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From curing to caring: exploring social care needs after the onset of chronic conditions among European older adults (50+)

Mariana Calderón-Jaramillo, PhD*, Elisenda Rentería, PhD, Jeroen Spijker, PhD

Centre d'Estudis Demogràfics (CERCA), Universitat Autònoma de Barcelona, Barcelona, Catalunya, Spain

*Address correspondence to: Mariana Calderón-Jaramillo, PhD. E-mail: mcalderon@ced.uab.es

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Abstract

Background and Objectives: Population aging affects health and social care needs. Although its effects on healthcare needs have been widely discussed, less has been said about its implications on social care needs, even though the consequences of living with chronic conditions are related to functional decline, disability, dependency, and mobility limitation. This study aims to identify trajectories of healthcare and social care needs after the onset of chronic conditions, as well as to explore through cross-country comparisons how demographic, socioeconomic, living arrangements, and health-related dimensions explain individuals' trajectories.

Research Design and Methods: Using data from the Survey of Health, Ageing and Retirement in Europe, we analyzed trajectories of 16,718 individuals aged 50 and above from 10 European countries through sequence analysis. Multinomial regression models were fitted to understand the factors that explained these trajectories.

Results: This study identified four trajectories after the onset of chronic conditions: (a) "Persistent multimorbidity and social care needs," (b) "Persistent 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 models present divergences in individuals' characteristics, including demographic and socioeconomic aspects, as well as differences by country, related to each trajectory.

Discussion and Implications: By acknowledging trajectories within health and social care needs, we showed the challenges posed by aging processes, which require tailored-made and person-centered services oriented towards preventing and postponing the onset of chronic conditions as well as dealing with their consequences on individuals' daily lives.

Keywords: Sequence Analysis, Morbidity, SHARE, Limitations

Translational Significance: The onset of chronic conditions is usually associated with rising healthcare needs. However, the consequences of diseases are not limited to healthcare provision but to emerging social care needs related to being able to perform daily life activities. Integration between the healthcare and social care systems is required in order to meet the diverse and dynamic needs of older individuals. These two systems are facing ongoing transformations that should provide a new approach for public responses to aging, whose main goal ought to shift from eradicating disease, something that is not always possible among older individuals, to enhancing quotidian well-being.

Background and objectives

The consequences of the increasing prevalence of chronic conditions among older individuals on healthcare and social care systems have been widely discussed (Palladino et al., 2016; Spiers, 2019). Available evidence suggests that (multi)morbidity increases healthcare and social care needs visibly through service utilization and costs (Blawat et al., 2020; Kasteridis et al., 2014; Wittenberg & Hu, 2015). 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, Von Strauss, et al., 2009), the relationship between experiencing chronic conditions and social care needs is usually assumed rather than studied. 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 (Mlinac & Feng, 2016; Ouwens et al., 2005) Hence, healthcare is being reoriented from curing chronic conditions, something that is not always possible, especially among aging populations, to maintaining well-being. This last

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scenario may translate, among other things, into increasing social care needs.

Social care needs refer to the necessity of help and support that individuals require during their daily lives, which applies to a wide range of activities like walking, getting out of bed, sitting, cooking, shopping for groceries, or taking medications. These tasks are usually taken as granted when you can do them, but create difficulties and barriers for quotidian lives among those who can't perform them. Existing literature has primarily defined social care needs as those not referring directly to medical aspects, like diagnosis and treatment (Simpson et al., 2022), by focusing on individuals' inability to move and perform Basic Activities of Daily Living (ADL) and Instrumental Activities of Daily Living (IADL) (Vlachantoni, 2019; Vlachantoni et al., 2011) Within the literature, there isn't agreement on how social care needs can be operationalized, mainly because it is difficult to define which kind of limitations imply (or do not) someone else's support, or to define a threshold for measuring its intensity of severity (McGilton et al., 2018; Van Oyen et al., 2018; Vlachantoni, 2019). Nevertheless, there is some agreement that social care needs can be defined through an absolute approach as experiencing limitations for performing ADL and IADL (Vlachantoni, 2019), and that functional decline associated with the need for social support is also related to difficulties with moving (Kingston et al., 2012). Previous evidence has highlighted that social care needs are the result of the experience of chronic conditions (McGilton et al., 2018); however, their trajectories might be more complex.

Analyses of chronic conditions and social care needs have generally understood the aging process as a unidirectional path of functional decline, beginning with the onset of one chronic condition, followed by multimorbidity (here defined as experiencing more than one chronic condition), which aggravation leads to dependency, emerging social care needs, and eventually, to death (Jenkins et al., 2022; Madero-Cabib et al., 2022). Yet, this assumed linear process could be less straightforward (Newman et al., 2023), mainly because the trajectories of multimorbidity and social care needs are complex and affected by individuals' characteristics like gender, age, and socioeconomic status; also because changes introduced by technological advancements and public health policies could have played a role in mitigating the negative outcomes of chronic conditions and multimorbidity; and, finally due to different country-specific characteristics related to mortality and morbidity trends, and healthcare systems' performance (Palladino et al., 2016).

