and 90+, but due to sample size restrictions, we kept it at 80+. The Sullivan Method was used as follows: using the mortality rates from the life tables and the prevalence rates from the surveys, we estimated YLCN by calculating the remaining average years individuals are expected to live at age 60 and the number of years expected to be lived in each state based on the prevalence. Specifically, we summed the person-years lived between age x and x + n (Lx), multiplied them by the prevalence of the specific state, and divided by the number of survivors at the corresponding age (lx) (see further details in the Appendix–Methodological details).

After this, we decomposed the gender gap in healthy life expectancy (state A: No chronic condition) at age 60 by different states using Horiuchi et al.'s method (2008). This method allows for the decomposition of change or differences in a function of multiple variables. While it is commonly used to compare differences in life expectancy within a population at two time points, it can also be applied to compare two different subpopulations like men and women. All analyses were conducted using R statistical software (version 4.3.2). The *DemoTools* and *DemoDecompose* packages were used to transform single-year life tables into abridged ones and to decompose the gender gap using an adapted version of the approach previously used by Van Raalte and Nepomuceno (2020) for decomposing healthy life expectancy. While these authors focused on two states (healthy and unhealthy), our analysis incorporated the five previously mentioned states (from A to E). This was achieved by including all the states within the Sullivan function used to estimate life expectancy. Although Van Raalte and Nepomuceno (2020) showed that this decomposition can also be done by using a stepwise function instead of Horiuchi et al.'s (2008) method, we found the results to be identical. Therefore, we chose the latter method, as it avoids the issue of having to pick a specific order for the included variables or states (in our case, the five states combining healthcare and social care needs). Further details are provided in the Appendix–Methodological details.

3.3 Results

Our results are presented in the order defined by our methodological approach. First, we show the state-specific prevalence rates used to calculate the Years of Life Expectancy with Care Needs (YLCN), followed by the estimation of the YLCN at age 60, along with the percentage of total remaining years. Finally, we present the results of decomposing the gender gap in healthy years (state A, defined as living without a chronic condition) across the other states. All results are presented by country and disaggregated by age group, gender, and state. Descriptive information about the sample by gender and age group can be found in Table 3.3. Across all analysed countries, a higher proportion of women than men were surveyed. Additionally, most of the sample is concentrated in the youngest age group (60 to 69 years), ranging from 38.06% for Spanish women to 59.01% for Brazilian men. There are differences in the sample distribution by age group between the Latin American and European countries that are worth mentioning. In the former, the 80+ age group constitutes less than 15% of the sample, whereas in the latter, the percentage is notably higher, reaching the highest proportion among Spanish women (29.60%).

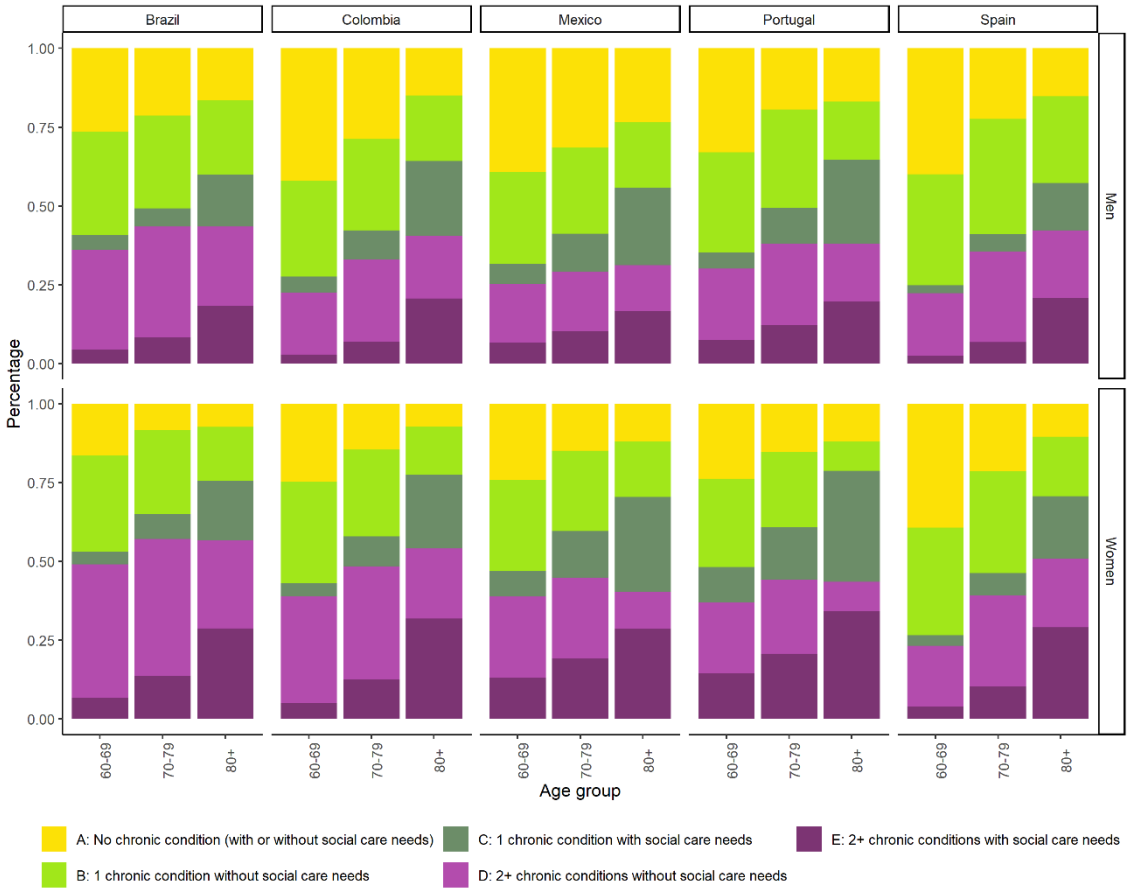
Table 3.3 Percentual sample distribution by gender and age group estimated by column

	Brasil		Colombia		Mexico		Spain		Portugal	
Age group	**Men**	**Women**	**Men**	**Women**	**Men**	**Women**	**Men**	**Women**	**Men**	**Women**
	n=2172	**n=3260**	**n=10112**	**n=13582**	**n=4068**	**n=5798**	**n=2064**	**n=2414**	**n=601**	**n=662**
60-69	59.01	54.70	58.61	55.42	52.93	54.01	45.72	39.66	51.31	43.20
70-79	29.32	30.29	29.65	30.63	32.12	31.39	33.51	30.71	31.85	31.45
80+	11.65	14.98	11.70	13.93	14.92	14.58	20.75	29.60	16.82	25.33

Figure 3.1 presents the prevalence of the five analysed states by age and gender. In general, all the analysed countries followed similar patterns for both men and women, despite differences in prevalence levels. For all countries, the youngest age group (60-69 years) shows a higher share of individuals in states without any chronic condition or 1 chronic condition without social care needs (states A and B). However, as age increases, the prevalence of these states decreases, while other states—particularly those involving 2+ chronic conditions with or without social care needs (states D and E)—become more prominent. In general, women and men follow similar patterns within each country. However, the prevalence of states D and E are consistently higher among women across all age groups. Brazilian women have the highest prevalence in these states, reaching 49.00% in the youngest age group and 56.60% in the oldest. In contrast, the prevalence of states D and E together is notably lower among Mexican and Colombian men. State C, which represents those with one chronic condition and social care needs, consistently shows the lowest prevalence,

especially in the younger age groups, ranging from 2.52% among Spanish men aged 60-69 years to 35.18% among Portuguese women aged 80+.

Figure 3.1 State prevalence for estimating Years of Life Expectancy with Care Needs by gender, age group and country

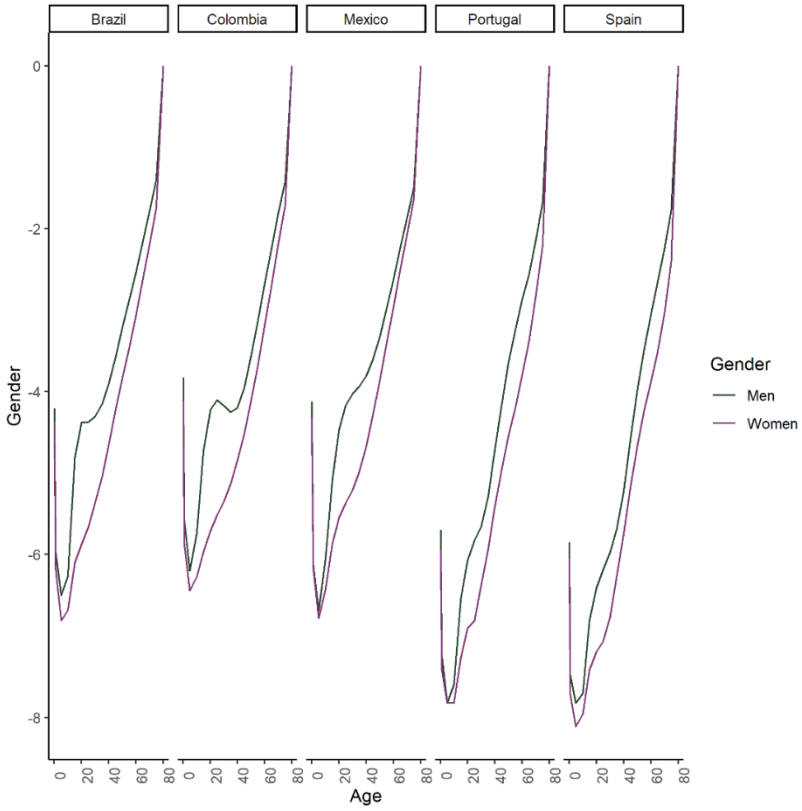


Based on these prevalence rates and corresponding mortality trends, YLCN were estimated. Mortality trends were generally consistent across countries (see Figure 3.2), with women showing lower mortality rates than men. As expected, Latin American countries exhibited higher mortality rates at younger ages, with a more pronounced gender gap in mortality. Colombia is the country with the widest gender gap. These differences in Brazil, Colombia and Mexico tend to diminish after age 40, when, despite varying mortality levels, all countries display a similar trend of a narrowing gender gap in mortality. Conversely, this gap starts to increase after age 50 in Spain and Portugal, and is driven by men's higher mortality.

Figure 3.3 presents the YLCN after age 60 in total years, while Figure 3.4 shows the same measure as a percentage of the life expectancy at age 60. The highest life expectancy at age 60 was

observed among Spanish women (27.32 years), whereas the lowest was recorded for Brazilian men (20.09 years). As anticipated, women in all analysed countries have a higher life expectancy after age 60 than men, with the largest gender gap in life expectancy observed in Spain (4.45) and the smallest in Mexico (1.58) (see Table 3.4). On average, women are expected to live more years than men after age 60 in states involving multimorbidity (2+ chronic conditions), regardless of whether they require social care (states D and E). Additionally, women are projected to spend more years with social care needs, either with one or 2+ chronic conditions (combining states C and E).

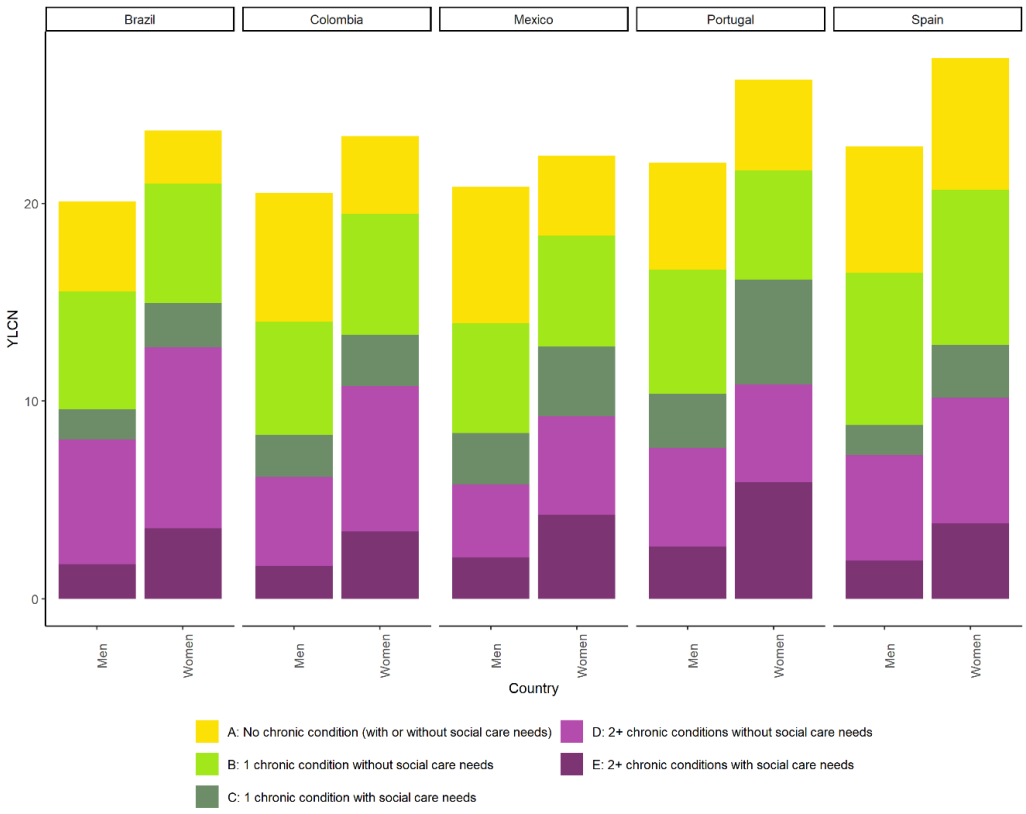
Figure 3.2 Probability of dying at specific age (qx) in the log scale by gender and country – 2015



When analysing the percentage of YLCN by each of the included states, the trends remained consistent, as shown in Figure 3.3. Women are projected to spend a higher share of their remaining life in states with multimorbidity (D and E) than men. Furthermore, comparisons between countries become more direct when considering the percentage of YLCN by specific state. For instance, Brazilian women are expected to live more than half of their remaining life expectancy at age 60 in states with multimorbidity (53.73% when combining states D and E). Meanwhile, Spanish women are expected to live about one-third of their remaining lives at age 60 in these states (37.19%). Additionally, Spaniards (both women and men) are expected to spend more than half of their remaining years in states without chronic conditions or with one chronic condition but without social

care needs (53.03% and 61.56%, respectively, when combining states A and B). Brazil, Colombia, Mexico and Portugal shared similar trends, where men are expected to spend more than half of their remaining years in states A and B, meaning not experiencing any chronic condition or just experiencing one chronic condition but without social care needs. On the other hand, women from these countries are expected to live over half of their remaining years in states that imply multimorbidity or social care needs (C, D and E). Nevertheless, noticeable differences exist among these three countries. For example, Portuguese women and men show the highest percentages of remaining years lived with 2+ chronic conditions with social care needs (State E is 5.89% and 2.63%, respectively). In contrast, Colombian women and men showed the lowest share of time spent in this state (3.41% and 1.66%, respectively).

Figure 3.3 Years of Life Expectancy with Care Needs (YLCN) by gender and country



To explore the differences in YLCN between women and men, Table 3.4 presents the gender gap in life expectancy at age 60, and by each state, resulting from subtracting the expected years of women from those of men. The previously mentioned positive gender gap in life expectancy indicates that women live longer on average across all countries. This is also particularly true in states of one chronic condition with social care needs (state C) and 2+ chronic conditions with social care needs (state E), with women living more years than men in these states. The gender

gap in state C ranges from 0.42 years in Colombia to 2.57 years in Portugal, while it varies from 1.75 years in Colombia to 3.26 years in Portugal in state E. Conversely, the gender gap in healthy life expectancy, here measured through state A (no chronic condition with or without social care needs), is negative for all countries but Spain, meaning men tend to live more years than women in this state.

Figure 3.4 Percentage of remaining life expectancy at age 60 of Years of Life Expectancy with Care Needs (YLCN) by gender and country

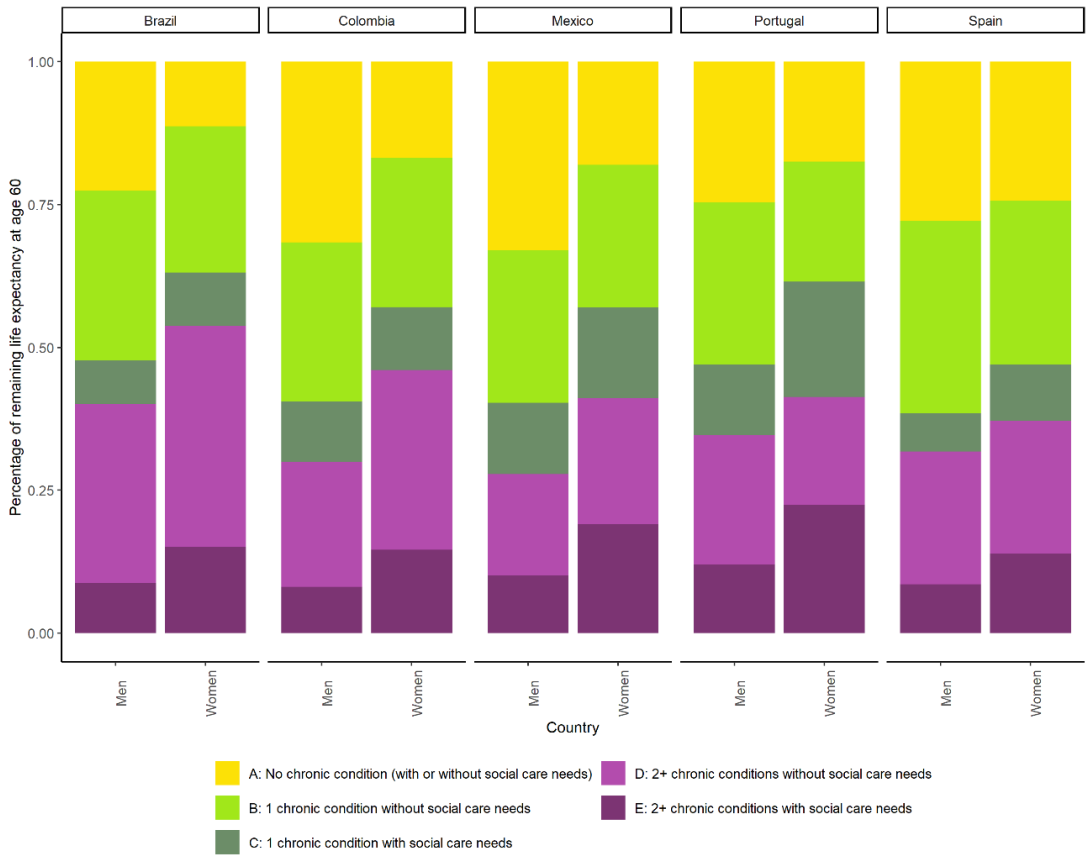
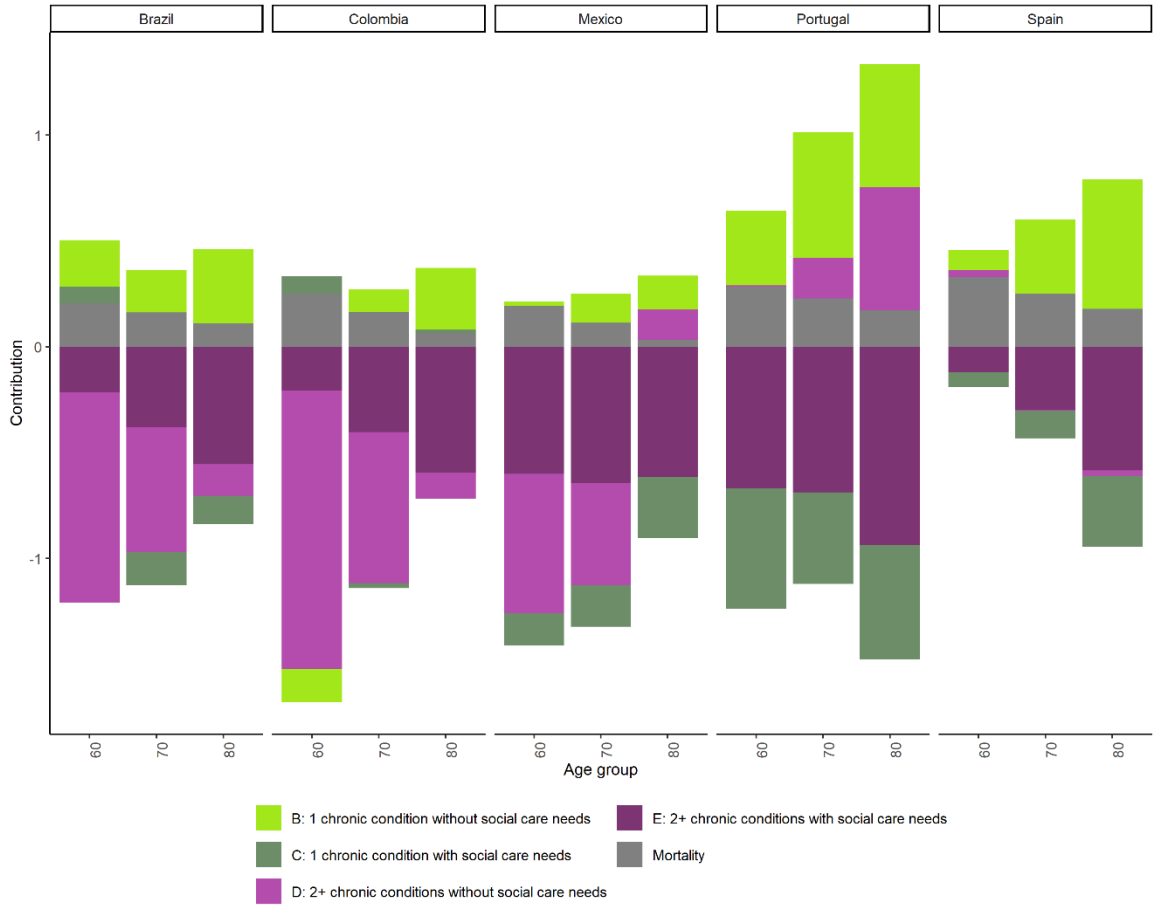


Table 3.4 Differences between women and men in life expectancy at age 60 and Years of Life Expectancy with Care Needs (YLCN) by state and country

YLCN	Brazil	Colombia	Mexico	Portugal	Spain
LE at 60	3.59	2.89	1.58	4.18	4.45
A: No chronic condition (with or without social care needs.	-1.85	-2.56	-2.84	-0.84	0.28
B: 1 chronic condition without social care needs.	0.07	0.41	0.05	-0.75	0.13
C: 1 chronic condition with social care needs.	0.69	0.42	0.95	2.57	1.14
D: 2+ chronic conditions without social care needs.	2.86	2.87	1.27	-0.06	1.03
E: 2+ chronic conditions with social care needs.	1.81	1.75	2.15	3.26	1.86

To further analyse these differences, we decomposed the gender gap in healthy years by all other states and for each 10-year age group. Figure 3.5 presents the results of the decomposition. Positive values indicate states that increase the differences in healthy life expectancy between men and women. In all the analysed countries except Spain, this gap is negative. Therefore, contributions above the zero line represent states that reduce the gender gap,. while negative values reflect states that widen the differences between men and women. In the Spanish case, where the gender gap in healthy life expectancy is positive, meaning women live more healthy years than men, the interpretation is the other way around, with positive contributions indicating factors that widen the gap, and negative contributions referring to those that narrow it.