Despite increasing evidence on the relationship between multimorbidity and social care needs (Henderson et al., 2021; Simpson et al., 2022, 2023; Spiers, 2019), few studies provide cross-country comparisons on the subject. Furthermore, the majority of research has been conducted from a cross-sectional perspective, regardless of the dynamic character of multimorbidity and social care needs (Madero-Cabib et al., 2022; Vlachantoni et al., 2022). To our knowledge, there are limited longitudinal studies on the subject (Cezard et al., 2022), and no study jointly analyzes the trajectories of multimorbidity with social care needs. Previous evidence suggests that there are social factors explaining the emergence of social care needs and multimorbidity related to gender, age, and socioeconomic factors. Although the health survival paradox has emphasized gender differences, with women being more exposed to experiencing multimorbidity and social care needs than men (Oksuzyan et al., 2010; Vlachantoni, 2019), socioeconomic factors refer to the educational gradients in multimorbidity and unmet care needs (Kröger et al., 2019; Nagel et al., 2008).

Furthermore, research has highlighted differences among European countries in morbidity and mortality trends impacting life expectancy and healthy life expectancy. When using different indicators of health for measuring healthy life expectancy, like comorbidity, physical functional limitations, and difficulties with ADL and IADL, previous research has highlighted that Switzerland has the highest healthy life expectancy, while Poland has the lowest. Moreover, there is a main group of countries with similar trends, including Austria, Belgium, Denmark, France, Germany, Italy, the Netherlands, Spain, and Sweden (Jagger et al., 2011). However, few studies refer to cross-country differences regarding social care needs, which can result from factors like behaviors, healthcare systems performance, and cultural understandings of social care and support (Palladino et al., 2016, 2019; Souza et al., 2021). For instance, preventive policies promoting healthy behavior and advances in medical technology may have improved the health outcomes of individuals with chronic conditions, which in turn might have mitigated their negative effects on individuals' lives (Head et al., 2021). Additionally, there are different ways in which societies approach social care and support, which can have positive (or negative) effects on individuals' care needs and dependency (Pfau-Effinger, 2005). Although evidence usually refers separately to either morbidity or social care needs trajectories and progression, few studies have jointly examined how these factors might affect individuals' experiences of morbidity and social care needs.

Hence, this longitudinal study aims to comprehend further the connection between the progression from morbidity to multimorbidity, here defined as the presence of more than one chronic condition, and the onset of social care needs, operationalized as facing mobility limitations or for performing ADL and IADL in 10 European countries. To achieve this, the study is oriented by two key objectives. First, to explore the main trajectories related to experiencing (multi)morbidity and social care needs. Second, to analyze whether there are individual factors and cross-country factors explaining the experience of diverse trajectories of (multi)morbidity and social care needs. Therefore, we expect to find multiple trajectories rather than a unique linear path, as well as to identify if previous evidence on gender, socioeconomic, and cross-country differences related to (multi)morbidity and social care needs also holds when the two dimensions are jointly analyzed.

Research design and methods

To analyze trajectories of (multi)morbidity and social care needs after the onset of chronic conditions, we operationalize them based on previous research. Morbidity was defined as having one chronic condition, and multimorbidity as having more than one chronic condition. Even though there are different ways of defining multimorbidity, this is the most commonly used definition among studies on the subject (Marengoni et al., 2011). Additionally, social care needs were defined as experiencing mobility limitations and for performing ADL and IADL (Vlachantoni, 2019; Vlachantoni et al., 2011). This definition emphasizes that social care needs entail the need for support to achieve outcomes across different realms of personhood, but they differ from healthcare needs as they are not related to the treatment, control, or prevention of illness

(Spiers, 2019). As previously mentioned, there isn't agreement within the literature on which specific tasks should be included when measuring social care needs, and these vary widely from one study to another. Nevertheless, we include limitations related to ADL, IADL, and mobility, due to their relationship with the need for further support. Two methods were employed in this analysis: First, sequence analysis was utilized to explore different states and trajectories of healthcare and social care needs. Second, after finding the best cluster solution to group individuals' sequences, 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).

Data

We used data from the longitudinal "Survey of Health, Ageing and Retirement in Europe" (SHARE), which provides self-reported information about both the experience of chronic conditions (used for measuring multimorbidity) and limitations in mobility, ADL, and IADL (social care needs) 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 five waves, which are all waves but the third and seventh waves, because the SHARELIFE questionnaire was applied to these, which did not ask all participants the relevant variables for this study. The following 10 countries that collected data without skipping any of the intermediate waves for at least five out of the six analyzed waves were included: 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, even though we also observed trajectories in which individuals recovered from all the analyzed 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 Supplementary Figure 1 for further information).