Figure 3.5 Decomposing the gender gap in healthy life expectancy after age 60 (state A) by states with healthcare and social care needs (states B to E) by country and age group



For Brazil, Colombia, Mexico and Portugal, mortality and state B (1 chronic condition without social care needs) contributed to reduce the gender gap in healthy life expectancy, while in Spain, these states explain why women are living more healthy years than men, with the latter being more affected by mortality and the experience of one chronic condition without social care needs. On the other hand, state E (2+ chronic conditions with social care needs) also played a role in this gap.

For all the analysed countries but Spain, the contribution of this state implies that women's healthy life expectancy is more affected than men's by multimorbidity with social care needs, which explains why men live more years in health than women, especially in the older age groups. For Spain, the contribution of state E indicates that it narrows the gender gap. Finally, differences were observed among the analysed Latin American countries and Portugal, primarily in relation to state D (2+ chronic conditions without social care needs). In the Latin American countries—except for Mexico in the 80+, age group—the contribution of this state is negative across all age groups, suggesting that women live more unhealthy years than men. In contrast, in Portugal, especially among the older age groups, this state contributes to shortening the gender gap, meaning that men's healthy life expectancy is more negatively affected by this state.

3.4 Discussion

This study aimed to provide a more nuanced understanding of healthcare needs, operationalised through (multi)morbidity, and social care needs, understood as facing limitations for ADL and IADL, and their effects on healthy life expectancy measures in selected Ibero-American countries. Our results showed consistent trends in the prevalence of the analysed states for all countries, despite differences in levels: We observed that the youngest age group experience a higher prevalence of individuals in a healthy state or with 1 chronic condition without social care needs, meanwhile, individuals at older age groups have lower prevalences in these states and are more affected by states involving 2+ chronic conditions, both with and without social care needs. As expected, our estimations of life expectancy at age 60 were higher among European countries than the Latin American ones and lower for men when compared to women. However, women are expected to live on average more years than men after age 60 in states with 2+ chronic conditions. Furthermore, the gender gap in healthy life expectancy was negative for all the analysed countries but Spain, meaning that in these countries, men are expected to spend more years of their life expectancy in good health than women, and that conversely, Spanish women are expected to spend more years in good health than men. The gender gap decomposition also showed that differences between men and women were explained by the contribution of mortality, which reduced the gap between men and women in all countries but Spain. However, the biggest contributions to this gap resulted from other states added together. In this sense, it is worth highlighting that the state referring to experiencing multimorbidity alongside social care needs contributed to widening the gap between men and women in Brazil, Colombia, Mexico and Portugal, which also explains why men are expected to live more years than women in healthy states.

Country-specific results reveal that, despite similar overall trends, important differences persist between Latin American and European countries. These findings underscore the diverse pathways of health transitions experienced by each country. This diversity is not only reflected in variations in life expectancy estimates, with the highest observed for the Spanish population and the lowest for the Mexican population, but also in their gender gap in life expectancy and healthy life expectancy. General differences between countries align with previous evidence highlighting the diverse processes of the epidemiological transition (Frenk et al., 1991). For instance, Spain and Portugal experienced improvements in their life expectancy indicators later in the 20th century when compared to other European countries (Mackenbach, 2020; Spijker & Blanes Llorens, 2009). They rapidly increased their life expectancies at age 60 from the 1980s, as progresses in mortality from degenerative diseases became concentrated at higher ages (Guardado Moreira & de Castro Henriques, 2016; Spijker et al., 2012). Additionally, when compared to the Latin American countries, Spain and Portugal have followed a "western model" of the epidemiological transition, unlike Brazil, Mexico and Colombia. This difference explains also our results regarding lower life expectancy and a larger gender gap (Palloni & Pinto-Aguirre, 2011; Van Oyen et al., 2013) for Latin American countries, in which the epidemiological transition is characterised by the predominance of stage overlapping, prolonged transitions and an epidemiological polarization model (Borges, 2017; Gómez-Dantés et al., 2016), where mortality driven by infectious diseases is coexisting with mortality due to chronic conditions.

In this sense, comparisons between Europe and Latin America are usually criticised by the fact that European countries are presented as the forerunners of a linear and evolutionary path. However, by emphasising differences between Ibero-American countries, we aim to show the opposite, that they have followed their own paths, and despite life expectancy gains, the challenges faced by them are different. This also stresses what other research has suggested regarding the complex relationship that exists between infectious diseases and morbidity patterns (Mercer, 2018). Furthermore, these differences are also the result of other factors associated with the health transition and the differences in living conditions between the two regions. While life quality in Europe is associated with lower deficits in housing, higher education levels and lower poverty, Latin American countries are characterised by dramatic inequalities affecting both mortality and morbidity trends (Alvarez et al., 2020), which can also translate into increasing social care needs due to more negative outcomes from diseases. Even though our results cannot disentangle the complex effects

of these differences regarding living conditions in the two regions, they should be considered as structural determinants of our analysis.

Additionally, cross-country differences were evident in the gender gap in healthy years between men and women. Our results are generally aligned with previous evidence supporting the health-survival paradox, which suggests that women's longer life expectancies are associated with living more years in states characterised by multimorbidity and dependency (Oksuzyan et al., 2010). Nevertheless, our results also indicate that the gender gap in healthy life expectancy is better explained by the contribution of states involving multimorbidity (2+ chronic conditions) and social care needs at younger ages. Furthermore, the main findings also highlight that the gender gap in healthy life expectancy is also explained by the experience of social care needs, with women facing higher prevalences in states including limitations for ADL and IADL and spending more years on average in these states than men. These results are consistent with studies indicating that women are at higher risk of experiencing social care needs as they grow older (Kingston et al., 2017; Vlachantoni, 2019), which also indicates the differential effects that the experience of morbidity and multimorbidity have on their lives, probably driven by differences in their health outcomes and the diverse pathways they experience between diagnosis and treatment.

The widest gender gap in life expectancy was observed in Spain, with women expecting to live on average 4.45 more years than men, while the shortest was in Mexico, with women living on average 1.58 years more than men. Additionally, the largest gender gap in healthy life expectancy was observed in Mexico, with women living on average 2.84 years less than men in this state, while the smallest was in Spain, with women living on average 0.84 years more than men in health. This is probably because the gap in mortality trends between men and women is widened among European countries after age 50. Meanwhile, this gap is bigger in Latin American countries at younger ages, which in turn can be related to a selection bias of men surviving after age 50. These survivors are probably coming from the most privileged segments of their populations and are in healthier conditions. While literature has consistently reported that the health-survival paradox is observed worldwide, not only when measuring life expectancy but also healthy life expectancy (Van Oyen et al., 2013), results from Spain call our attention to the fact that this could change over time. There are diverse explanations of why differences in the healthy life expectancy's gender gap might occur that refer to the selection bias of survival men at older ages, especially in Latin America, due to the effect of violent deaths, and also behavioural aspects that contribute to the worse health of

men among Spaniards. However, this topic should be further investigated using other data sets and comparing trends over time.

There is a robust literature comparing the gender gap in longevity between different countries (Austad, 2006; Oksuzyan et al., 2010). Nevertheless, our study is novel in this endeavour by combining indicators of social care needs with healthcare ones, our results emphasise the importance of including social care needs in discussions on the compression and expansion of morbidity, as well as in healthy life expectancy studies. Aligned with other studies, we stress the relevance of estimating the average time individuals are expected to live with chronic diseases and different levels of dependency and disability (Lam et al., 2024; Shen & Payne, 2023). Additionally, our work contributes to this area of research by exploring the relationship between healthcare and social care needs when introducing the Years of Life with Care Needs (YLCN) as a nuanced indicator, and their gendered implications when it comes to understanding older men's and women's specific needs. To our knowledge, no previous study has accounted for social care needs, including limitations for ADL and IADL alongside health care needs (by measuring chronic conditions) in their healthy life expectancy estimations, nor have they decomposed the gender gap in healthy life expectancy into more than two states. In this sense, one of the main advantages of the YLCN measure is its ability to allow comparison across populations, thanks to the properties of life expectancy indicators. Therefore, our results account for the age structure of each analysed country, providing a synthetic indicator that can be interpreted by diverse audiences. However, compared to official life expectancy reports, our estimations tend to be slightly higher. This discrepancy arises from the fact that our last age group of analysis is relatively young (80+) in a scenario of an ageing population, when many deaths occur after age 80. This limitation is more likely to affect the estimations for European countries than the Latin American ones, and the conclusions that we can make about the healthcare and social care needs of individuals after age 80+. It also might have played a role in underestimating the unhealthy years of women.

Regarding other limitations of the study, it is important to acknowledge that Sullivan's method assumes constant state prevalence over time. Unfortunately, longitudinal data for Colombia is not available, which prevented us from fitting a multistate model. Additionally, the inclusion of several states likely added complexity to the models, which posed technical challenges involved in performing decomposition with multistate estimations. Second, our analysis is focused on data from 2015. While more recent information is available for some other countries, we prioritised comparing very different countries and therefore focused on a period where data was available for all.

Moreover, although Brazil, Spain and Portugal have more recent longitudinal data, much of it was collected during the COVID pandemic, which affected its collection and quality. Third, regarding data collection, it is important to mention that the analysed states were constructed based on self-reported variables, which may introduce underreporting bias. This is particularly relevant in Latin American countries, where individuals often face barriers to accessing healthcare services and limited resources in the diagnosis and treatment of disease, which can affect the measurement of morbidity. Despite improvements in mortality data from Latin American countries, it is also worth mentioning that these data may still suffer from under-registration and coverage issues (Gonzaga et al., 2018). Additionally, the measure of social care needs may be affected by two sources of bias: on the one hand, underreporting by individuals already receiving help for their limitations (who may not report them as such); on the other hand, our measure assumes that facing limitations for performing ADL and IADL implies needing someone's support for performing the task and, therefore, a need for social care needs, which might not be always the case. This assumption is particularly relevant in countries where responses to facing limitations are dichotomous (Mexico, Spain and Portugal).

Finally, our results also depended on the harmonisation process that aimed to make data coming from different surveys comparable. To achieve this, we chose surveys that shared similarities in their design, sample, objective, and questions, and we decided to work with individuals aged 60+ to ensure comparability across all included countries. Additionally, we tested different methods for operationalising our variables of interest and evaluated several alternatives to achieve consistency in the presented results. Despite the challenges of harmonisation and the complexity of working with different populations, these cross-country comparisons provide valuable insights into how diverse pathways of the epidemiological and health transition, including the effect of structural determinants related to each country living conditions and levels of access to healthcare services, might lead to heterogenous consequences for ageing populations. This emphasises that there is no easy solution for societies to prepare for and respond to the needs of older individuals. By estimating YLCN accounting for both health and social care needs, we demonstrate that healthy life expectancy can be indicative of population health but not necessarily reflect the social care needs that individuals might face due to their health status. Furthermore, our results also highlight the complex relationship that exists between country differences and the gender gap. This underscore, for instance, the pressing healthcare and social care needs that Latin American women are facing, because of this relationship and how mortality trends after age 50 are differentially affecting the healthy life expectancy of Spanish men when compared to women. Finally, our results

show that having healthcare needs due to the presence of a chronic condition is not always linked to social care needs, and that the health-survival paradox is not only explained by men's mortality but also by how they experience chronic conditions and limitations.

3.5 Conclusions

The results presented here demonstrate the value of combining estimations of healthcare and social care needs to improve our understanding of how healthcare and social care systems can enhance individuals' well-being within ageing populations, as well as adapt their services for those who need them. One of the key contributions of our findings is the awareness that after age 60, individuals may experience different states that suggest the need for social care, though this need does not always materialise. By showing that the smallest proportion of life expectancy after age 60 will be spent in states not requiring social care, this study underscores the importance of refining how we interpret and utilise healthy life expectancy as an indicator, ensuring that it captures more accurately the nuances of healthcare and social care needs in ageing populations. By using measures that account for this interplay, we emphasise the importance of considering a broader perspective when adapting these systems to meet the evolving needs and demands of older individuals. Furthermore, comparisons between Ibero-American countries and the different states of multimorbidity and social care needs contribute to explaining the gender differences in healthy life expectancy, provide useful insights into the specific challenges of ageing populations. We know that women are living longer years than men and that these years are usually lived in poorer health than men. However, the needs that underlie these unhealthy years entail account at the same time for their healthcare and social care needs. Future research should focus on disentangling the relationship between social care needs and specific chronic conditions, as well as different gendered constellations of multimorbidity, also considering the effects of infectious diseases on morbidity, especially among countries from the Global South. Our results also suggest that the common suggestion that chronic conditions inevitably lead to dependency and social care needs may not always be true. These relationships often vary by gender and country, highlighting the need for novel approaches to planning care provision.

4. From Curing to Caring: Exploring Health and Social Care Needs after the Onset of Chronic Conditions among European Older Adults (50+)[6]

Abstract

Population ageing effects on healthcare needs have been widely discussed. Nevertheless, less has been said about its implications on social care needs, even though living with one or more chronic conditions usually affects individuals' daily lives through functional decline and disability, which in turn might translate into the emergence of social care needs. Using data from the Survey of Health, Ageing and Retirement in Europe (SHARE), we analysed trajectories of multimorbidity and social care needs of 16,718 individuals aged 50+ from 10 European countries through sequence analysis. Four trajectories after the onset of chronic conditions were identified: a) "Permanent multimorbidity and social care needs", b) "Permanent multimorbidity without social care needs", c) "One chronic condition and social care needs", and d) "One chronic condition without social care needs and some recoveries". Multinomial regression models were fitted to understand through cross-country comparisons how demographic, socioeconomic, living arrangements, and health-related dimensions explain individuals' trajectories. The models present divergences related to demographic and socioeconomic aspects and differences by country. By acknowledging trajectories within health and social care needs, we showed the challenges posed by ageing processes which require tailored-made and person-centred services oriented towards preventing and postponing the onset of chronic conditions.

Key words: Sequence analysis, Morbidity, SHARE, Limitations.

4.1 Background and Objectives

The extension of human lives is being challenged by how we grow old and how we live before dying. The fact that we live longer than before raises questions about whether these years are lived in states of health and well-being. Much of the literature on the subject is focused on debates about morbidity, its compression or expansion, and its consequences on healthcare needs and service provision. Nevertheless, less has been said about its implications on social care needs, even though living with one or more chronic conditions usually affects individuals' daily lives through functional decline, disability, dependency, and mobility limitation. Social care needs refer to the

[6] This chapter was coauthored with PhD Elisenda Rentería and PhD Jeroen Spijker

need for help and support that a person needs during their daily lives, which refer to a wide range of activities like getting out of bed, sitting, cooking, shopping for groceries or taking medications. These activities are usually undervalued when you can do them, but create difficulties and barriers for quotidian lives among those who can't do them.

While the consequences of morbidity on healthcare needs have been widely discussed (Calderón-Larrañaga et al., 2017; McGilton et al., 2018; Simpson et al., 2022; Warner et al., 2011), less has been said of its consequences on social care needs, even though the consequences of living with a chronic condition usually affect individuals' daily lives through functional decline, disability, dependency and mobility limitations (Davies et al., 2022; Jackson et al., 2015; Marengoni et al., 2009; Saadeh et al., 2023; Tesch-Römer & Wahl, 2016). The relationship between healthcare and social care needs has only recently started to be studied (Simpson et al., 2023). Furthermore, few analyses provide cross-country comparisons of how these phenomena evolve alongside life expectancy increases. However, novel approaches for guaranteeing older individuals' well-being have encouraged strategies ranging from curing diseases, delaying the onset of diseases, increasing autonomy, and providing integrated healthcare from a multidisciplinary perspective (Brown & Menec, 2019; Mlinac & Feng, 2016; Ouwens et al., 2005; Warner et al., 2011). Hence, healthcare is being reoriented from curing chronic conditions, something that is not always possible, especially in ageing scenarios, to maintaining well-being. This last scenario may translate, among other things, into the necessity of accounting for social care needs.

Generally, analyses of this issue have understood the ageing process as a unidirectional path of functional decline, beginning with the onset of chronic conditions, the aggravation of which leads to dependency, and eventually, to death (Jenkins et al., 2022; Madero-Cabib et al., 2022). Yet, this assumed linear process might be less straightforward (Newman et al., 2023), mainly because the trajectories of health and social care needs are complex and affected by individuals' characteristics like gender, age, and socio-economic status, but also due to the heterogeneous ways through which healthcare and social care systems in each country approach individuals' needs. Previous research has emphasised gender and socio-economic inequalities related to the experience of multimorbidity and social care needs. While the health survival paradox has stressed gender differences, with women being more exposed to experiencing multimorbidity and social care needs than men (Oksuzyan et al., 2010; Vlachantoni, 2019), socio-economic factors also play a role, typically visible through the educational gradients in multimorbidity and unmet care needs (Kröger et al., 2019; Nagel et al., 2008). Furthermore, research has highlighted differences between

countries regarding health and dependency indicators, although they belong to the same region, such as Europe (Jagger et al., 2011). Still, these studies often examine health and social care needs in isolation and rely on cross-sectional data, making it difficult to capture trajectories or pathways over time.

One of the main difficulties of studying health and social care needs is the lack of longitudinal data on multimorbidity, which is why epidemiological research has mainly focused on cross-sectional analysis (Cezard et al., 2021). In general, longitudinal studies about multimorbidity have used administrative records as a source. However, these registers do not usually include information on social care needs, which is, alongside the lack of integration of healthcare and social care services (Dambha-Miller et al., 2021), one of the issues challenging its analysis. Yet, surveys focused on individuals at older stages of their life course incorporate questions about these two dimensions of well-being. Therefore, we used data from the longitudinal Survey of Health, Ageing and Retirement in Europe (SHARE), which provides self-reported information about health and social care needs.

Hence, this longitudinal study aims to comprehend further the connection between the onset of healthcare needs, here defined as the experience of chronic conditions, with the rise of social care needs, understood as experiencing moving limitations or for performing Activities of Daily Living (ADL) and Instrumental Activities of Daily Living (IADL), in 10 European countries in two ways. First, by exploring the different trajectories associated with experiencing health and social care needs. Second, by simultaneously analysing individual factors and cross-country differences related to the experience of diverse trajectories of health and social care needs. Therefore, in this analysis, we expect to find multiple trajectories of health and social care needs rather than a unique linear path. We will also examine if previous evidence on gender and socio-economic differences related to health and social care needs holds when the two dimensions are combined in the analysis, and which differences between countries can be identified.

4.2 Research Design and Methods

To analyse trajectories of health and social care needs after the onset of chronic conditions, we operationalise them based on previous research. Regarding healthcare needs, we focused on morbidity (having one chronic condition) and multimorbidity (having more than one chronic condition). As for a definition of social care needs, existing literature has primarily used a definition based on aspects that do not refer directly to medical aspects like diagnosis and treatment

(Simpson et al., 2022), by focusing on individuals' difficulties or limitations for moving and for performing ADL and IADL (Vlachantoni, 2019; Vlachantoni et al., 2011). This definition emphasises that social care needs entail the need for support to achieve outcomes across different realms of personhood, but differ from healthcare needs as they are not linked to the treatment, control or prevention of illness (Spiers, 2019). Two methods were employed in this analysis: Firstly, sequence analysis was utilised to explore different states and trajectories of health and social care needs. Secondly, after grouping individuals' sequences using the best cluster solution, multinomial regression models were fitted to identify the main factors that accounted for differences between clusters' trajectories. All the analyses were conducted using the statistical program R (version 4.2.3), with the *Traminer* package for the sequence analysis (Gabadinho et al., 2011).

4.2.1 Data

We used data from the longitudinal Survey of Health, Ageing and Retirement in Europe (SHARE), which provides self-reported information of individuals aged 50 years and over. Between 2004 and 2020, SHARE collected eight waves from 26 European countries and Israel, generally within a two-year interval (Börsch-Supan, 2017). However, not all countries participated in every wave, nor were the same questions always included. Thus, our analysis focuses on all but the third, seventh and eighth waves, the latter was excluded because it was collected during the pandemic and was particularly affected by attrition, while the third and the seventh applied the SHARELIFE questionnaire for sample refreshment, which didn't have the relevant variables for this study available for all participants. We included the following 10 countries that collected data without skipping any intermediate waves for at least five of the six analysed waves: Austria, Belgium, the Czech Republic, Denmark, France, Germany, Italy, Spain, Sweden, and Switzerland. The inclusion criteria for the sample required individuals to be 50 years or older and to have at least one of the chronic conditions under study at the first observation (47,235 out of 75,991). This criterion was set because we aimed to explore the sequence of events following the onset of a chronic condition, though we also observed trajectories in which individuals recovered from all the analysed chronic conditions. After internal imputation, we retained only individuals with at least two observations containing information on chronic conditions, limitations in mobility, ADL, IADL, and mortality, which left us with a final analytical sample of 16,718 individuals (see Figure A4.1 from the Appendix for further information).

4.2.2 Measures

a) Response variables and states

To identify individuals having health and social care needs two types of variables were constructed: a variable classifying individuals' (multi)morbidity (0 = no chronic condition, 1 = one chronic condition, 2 = two or more chronic conditions), and a dummy variable that measured if individuals were experiencing at least one difficulty in performing an ADL and/or IADL and/or had mobility limitations (no=0, yes=1). The chronic conditions included were those asked for in all the analysed waves[7]. Meanwhile, the limitations include 23 activities referring to individuals' ability to live an independent life[8]. Creating a dummy variable was a methodological decision to facilitate the analysis of the many activities for which individuals might need social care or support. Based on these two variables of health and social care needs, the following seven states were created: having (a) no chronic condition without social care needs; (b) no chronic condition with social care needs; c) one chronic condition without social care needs; (d) one chronic condition with care needs; (e) two or more chronic condition without social care needs; (f) two or more chronic condition with social care needs; and, (g) being dead.

Regarding attrition of panel data from SHARE, we followed several strategies to deal with missing values. To check if information was lost due to the interviewee's death, we used data from the SHARE's "End-of-Life" interview and the date of death. If the information about the date of death was not available (0.5% of the cases, n=844), we assumed that participants died halfway the observation period when the successive number of waves with no information on the state was even and halfway plus one wave of the observation period when the number of empty states was uneven. For missing values unrelated to death because the person appeared in later waves, internal imputation was performed based on two assumptions: if the state remained unchanged

[7] The included chronic conditions were: 1) a heart attack including myocardial infarction or coronary thrombosis or any other heart problem including congestive heart failure, 2) high blood pressure or hypertension, 3) high blood cholesterol, 4) stroke or cerebral vascular disease, 5) diabetes or high blood sugar, 6) chronic lung disease such as chronic bronchitis or emphysema, 7) cancer or malignant tumour, including leukemia or lymphoma, but excluding minor skin cancers, 8) stomach or duodenal ulcer, peptic ulcer, 9) Parkinson disease, 10) cataracts, 11) hip fracture or femoral fracture, and, 12) arthritis osteoarthritis, osteoporosis or rheumatoid arthritis. All but the last chronic condition was included in the same way they were asked by the SHARE's questionnaire. However, we grouped the last category because it was asked differently across waves, referring to: a) Arthritis, including osteoarthritis, or rheumatism, b) Osteoporosis, c) Rheumatoid Arthritis, d) Osteoarthritis, or other rheumatism

[8] Regarding mobility limitations the SHARE asks participants to "Please look at card 36. Please tell me whether you have any difficulty doing each of the everyday activities on this card. Exclude any difficulties that you expect to last less than three months." And the following actions are included in card 36: i) Walking 100 meters; ii) Sitting for about two hours; iii) Getting up from a chair after sitting for long periods; iv) Climbing several flights of stairs without resting; v) Climbing one flight of stairs without resting; vi) Stopping, kneeling, or crouching; vii) Reaching or extending your arms above shoulder level; viii) Pulling or pushing large objects like a living room chair; ix) Lifting or carrying weights over 10 pounds/5 kilos, like a heavy bag of groceries; and x) Picking up a small coin from a table. Whereas for measuring I/ADL limitations, the SHARE's questionnaire includes the question: "Please tell me if you have any difficulty with these activities because of a physical, mental, emotional or memory problem. Again, exclude any difficulties you expect to last less than three months.", and the activities referred to: i) Dressing, including putting on shoes and socks; ii) Walking across a room; iii) Bathing or showering; iv) Eating, such as cutting up your food; v) Getting in or out of bed; vi) Using the toilet, including getting up or down; vii) Using a map to figure out how to get around in a strange place; viii) Preparing a hot meal; ix) Shopping for groceries; x) Making telephone calls; xi) Taking medications; xii) Doing work around the house or garden; xiii) Managing money, such as paying bills and keeping track of expenses; xiv) Leaving the house independently and accessing transportation services; and xv) Doing personal laundry.

between two observations with an empty state in between, then the state was kept the same throughout the observations with missing information (applied in 7.4% of cases, n=1237). Otherwise, the state was assumed to change halfway through the observation period if the number of observations with missing values was even, or after halfway plus one when this number was uneven (applied for 8.7% of cases, n=1458).

b) Explanatory variables of the regression models

The regression models covered various dimensions. Regarding demographic factors, the included variables were country, gender, and age group at first observation (ages 50-64, 65-79, and 80+). Concerning socioeconomic factors, educational level, housing tenure, and living arrangements were accounted for. Educational level was assessed at each individual's first observation and categorised as low, medium, or high education according to Eurostat's (n.d.) recommendations. Given the age of the studied population, changes in education level are rare, hence, missing values were imputed from subsequent waves (applied in 0.4% of cases, n=78). The remaining 46 individuals with missing values were removed from the multinomial models. The housing tenure variable was classified into four categories derived from the six categories in the SHARE dataset: Owner or rent-free, Tenant, Other - including cooperative members, subtenants and living in usufruct, and a fourth category for cases with missing information. The living arrangement variable was constructed by combining information on household size, presence of a partner in the household, and the children's residence of the individuals' last available observation. Four categories were created: (i) living alone (household size=1); (ii) living only with the partner (household size = 2 & the partner present); (iii) living with the partner and/or children (household ≥ 2 & at least the partner or child living in the same household); and (iv) other. Finally, the dichotomised chronic condition variable analysed in the multinomial regression models was operationalised as having or not having experienced any of the included chronic conditions in the survey during the observation period.

4.2.3 Sequence analysis

Sequence analysis was used to identify health and social care needs trajectories. Due to attrition and sample refreshment, which led to sequences of different lengths, the analysis focused on sequence order rather than timing and duration (Liao et al., 2022). Participants were followed over 3 to 6 observations (unless they died before the third observation), starting from the first observation in which they reported experiencing at least one chronic condition, until their last available

observation. Individuals who never experienced a chronic condition were excluded from the analytical sample. The creation of individuals' sequences was followed by a cluster analysis based on Optimal Matching (OM) using constant costs that compared all individuals' sequences through a matrix of distances (Studer & Ritschard, 2016). The optimal cluster solution was determined using agglomerative hierarchical cluster analysis, selecting Ward's method as the linkage criterion. Cluster quality was assessed using various strategies: Pruning (a horizontal cut of the dendrogram) was combined with other indicators, such as Average Silhouettes Width (ASW), which measures clusters' coherence by capturing distances between clusters and homogeneity within clusters, Hubert's Gamma with Sommers' D coefficient (HGSD) and Point Biserial Correlation (PBC).

4.2.4 Multinomial regression models

Using the clusters obtained from the sequence analysis, multinomial regression models were fitted to examine the effect of demographic, socioeconomic, living arrangements and health-related dimensions on the probability of experiencing each trajectory of multimorbidity and social care needs. To explore potential gender differences, separate models were run for women and men. The statistical significance of these differences was tested by fitting a model with interactions between all variables and gender. The models focus on chronic diseases experienced over the whole observation period. This approach provides a more comprehensive understanding of the progression and interaction of chronic conditions with social care needs.

4.2.5 Sensitivity checks

Several additional methods were used to validate the cluster groups based on estimating differences between sequences, the definition of social care needs and gender differences. Firstly, we tested Optimal Matching with constant costs and Optimal Matching between sequences of transitions (OMstran) for estimating the distance matrices: in both cases, a fourth-cluster solution was reached. Secondly, an alternative definition of social care needs, excluding mobility limitations, was considered, yielding similar results. Finally, we conducted separate sequence analyses for men and women, leading also to a four-cluster solution. Therefore, the results presented here are based on the sequence analysis using OM, a definition of social care needs that comprises mobility limitations as social care needs and includes both genders. For the inferential analysis, we also estimated logistic regression models, treating each cluster as a dummy variable, before fitting the multinomial models (see Table A4.1 of the Appendix). The results from these models followed trends similar to those of the multinomial regression models.

4.3 Results

In this section, we present the main results by referring to the sequence analysis and clusters and to the results from the multinomial regression models. The analytical sample was composed by 16,718 individuals who provided 67,777 observations. Women represented 56.61% of the sample, and the majority (44.11%) were in the 65-79 age group, meanwhile, the minority (13.71%) were 80+. About half of the sample had a low level of education (49.9%), followed by those with a middle level (32.15%). Most of the sample (62.9%) owned the house or didn't have to pay rent. Around half of the included individuals lived only with their partners (49.9%), even though more than a third of the analytical sample were living alone (33.6%). Regarding the countries, the sample distribution ranged between 5.4% represented by Germany to 14.2% in France. Finally, the most common chronic condition was hypertension (69.8%), followed by arthritis- and osteoporosis-related diseases (61.3%), while the less common ones were hip fracture (7.6%) and Parkinson's disease (2.7%).

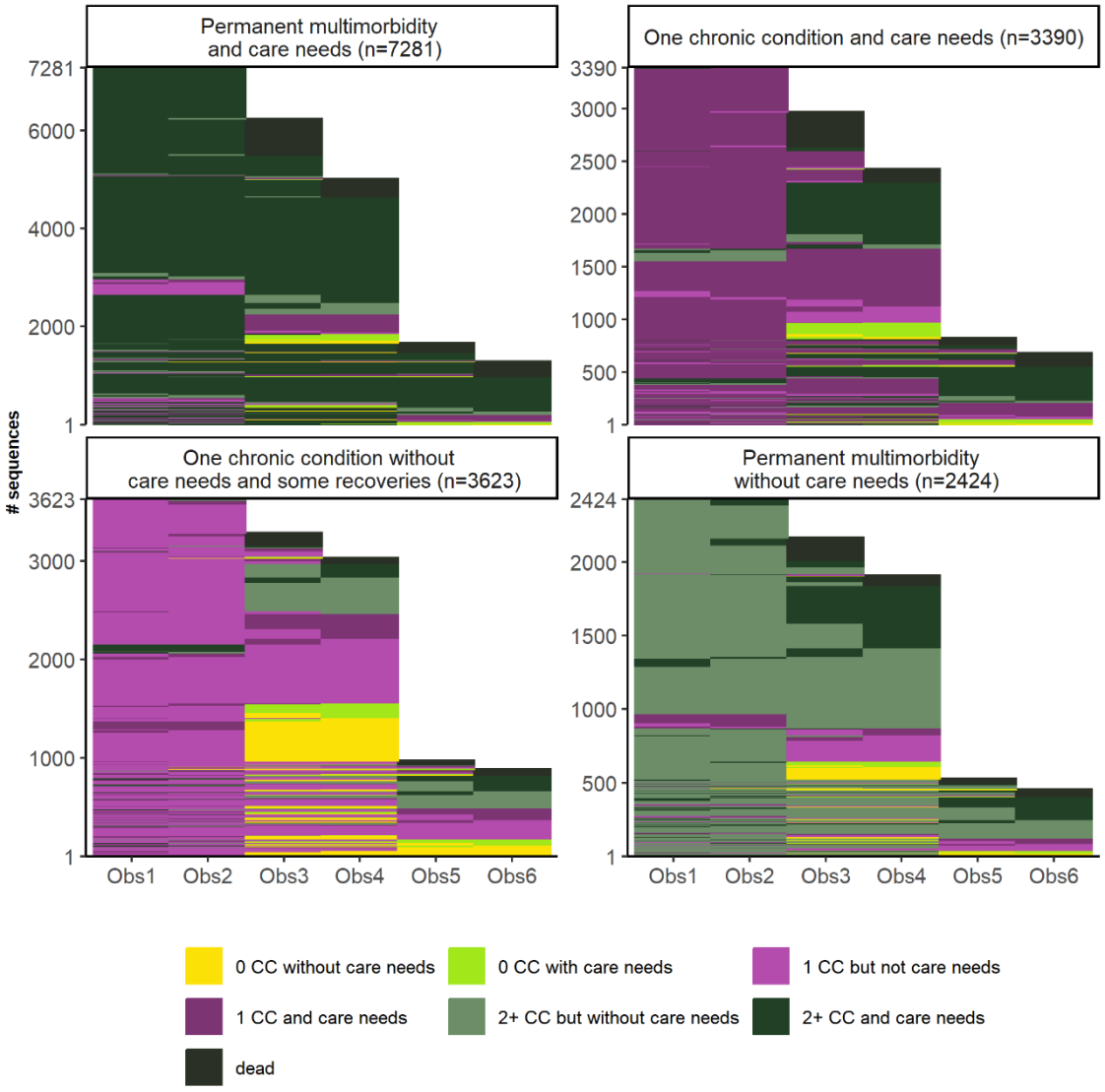
4.3.1 Identifying multimorbidity and social care needs trajectories

Based on data from six states that combined information on chronic conditions and social care needs, individuals' sequences were created (see Table A4.2 of the Appendix). Figure A4.2 (Appendix) shows the dendrogram and cluster quality indicators for the distance matrix calculated using constant costs with the OM method. From the dendrogram, it is evident that upper cuttings result in 2 to 4 clusters. Furthermore, the cluster quality indicators (ASW, HGSD and PBC) reached their highest values with the fourth cluster solution. Additionally, results from the ASH show positive silhouette width values for all four clusters (see Figure A4.3 in the Appendix). We named these four clusters descriptively as follows: A) "Permanent multimorbidity and social care needs", B) "Permanent multimorbidity without social care needs", C) "One chronic condition and social care needs", and D) "One chronic condition without social care needs and some recoveries", (see Figure 4.1).

Cluster A was the largest (7,281 individuals) and primarily consisted of individuals living with multimorbidity (2 or more chronic conditions) alongside social care needs throughout the observation period. Although some individuals in this cluster transitioned to having only one chronic condition or recovered, such transitions were rare, as most remained in states of multimorbidity for at least two or more observations. Cluster B was the smallest cluster (2,424 individuals) and was

characterised by individuals living with 2 or more chronic conditions without experiencing social care needs for the most part. The other two clusters (C and D) primarily consisted of individuals living with one chronic condition, differentiated by the presence or absence of social care needs. Individuals in cluster C steadily experienced social care needs alongside their chronic condition, while those in cluster D generally did not require social care. Notably, Cluster D included a higher proportion of individuals who recovered from (multi)morbidity.

Figure 4.1 Four-cluster solution composition by state and cluster



4.3.2 Explanations behind individuals' different trajectories

Similarities and differences in the composition of the four clusters created through sequence analysis can be discerned (see Table 4.1). The highest percentage of women was found in the clusters of permanent multimorbidity with social needs (cluster A) and one chronic condition with

care needs (cluster C) (63.0% and 62.7%), while the highest shares of men were in the clusters of permanent multimorbidity without care needs (cluster B) and one chronic condition but without care needs and some recoveries (cluster D) (55.2% and 54.0%). Concerning age groups, the highest percentages of individuals aged 65+ were in the cluster of permanent multimorbidity with care needs (cluster A) (68.8%), while the highest percentages of those younger than 65 years were in the cluster of one chronic condition without care needs and some recoveries (cluster D) (62.0%). In all clusters, the largest proportion was observed among those living only with a partner (ranging from 44.3% to 58.6%). Conversely, living with a partner and/or child was the least common living arrangement within the clusters (ranging from 1.4% to 1.7%).

Table 4.1 Descriptive statistics for the analytical sample by clusters

	Permanent multimorbidity and care needs	**Permanent multimorbidity without care needs**	**Chronic condition and care needs**	**Chronic condition without care needs and some recoveries**
	n = 7281	n = 2424	n = 3390	n = 3623
Gender				
Men	2696 (37%)	1339 (55.2%)	1264 (37.3%)	1955 (54%)
Women	4585 (63%)	1085 (44.8%)	2126 (62.7%)	1668 (46%)
Age group				
50-64	2200 (30.2%)	1187 (49%)	1419 (41.9%)	2245 (62%)
65-79	3652 (50.2%)	1080 (44.6%)	1409 (41.6%)	1233 (34%)
80+	1429 (19.6%)	157 (6.5%)	562 (16.6%)	145 (4%)
Education				
High	947 (13%)	541 (22.3%)	505 (14.9%)	961 (26.5%)
Middle	2026 (27.8%)	890 (36.7%)	1057 (31.2%)	1402 (38.7%)
Low	4287 (58.9%)	986 (40.7%)	1817 (53.6%)	1253 (34.6%)
Missing	21 (0.3%)	7 (0.3%)	11 (0.3%)	7 (0.2%)
Housing tenure				
Tenant	766 (10.5%)	183 (7.5%)	319 (9.4%)	238 (6.6%)
Owner or rent free	4316 (59.3%)	1639 (67.6%)	2041 (60.2%)	2530 (69.8%)
Other	1408 (19.3%)	367 (15.1%)	641 (18.9%)	525 (14.5%)
Missing	791 (10.9%)	235 (9.7%)	389 (11.5%)	330 (9.1%)
Living arrangements				
Living with the partner and/or children	127 (1.7%)	38 (1.6%)	52 (1.5%)	49 (1.4%)
Living only with the partner	3225 (44.3%)	1407 (58%)	1587 (46.8%)	2124 (58.6%)
Living alone	2806 (38.5%)	659 (27.2%)	1219 (36%)	941 (26%)
Other	1123 (15.4%)	320 (13.2%)	532 (15.7%)	509 (14%)
Country				
Austria	667 (9.2%)	206 (8.5%)	351 (10.4%)	318 (8.8%)
Belgium	1080 (14.8%)	352 (14.5%)	448 (13.2%)	467 (12.9%)
Czech Republic	962 (13.2%)	299 (12.3%)	395 (11.7%)	378 (10.4%)
Denmark	503 (6.9%)	265 (10.9%)	247 (7.3%)	366 (10.1%)
France	1031 (14.2%)	338 (13.9%)	506 (14.9%)	499 (13.8%)
Germany	403 (5.5%)	98 (4%)	210 (6.2%)	198 (5.5%)
Italy	812 (11.2%)	198 (8.2%)	343 (10.1%)	344 (9.5%)
Spain	923 (12.7%)	216 (8.9%)	372 (11%)	309 (8.5%)
Sweden	538 (7.4%)	210 (8.7%)	288 (8.5%)	325 (9%)
Switzerland	362 (5%)	242 (10%)	230 (6.8%)	419 (11.6%)
Chronic condition (having it)				
Hearth attack	3345 (45.9%)	765 (31.6%)	853 (25.2%)	595 (16.4%)
Hypertension	5789 (79.5%)	1953 (80.6%)	1916 (56.5%)	2026 (55.9%)

High cholesterol	4336 (59.6%)	1687 (69.6%)	1159 (34.2%)	1463 (40.4%)
Stroke or cerebrovascular disease	1369 (18.8%)	283 (11.7%)	348 (10.3%)	171 (4.7%)
Diabetes	2616 (35.9%)	755 (31.1%)	557 (16.4%)	430 (11.9%)
Chronic lung diseases	1863 (25.6%)	349 (14.4%)	519 (15.3%)	293 (8.1%)
Cancer	1339 (18.4%)	389 (16%)	444 (13.1%)	422 (11.6%)
Stomach or duodenal ulcer	1326 (18.2%)	308 (12.7%)	319 (9.4%)	294 (8.1%)
Parkinson	306 (4.2%)	22 (0.9%)	95 (2.8%)	42 (1.2%)
Cataracts	3005 (41.3%)	704 (29%)	807 (23.8%)	633 (17.5%)
Hip fracture	828 (11.4%)	93 (3.8%)	262 (7.7%)	96 (2.6%)
Arthritis- and osteoporosis-related disease	5471 (75.1%)	1251 (51.6%)	2075 (61.2%)	1465 (40.4%)

Source: Survey of Health Ageing and Retirement in Europe, waves 1-2, 4-6 and 8.