Measures

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 included chronic conditions were those asked for in all the analyzed waves, while the limitations include a set of 23 activities referring to individuals' ability to live an independent life (see Author Notes). The construction of a dummy variable was a methodological decision aiming to assess the relationship between the experience of these needs and the progress or (multi)morbidity. Given that we were studying the onset rather than the rise of social care needs, we did not account for its severity as other studies have done (Abdi et al., 2019; Calderón-Jaramillo & Zueras, 2023; Marengoni, von Strauss, et al., 2009). We were more interested in whether individuals facing any of these limitations also required social care support, regardless of their kind, quantity, or severity, that can be associated (or not) with the experience of (multi)morbidity. Based on these two variables of healthcare 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 determine if information was lost due to the interviewee's death, we used data from 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 through the observation period when the successive number of waves with no information on the state was even, and halfway plus one observation 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 between two observations with an empty state in the middle, then the state remained the same throughout the period (applied in 7.4% of cases, $n = 1{,}237$); otherwise, the state was assumed to change halfway through the observation period if the number of states with missing values was even, or after halfway plus one when the number of missing observations was uneven (applied for 8.7% of cases, $n = 1{,}458$).

Explanatory variables of the regression models

The regression models covered various dimensions. In terms of demographic factors, the variables included country, gender, and age group at first observation (ages 50–64, 65–79, and 80+). Concerning socioeconomic factors, variables included educational level, housing tenure, and living arrangement. We did not control for income and wealth as socioeconomic factors because these variables often fluctuate throughout the life course, particularly in older populations transitioning into retirement, making it challenging to determine the appropriate time points for measurement and inclusion. Instead, we used educational level and housing tenure as proxies for socioeconomic status. These variables tend to be more stable over time, as they do not usually change as individuals age, thus offering a more consistent and comparable measure of individuals' socioeconomic position in their late lives.

Educational level was assessed at each individual's first observation and categorized 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 (e.g., members of a cooperative, subtenants, and 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 residence of children at the individual's last available observation. Four categories were created: (i) living alone (household size = 1); (ii) living only with the partner (household size = 2 and the partner present); (iii) living with the partner and/or children (household ≥2 and at least the partner or child living in the same household); and (iv) other (referring to those that do not live with their partners or children). Finally, the dichotomized chronic condition variable controlled for in the multinomial regression model was operationalized as having (or not) experienced any of the included chronic conditions in the survey during the observation period.

Sequence analysis

Sequence analysis was used to identify (multi)morbidity 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 three to six 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 had 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). We used agglomerative hierarchical cluster analysis to determine the optimal cluster solution, 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).

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. For the multinomial regression models, cluster A, referring to "Persistent multimorbidity and social care needs," was set as the reference (more details on the best cluster solution are presented in the Results). This cluster refers to the linear or evolutionary pathway that is usually used as the expected trajectory of (multi)morbidity and social care needs; therefore, when used this cluster as the reference to the other clusters that we have found, we were testing which specific factors better explain that individuals move away from this "expected" trajectory. 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. To capture the processual perspective of multimorbidity in this analysis, the models focused 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.

Sensitivity checks

Several checks were conducted to validate our results for the sequence analysis regarding the method used for estimating differences between sequences, the definition of social care needs, and the gender differences. First, we tested OM with constant costs and Optimal Matching between sequences of transitions for estimating the distance matrices: in both cases, a fourth-cluster solution was reached. Second, an alternative definition of social care needs, excluding mobility limitations, was considered to test if including mobility limitations implied an overestimation of estates and trajectories of (multi)morbidity and social care needs. Nevertheless, this sensitivity check yielded very similar results, which are aligned with previous evidence that suggests a correlation between multimorbidity, functional decline, dependency, and, therefore, social care needs (Davies et al., 2022; Jackson et al., 2015; Marengoni, von Strauss, et al., 2009). We also conducted separate sequence analyses for men and women, both of which resulted in 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 and includes both genders.

Furthermore, for the inferential analysis, besides fitting the multinomial models, we also estimated separate logistic regression models treating each cluster as a binary outcome (see Supplementary Table 1). This enabled us to examine the probability of pertaining to each cluster relative to all the other individuals in the sample. This approach served as a test of whether selecting Cluster A as the reference category would provide different results than using other clusters as the reference. Nevertheless, the results from these models followed trends like those of the multinomial regression models. Finally, we also checked results by setting different reference categories for each variable we controlled for. The general decision was to set the reference category as the one containing those who, based on previous literature, were expected to have better outcomes regarding their trajectories of (multi)morbidity and social care needs, meaning those with only one chronic condition or recovered and without social care needs. For instance, reference categories were younger men, those with higher socioeconomic levels (the higher educated, owners or not paying rent), those who lived with a partner and/or their children, and those who did not have any of the specified chronic conditions. Regarding the country variable, Switzerland demonstrated the best overall performance, especially when experiencing persistent multimorbidity and social care needs, and was therefore selected as the reference category in the presented models.