Regarding the educational level, individuals with lower educational levels were the majority in all clusters except the "chronic condition without social care needs and some recoveries" cluster (D) (less than 40%), where middle-educated individuals were more common (38.7%), and has the highest share of higher educated individuals (26.5%) when compared to the other clusters. Across all clusters, the highest percentages of individuals were homeowners or lived rent-free, with values ranging between 59.3% and 69.8%. When analysing chronic conditions by cluster, hypertension was the most common condition across all clusters except for the "One chronic condition without care needs and some recoveries" cluster (D) (ranging between 55.9% to 80.6%). For this last cluster, the chronic condition with the highest prevalence was arthritis- and osteoporosis-related diseases (61.2%). The disease with the lowest prevalence in all clusters was Parkinson's (ranging between 0.9% to 4.2%). Finally, there were differences in the percentage of individuals by country within each cluster, although these variations could be due to differences in sample sizes.

The average marginal effects (AME) of the multinomial regression model (see Figure 4.2 and also Table A4.3 of the Appendix) showed that women had a higher relative probability than men of being in clusters associated with care needs (clusters A and C), with AMEs of 0.07 and 0.04, respectively. Similarly, older age groups (65-79 and 80+) faced higher chances of being in these same clusters compared to those aged 50-64, with AMEs of 0.09 and 0.22 for cluster A and 0.00 and 0.03 for cluster C. Regarding the education level, those with low and middle levels of education faced a higher risk of being in clusters A (AMEs of 0.06 and 0.04) and cluster C (AMEs of 0.06 and 0.02) than those with higher education. Overall, factors related to housing tenure and living arrangements did not hold statistically significant results.

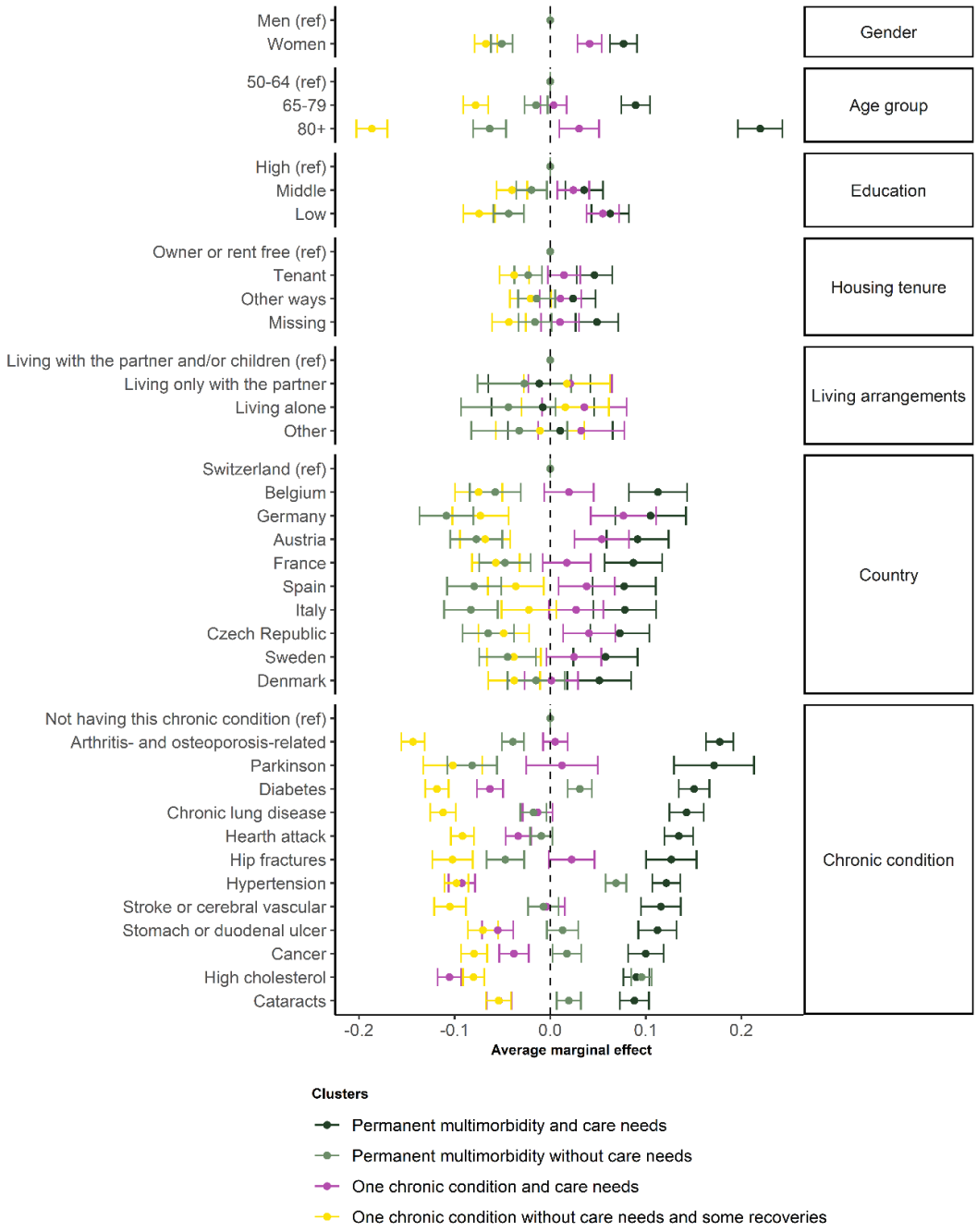
Similarly, the country-specific results showed a diverse panorama. Statistically significant differences between clusters were observed in Belgium, Germany, Austria, France, Spain and the

Czech Republic. The overall trend was that individuals in all countries had a higher likelihood of being in cluster A (multimorbidity with care needs) compared to individuals from Switzerland (reference category). This was also the case for Germany, Austria, Spain, and the Czech Republic regarding cluster C (one chronic condition and care needs). In contrast, all countries except Italy had a lower probability of being in cluster D (one chronic condition without care needs and some recoveries) than Switzerland. Although Switzerland stands out markedly from the other countries, there was little variation between the countries. Nevertheless, a gradient was observed, with individuals from Denmark and Sweden showing a lower probability of belonging to the cluster of "Permanent multimorbidity and care needs" (A), while those from Belgium and Germany showed a higher probability of being in this cluster, which was inversely associated with a lower probability of being in clusters B and D (those without care needs).

Regarding the type of chronic condition, statistically significant results were observed for cluster A across all included chronic health conditions, except high cholesterol. Individuals with arthritis- and osteoporosis-related conditions exhibited the highest probability of being in cluster A (AME 0.178), whereas those with cataracts had the lowest (AME 0.090). Furthermore, conditions related to arthritis and osteoporosis, diabetes, and hip fracture showed the biggest differences in the AME between clusters. The general trend observed for all these conditions, except high cholesterol, indicates that having them is associated with lower risks of belonging to cluster D of one chronic condition without care needs and some recoveries.

To explore gender differences explaining individuals' trajectories, separate models were fitted for men and women (see Table A4.4 in the Appendix). Subsequently, to test the statistical significance of these differences in odds ratios (OR), a model was fitted with all included variables interacting with gender (see Table S5 in the supplementary materials). The results showed statistically significant differences between women and men aged 80+ for the cluster B and D, with men of 50 to 64 experiencing a higher chance than women of being in trajectories of permanent multimorbidity without care needs (OR 0.349 vs 0.239) and a higher chance than women of being in trajectories of chronic condition without care needs and some recoveries (OR 0.140 vs 0.085). Statistically significant differences were also found between low-educated women and men in cluster D (OR 0.446 vs 0.577), meaning that low-educated women face lower probabilities of experiencing a trajectory of one chronic condition without care needs and some recoveries than men with a high level of education.

Figure 4.2 Average Marginal Effects (AME) of the multinomial regression model for explaining individuals' trajectories



Regarding specific chronic conditions, statistically significant differences between men and women were found for heart attack in clusters B of permanent multimorbidity without care needs (OR 0.656 vs 0.528) with men having a higher chance of suffering this health problem than women, and cluster C of chronic condition and care needs (OR 0.475 vs 0.567) with women facing higher chances than men of suffering it. Something similar occurred for stroke and cerebrovascular disease (OR 0.568 vs 0.777), as well as for stomach and duodenal ulcer (OR 7.55 vs 0.789) in cluster B, with women facing higher chances of having these chronic condition. In the case of Parkinson's disease (0.797

vs 0.498) in cluster C, and hypertension (0.385 vs 0.307), high cholesterol (0.482 vs 0.375), cataracts (0.572 vs 0.438), and arthritis- and osteoporosis-related diseases (0.258 vs 0.180) in cluster D of chronic condition without care needs and some recoveries, men had a higher risk of experiencing them than women. Gender differences across countries were also analysed, with Swiss men being the reference group (see Table A4.6 in the Appendix). Statistically significant results were found for some gender and country interactions within clusters B and D. Overall, compared to Swiss men, all combinations of gender and country indicated a lower chance of being in these clusters, which refer to trajectories that did not involve care needs.

4.4 Discussion and Implications

4.4.1 Main results

This study identified four groups of trajectories of health and social care needs after the onset of chronic conditions: a) "Permanent multimorbidity and social care needs", b) "Permanent multimorbidity without social care needs", c) "One chronic condition and social care needs", and d) "One chronic condition without social care needs and some recoveries". The existence of different trajectories highlights that, instead of being unidirectional, this process is less straightforward and is affected by individual characteristics including demographic and socioeconomic aspects, which also differs by country. Previous research on health trajectories has similarly found that different paths exist, and that they are related to individuals' characteristics, including socio-demographic ones and types of chronic conditions (Ashworth et al., 2019; Cezard et al., 2021; Madero-Cabib et al., 2022). However, the main contribution of this paper is to integrate health and social care needs in the study of these trajectories, aligning them with current debates about ageing, multimorbidity, and long-term care provision. By showing that the experience of chronic conditions does not necessarily translate into dependency associated with ADL and IADL limitations, we underscored that ageing at the population level has diverse consequences on individuals' healthcare and social care needs. It cannot be assumed that a mechanical relationship will inevitably occur between increasing multimorbidity and the need for social care. Moreover, this study also contributes to the evidence that recovery occurs (Solé-Auró & Gumà, 2023), a transition usually not included in multistate models of healthy life expectancies due to its low prevalence. Nevertheless, our results showed that around one-fifth of the analytical sample followed the trajectory characterised by chronic conditions without care needs and some recoveries, and men in younger age groups with higher educational level were more likely to be part of these trajectories.

Available evidence shows that the implications of multimorbidity are visible in the realm of causes of mortality but also individuals' healthcare needs (Palladino et al., 2016). In the last decades, demographic research has studied whether gains in life expectancy have been followed by years in good or poor health and their effects on the compression or expansion of morbidity, a question that is still open (Vaupel, 2010). Previous findings have suggested that when the analysis is focused on disability indicators, compression of morbidity seems to be an appropriate hypothesis, while focusing on chronic conditions is more aligned with its expansion (Tesch-Römer & Wahl, 2016). However, few analyses have approached the combination of these two types of measures (Kröger et al., 2019; Nagel et al., 2008) that might provide a more nuanced approach to the debate about whether gains in life expectancy have been encompassed with gains in years lived in health and well-being (Shen & Payne, 2023). Furthermore, few studies have explored the relationship between multimorbidity and social care services utilisation using cross-sectional data (Henderson et al., 2021; Kingston et al., 2018; Wittenberg & Hu, 2015) and costs (Blawat et al., 2020), but there are scarce longitudinal analyses on this subject (Cezard et al., 2021; Simpson et al., 2022).

4.4.2 Gender, age, and socioeconomic factors

This study aligns with previous evidence on differences in mortality and morbidity patterns due to age-cohort differences, the female-male health-mortality paradox, and the educational gradient (Kröger et al., 2019; Nagel et al., 2008; Oksuzyan et al., 2010). It confirms that younger individuals, men, and those with higher levels of education face lower risks of having social care needs associated with chronic conditions. Additionally, it supports similar findings regarding social care needs (Vlachantoni, 2019), by highlighting that older individuals, women, and those with lower levels of education are at higher risk of experiencing the trajectories of having one chronic condition or multimorbidity with social care needs. Finally, the study found few statistically significant results related to differences in living arrangements and housing tenure. This lack of significance could be due to the size and composition of the analytical sample, which affected confidence intervals and the robustness of the results. Lastly, it is worth highlighting that despite the consistent results regarding the health survival paradox, this study also showed that women face a higher risk of belonging to clusters associated with (multi)morbidity with social care needs. This may indicate that they face worse health outcomes than men regarding their dependency and life quality stemming from the experience of chronic conditions. However, these gender differences vary by specific chronic conditions, depending on the trajectory.

4.4.3 Chronic conditions, morbidity and multimorbidity

Regarding the type of chronic conditions explaining these trajectories, results showed that all the studied chronic conditions, except high cholesterol, are significantly associated with belonging to the cluster of "Permanent multimorbidity and social care needs" (Cluster A). Furthermore, those having arthritis and osteoporosis showed the highest probabilities of being part of this cluster. This finding aligns with previous research that has underscored the high prevalence of these conditions, coupled with their association with pain and disability (Srikanth et al., 2005), as well as care dependency (Schnitzer et al., 2020). Gender interactions with chronic diseases and the risk of being in different trajectories are comparable with evidence suggesting the multifactorial nature of these differences that might be attributed to biological (sex), behavioural and socioeconomic (gender) aspects. These differences impact the onset, diagnosis, treatment, and outcome of chronic conditions (Connelly et al., 2022; Khosla et al., 1999; Zhernakova et al., 2022). Previous studies shows that arthritis- and osteoporosis-related disease (Spijker & Rentería, 2023; Srikanth et al., 2005) , hypertension (Connelly et al., 2022; Spijker & Rentería, 2023), high cholesterol (Shohaimi et al., 2014) and cataracts (Fang et al., 2022) are more related to women's multimorbidity trajectories. Conversely, heart attack (Ashworth et al., 2019), chronic lung diseases (Somayaji & Chalmers, 2022), and cerebrovascular disease (Kremer et al., 2023) and diabetes (Spijker & Rentería, 2023) are more associated with men's multimorbidity, as we have also observed from our empirical analysis.

4.4.5 Country comparisons

Differences between some clusters were observed in Belgium, Germany, Austria, France, Spain and the Czech Republic, suggesting wider gaps among trajectories experienced by individuals within each of these countries, which might indicate higher prevailing inequalities. When compared to other countries, Swiss individuals (the reference category) showed lower probabilities of being in the cluster of multimorbidity with social care needs compared to the rest of the countries, followed by Sweden and Denmark. Belgium, on the contrary, showed higher probabilities, which relates to previous studies that showed diverse patterns in European countries' healthy life expectancy (Welsh et al., 2021). Although our results aren't fully comparable with previous research, patterns observed in Austria, Belgium, Denmark, France, Germany, Italy, Spain, Sweden, align well with findings related to Healthy Live Years and Life expectancy free of ADL, while Czech Republic showed improved outcomes based on our updated results (Jagger et al., 2011). Previous research

on multimorbidity using SHARE data consistently highlights Switzerland as having the lowest prevalence of multimorbidity and average number of chronic health conditions among European countries (Palladino et al., 2016; Souza et al., 2021). However, differences between countries indicate varied mortality and morbidity trends, reflecting the differing presence of chronic diseases, healthcare and social care systems across Europe. Specifically, these might be driven by healthcare systems' uneven performance across countries, particularly regarding access to healthcare services, public health policies, and protocols for treating chronic conditions. In many scenarios, higher prevalences of multimorbidity can signal more opportune responses from healthcare systems, which translates into earlier detection and treatment. Extensive evidence on this subject has been published regarding cancer screening programs (Kalager & Bretthauer, 2020). Moreover, this is one of the reasons why (multi)morbidity as a proxy of health needs to be complemented by other measures like social care needs, to better account for its consequences on individuals' lives (Shen & Payne, 2023). This is an area that should be further explored in future research.

4.4.6 Study Limitations

The main limitations of this study refer to the data used. Attrition and sample refreshment of the longitudinal dataset led to sequences of different lengths. Therefore, our analysis focused on sequence order rather than timing and duration. This means that even though some data imputation was performed, it didn't affect the sequence analysis. We also analysed the data separately by gender and country, which, although robust, reduced the sample size and represents a limitation. Selection bias and limited cross-country comparability may affect data quality due to individuals' diverse access to healthcare institutions and the variation in administrative records across countries (Simpson et al., 2022). However, SHARE data has been widely used for country comparisons. Additionally, self-reported answers of chronic diseases might introduce under-registration, particularly among individuals facing access barriers to the healthcare system. However, such under-registration is expected to be low among the European countries included in this study, even though it deeply depends on their healthcare systems' policies and programs. Additional limitations stem from longitudinal attrition, which particularly affected the eighth wave of SHARE and institutionalised individuals (who represent about 1% of the total sample) during the observation period. However, we addressed this by imputing missing values using information from available waves and the "End of life" questionnaire, while acknowledging that our results do not represent the institutionalised population. Furthermore, we lack information on the exact onset of chronic

conditions, which means that individuals may be at different stages of the disease progression, although we are controlling for age to mitigate this effect.

4.4.7 Concluding remarks

Urgent action is needed to implement integrated health and social care programs that address the diverse and dynamic needs of older individuals. Both systems are facing ongoing transformations as a result of policies, changes in the balance between informal and formal care, rising demand for social care provision among older individuals, the popularization of ambulatory/outpatient healthcare alongside ageing in place, critics of the 'medicalization of ageing', and a new focus on maintaining functionality rather than eradicating disease as the aim of public responses to ageing. By acknowledging the range of possible trajectories within health and social care needs, we tried to show the complexity of the challenges posed by ageing processes, which require a design of tailor-made and person-centred services oriented towards preventing and postponing the onset of chronic conditions, while also addressing their impacts on individuals' daily lives, especially regarding their needs for social care.

5. Conclusions

Throughout the previous chapters, I have empirically analysed care needs related to multimorbidity and social care needs associated with limitations from a demographic perspective. The presented results aimed to explore these needs among older individuals within populations facing ageing processes, though they are experiencing them differently due to country, gender, and other sociodemographic factors. Each chapter included cross-country comparisons, finding noticeable differences in the experience of healthcare needs and social care needs. By doing so, I highlight that the relationship between multimorbidity and social care needs is not straightforward but rather complex. More importantly, I stress the relevance of understanding specific scenarios at the country level and gender disparities when designing and adjusting policies for older individuals. Comparisons between European countries showed that despite their relative homogeneity, there are differences in the experience of chronic conditions, limitations, and social care provision, which are especially highlighted when contrasting social care regimes (second chapter) and trajectories of multimorbidity and social care needs (fourth chapter). Moreover, the analyses presented in the third chapter of Ibero-American countries suggest that these differences have implications for the average number of years living with multimorbidity and social care needs that individuals from these countries are experiencing. A more detailed reflection on the conclusions of these cross-country comparisons can be found below. There are many possible explanations for these country differences, which should be disentangled in future research. Nevertheless, I have tried to show their existence and suggest some contextual factors that might shape them.

Additionally, all the included chapters provided analyses broken down by gender to explore how differences between men and women explained these healthcare and social care needs. The importance of gender was also highlighted by further explorations that were supposed to decompose the gender gap in healthy life expectancy (third chapter) and to create models interacting gender with other variables like country and specific chronic conditions for understanding different trajectories of multimorbidity and social care needs (fourth chapter). The long tradition of providing sex-specific results in demographic analysis has proved its utility when analysing life expectancy and healthy life expectancy. Nonetheless, this analysis is also relevant for understanding the relationship between healthcare needs derived from chronic conditions and social care needs. Further details on the results raised by gender disaggregation can also be found below. Even though the health survival paradox provided explanations for the general results of this dissertation, I tried to extend it to discussions about the differential consequences that chronic conditions have on the experience of social care needs for men and women. Finally, this thesis

aimed to show different dimensions of social care needs by applying diverse methods, combining traditional descriptive and inferential analysis (second chapter and fourth chapter) with other techniques like introducing the measure of Years of Life Expectancy with Care Needs (YLCN) (third chapter) and trajectories of multimorbidity and social care needs (fourth chapter), which specific potentialities are highlighted in each one of the chore chapters.