Results

In this section, we present the main results by first referring to the sequence analysis and the clustering process and then to the results from the multinomial regression models. The analytical sample was composed of 16,718 individuals who provided 67,777 observations. Women represented 56.6% of the sample, and the majority (44.1%) were in the 65–79 age group; meanwhile, the minority (13.7%) 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 and 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%).

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 Supplementary Table 2). Specific trajectories were identified using clustering methods by comparing sequences. Supplementary Figure 2 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 a two to four cluster solution. The cluster quality indicators (average silhouettes width, Hubert's gamma with Sommers' D coefficient, and point biserial correlation) reached their highest values with the fourth cluster solution. Moreover, results from the ASH show positive silhouette width values for all four clusters (see Supplementary Figure 3). We named these four clusters descriptively as follows: (A) "Persistent multimorbidity and social care needs," (B) "Persistent 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 1). Cluster A was the largest (7,281 individuals) and primarily consisted of individuals living with two 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 characterized by individuals living mostly with two or more chronic conditions without experiencing

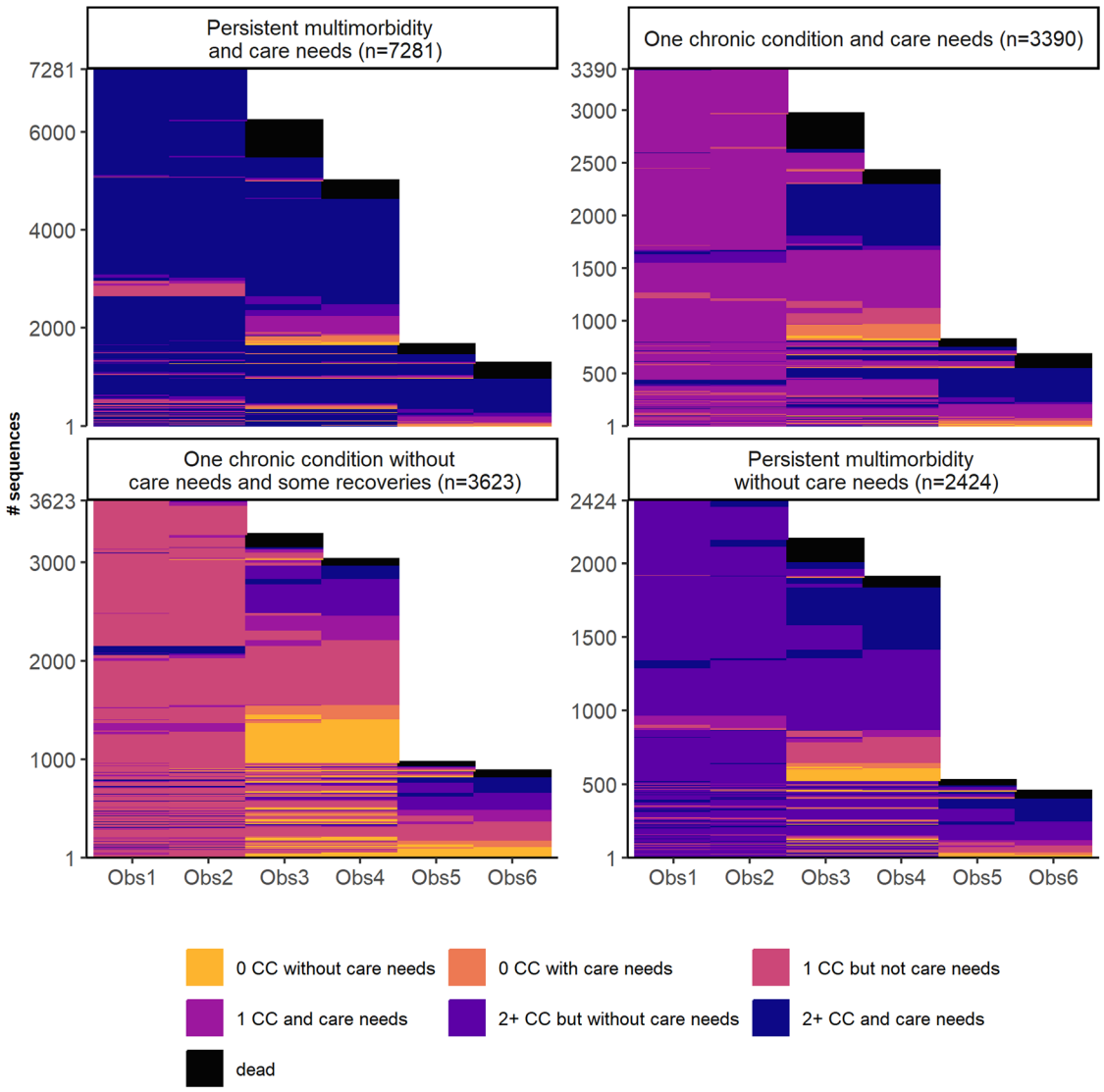

Figure 1. Four-cluster solution composition by state and cluster.