The conclusions of these three essays are summarised in the following pages. First, I underscore the main results from each analytical chapter with some specific remarks regarding the cross-country comparisons and their contributions to understanding social care needs, as well as more detailed conclusions regarding gender differences. I also provide an explanation of the implications of the presented results as well as their limitations. Nonetheless, more detailed revisions of these aspects were also provided in the discussion section of each of the core chapters. Based on these main conclusions, I suggest some of the consequences of these results, their value in providing some public policy recommendations, and some future research paths based on what can be further explored regarding healthcare needs associated with multimorbidity and their relationship with social care needs derived from facing limitations. I end up with some final remarks about the central lessons that arise from this dissertation.

5.1 Main results

Two key messages are driven by the results presented in each of the core chapters. Firstly, they highlight that social differences explain the experience of healthcare needs due to multimorbidity and social care needs, which are principally related, but not exclusively, to countries' specific characteristics, gender, age, socioeconomic status, and chronic conditions. Secondly, they emphasise the importance of studying the complex relationship between curing and caring associated with older individuals' needs. This connection does not mean that the consequences of the ageing process on healthcare and social care needs are linear pathways. Quite the opposite, it supposes that the linkage between these two is multidimensionally affected, which, aside from making it difficult to set a clean border between these two types of needs, also shows that experiencing them results from social factors that interact in intricate manners.

All chapters aim to provide a nuanced approach to the consequences that ageing might have on individuals' health and dependency. This is specifically highlighted in the second chapter by showing that social care regimes are generally capable of meeting the needs of the most vulnerable individuals, probably due to social awareness about their pressing needs, but are less prepared

when dealing with less urgent needs. The third and fourth chapters also contribute to this perspective by highlighting the utility of jointly studying healthcare needs associated with multimorbidity and social care needs. In the third chapter, this is crucial for highlighting that some individuals will face social care needs even though they do not have any chronic condition and for understanding that unhealthy life expectancy can be divided into diverse states of (multi)morbidity and social care needs. Likewise, the fourth chapter emphasises the different trajectories of healthcare needs associated with (multi)morbidity and social care needs following the onset of a chronic condition. These trajectories show that some recoveries might occur, attenuating healthcare needs, but also that after the age of 50, many individuals would not necessarily experience multimorbidity and social care needs before dying.

While debates about compression, equilibrium, or expansion of morbidity persist, evidence remains mixed (Fries, 2002; Gruenberg, 1977; Manton, 1982; Vaupel, 2010), with findings often depending on the indicators used to assess them (Tesch-Römer & Wahl, 2016). By combining indicators of limitations and chronic conditions, this thesis emphasises that the consequences of multimorbidity on health and well-being are more complex. Thus far, the literature on this subject has primarily highlighted the relationship between multimorbidity as a predictor of social care needs (Simpson et al., 2023). However, we should think the other way around, too. For instance, how social care needs, especially the unmet ones, might translate into the emergence of chronic conditions (Dambha-Miller et al., 2021). This is particularly evident when you think about accidents and falls, where the lack of adequate care can lead to severe health consequences. Furthermore, to understand whether gains in life expectancy translate into more years in healthy states, nuanced approaches are still needed. While improvements in healthcare systems could increase the prevalence of multimorbidity, better technologies for diagnosis and treatment could mitigate the negative effects of chronic conditions on individuals' lives, reducing social care needs. The study of its relationship helps better understand what further life expectancy means for individuals' well-being within ageing populations. The approach that I have proposed could be more sensitive to the performance of healthcare systems and the needs faced by individuals. Moreover, the results highlight that debates on the compression or expansion of multimorbidity are also influenced by compositional effects and vary by age group. This underscores the importance of considering the heterogeneity of experiences among older adults and of examining how these dynamics evolve from age 50 onward. Lastly, we should always take into account gender- and country-specificities, as these general theories do not apply equally to explain how individuals spend their longer life spans across countries and by gender.

5.2 Cross-country comparisons and the differences in care needs

As mentioned, all the analyses presented here provided cross-country comparisons due to the importance of specific scenarios for exploring social care needs. In the second chapter, this was done by grouping countries by social care regimes that showed differences between places with generally available publicly funded services and those that rely deeply on family structures. This analysis showed that individuals from Mediterranean countries, whose care systems are more family-centred, are at higher risk of experiencing unmet care needs. Differences between European countries have been previously studied separately when referring to social care needs and healthcare needs derived from multimorbidity, but they aren't usually analysed jointly. The fourth chapter also explores them. Results from the multinomial models accounting for different trajectories showed wider and statistically significant differences of the average marginal effects explaining each one of the four found trajectories in Belgium, Germany, Austria, France, Spain, and the Czech Republic, which might indicate higher inequalities in individuals from these countries. Findings from Austria, Belgium, Denmark, France, Germany, Italy, Spain, and Sweden are aligned with evidence about healthy life expectancy and disability-free life expectancy (Jagger et al., 2011), indicating the persistent differences between European countries that are probably driven by a combination of morbidity and mortality trends, alongside differences in how social care and healthcare systems approach them.

Lastly, comparisons between Ibero-American countries presented in the third chapter provided a valuable example of how the relationship between healthcare needs associated with multimorbidity and social care needs is deeply affected by country-specific scenarios. Results showed consistent trends in the experience of different states combining (multi)morbidity with social care needs, while country-level differences were informative regarding the diverse pathways of health transitions experienced in Latin America and Iberia. These differences are reflected in healthy life expectancy and gender gaps in comprehensive unhealthy states. This comparison offers an opportunity to move beyond using the "Western" experience as the standard (Frenk et al., 1991). As a matter of fact, it helps to dig deeper into how the epidemiological transitions, as well as other factors related to socioeconomic and public health conditions, shape the relationship between healthcare needs due to chronic conditions and social care needs, allowing to monitor healthcare systems' performance. I also think that given the precariousness of Latin American social care systems, it is worth calling attention to how different population ageing processes will affect countries, and

observe whether they are prepared or not. Moreover, I also put an effort into highlighting that gender differences are visible not only within but also between countries.

5.3 Gender differences in the experience of social care needs

As previously highlighted, gender was understood as a key determinant of social care needs and health differences since the beginning of this research. This was due to previous evidence about gender differences in life expectancy, healthy life expectancy, and social care needs (Crimmins et al., 2011; Mauvais-Jarvis et al., 2020; Oksuzyan et al., 2010; Zarulli et al., 2018). The findings of the three core chapters strongly align with the health-survival paradox, wherein women tend to live longer than men but often live these additional years with poorer personal well-being, explained by the experience of multimorbidity and social care needs. Nevertheless, the results presented here show that this process can be more complex when accounting simultaneously for healthcare needs related to multimorbidity and social care needs. Results from the second chapter suggest that women are more vulnerable to face social care needs, even though men seem to have a higher chance of experiencing unmet care needs. Likewise, the third chapter showed that gender differences are complex due to diverse mortality and morbidity patterns at older ages. In this case, across all the studied age groups, the prevalence of states referring to multimorbidity and social care needs is higher among women than men. In all analysed countries, there was a gender gap in life expectancy, with women living more years than men, but also generally spending more of these years with health problems related to chronic conditions and social care needs.

However, when measuring and decomposing the gender gap in healthy life expectancy, results show that this gap is in the other direction for Spain, with men living more unhealthy years than women. This is likely explained by the widening of the gender differences in mortality rates in this country after age 50. On the other hand, given that gender gaps in mortality in Latin American countries at younger ages are wider than in Spain and Portugal, this could be causing a selection of men surviving until older ages in Latin America, which leads to lower mortality gaps at older ages, and lower healthy life expectancy gaps. In this sense, if gender gaps in mortality reduce at younger ages and, therefore, increase at older ages in Latin America, as has happened in Europe, a future widening of the gender gap in healthy life expectancy (free of morbidity) may emerge in Latin American countries. This calls for urgent policies (see section 5.5) protecting women in a region already characterised by deep gender inequalities (Medina-Hernández et al., 2021). Finally, the fourth chapter also confirms that women are at higher risk of experiencing the trajectories

referring to morbidity and multimorbidity alongside social care needs. Furthermore, when interacting gender with chronic diseases, it is visible that biological and social factors shape the specific effect on the experience of these trajectories.

5.4 Limitations

In addition to the limitations detailed in each of the core chapters, the analyses presented here face some shared limitations referring to data issues and the measures used. When it comes to operationalising care needs through multimorbidity and social care needs, problems might arise from interpreting cross-sectional results and the restrictions of the data used for conducting longitudinal analysis. Regarding data, it is worth mentioning that despite my analyses were based on nationally representative surveys of older adults living in non-institutionalised households, when disaggregating this data by specific measures of social care needs by country, age, and gender, sample sizes shrank. In some cases, this probably led to non-significant results. Furthermore, when accounting for inequalities, we did not include analysis within regions of a specific country, which is particularly relevant, especially for Latin American countries that are characterised by persistent regional heterogeneity (Borges, 2017; Calazans & Queiroz, 2020), even though these regional differences can also be found in European countries (Zueras & Rentería, 2020). This issue also affected the quality of the mortality data used in the third chapter, notwithstanding the improvements in these realms were achieved in the analysed countries during the last decades (Gonzaga et al., 2018).

Another limitation of the survey data used is that it is self-reported. As mentioned in the Introduction, this might be the source of under- or over-registration of healthcare needs measured through multimorbidity and social care needs. In the case of chronic conditions, this is particularly relevant for Latin American countries due to access barriers to healthcare services that may translate into underdiagnosis of some conditions (Ruano et al., 2021). On the contrary, European countries had a higher prevalence of some specific chronic conditions that can be explained by more opportune access to healthcare services. Instead, when referring to social care needs, these measures are affected by cultural perspectives of what a limitation is, as well as by the division of labour that could guarantee support for performing some activities that are not perceived as limitations by surveyed individuals. However, it should be emphasised that currently, surveys are the only source providing data for jointly studying healthcare and social care needs, which is deeply affected by the lack of integration between social and healthcare systems and services (Dambha-Miller et al.,

2021). Notwithstanding, subjective bias when reporting ADL and IADL limitations was probably reduced by the wording of the questions, which usually use verbs like “can” or “being able to”. However, these may vary from one survey to another and can specifically affect Latin American surveys that do not have ex-ante harmonised surveys like the SHARE.

Regarding the measures used for healthcare needs related to multimorbidity and social care needs, one of the limitations of this thesis is the difficulty in comparing the obtained results with previous evidence. In the case of chronic conditions, this is due to the lack of agreement regarding which conditions should be included in the analysis of multimorbidity (Calderón-Larrañaga et al., 2017) and the fact that not all the surveys, not even all the waves of a study, ask for the same chronic conditions. Something similar affects comparisons of measuring social care needs within the literature. There is some agreement about using limitations in carrying out ADL as proxies. However, different studies could include or not include IADL and mobility limitations, or even select only some specific tasks of the list asked by surveys (Vlachantoni, 2019). The decision to operationalise social care needs as facing ADL and IADL limitations, can be questioned because it does not account for severity. In the second chapter, this was approached in a detailed way by providing separate analysis for those facing any limitations, only mobility limitations, one ADL or any IADL and those with two or more ADL. Meanwhile, in the third and fourth chapters, I stated that having any type of ADL or IADL limitation implied the need for social support. Indeed, facing a limitation for getting out of bed is not the same as having difficulties buying groceries, especially in terms of the impact on individuals’ daily lives. However, I am also convinced that there is no such thing as a negligible or small need for social care, as experiencing a limitation implies that the person will likely need support from someone else.

Furthermore, one of the biggest challenges in comparing these results with available evidence comes when indicators combining chronic conditions and social care needs are used, because few studies have done this (Lam et al., 2024; Shen & Payne, 2023; Simpson et al., 2022; Spiers, 2019). Nevertheless, I have tried to discuss my results with the available evidence regarding healthy life expectancy, social care needs, multimorbidity, disability, and limitations for performing certain activities. Finally, some other limitations come from the diverse analytical approaches of this thesis. A detailed discussion of the methods used is presented in each chapter. However, it is relevant to highlight the limitations raised by cross-sectional and longitudinal analyses. Regarding the former, demographic research has always stressed the restraints of these to capture the dynamic nature of populations. Nevertheless, due to data availability, we usually must work with this kind of data.

In the second and third chapters, the data about a selected period aims to describe the scenario of social care needs that can be useful for considering the current and future needs of older individuals. Nevertheless, it should be stated that this limitation has a more pronounced effect in the third chapter since prevalence rates coming from cross-sectional data are included in life expectancy estimations, which suppose that they will remain static over time. This limitation is shared by all life expectancy indicators based on period data. However, we still use them because they are good indicators that account for age structure, which is critical when comparing different populations.

The fourth chapter provided a longitudinal analysis, usually the gold standard scenario when studying phenomena from a life course perspective. However, this kind of data is affected by attrition, given the difficulties of following individuals for many years. Even though the longitudinal data used also provides information about the death of individuals included in the sample, and previous analyses have shown that mortality data coming from the used source is consistent with registers from other sources when estimating life expectancy and disability-free life expectancy (Stonkute et al., 2023), we cannot test its performance when using sequence analysis. This method has the potential to explore longitudinal data. Nonetheless, these might be limited by attrition, the effect that missing data might have on sample selection, and the clustering methods used. Still, sensitivity checks including and excluding individuals with missing values and trying different approaches for imputing missing values, including internal imputation, provided similar results.

5.5 Implications and public policy recommendations

At this point, reflecting on what these results tell us about care needs associated with multimorbidity and social care needs and how they can contribute to public policies regarding ageing is relevant. Firstly, results from cross-country comparisons have shown that even though some similar trends can be found between countries, the different experiences of the ageing processes shaped the healthcare and social care needs of older individuals in diverse populations. This is particularly evident when it comes to comparing Latin American and European scenarios, yet this is also visible in analysis involving different European countries, whether they share a common history (like in the third chapter with Spain and Portugal) or specific types of social care regimes (as shown in the second chapter). In general, the main suggestion of this comparison is that the performance of multimorbidity and social care needs is different between countries, and this is probably the consequence of different public health policies and behaviours that are culturally shaped. These results also indicate the importance of looking at health problems derived from multimorbidity jointly

with social care needs due to their complex relationship (Dambha-Miller et al., 2021; Kuluski et al., 2017). Furthermore, by examining the relationship between multi(morbidity) and social care needs, it is demonstrated how these factors interact, influencing one another, being able to account for the severity of the analysed chronic conditions and its implications on social care needs at the same time highlighting how specific chronic conditions rise particular social care demands. Summing up, this is a strategy to enrich our analysis of older individuals' health from a more comprehensive perspective, which can contribute to current debates about morbidity compression and expansion.

The results from this thesis challenge the assumption that chronic conditions necessarily translate into social care needs and an increasing burden of care needs. Evidence showed that this depends on different factors, and differs by country, gender, age group, and especially by chronic condition. Additionally, results from the third and fourth chapters call attention to the different ways these are connected. While this might be interpreted as the contrary of a need for services' integration, the fact that there are blurry boundaries between curing and caring realms is indicative of how their integration might translate into a more holistic perspective of the needs of ageing populations and how to meet them. Furthermore, previous evidence on the subject has emphasised that social care provision might be part of preventive measures for the emergence of chronic conditions and their adverse outcomes as well (Bień et al., 2013; Kröger et al., 2019) and that in many cases, living with chronic conditions not only affects health but also well-being due to the emergence of limitations (Davies et al., 2022; Tesch-Römer & Wahl, 2016). Integrating curing and caring is somehow the best way to acknowledge their complex relationship. Alongside facilitating data availability on the subject, it may translate into cost reduction for both healthcare and social care systems and changes in the intensity of the care and support needed by older adults (Dambha-Miller et al., 2021; Simpson et al., 2022). In this sense, adapting services calls for holistically tailored systems centred around the care needs of older individuals.

5.6 Pathways for Future Research

As previously stated, this thesis aimed to contribute to the ongoing research that explores the relationship between healthcare needs through multimorbidity and social care needs (Palladino et al., 2016; Simpson et al., 2022, 2023; Spiers, 2019). This theme has been widely explored by scholars within gerontology and policymakers in charge of providing social care services. Their previous work has shown that the complex relationship between these two dimensions should be further analysed through different research designs and methods. In the core chapters that compose this dissertation, I have proposed diverse approaches to studying this linkage through

cross-country comparisons and gender specific analysis. It is worth mentioning that much of the available research has been produced from an economic perspective oriented toward measuring the present and future costs of care provision (Blawat et al., 2020; Kasteridis et al., 2014), even though there are crucial exceptions that have referred explicitly to the predictive character of healthcare needs and multimorbidity for social care needs (Nepal et al., 2011; Simpson et al., 2022; Spiers, 2019).

Future research on the subject can tackle some issues highlighted by other authors and in this thesis that remain barely explored. I suggest four matters that can be analysed when understanding care needs and the linkage between curing and caring. Firstly, alternative measuring techniques to guarantee an accurate estimation of needs can be proposed. As I have mentioned, the variables that were used in this analysis face constraints in assuming that the experience of limitations translates directly to the experience of needs. However, changes in how these questions are asked by explicitly accounting for healthcare needs through multimorbidity and social care needs, as well as the follow-up questions for estimating met, unmet, and under-met (or absolute and relative unmet) care needs, will improve the study of this topic. Moreover, the integration of social care services and healthcare services that I have previously pointed out will also contribute to improving data sources to understand this linkage better.

Secondly, and aligned with the previous point, future research should be able to account for the severity of the experienced social care needs as well as for the quality of received care. Even though it is challenging to define a threshold for which number of limitations is more severe, research about social care needs is needed to design and adapt care provision, and the fact that some individuals are facing more demanding or intensive care needs is a critical aspect of this subject. In this sense, research about long-term care services has emphasised this, but generally has done it by using a specific chronic condition as the starting point or focusing on healthcare needs, leaving social care needs outside of their analysis (Ariaans et al., 2021; Scholz & Schulz, 2010; Worrall & Chaussalet, 2015). Although in this thesis the linkage between specific chronic conditions and social care needs is a way of accounting for this severity, as I did in Chapter 3. However, future research should be able to explore specific constellations of chronic conditions and limitations, something that I did not do, partly because of the methodological complexity of studying them. There are some examples of how this can be done through clustering methods (Calderón-Larrañaga et al., 2017; Newman et al., 2023; Palladino et al., 2016), although none of these studies refer to social care needs.

Furthermore, with the measures I have used, it is not possible to assess the quality of care. This topic has been mainly studied through qualitative methods and is particularly relevant when considering unmet care needs (Dambha-Miller et al., 2021; Ouwens et al., 2005). It is also related to their severity and, at the same time, to the capacity of social care and healthcare services to take on older individuals' demands. Though it is very subjective and difficult to measure, future research could explore different tools or approaches to study it from a quantitative and population-based perspective. Lastly, the study of the relationship between healthcare needs related to chronic conditions and social care needs can be enriched with a deeper understanding of unmet and under-met care needs, even by further analysing the specific limitations that are more often neglected or undersaw by social care regimes. In this sense, literature about care poverty may help to better understand the implications of the current systems' inability to guarantee older individuals' social care needs (Kröger et al., 2019). Summing up future research can contribute to debates about the compression or expansion of morbidity by exploring why gender and country differences emerge when healthy life expectancy is analysed from a nuanced approach.

5.7 Final remarks

In recent decades, public discussion about social care has emphasised the importance of not neglecting this fundamental realm of humankind. Both feminist research and critical studies of disability have challenged the idea that there are no such things as independent individuals (Mladenov, 2024; Tronto, 2013), as we all need each other. However, we should not take care as given but as the result of social arrangements that ought to be democratised, in the sense of being universally available while being a shared responsibility for all the members of society. Even though we all need some social care and support, it is important to remember that some segments of the population have more pressing care demands. Here, I have explored the care needs of older individuals facing chronic conditions and limitations, which are usually seen as a burden for ageing populations. However, rather than framing ageing in a negative light, accounting for these individuals' urgent care needs allows us to reimagine social care systems and regimes to democratise care. By asking what we should care for, I aimed to emphasise that the question about care demands in ageing populations implies considering the relationship between healthcare and social care needs from a perspective that understands its particular dimensions across gender and country-level contexts. This more nuanced perspective on the consequences of ageing, multimorbidity, and social care needs offers an opportunity to explore how to organise care and its

provision in a way that everybody takes part according to their capacity, and receives care based on their needs.