social care needs. 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 (3,390) steadily experienced social care needs alongside having morbidity (one chronic condition), while those in cluster D generally did not require social care (3,623). Notably, Cluster D included a higher proportion of individuals who recovered from (multi)morbidity.

Explanations behind individuals' different trajectories

Similarities and differences in the composition of the four clusters created through sequence analysis can be discerned (see Table 1). The highest percentage of women was found in the clusters of persistent multimorbidity with social care needs (cluster A) and one chronic condition with care needs (cluster C) (respectively, 63.0% and 62.7%). Meanwhile, the

Table 1. Descriptive statistics for the analytical sample by clusters.

Variable	Persistent multimorbidity and care needs	Persistent multimorbidity without care needs	Chronic condition and care needs	Chronic condition without care needs and some recoveries
	n =7,281	*n* =2,424	*n* =3,390	*n* =3,623
Gender				
Men	2,696 (37.0%)	1,339 (55.2%)	1,264 (37.3%)	1,955 (54.0%)
Women	4,585 (63.0%)	1,085 (44.8%)	2,126 (62.7%)	1,668 (46.0%)
Age group				
50–64	2,200 (30.2%)	1,187 (49%)	1,419 (41.9%)	2,245 (62.0%)
65–79	3,652 (50.2%)	1,080 (44.6%)	1,409 (41.6%)	1,233 (34.0%)
80+	1,429 (19.6%)	157 (6.5%)	562 (16.6%)	145 (4.0%)
Education				
High	947 (13.0%)	541 (22.3%)	505 (14.9%)	961 (26.5%)
Middle	2,026 (27.8%)	890 (36.7%)	1,057 (31.2%)	1,402 (38.7%)
Low	4,287 (58.9%)	986 (40.7%)	1,817 (53.6%)	1,253 (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	4,316 (59.3%)	1,639 (67.6%)	2,041 (60.2%)	2,530 (69.8%)
Other	1,408 (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	3,225 (44.3%)	1,407 (58.0%)	1,587 (46.8%)	2,124 (58.6%)
Living alone	2,806 (38.5%)	659 (27.2%)	1,219 (36.0%)	941 (26.0%)
Other	1,123 (15.4%)	320 (13.2%)	532 (15.7%)	509 (14.0%)
Country				
Austria	667 (9.2%)	206 (8.5%)	351 (10.4%)	318 (8.8%)
Belgium	1,080 (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	1,031 (14.2%)	338 (13.9%)	506 (14.9%)	499 (13.8%)
Germany	403 (5.5%)	98 (4.0%)	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 (11.0%)	309 (8.5%)
Sweden	538 (7.4%)	210 (8.7%)	288 (8.5%)	325 (9.0%)
Switzerland	362 (5.0%)	242 (10.0%)	230 (6.8%)	419 (11.6%)
Chronic condition (having it)				
Hearth attack	3,345 (45.9%)	765 (31.6%)	853 (25.2%)	595 (16.4%)
Hypertension	5,789 (79.5%)	1,953 (80.6%)	1,916 (56.5%)	2,026 (55.9%)
High cholesterol	4,336 (59.6%)	1,687 (69.6%)	1,159 (34.2%)	1,463 (40.4%)
Stroke or cerebrovascular disease	1,369 (18.8%)	283 (11.7%)	348 (10.3%)	171 (4.7%)
Diabetes	2,616 (35.9%)	755 (31.1%)	557 (16.4%)	430 (11.9%)
Chronic lung diseases	1,863 (25.6%)	349 (14.4%)	519 (15.3%)	293 (8.1%)
Cancer	1,339 (18.4%)	389 (16.0%)	444 (13.1%)	422 (11.6%)
Stomach or duodenal ulcer	1,326 (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	3,005 (41.3%)	704 (29.0%)	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	5,471 (75.1%)	1,251 (51.6%)	2,075 (61.2%)	1,465 (40.4%)

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

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

Regarding the educational level, individuals with lower educational levels were the majority in all clusters (more than 40%) except for cluster D of "chronic condition without social care needs and some recoveries" (34.6%), with the highest share of middle-educated individuals (38.7%). Across all clusters, most individuals were homeowners or lived rent-free, with values ranging between 59.3% and 69.8% (respectively for cluster A and D). Furthermore, concerning chronic conditions, hypertension was the most common across all clusters but cluster C (ranging between 80.6% for cluster B and 55.9% for cluster D). For the cluster of one chronic condition and social care needs (cluster C), arthritis- and osteoporosis-related diseases were the most common ones (61.2%). The disease with the lowest prevalence in all clusters was Parkinson's (ranging between 0.9% and 4.2%). Finally, differences in the percentage of individuals by country within each cluster are probably explained by differences in sample sizes.

The average marginal effects (AMEs) of the multinomial regression model (see Figure 2 and also Supplementary Table 3) showed that women had a higher relative probability than men of being in clusters associated with social 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 cluster 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 show statistically significant results.

Regarding the analyzed countries, significant differences were observed in Belgium, Germany, Austria, France, Spain, and the Czech Republic. The overall trend was that individuals in all countries faced a higher likelihood of being in cluster A (multimorbidity with social 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 social 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 rest of the countries, there was little variation between them. Nevertheless, a gradient was observed, with Denmark and Sweden showing a lower probability of belonging to the cluster of "Persistent multimorbidity and social care needs" (A), whereas, Belgium and Germany showed a higher probability of having individuals in this cluster, which was inversely associated with a lower chance of being in clusters B and D (those without social care needs).

For the included 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 0.09). Furthermore, conditions related to arthritis and osteoporosis, diabetes, and hip fracture showed the largest 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 social care needs and some recoveries.

To explore gender differences explaining individuals' trajectories, separate models were fitted for men and women (see Supplementary Table 4). Subsequently, to test the statistical significance of these differences in odds ratios (ORs), a model with all included variables interacting with gender was constructed (see Supplementary Table 5). The results showed statistically significant differences between women and men aged 80+ for the cluster B and D, with women experiencing a higher chance than men of being in trajectories of persistent multimorbidity without social care needs (OR 0.239 vs 0.349) and a lower chance than men of being in trajectories of chronic condition without social care needs and some recoveries (OR 0.085 vs 0.140). 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 social care needs and some recoveries.

Regarding specific chronic conditions, statistically significant differences between men and women were found for heart attack in clusters B and C, stroke or cerebrovascular disease in cluster B, stomach or duodenal ulcer and Parkinson's diseases in cluster C, and hypertension, high cholesterol, cataracts, and arthritis- and osteoporosis-related diseases in cluster D. For heart attacks, women were less likely to have experienced it than men when following the trajectory of persistent multimorbidity without care needs (OR 0.528 vs 0.656). However, women were at a higher risk of experiencing a heart attack in the trajectory of one chronic condition with social care needs (0.567 vs 0.475). Regarding stroke or cerebrovascular disease, women also faced a higher risk than men when they were in the persistent multimorbidity without social care needs trajectory (cluster B) (OR 0.777 vs 0.568). Concerning stomach or duodenal ulcer, women faced a higher risk when following the one chronic condition with social care needs trajectory (cluster C with OR 0.542 vs 0.407). In comparison, men had a higher risk of experiencing Parkinson's disease within this same trajectory (OR 0.498 vs 0.797). Finally, women faced a lower risk than men of experiencing hypertension (OR 0.307 vs 0.385), high cholesterol (0.375 vs 0.482), cataracts (0.438 vs 0.572), and arthritis- and osteoporosis-related diseases (0.180 vs 0.258) when following the chronic condition without social care needs and some recovery trajectory (cluster D). Gender differences across countries were also analyzed, with Swiss men being the reference group (see Supplementary Table 6). 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 (B and D), representing trajectories that did not involve social care needs.