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Appendix

Table A1.1 Available surveys about ageing in Latin American countries

Country	Survey name	Period	Representativeness	Study design	Targeted population
Argentina	ENCaVIAM	2012	National	Cross-sectional	60+
Belice	Situational Analysis of Older Persons	2010	Six districts	Cross-sectional	60+
Brazil	ELSI	2015-16 2019-21	National	Longitudinal	50+
Chile	**Encuesta Nacional de Calidad de Vida en la Vejez**	Not reported	Not reported	Not reported	Not reported
Colombia	SABE	2015	National	Cross-sectional	60+
Costa Rica	CRELES	Pre-cohort 2005 2007 Retirement cohort 2009 2010 2012	National	Longitudinal	Born before 1945 – pre-cohort Born between 1945-1955 Retirement cohort
Ecuador	SABE	2009 2010	Several provinces but it is not national representative	Longitudinal	60+
Mexico	MHAS/ ENASEM	2001-2003 2012-2015 2018 - 2021	National	Longitudinal	50+

Table A3.1 Available questions on multimorbidity and social care needs by survey

Survey	**SHARE Wave 6 – 2015-16 (Spain and Portugal)**	**MHAS (Mexico) - 2015**	**ELSI (Brasil) 2015-2016**	**SABE (Colombia) 2015**
Chronic Diseases	**Chronic Diseases**	**Chronic Diseases**	**Doenças crônicas**	**Enfermedades no transmisibles**
Question	Please look at card. Has a doctor ever told you that you had/Do you currently have] any of the conditions on this card? [With this we mean that a doctor has told you that you have this condition, and that you are either currently being treated for or bothered by this condition.	Has a doctor or medical personnel ever diagnosed/told you with/that you have had….	Algum médico já lhe disse que o(a) Sr(a) tem/teve	¿Alguna vez un médico o enfermera le dijo que tiene/ha tenido…
Heart attack	A heart attack including myocardial infarction or coronary thrombosis or any other heart problem including congestive heart failure	A heart attack? Heart failure/cardiac failure/congestive heart failure, arrhythmia, or angina?	Infarto do coração? Insuficiência cardíaca?	Infarto del corazón, preinfarto, u otros problemas del corazón?
High blood preasure	High blood pressure or hypertension	Hypertension or high blood pressure?	Hipertensão arterial (pressão alta)?	Presión arterial alta, es decir, hipertensión?
Stroke or cerebral vascular disease	A stroke or cerebral vascular disease	A stroke, possible stroke or transient ischemic attack (TIA)?	Acidente vascular cerebral (derrame)?	Un derrame o una trombosis cerebral?

Diabates	Diabetes or high blood sugar	Diabetes?	Diabetes (açúcar no sangue)?	Diabetes, es decir, el azúcar alto en la sangre?
Chronic lung diseases	Chronic lung disease such as chronic bronchitis or emphysema	A respiratory illness, such as asthma or emphysema?	Asma? Enfisema, bronquite crônica ou doença pulmonar obstrutiva crônica (DPOC)?	Alguna enfermedad pulmonar crónica tal como EPOC, asma, bronquitis o enfisema?
Cancer	Cancer or malignant tumour, including leukaemia or lymphoma, but excluding minor skin cancers	Cancer?	Câncer?	Cáncer o tumor maligno, excluyendo tumores pequeños de la piel?
Arthritis or rheumatism	Rheumatoid Arthritis Osteoarthritis, or other rheumatism	Arthritis or rheumatism?	Artrite ou reumatismo?	Artritis, artrosis o reumatismo?
Other questions that cannot be harmonised	High blood cholesterol Stomach or duodenal ulcer, peptic ulcer Parkinson disease Cataracts Hip fracture Other fractures Alzheimer's disease, dementia, organic brain syndrome, senility or any other serious memory impairment Other affective or emotional disorders, including anxiety, nervous or psychiatric problems Chronic kidney disease Other conditions, not yet mentioned	Do you feel pain, stiffness, or swelling in your joints?	Colesterol alto? Osteoporose? Problema crônico de coluna, como dor nas costas, no pescoço, lombalgia, dor ciática, problemas nas vértebras ou disco Depressão? Insuficiência renal crônica? Doença de Parkinson? Doença de Alzheimer?	Osteoporosis? Colesterol alto Triglicéridos altos? Problema nervioso, mental o psiquiátrico?
	ADL and IADL	**ADL and IADL**	**Atividades básicas de vida diária**	**Actividades Básicas e instrumentales de la vida diaria**
Question	Please tell me if you have any difficulty with these because of a physical, mental, emotional or memory problem. Again, exclude any difficulties you expect to last less than three months.	Because of a health problem, do you have any difficulty for/anyone ever help you …	O(a) Sr(a) tem dificuldade para…	Em cuanto a (actividad) usted hoy fue capaz de…
Dressing	Dressing, including putting on shoes and socks	Get dressed?	Vestirse?	Vestido
Bathing	Bathing or showering	Bathing or showering?	Tomar banho?	Baño
Eating	Eating, such as cutting up your food	Eating, such as cutting your food?	Comer a partir de um prato colocado à sua frente?	Alimentación
Getting in or out the bed	Getting in or out of bed	Getting into or out of bed?	Deitar e/ou levantar da cama?	Traslado silla - Cama:
Using the toilet	Using the toilet, including getting up or down	Using the toilet, including getting on and off the toilet or squatting?	Usar o banheiro?	Uso del inodoro o Sanitario, hoy usted fue capaz de…
Shopping for groceries	Shopping for groceries	Shopping for groceries?	Fazer compras?	Hacer las compras del diario (especialmente comida)
Taking medications	Taking medications	Taking medications (if you take any or needed to do so)?	Administrar os próprios medicamentos?	Manejar sus propios medicamentos
Managing Money	Managing money, such as paying bills and keeping track of expenses	Managing your money?	Administrar o próprio dinheiro?	Maneja su propio dinero
Other questions that cannot be harmonised	Walking across a room Using a map to figure out how to get around in a strange place Preparing a hot meal Making telephone calls Doing work around the house	Walking across a room?	Fazer sua higiene pessoal? Preparar uma refeição quente? Utilizar algum tipo de transporte? Utilizar o telefone (fixo ou celular)?	Arreglarse, como lavarse manos y cara, peinarse, afeitarse o lavarse los dientes Preparar la comida Uso de transporte público o taxi Uso de teléfono

	or garden Leaving the house independently and accessing transportation services Doing personal laundry		Realizar tarefas domésticas leves (arrumar cama, tirar pó, cuidar do lixo etc.)? Realizar tarefas domésticas pesadas? Atravessar um cômodo ou andar de um cômodo para outro no mesmo andar?	
Answers	Selected or not selected	Yes No Can't do Doesn't do	Não tem dificuldade (faz a atividade sem esforço) Tem pequena dificuldade (só faz a atividade com algum esforço) Tem grande dificuldade (só faz a atividade com muito esforço, mas consegue fazer sozinho) Não consegue (só faz a atividade com a ajuda de outra pessoa)	Lo hace sin ayuda de nadie y sin dificultad Lo hace sin ayuda, pero con dificultad Necesita o necesitaría ayuda para hacerlo No es capaz de hacerlo

Methodological details

Formulas for estimating Years of Life Expectancy with Care Needs (YLCN) and Decomposing the gender gap in healhty life expectancy (No chronic conditions with and without social care needs)

Libraries

The package DemoDecomp created by Tim Riffe was used for decomposing the gender gap in healthy life expectancy through Horiuchi's et al. (2008) method.

```
library(vctrs)
library(tidyverse)
library(dplyr)
library(haven)
library(DemoDecomp)
```

1. Data

Based on previous examples done by Van Raalte and Nepomuceno (2020) the Sullivan method (1971) for estimate Years of Life Expectancy with Care Needs (YLCN) after 60 was adapted. Here we used data previously prepared that combined mx (mortality rates) obtained from 10-years abridged lifetables, with prevalence by state (wxA, wxB, wxC, wxD, wxE) obtained from surveys, each column of the used data refer to one combination of country and gender (i.e Men_Brazil, Women_Brazil), and every three rows refer to the analysed age groups (60-69, 70-79 and 80+). The analysed prevalence by state refer to the following states:

WxA: No chronic condition (with or without social care needs);

WxB: 1 chronic condition without social care needs;

WxC: 1 chronic condition with social care needs;

WxD: 2+ chronic conditions without social care needs;

WxE: 2+ chronic conditions with social care needs.

```
rates <- c("mx", "mx","mx",
           "wxA", "wxA", "wxA",
           "wxB", "wxB", "wxB",
           "wxC", "wxC", "wxC",
           "wxD", "wxD", "wxD",
           "wxE", "wxE", "wxE")

pars <- c("mortality", "mortality", "mortality",
          "prev", "prev", "prev",
          "prev", "prev", "prev",
          "prev", "prev", "prev",
          "prev", "prev", "prev",
          "prev", "prev", "prev")

age <- rep(c("60", "70", "80"), 6)

Men_Brazil <- c(0.02009385, 0.04531641, 0.11876282,
                0.26333616, 0.21387283, 0.16387960,
                0.32938188, 0.29335260, 0.23745819,
                0.04741744, 0.05780347, 0.16387960,
                0.31583404, 0.35115607, 0.25083612,
                0.04403048, 0.08381503, 0.18394649)

Women_Brazil <- c(0.01213633, 0.03028726, 0.09943823,
                  0.16469894, 0.08448118, 0.07337526,
                  0.30578512, 0.26538108, 0.17190776,
                  0.03896104, 0.07988981, 0.18867925,
                  0.42325856, 0.43342516, 0.27882600,
                  0.06729634, 0.13682277, 0.28721174)

Men_Colombia <- c(0.01810670, 0.04403757, 0.11820053,
                  0.41961321, 0.28782506, 0.14978247,
                  0.30474702, 0.29018913, 0.20758235,
                  0.05000977, 0.09160757, 0.23679304,
                  0.19691346, 0.26122931, 0.19950280,
                  0.02871655, 0.06914894, 0.20633934)

Women_Colombia <- c(0.01110631, 0.03100158, 0.10587417,
                    0.24820968, 0.14575646, 0.07287986,
                    0.32168433, 0.27559963, 0.15238516,
                    0.04139215, 0.09501845, 0.23365724,
                    0.33786881, 0.35908672, 0.22261484,
                    0.05084503, 0.12453875, 0.31846290)

Men_Mexico <- c(0.01857821, 0.04102232, 0.11441781,
                0.39249771, 0.31459330, 0.23466667,
                0.29094236, 0.27392344, 0.20800000,
                0.06450137, 0.12081340, 0.24533333,
                0.18572736, 0.18779904, 0.14533333,
                0.06633120, 0.10287081, 0.16666667)

Women_Mexico <- c(0.01365719, 0.03414369, 0.11040399,
```

```
                  0.24219292, 0.14928425, 0.11875000,
                  0.28868841, 0.25460123, 0.17708333,
                  0.08119362, 0.14826176, 0.30104167,
                  0.25676613, 0.25511247, 0.11770833,
                  0.13115892, 0.19274029, 0.28541667)

Men_Spain <- c(0.01234028, 0.02865135, 0.11570550,
                0.40000000, 0.22425952, 0.15257732,
                0.35172414, 0.36530324, 0.27422680,
                0.02528736, 0.05500705, 0.15051546,
                0.19770115, 0.28772920, 0.21443299,
                0.02528736, 0.06770099, 0.20824742)

Women_Spain <- c(0.005053529, 0.014130894, 0.094913898,
                 0.393270242, 0.214191853, 0.105413105,
                 0.341745531, 0.323258870, 0.188034188,
                 0.032597266, 0.070959264, 0.198005698,
                 0.194532072, 0.287779238, 0.217948718,
                 0.037854890, 0.103810775, 0.290598291)

Men_Portugal <- c(0.01374674, 0.03211270, 0.12113241,
                  0.33009709, 0.19457014, 0.16901408,
                  0.31715210, 0.31221719, 0.18309859,
                  0.05177994, 0.11312217, 0.26760563,
                  0.22653722, 0.25791855, 0.18309859,
                  0.07443366, 0.12217195, 0.19718310)

Women_Portugal <- c(0.005896711, 0.017471775, 0.100568811,
                    0.237951807, 0.153153153, 0.120370370,
                    0.280120482, 0.238738739, 0.092592593,
                    0.111445783, 0.166666667, 0.351851852,
                    0.225903614, 0.234234234, 0.092592593,
                    0.144578313, 0.207207207, 0.342592593)

country_sex_dataframe <- data.frame(rates,
                                    pars,
                                    age,
                                    Men_Brazil,
                                    Women_Brazil,
                                    Men_Colombia,
                                    Women_Colombia,
                                    Men_Mexico,
                                    Women_Mexico,
                                    Men_Spain,
                                    Women_Spain,
                                    Men_Portugal,
                                    Women_Portugal)

head(country_sex_dataframe)

##   rates      pars age Men_Brazil Women_Brazil Men_Colombia Women_Co
lombia
## 1    mx mortality  60 0.02009385   0.01213633   0.01810670     0.01
110631
```

```
## 2    mx mortality  70 0.04531641   0.03028726   0.04403757     0.03
100158
## 3    mx mortality  80 0.11876282   0.09943823   0.11820053     0.10
587417
## 4   wxA      prev  60 0.26333616   0.16469894   0.41961321     0.24
820968
## 5   wxA      prev  70 0.21387283   0.08448118   0.28782506     0.14
575646
## 6   wxA      prev  80 0.16387960   0.07337526   0.14978247     0.07
287986
##   Men_Mexico Women_Mexico  Men_Spain Women_Spain Men_Portugal Women
_Portugal
## 1 0.01857821   0.01365719 0.01234028 0.005053529   0.01374674    0.
005896711
## 2 0.04102232   0.03414369 0.02865135 0.014130894   0.03211270    0.
017471775
## 3 0.11441781   0.11040399 0.11570550 0.094913898   0.12113241    0.
100568811
## 4 0.39249771   0.24219292 0.40000000 0.393270242   0.33009709    0.
237951807
## 5 0.31459330   0.14928425 0.22425952 0.214191853   0.19457014    0.
153153153
## 6 0.23466667   0.11875000 0.15257732 0.105413105   0.16901408    0.
120370370
```

```
Sull.data<- as_tibble(country_sex_dataframe) |> select(4:13)
```

2. Sullivan's Method

2.1 Sullivan function for estimating Years of Life Expectancy with Care Needs (YLCN) after 60

This formula is similar than the one used by Van Raalte and Nepomuceno (2020). The main difference is that the output estimate YLCN for each one of the analysed states and not just for healthy and unhealthy states.

```
Sullivan.fun.states <- function (rates,age=seq(start.age,open.age,10))
{
# 1) First, we split from our single vector 'rates' the set of age-spe
cific
#death rates (mx) and age-specific prevalence of disability (wx)
lengthvec <- length(rates)
mx <- rep(rates[1:3])
wxA <- rates[4:6]
wxB <- rates[7:9]
wxC <- rates[10:12]
wxD <- rates[13:15]
wxE <- rates[16:18]
# 2) Calculating period life table functions
# ax
n <- c(diff(age), 1)
ax <- 0.5 * n
# probability of dying (qx) and surviving (px)
qx <- (n * mx)/(1 + (n - ax) * mx)
qx <- c(qx[-(length(qx))], 1)
```

```
qx[qx > 1] <- 1
px <- 1 - qx
# survivors at age x (lx)
lx <- c(100000,rep(0,(length(mx)-1)))
for (i in 1:(length(mx) -1)){
lx[i+1] <- lx[i]*px[i] }
# deaths between ages x and x+n (dx)
dx <- lx * qx
# person-years lived between ages x and x+n (Lx)
Lx <- rep(0,length(mx))
for (i in 1:length(mx) -1){
Lx[i] <- lx[i+1]*n[i] + ax[i]*dx[i] }
Lx[length(mx)] <- lx[length(mx)]/mx[length(mx)]
# 3) Person-years lived in each state
YLCN.stateA <- sum(Lx*(1-(wxB+wxC+wxD+wxE)))/lx[1]
YLCN.stateB <- sum(Lx*(1-(wxA+wxC+wxD+wxE)))/lx[1]
YLCN.stateC <- sum(Lx*(1-(wxA+wxB+wxD+wxE)))/lx[1]
YLCN.stateD <- sum(Lx*(1-(wxA+wxB+wxC+wxE)))/lx[1]
YLCN.stateE <- sum(Lx*(1-(wxA+wxB+wxC+wxD)))/lx[1]
return(c(YLCN.stateA, YLCN.stateB, YLCN.stateC, YLCN.stateD, YLCN.stat
eE))
}
```

2.2 Applying the Sullivan function for estimating YLCN

Here we applied the previous formula to all the combinations of country and sex.

```
start.age <- 60
open.age <-  80
app.sull <- matrix(ncol=10, nrow=5)
for(i in 1:ncol(Sull.data)) {app.sull[,i] <- Sullivan.fun.states(
                                              rates= Sull.data[1:18,i][
[1]])}
app.sull <- as.data.frame(app.sull)
colnames(app.sull) <- colnames(Sull.data)
app.sull <- app.sull |> mutate(states=c("A", "B", "C", "D", "E")) |>
                        select(states, 1:10) |>
                        pivot_longer(2:11, names_to = c("Sex", "Countr
y"),
                                           values_to= "YLCN", names_sep = "_
")
```

3. Decomposing the gender gap in Healthy life expectancy (state A)

Now for the decomposition we have to arrange the data by having all the rates for men and women of the same country in one column that will be used as a vector.

```
decompo <- country_sex_dataframe |>  as_tibble() |>
            select(age, rates, pars, 4:13) |>
            pivot_longer(4:13, names_to =c("Sex", "Country"),
                         values_to = "est", names_sep = "_") |>
            pivot_wider(names_from = "Country", values_from="est") |>
            arrange(Sex, rates)
```

```
head(decompo)
```

```
## # A tibble: 6 × 9
##   age   rates pars      Sex   Brazil Colombia Mexico  Spain Portuga
l
##   <chr> <chr> <chr>     <chr>  <dbl>    <dbl>  <dbl>  <dbl>    <dbl
>
## 1 60    mx    mortality Men   0.0201   0.0181 0.0186 0.0123   0.013
7
## 2 70    mx    mortality Men   0.0453   0.0440 0.0410 0.0287   0.032
1
## 3 80    mx    mortality Men   0.119    0.118  0.114  0.116    0.121
## 4 60    wxA   prev      Men   0.263    0.420  0.392  0.4      0.330
## 5 70    wxA   prev      Men   0.214    0.288  0.315  0.224    0.195
## 6 80    wxA   prev      Men   0.164    0.150  0.235  0.153    0.169
```

In the object "decomposing" we just keep the information from each country's vector.

```
decomposing <- decompo |>   select(5:9)
```

3.1 Sullivan function for decomposing the gender gap in Healthy Life Expectancy

Then we set again the Sullivan function by adapting the one proposed by Van Raalte and Nepomuceno (2020). They suggest how to decompose healthy life expectancy into the effects of mortality and unhealthy life expectancy (two states). Here we are decomposing healthy life expectancy (state A) at age 60 into states B, C, D, E and mortality. This is done by including in the formula for estimating life expectancy all states but A.

For doing so we remove from the object "decomposing" all the rows referring to prevalence of state A

```
decomposing.HLE <- decomposing[-c(4:6,22:24),]
```

Then the formula is the following. Note that the Life expectancy in states of Health (state A) is estimated by subtracting from 1 the values from all the states but A (B, C, D, E)

```
Sullivan.fun.HLE = function (rates,age=seq(start.age,open.age,10)) {
# 1) First, we split from our single vector 'rates' the set of age-spe
cific
#death rates (mx) and age-specific prevalence of disability (wx)
lengthvec <- length(rates)
mx <- rep(rates[1:3])
wxB <- rates[4:6]
wxC <- rates[7:9]
wxD <- rates[10:12]
wxE <- rates[13:15]
# 2) Calculating period life table functions
# ax
n <- c(diff(age), 1)
ax <- 0.5 * n
```

```
# probability of dying (qx) and surviving (px)
qx <- (n * mx)/(1 + (n - ax) * mx)
qx <- c(qx[-(length(qx))], 1)
qx[qx > 1] <- 1
px <- 1 - qx
# survivors at age x (lx)
lx <- c(100000,rep(0,(length(mx)-1)))
for (i in 1:(length(mx) -1)){
lx[i+1] <- lx[i]*px[i] }
# deaths between ages x and x+n (dx)
dx <- lx * qx
# person-years lived between ages x and x+n (Lx)
Lx <- rep(0,length(mx))
for (i in 1:length(mx) -1){
Lx[i] <- lx[i+1]*n[i] + ax[i]*dx[i] }
Lx[length(mx)] <- lx[length(mx)]/mx[length(mx)]
# 3) Person-years lived including each state
Lx.health <- Lx*(1-(wxB+wxC+wxD+wxE))
# Healthy Life expectancy at age 60
ex.health <- sum(Lx.health)/lx[1]
return(ex.health)
}
```

3.2 Decomposition with Horiuchi

Here we apply the Sullivan function for decomposing the gender gap in healthy life expectancy.