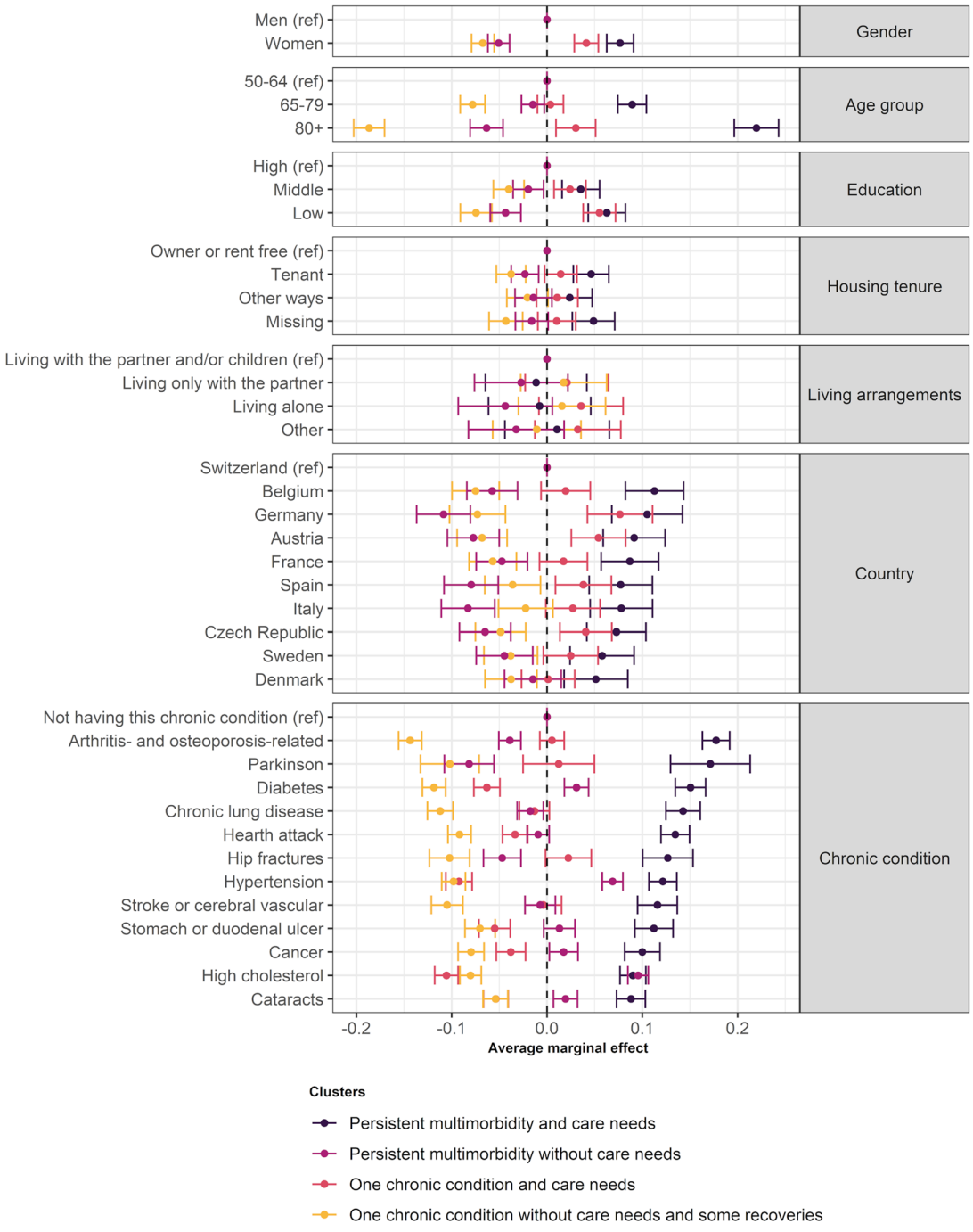

Figure 2. Average marginal effects of the multinomial regression model explaining individuals' trajectories.

Discussion and implications

Main results

This study identified four clusters of trajectories of (multi)morbidity and social care needs after the onset of chronic conditions: (a) "Persistent multimorbidity and social care needs," (b) "Persistent 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 individuals' characteristics, including gender and other demographic and socioeconomic factors, which also differ by country. Previous research on multimorbidity trajectories has similarly found that different paths exist, and that they are related to individuals' characteristics, including sociodemographic 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 article is to integrate (multi)morbidity and social care needs in the study of these trajectories, aligning them with current debates about aging, multimorbidity, and long-term care provision.

Available literature has highlighted the relationship that exists between increasing multimorbidity and the emergence

of social care needs due to disability and functional decline, as well as explored some individuals' characteristics that explain it. Evidence on the subject highlights a linkage between these two realms (Blawat et al., 2020; Cezard et al., 2022; Henderson et al., 2021; Simpson et al., 2023). By providing a Sequence Analysis, our study aimed to approach, from a longitudinal perspective, the different ways these are associated through individuals' life courses. Furthermore, individuals' trajectories might vary due to gender, sociodemographic factors, the specific chronic conditions experienced by individuals, and their country of origin. In this sense, we contribute to the ongoing debate about this relationship by providing longitudinal evidence on how it manifests, and exploring how different factors affect individuals' trajectories when we account jointly for (multi)morbidity and social care needs.

Gender, age, and socioeconomic factors

Few studies jointly analyze the sociodemographic factors that explain the trajectories of multimorbidity and social care needs. However, our findings are aligned with most of the evidence regarding each of these dimensions. Concerning multimorbidity, this study confirms previous evidence on differences in mortality and morbidity patterns due to age, the female-male health-mortality paradox, and the educational gradient (Kröger et al., 2019; Nagel et al., 2008; Oksuzyan et al., 2010). It reassures that younger individuals, men, and those with higher levels of education face lower risks of multimorbidity. 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, which have been shown by previous evidence (Uccheddu et al., 2019; Vlachantoni, 2019). 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.

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 "Persistent 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), behavioral, 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 evidence shows that arthritis- and osteoporosis-related disease (Srikanth et al., 2005), hypertension (Connelly et al., 2022), 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) are more associated with men's multimorbidity clusters.