This is done through a loop for doing the decomposition for each country in decomposing.HLE

```
decomposition.HLE <- matrix(ncol=5, nrow=15)
start.age= 60
open.age = 80

for(i in 1:ncol(decomposing.HLE)) {decomposition.HLE[,i] <- horiuchi(f
unc=Sullivan.fun.HLE,
       pars1 = decomposing.HLE[1:15,i][[1]],
       pars2 = decomposing.HLE[16:30,i][[1]],
       N=30)}
decomposition.HLE <- as.data.frame(decomposition.HLE)
```

Preparing the outputs to check them

```
colnames(decomposition.HLE) <- colnames(decomposing.HLE)
dec.final.HLE <- decomposition.HLE |>
                 mutate(effect=rep(c("Mortality", "B", "C", "D", "E"),
each=3),
                 Age=rep(unique(decompo$age), 5)) |>
                 pivot_longer(1:5, names_to="Country", values_to="Cont
ribution")|>
                 mutate(Country=(factor(Country,
                 levels=c("Brazil",
                          "Colombia",
                          "Mexico",
                          "Portugal",
                          "Spain"))))
```

Check that the decomposition account for the gender gap in healthy life expectancy

This is the check for Brazil. The gender gap in healthy life expectancy between men and women should be equal to the sum of the decomposition.

```
check1 <- Sullivan.fun.HLE(decomposing.HLE$Brazil[16:30])-
          Sullivan.fun.HLE(decomposing.HLE$Brazil[1:15])


check1

## [1] -1.845331

check2 <- sum(decomposition.HLE$Brazil)
check2

## [1] -1.845316
```

Figure A4.1 Analytical sample selection process

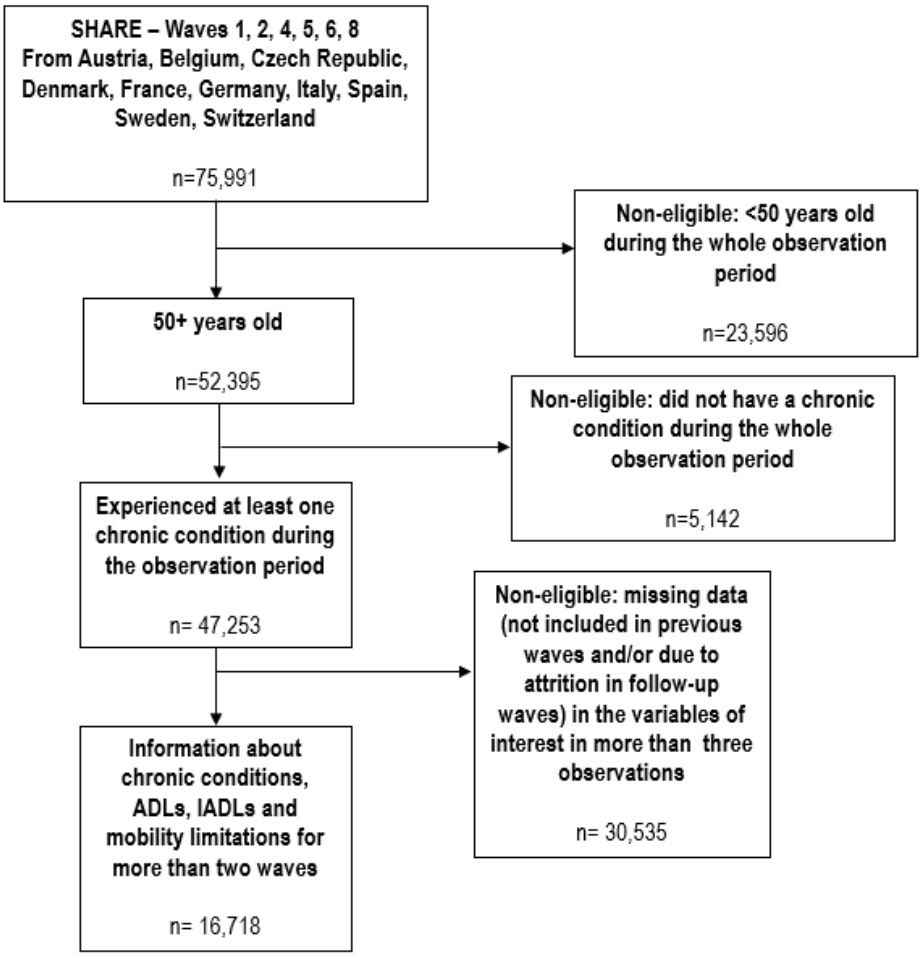

Figure A4. 2 Dendrogram and cluster quality indicators

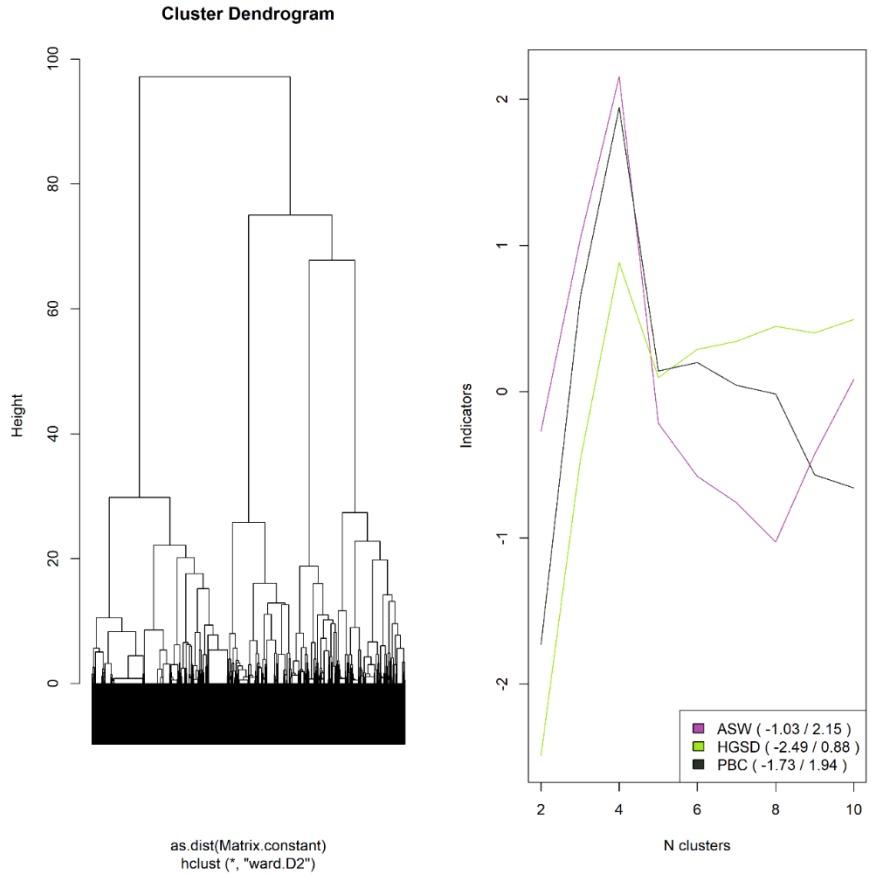

Figure A4. 3 Average Silhouette Width (ASW) for the four-cluster solution

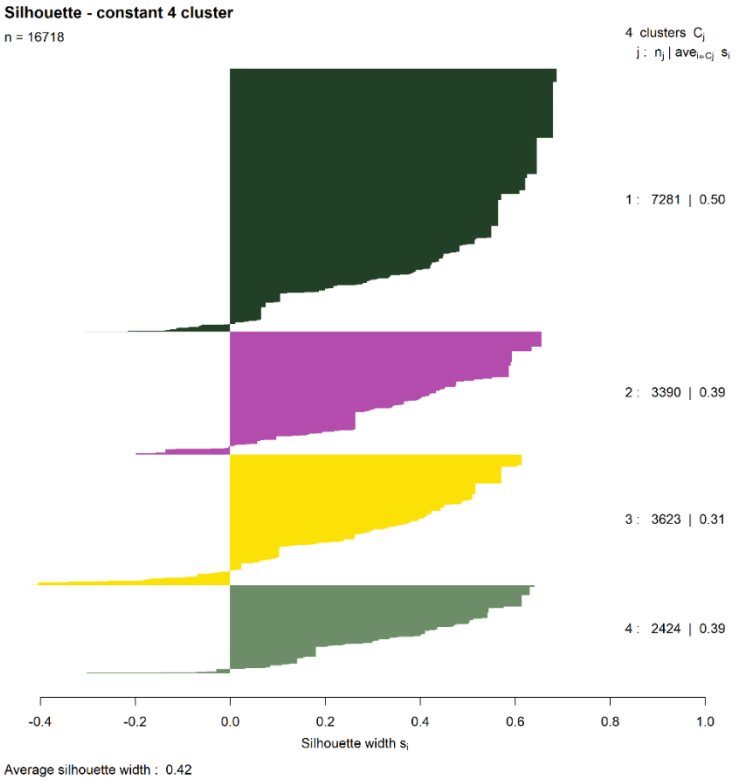

Table A4. 1 Logistic regression models studying the odds of belonging to each one of the clusters

	Permanent multimorbidity and care needs	Permanent multimorbidity without care needs	Chronic condition and care needs	Chronic condition without care needs and some recoveries
(Intercept)	0.018*** [0.012-0.024]	0.275*** [0.161-0.388]	0.315*** [0.196-0.433]	10.799*** [6.398-15.2]
Gender				
Men (ref)	1.000	1.000	1.000	1.00
Women	1.523*** [1.404-1.643]	0.638*** [0.577-0.699]	1.296*** [1.184-1.408]	0.595*** [0.541-0.649]
Age group				
50-64 (ref)	1.000	1.000	1.000	1.00
65-79	1.651*** [1.516-1.786]	0.919+ [0.828-1.011]	1.072 [0.974-1.171]	0.571*** [0.517-0.624]
80+	3.063*** [2.687-3.44]	0.534*** [0.433-0.635]	1.191** [1.034-1.347]	0.176*** [0.141-0.211]
Education				
High (ref)	1.000	1.000	1.000	1.00
Middle	1.228*** [1.092-1.364]	0.88* [0.77-0.989]	1.236*** [1.084-1.388]	0.753*** [0.666-0.84]
Low	1.431*** [1.274-1.587]	0.709*** [0.617-0.8]	1.523*** [1.337-1.709]	0.574*** [0.505-0.644]
Housing tenure				
Owner or rent free (ref)	1.000	1.000	1.000	1.00
Tenant	1.289*** [1.157-1.421]	0.823** [0.713-0.932]	1.123* [0.998-1.248]	0.74*** [0.646-0.833]
Other	1.141* [0.993-1.289]	0.886 [0.732-1.041]	1.076 [0.922-1.23]	0.85+ [0.705-0.994]
Missing	1.313*** [1.153-1.473]	0.884 [0.746-1.022]	1.103 [0.957-1.248]	0.712*** [0.607-0.817]
Living arrangements				
Living with the partner and/or children (ref)	1.000	1.000	1.000	1.00
Living only with the partner	0.946 [0.669-1.224]	0.817 [0.518-1.117]	1.183 [0.799-1.567]	1.141 [0.727-1.555]
Living alone	0.967 [0.682-1.253]	0.701+ [0.441-0.962]	1.299 [0.875-1.723]	1.123 [0.709-1.536]
Other	1.057 [0.738-1.375]	0.758 [0.47-1.045]	1.225 [0.818-1.632]	0.902 [0.564-1.239]
Country				
Switzerland (ref)	1.000	1.000	1.000	1.00
Austria	1.697*** [1.383-2.011]	0.596*** [0.468-0.723]	1.597*** [1.284-1.909]	0.607*** [0.487-0.728]
Belgium	1.914*** [1.582-2.247]	0.701*** [0.565-0.838]	1.255* [1.019-1.49]	0.572*** [0.466-0.678]
Czech Republic	1.542*** [1.268-1.816]	0.649*** [0.518-0.779]	1.455*** [1.175-1.735]	0.712*** [0.575-0.85]
Denmark	1.314** [1.062-1.565]	0.961 [0.763-1.158]	1.061 [0.84-1.282]	0.756** [0.606-0.906]
France	1.647*** [1.363-1.93]	0.761** [0.614-0.909]	1.223* [0.998-1.448]	0.661*** [0.541-0.782]
Germany	1.88*** [1.488-2.272]	0.421*** [0.311-0.531]	1.821*** [1.419-2.223]	0.59*** [0.455-0.725]
Italy	1.574*** [1.278-1.869]	0.544*** [0.422-0.666]	1.317** [1.05-1.584]	0.856 [0.681-1.031]
Spain	1.572***	0.561***	1.411***	0.777*

	[1.273-1.87]	[0.434-0.687]	[1.122-1.701]	[0.612-0.943]
Sweden	1.408***	0.78*	1.314**	0.766*
	[1.137-1.678]	[0.611-0.95]	[1.045-1.584]	[0.609-0.923]
Chronic condition				
Not having this disease (ref.)	1.000	1.000	1.000	1.00
Hearth attack	2.01***	0.876*	0.738***	0.456***
	[1.853-2.167]	[0.788-0.965]	[0.67-0.806]	[0.407-0.506]
Hypertension	1.994***	1.922***	0.528***	0.475***
	[1.83-2.159]	[1.705-2.138]	[0.484-0.572]	[0.433-0.518]
High Cholesterol	1.627***	2.254***	0.468***	0.526***
	[1.505-1.748]	[2.034-2.474]	[0.429-0.507]	[0.479-0.572]
Stroke or cerebrovascular disease	1.807***	0.852*	0.882+	0.377***
	[1.608-2.007]	[0.732-0.973]	[0.767-0.996]	[0.309-0.445]
Diabetes	2.149***	1.218***	0.594***	0.347***
	[1.968-2.33]	[1.094-1.341]	[0.532-0.656]	[0.305-0.39]
Chronic lung diseases	2.118***	0.78***	0.849**	0.36***
	[1.916-2.321]	[0.681-0.88]	[0.756-0.942]	[0.308-0.411]
Cancer	1.72***	1.119+	0.734***	0.501***
	[1.548-1.893]	[0.982-1.257]	[0.649-0.818]	[0.435-0.566]
Stomach or duodenal ulcer	1.802***	1.024	0.62***	0.538***
	[1.608-1.996]	[0.886-1.163]	[0.538-0.701]	[0.457-0.618]
Parkinson	2.401***	0.342***	0.97	0.362***
	[1.846-2.955]	[0.192-0.491]	[0.735-1.205]	[0.231-0.492]
Cataracts	1.611***	1.114*	0.648***	0.64***
	[1.482-1.741]	[0.998-1.23]	[0.587-0.71]	[0.57-0.71]
Hip fracture	1.848***	0.551***	0.978	0.372***
	[1.588-2.108]	[0.428-0.675]	[0.83-1.126]	[0.283-0.46]
Arthritis- and osteoporosis-related disease	2.613***	0.721***	1.007	0.338***
	[2.407-2.82]	[0.652-0.79]	[0.921-1.093]	[0.307-0.368]

Note: Confidence intervals are provided in squared brackets and reported p values correspond to + p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001.

Source: Survey of Health Ageing and Retirement in Europe, waves 1-2, 4-6 and 8

Table A4.2 Analytical sample composition by observed states – Percentages by row

	No chronic condition without care needs		No chronic condition with care needs		One chronic condition without care needs		One chronic condition with care needs		Two or more chronic conditions without care needs		Two or more chronic conditions with care needs		Dead		
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	Total
Gender															
Men	1210	4.2	611	2.1	6195	21.4	4550	15.7	5544	19.1	9550	2.1	1328	4.6	28988
Women	1140	2.9	1160	3	5516	14.2	7472	19.3	4636	12	17412	3	1453	3.7	38789
Age group															
50-64	1597	5.3	809	2.7	7305	24.1	5381	17.8	5380	17.8	9394	2.7	441	1.5	30307
65-79	707	2.4	782	2.6	4013	13.5	4982	16.8	4338	14.6	13491	2.6	1405	4.7	29718
80+	46	0.6	180	2.3	393	5.1	1659	21.4	462	6	4077	2.3	935	12.1	7752
Education															
High	662	5.4	317	2.6	3059	24.7	1929	15.6	2285	18.5	3749	2.6	364	2.9	12365
Middle	842	3.9	560	2.6	4488	20.6	3828	17.5	3660	16.8	7711	2.6	730	3.3	21819
Low	844	2.5	890	2.7	4145	12.4	6239	18.6	4220	12.6	15445	2.7	1676	5	33459
Missing	2	1.5	4	3	19	14.2	26	19.4	15	11.2	57	3	11	8.2	134
Housing tenure															
Owner or rent free	1672	3.8	1147	2.6	8311	19	7574	17.3	7028	16	16680	2.6	1392	3.2	43804
Tenant	339	2.9	333	2.8	1682	14.2	2207	18.6	1558	13.2	5064	2.8	652	5.5	11835
Other	164	2.8	146	2.4	736	12.3	1068	17.9	755	12.7	2792	2.4	300	5	5961

Missing	175	2.8	145	2.3	982	15.9	1173	19	839	13.6	2426	2.3	437	7.1	6177
Living arrangements															
Living with the partner and/or children	26	2.7	13	1.4	143	15	160	16.8	122	12.8	417	1.4	70	7.4	951
Living only with the partner	1363	4	809	2.4	6896	20.4	5740	16.9	5914	17.5	12098	2.4	1049	3.1	33869
Living alone	650	2.8	722	3.1	3114	13.4	4308	18.5	2848	12.2	10408	3.1	1217	5.2	23267
Other	311	3.2	227	2.3	1558	16.1	1814	18.7	1296	13.4	4039	2.3	445	4.6	9690
Country															
Austria	210	3.4	201	3.3	1039	17	1196	19.6	795	13	2378	3.3	283	4.6	6102
Belgium	300	3	293	3	1593	16.2	1695	17.2	1538	15.6	4001	3	442	4.5	9862
Czech Republic	129	1.8	101	1.4	1101	15.4	1230	17.2	1119	15.6	3305	1.4	172	2.4	7157
Denmark	211	3.9	121	2.2	1170	21.4	874	16	1058	19.4	1766	2.2	259	4.7	5459
France	293	3	218	2.2	1678	17	1800	18.3	1454	14.7	3963	2.2	456	4.6	9862
Germany	126	3.2	121	3.1	658	16.6	739	18.7	483	12.2	1604	3.1	231	5.8	3962
Italy	285	4	216	3	1088	15.3	1262	17.8	890	12.5	3126	3	225	3.2	7092
Spain	231	3.1	191	2.6	1002	13.6	1299	17.7	963	13.1	3372	2.6	301	4.1	7359
Sweden	241	4.1	152	2.6	1105	18.8	1038	17.6	931	15.8	2093	2.6	324	5.5	5884
Switzerland	324	6.4	157	3.1	1277	25.3	889	17.6	949	18.8	1354	3.1	88	1.7	5038
Chronic condition															
Hearth attack	348	1.5	400	1.8	2090	9.2	2985	13.1	3346	14.7	12415	1.8	1146	5	22730
Hypertension	855	1.8	862	1.8	7133	14.8	6918	14.4	8356	17.4	22151	1.8	1784	3.7	48059
High Cholesterol	980	2.7	701	1.9	4960	13.7	4380	12.1	7237	20	16950	1.9	1059	2.9	36267
Stroke or cerebrovascular disease	91	1	152	1.8	606	7	1229	14.2	1188	13.7	4937	1.8	477	5.5	8680
Diabetes	174	1	198	1.1	1536	8.7	1935	11	3258	18.5	9797	1.1	733	4.2	17631
Chronic lung diseases	197	1.6	181	1.5	1029	8.4	1788	14.6	1477	12	7011	1.5	586	4.8	12269
Cancer	315	3	219	2.1	1397	13.1	1577	14.8	1640	15.4	4950	2.1	529	5	10627
Stomach or duodenal ulcer	269	2.9	239	2.6	947	10.2	1261	13.5	1272	13.6	4972	2.6	362	3.9	9322
Parkinson	21	1.1	35	1.9	169	9	325	17.3	127	6.8	1094	1.9	110	5.8	1881
Cataracts	438	2	489	2.3	2172	10.1	2981	13.9	3065	14.3	11403	2.3	925	4.3	21473
Hip Fracture	71	1.3	148	2.8	359	6.8	941	17.8	443	8.4	3037	2.8	292	5.5	5291
Arthritis- and osteoporosis-related disease	1017	2.4	1084	2.5	5057	11.8	7547	17.7	5616	13.1	20864	2.5	1528	3.6	42713

Source: Survey of Health Ageing and Retirement in Europe, waves 1-2, 4-6 and 8.