Country comparisons

Many studies regarding multimorbidity have used cross-country comparisons of European countries, which reflect mortality and morbidity patterns, healthcare systems performance, and cultural differences (Ahrenfeldt et al., 2018; Palladino et al., 2016; Souza et al., 2021). Nevertheless, evidence on European differences regarding the experience of chronic conditions and their relationship with social care needs is scarce, given that most of the studies on this subject are focused on specific countries. However, previous research has created typologies of European countries based on their healthcare systems and long-term care services (Ariaans et al., 2021; Kaschowitz & Brandt, 2017; van Damme et al., 2025) or highlighted the persisting differences between European countries regarding their multimorbidity patterns and social care needs (Welsh et al., 2021). These differences were also visible in our results. When compared to other countries, Swiss individuals (the reference category) showed lower probabilities of being in the cluster of persistent multimorbidity with social care needs, followed by Sweden and Denmark, these countries are known for their strong healthcare systems which might translate in better health outcomes of multimorbidity, which is also shown by previous research consistently highlighting 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). Preceding literature has highlighted the Swiss healthcare system's good performance, which probably explains our results (de Pietro et al., 2015), alongside the ones from the Nordic countries that are also characterized by their welfare states, which guarantee universal coverage and opportune access to healthcare services (Bliddal et al., 2024). Belgian individuals, on the contrary, showed higher probabilities of being in the cluster of persistent multimorbidity and social care needs, a difference that might be driven by their worse performance regarding the burden of disease when compared to other European countries (Ghattas et al., 2022) and their higher prevalence of disability (de (de Yokota) Yokota et al., 2016). Patterns observed in Austria, Belgium, Denmark, France, Germany, Italy, Spain, Sweden, align well with findings related to Healthy Life Years and Life expectancy free of ADL, while the Czech Republic showed improved outcomes based on our updated results (Jagger et al., 2011). However, differences between countries indicate varied mortality and morbidity trends, reflecting differences in healthcare and social care systems across Europe.

Study limitations

Attrition and sample refreshment of the longitudinal dataset led to sequences of different lengths. However, our analysis focused on sequence order rather than timing and duration. This means that even though some data imputation was performed, it did not affect the sequence analysis. We also analyzed the data separately by gender and country, which, although robust, reduced the sample size and represents a limitation of our analysis. 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 have been widely used for country comparisons. Additionally, self-reported answers of chronic conditions might introduce under-registration, particularly among individuals facing access barriers to the healthcare system. Yet, such under-registration is expected to be low among the European countries included in this study. Furthermore, differences between countries might also result from cultural practices and risky health-related behaviors. Although there is extensive evidence on the consequences of risky behaviors—such as drinking, smoking, and sedentarism—on the onset of chronic conditions and social care needs due to functional decline, we did not control for these factors. This decision was based on the likelihood that their effects accumulate over many years prior to being surveyed and may fluctuate throughout the observation period, making it difficult to capture their influence accurately within our models (Zacarías-Pons et al., 2021). Additional limitations stem from longitudinal attrition, which particularly affected the eighth wave of SHARE and institutionalized 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 institutionalized 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.

Concluding remarks

This study is aligned with current efforts to comprehensively understand health and well-being, as well as closing the gap between healthcare and social care needs, especially among older persons who need both types of care (Dambha-Miller et al., 2021). Europe, as an outrunning region in population ageing, offers the opportunity to increase our awareness of older individuals' needs and demands. Future research could continue to explore strategies for analyzing data that is structurally separated due to the lack of integration of social care and healthcare systems (Johri et al., 2003; Simpson et al., 2023) and delve more into how specific chronic conditions are associated with the specific kind of social care someone might need. Our analysis showed that trajectories of multimorbidity and social care needs are diverse, and are attached to individual and structural factors, as well as to country differences that should be further analyzed by future research on policy implementation. These different trajectories underlined the complexity of the challenges posed by ageing processes, requiring the design of tailored-made and person-centered services oriented toward preventing and postponing the onset of chronic conditions as well as their negative outcomes related to functional decline, limitations, and therefore, the emergence of social care needs. Healthcare services dealing with multimorbidity should be integrated with social care services to handle its consequences and meet older individuals' diverse and dynamic needs.

Author Notes

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 tumor, 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 were included in the same way as 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. 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 2 hr; (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.

Supplementary material

Supplementary material is available at *Innovation in Aging* (https://academic.oup.com/innovateage).

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Conflict of interest

None declared.

Data availability

Data from the Survey of Health, Ageing and Retirement in Europe (SHARE) are publicly available for scientific purposes upon registration. M.C.J. registered for using data for this research; however, the study was not preregistered in any repository. The R code used for preparing the example can be shared upon request.

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