Table A4. 3 Average Marginal Effects (AME) of the multinomial regression model by cluster

	Permanent multimorbidity and care needs	**Permanent multimorbidity without care needs**	**Chronic condition and care needs**	**Chronic condition without care needs and some recoveries**
Gender				
Men (ref)	0 [0-0]	0 [0-0]	0 [0-0]	0 [0-0]
Women	0.0767 [0.0626-0.0908]	-0.0506 [-0.062--0.0393]	0.0413 [0.0286-0.0539]	-0.0674 [-0.0793--0.0555]
Age group				
50-64 (ref)	0 [0-0]	0 [0-0]	0 [0-0]	0 [0-0]
65-79	0.0893 [0.0744-0.1043]	-0.0149 [-0.0269--0.0029]	0.0036 [-0.01-0.0172]	-0.0781 [-0.0911--0.065]
80+	0.2197 [0.1964-0.243]	-0.0634 [-0.0806--0.0461]	0.0303 [0.0096-0.051]	-0.1866 [-0.2028--0.1705]
Education				
High (ref)	0 [0-0]	0 [0-0]	0 [0-0]	0 [0-0]
Middle	0.0355 [0.0158-0.0552]	-0.0195 [-0.0355--0.0035]	0.0241 [0.0074-0.0408]	-0.0401 [-0.0562--0.0239]
Low	0.0628 [0.0433-0.0823]	-0.0434 [-0.0594--0.0274]	0.0551 [0.0381-0.072]	-0.0744 [-0.091--0.0579]

Housing tenure				
	0		0	0
Owner or rent free (ref)	[0-0]	0 [0-0]	[0-0]	[0-0]
	0.0463	-0.0231	0.0145	-0.0377
Tenant	[0.0277-0.0649]	[-0.0375--0.0087]	[-0.0025-0.0314]	[-0.0531--0.0222]
	0.0239	-0.0142	0.0108	-0.0205
Other ways	[0.0000-0.0473]	[-0.0335-0.0052]	[-0.0109-0.0324]	[-0.0421-0.001]
	0.0488	-0.0159	0.0102	-0.0432
Missing	[0.0266-0.071]	[-0.0331-0.0012]	[-0.0096-0.0301]	[-0.0608--0.0255]
Living arrangements				
Living with the partner and/or	0	0	0	0
children (ref)	[0-0]	[0-0]	[0-0]	[0-0]
	-0.0114	-0.0271	0.0209	0.0175
Living only with the partner	[-0.0646-0.0419]	[-0.0761-0.022]	[-0.0228-0.0645]	[-0.0275-0.0626]
	-0.0077	-0.0437	0.0357	0.0157
Living alone	[-0.0613-0.0459]	[-0.0931-0.0056]	[-0.0084-0.0799]	[-0.03-0.0614]
	0.0106	-0.0323	0.0323	-0.0106
Other	[-0.0442-0.0654]	[-0.0825-0.0179]	[-0.0128-0.0775]	[-0.0569-0.0356]
Country				
	0	0	0	0
Switzerland (ref)	[0-0]	[0-0]	[0-0]	[0-0]
	0.0915	-0.0773	0.054	-0.0681
Austria	[0.059-0.1239]	[-0.1046--0.0501]	[0.0255-0.0825]	[-0.0944--0.0418]
	0.1128	-0.0575	0.0196	-0.0749
Belgium	[0.0823-0.1433]	[-0.0841--0.0309]	[-0.0062-0.0454]	[-0.0997--0.0501]
	0.0728	-0.0649	0.0407	-0.0487
Czech Republic	[0.0418-0.1038]	[-0.0918--0.038]	[0.0135-0.068]	[-0.075--0.0223]
	0.0514	-0.0148	0.0012	-0.0377
Denmark	[0.018-0.0848]	[-0.0447-0.015]	[-0.0267-0.029]	[-0.0649--0.0105]
	0.0869	-0.0473	0.0173	-0.0569
France	[0.0568-0.117]	[-0.0742--0.0204]	[-0.0079-0.0425]	[-0.0817--0.0321]
	0.105	-0.1086	0.0766	-0.073
Germany	[0.0679-0.1421]	[-0.1368--0.0803]	[0.0425-0.1107]	[-0.1024--0.0436]
	0.078	-0.0829	0.0272	-0.0223
Italy	[0.0452-0.1108]	[-0.111--0.0548]	[-0.0012-0.0556]	[-0.0508-0.0062]
	0.0774	-0.0796	0.0382 [0.009-	-0.036
Spain	[0.0442-0.1105]	[-0.108--0.0511]	0.0675]	[-0.0652--0.0068]
	0.0578	-0.0447	0.0249 [-0.0038-	-0.038
Sweden	[0.0243-0.0914]	[-0.0743--0.015]	0.0536]	[-0.0661--0.01]
Chronic condition				
Not having this chronic	0	0	0	0
condition (ref)	[0-0]	[0-0]	[0-0]	[0-0]
	0.1	0.0175	-0.0379	-0.0796
Cancer	[0.0815-0.1185]	[0.0025-0.0325]	[-0.0533--0.0225]	[-0.0933--0.066]
			-0.0536	
	0.0881	0.0195	[-0.0666--	-0.054
Cataracts	[0.073-0.1033]	[0.0069-0.032]	0.0406]	[-0.067--0.041]
	0.0901	0.0955	-0.1055	-0.0802
High cholesterol	[0.0766-0.1037]	[0.0849-0.1062]	[-0.1177--0.0932]	[-0.0914--0.0689]
	0.1506	0.031	-0.063	-0.1185
Diabetes	[0.1346-0.1665]	[0.0183-0.0437]	[-0.0766--0.0494]	[-0.1307--0.1064]
Arthritis- and osteoporosis-	0.1774	-0.039	0.0052	-0.1436
related	[0.1631-0.1917]	[-0.0506--0.0275]	[-0.0076-0.0181]	[-0.1558--0.1314]
	0.1346	-0.0093	-0.0334	-0.0918
Hearth attack	[0.1196-0.1496]	[-0.0208-0.0023]	[-0.0467--0.0202]	[-0.104--0.0796]
	0.1267	-0.0469	0.0224	-0.1022
Hip fractures	[0.1004-0.1531]	[-0.0665--0.0273]	[-0.0017-0.0465]	[-0.1233--0.0811]
	0.1216	0.0688	-0.0924	-0.098
Hypertension	[0.107-0.1361]	[0.058-0.0797]	[-0.1062--0.0786]	[-0.1104--0.0856]
Chronic lung disease	0.1428	-0.0175	-0.0132	-0.112

	[0.1248-0.1608]	[-0.0313--0.0038]	[-0.029-0.0025]	[-0.1254--0.0986]
	0.1713	-0.0817	0.0123	-0.1019
Parkinson	[0.1295-0.2132]	[-0.1077--0.0557]	[-0.0251-0.0498]	[-0.1327--0.0712]
	0.1159	-0.0071	-0.0039	-0.1048
Stroke or cerebral vascular	[0.095-0.1367]	[-0.0231-0.0088]	[-0.023-0.0153]	[-0.1214--0.0883]
	0.1121	0.013	-0.0549	-0.0703
Stomach or duodenal ulcer	[0.0921-0.1322]	[-0.0034-0.0294]	[-0.0713--0.0385]	[-0.0861--0.0544]

Source: Survey of Health Ageing and Retirement in Europe, waves 1-2, 4-6 and 8

Table A4. 4 Odds ratios for multinomial regression models separated by gender, explaining individuals' trajectories of multimorbidity and social care needs.

Reference: Permanent multimorbidity and care needs

	Permanent multimorbidity without care needs		**Chronic condition and care needs**		**Chronic condition without care needs and some recoveries**	
	Men	**Women**	**Men**	**Women**	**Men**	**Women**
	Odds ratios	**Odds ratios**	**Odds ratios**	**Odds ratios**	**Odds ratios**	**Odds ratios**
(Intercept)	10.727*** [3.388-18.065]	1.715 [0.462-2.968]	7.174*** [1.751-12.596]	8.051*** [3.661-12.44]	108.151*** [30.223-186.079]	83.483*** [28.51-138.457]
Age group						
50-64 (ref)	1.000	1.000	1.000	1.000	1.000	1.000
65-79	0.664*** [0.56-0.768]	0.66*** [0.556-0.763]	0.713*** [0.593-0.833]	0.715*** [0.619-0.81]	0.466*** [0.393-0.539]	0.444*** [0.374-0.513]
80+	0.349*** [0.255-0.442]	0.239*** [0.166-0.313]	0.555*** [0.422-0.687]	0.526*** [0.428-0.623]	0.14*** [0.099-0.18]	0.085*** [0.057-0.113]
Education						
High (ref)	1.000	1.000	1.000	1.000	1.000	1.000
Middle	0.704*** [0.567-0.84]	0.88 [0.69-1.071]	1.039 [0.811-1.267]	0.952 [0.769-1.134]	0.699*** [0.562-0.835]	0.689*** [0.552-0.827]
Low	0.538*** [0.43-0.646]	0.659*** [0.518-0.801]	1.171 [0.911-1.431]	0.972 [0.794-1.15]	0.577*** [0.459-0.694]	0.446*** [0.356-0.536]
Housing tenure						
Owner or rent free (ref)	1.000	1.000	1.000	1.000	1.000	1.000
Tenant	0.759** [0.601-0.917]	0.672*** [0.534-0.81]	0.976 [0.768-1.184]	0.877+ [0.739-1.014]	0.686*** [0.541-0.831]	0.65*** [0.521-0.779]
Other	0.987 [0.716-1.257]	0.704** [0.521-0.888]	1.194 [0.863-1.525]	0.883 [0.712-1.055]	0.816 [0.579-1.054]	0.834 [0.622-1.045]
Missing	0.693** [0.536-0.85]	0.823 [0.61-1.036]	0.824+ [0.641-1.007]	0.94 [0.747-1.134]	0.537*** [0.413-0.66]	0.746* [0.561-0.931]
Living arrangements						
Living with the partner and/or children (ref)	1.000	1.000	1.000	1.000	1.000	1.000
Living only with the partner	0.448** [0.18-0.716]	1.644 [0.591-2.697]	1.018 [0.357-1.68]	1.245 [0.692-1.799]	0.957 [0.348-1.566]	1.116 [0.483-1.748]
Living alone	0.374** [0.146-0.603]	1.456 [0.52-2.391]	0.955 [0.325-1.586]	1.416 [0.788-2.044]	0.819 [0.288-1.351]	1.233 [0.531-1.936]
Other	0.454* [0.174-0.734]	1.285 [0.44-2.129]	1.005 [0.334-1.676]	1.221 [0.667-1.776]	0.825 [0.285-1.365]	0.793 [0.329-1.257]
Country						
Switzerland (ref)	1.000	1.000	1.000	1.000	1.000	1.000
Austria	0.368***	0.489***	1.068	0.884	0.419***	0.506***

	[0.239-0.497]	[0.32-0.658]	[0.653-1.484]	[0.629-1.139]	[0.272-0.565]	[0.339-0.673]
Belgium	0.489*** [0.335-0.643]	0.448*** [0.303-0.593]	0.945 [0.599-1.291]	0.629** [0.454-0.804]	0.404*** [0.273-0.534]	0.425*** [0.292-0.559]
Czech Republic	0.478*** [0.319-0.636]	0.535*** [0.362-0.709]	1.00 [0.615-1.385]	0.919 [0.66-1.177]	0.588** [0.388-0.787]	0.541*** [0.368-0.715]
Denmark	0.708+ [0.464-0.953]	0.862 [0.569-1.155]	1.202 [0.716-1.688]	0.654** [0.449-0.858]	0.664* [0.428-0.9]	0.651* [0.433-0.869]
France	0.569*** [0.389-0.749]	0.527*** [0.358-0.696]	0.881 [0.555-1.207]	0.754* [0.55-0.957]	0.49*** [0.332-0.649]	0.528*** [0.368-0.689]
Germany	0.312*** [0.19-0.435]	0.281*** [0.156-0.407]	1.193 [0.698-1.689]	0.932 [0.62-1.243]	0.375*** [0.229-0.52]	0.516*** [0.318-0.713]
Italy	0.433*** [0.277-0.589]	0.45*** [0.288-0.612]	1.019 [0.613-1.425]	0.828 [0.582-1.073]	0.677* [0.438-0.917]	0.637* [0.418-0.857]
Spain	0.506*** [0.324-0.688]	0.407*** [0.258-0.556]	1.298 [0.777-1.818]	0.788 [0.552-1.024]	0.619* [0.392-0.846]	0.643* [0.417-0.868]
Sweden	0.721+ [0.47-0.972]	0.508*** [0.319-0.698]	0.953 [0.565-1.341]	0.902 [0.629-1.175]	0.696* [0.448-0.944]	0.569** [0.37-0.768]
Chronic condition						
Not having this disease (ref.)	1.000	1.000	1.000	1.000	1.000	1.000
Hearth attack	0.656*** [0.561-0.751]	0.528*** [0.441-0.615]	0.475*** [0.401-0.549]	0.567*** [0.492-0.641]	0.339*** [0.286-0.392]	0.311*** [0.251-0.37]
Hypertension	1.161+ [0.957-1.366]	1.115 [0.914-1.316]	0.395*** [0.332-0.458]	0.394*** [0.344-0.443]	0.385*** [0.324-0.445]	0.307*** [0.262-0.353]
High Cholesterol	1.502*** [1.272-1.732]	1.491*** [1.262-1.719]	0.368*** [0.311-0.426]	0.418*** [0.368-0.467]	0.482*** [0.41-0.555]	0.375*** [0.322-0.429]
Stroke or cerebrovascular disease	0.568*** [0.457-0.679]	0.777* [0.598-0.956]	0.676*** [0.539-0.813]	0.62*** [0.499-0.74]	0.288*** [0.218-0.357]	0.309*** [0.211-0.408]
Diabetes	0.767*** [0.652-0.882]	0.754*** [0.632-0.876]	0.405*** [0.334-0.476]	0.416*** [0.354-0.478]	0.252*** [0.208-0.296]	0.243*** [0.192-0.294]
Chronic lung diseases	0.516*** [0.423-0.609]	0.59*** [0.471-0.709]	0.53*** [0.433-0.627]	0.581*** [0.488-0.673]	0.245*** [0.194-0.295]	0.276*** [0.21-0.341]
Cancer	0.827* [0.673-0.981]	0.777* [0.626-0.927]	0.572*** [0.455-0.69]	0.543*** [0.453-0.633]	0.398*** [0.315-0.481]	0.369*** [0.293-0.446]
Stomach or duodenal ulcer	0.755** [0.606-0.904]	0.789* [0.621-0.956]	0.407*** [0.314-0.499]	0.542*** [0.443-0.641]	0.423*** [0.331-0.516]	0.366*** [0.273-0.459]
Parkinson	0.273*** [0.12-0.425]	0.232*** [0.052-0.412]	0.797 [0.497-1.096]	0.498*** [0.31-0.686]	0.27*** [0.136-0.404]	0.255*** [0.1-0.409]
Cataracts	0.897 [0.752-1.041]	0.836* [0.707-0.965]	0.539*** [0.443-0.634]	0.535*** [0.467-0.604]	0.572*** [0.472-0.672]	0.438*** [0.364-0.511]
Hip fracture	0.482*** [0.328-0.636]	0.4*** [0.262-0.539]	0.765+ [0.549-0.981]	0.709*** [0.566-0.852]	0.273*** [0.175-0.372]	0.332*** [0.214-0.45]
Arthritis- and osteoporosis-related disease	0.437*** [0.374-0.501]	0.393*** [0.331-0.456]	0.571*** [0.484-0.657]	0.49*** [0.425-0.556]	0.258*** [0.22-0.297]	0.18*** [0.152-0.207]

Note: Confidence intervals are provided in squared brackets and reported p values correspond to + p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001.

Source: Survey of Health Ageing and Retirement in Europe, waves 1-2, 4-6 and 8

Table A4. 5 Odds ratios of multinomial regression model interacting all included variables with gender.

Reference: Permanent multimorbidity and care needs*

	Permanent multimorbidity without care needs	**Chronic condition and care needs**	**Chronic condition without care needs and some recoveries**

	Odds ratios	Odds ratios	Odds ratios
(Intercept)	10.898*** [3.47-18.327]	7.027*** [1.705-12.348]	110.425*** [30.755-190.095]
Gender *Age group			
Men of 50-64 (ref)	1.000	1.000	1.000
Women of 65-79	0.98 [0.763-1.197]	0.998 [0.784-1.212]	0.957 [0.744-1.17]
Women of 80+	0.667+ [0.395-0.938]	0.944 [0.658-1.23]	0.606* [0.34-0.872]
Gender * Education			
Men with high education (ref)	1.000	1.000	1.000
Women with middle education	1.271 [0.902-1.639]	0.929 [0.658-1.2]	0.998 [0.719-1.278]
Women with low education	1.225 [0.865-1.585]	0.845 [0.602-1.089]	0.783+ [0.558-1.009]
Gender * Housing tenure			
Men that are owners or do not pay rent (ref)	1.000	1.000	1.000
Tenant women	0.872 [0.617-1.127]	0.9 [0.662-1.137]	0.958 [0.679-1.237]
Women with other types of housing tenure	0.705+ [0.439-0.971]	0.751+ [0.496-1.005]	1.022 [0.627-1.417]
Women with missing information	1.174 [0.77-1.577]	1.141 [0.796-1.487]	1.38+ [0.912-1.849]
Gender * Living arrangements			
Men living with the partner and/or the children	1.000	1.000	1.000
Women living only with the partner	3.659** [0.472-6.846]	1.253 [0.262-2.243]	1.164 [0.171-2.157]
Women living alone	3.86** [0.457-7.262]	1.489 [0.3-2.678]	1.494 [0.203-2.785]
Women in other living arrangements	2.844* [0.293-5.395]	1.245 [0.236-2.253]	0.964 [0.116-1.811]
Gender * Chronic condition			
Men without these conditions (ref)	1.000	1.000	1.000
Women that suffered a hearth attack	0.804+ [0.627-0.981]	1.193+ [0.95-1.435]	0.913 [0.686-1.14]
Women with hypertension	0.952 [0.712-1.191]	0.99 [0.79-1.19]	0.798* [0.625-0.97]
Women with high cholesterol	0.994 [0.778-1.209]	1.132 [0.909-1.356]	0.779* [0.617-0.94]
Women with stroke or cerebrovascular diseases	1.365* [0.951-1.778]	0.897 [0.645-1.149]	1.082 [0.647-1.516]
Women with diabetes	0.984 [0.767-1.201]	1.018 [0.785-1.251]	0.96 [0.698-1.223]
Women with chronic lung disease	1.133 [0.827-1.439]	1.093 [0.828-1.358]	1.136 [0.778-1.493]
Women with cancer	0.942 [0.688-1.196]	0.939 [0.691-1.187]	0.926 [0.652-1.199]
Women with stomach or duodenal ulcer	1.045 [0.742-1.348]	1.343* [0.95-1.736]	0.878 [0.583-1.173]
Women with Parkinson's disease	0.834 [0.025-1.643]	0.615+ [0.288-0.942]	0.922 [0.194-1.65]
Women with cataracts	0.937 [0.728-1.146]	1 [0.782-1.218]	0.77* [0.582-0.957]
Women with hip fractures	0.848 [0.448-1.248]	0.926 [0.605-1.247]	1.208 [0.594-1.822]

Women with Arthritis- and osteoporosis-related disease	0.902 [0.709-1.095]	0.857 [0.684-1.031]	0.699** [0.55-0.849]

*Only the interaction terms are showed.
Note: Confidence intervals are provided in squared brackets and reported p values correspond to + p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001.
Source: Survey of Health Ageing and Retirement in Europe, waves 1-2, 4-6 and 8

Table A4. 6 Odds ratios of multinomial regression model interacting countries with sex.

Reference: Permanent multimorbidity and care needs*

	Permanent multimorbidity without care needs	Chronic condition and care needs	Chronic condition without care needs and some recoveries
	Odds ratios	Odds ratios	Odds ratios
Swiss men (ref)	1.000	1.000	1.000
Swiss women	1.526** [1.128-1.925]	1.199 [0.924-1.474]	1.579*** [1.187-1.972]
Austrian men	0.366*** [0.238-0.494]	1.066 [0.652-1.481]	0.417*** [0.271-0.563]
Austrian women	0.756* [0.576-0.936]	1.071 [0.867-1.275]	0.789* [0.609-0.97]
Belgian men	0.484*** [0.332-0.637]	0.939 [0.595-1.283]	0.398*** [0.269-0.526]
Belgian women	0.687*** [0.547-0.827]	0.756** [0.625-0.887]	0.678*** [0.54-0.815]
Czech men	0.473*** [0.317-0.63]	0.993 [0.611-1.374]	0.579** [0.382-0.775]
Czech women	0.828+ [0.656-0.999]	1.112 [0.912-1.311]	0.858 [0.673-1.043]
Danish men	0.695* [0.456-0.935]	1.185 [0.707-1.664]	0.654* [0.421-0.887]
Danish women	1.345* [1.034-1.656]	0.795* [0.618-0.971]	1.047 [0.801-1.293]
French men	0.565*** [0.387-0.744]	0.876 [0.552-1.199]	0.481*** [0.325-0.637]
French women	0.814* [0.648-0.981]	0.915 [0.763-1.067]	0.842+ [0.677-1.007]
German men	0.31*** [0.188-0.431]	1.178 [0.689-1.667]	0.369*** [0.225-0.512]
German women	0.441*** [0.287-0.594]	1.127 [0.848-1.405]	0.811 [0.575-1.047]
Italian men	0.427*** [0.273-0.581]	1.005 [0.604-1.405]	0.671* [0.434-0.909]
Italian women	0.692** [0.522-0.863]	0.997 [0.802-1.191]	0.997 [0.759-1.236]
Spanish men	0.506*** [0.324-0.688]	1.294 [0.775-1.813]	0.621* [0.393-0.85]
Spanish women	0.616*** [0.461-0.772]	0.948 [0.763-1.134]	1.024 [0.774-1.275]
Swedish men	0.715+ [0.467-0.964]	0.941 [0.557-1.324]	0.688* [0.442-0.933]
Swedish women	0.769+ [0.563-0.975]	1.081 [0.855-1.307]	0.9 [0.673-1.127]

*Only the interaction terms of sex and country are showed.
Note: Confidence intervals are provided in squared brackets and reported p values correspond to + p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001.

Source: Survey of Health Ageing and Retirement in Europe, waves 1-2, 4-6 and 8