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Original Article

Multimorbidity and functional status in community-dwelling older adults

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ABSTRACT

Background: Multimorbidity is common in older people and may contribute to many adverse health events, such as disability. The aim of the study was to investigate how chronic health conditions (single, paired, and grouped) affect functional independence.
Method: We used two samples (a one-time, convenience sample and a nationally representative cross-sectional survey) of community-dwelling people of 65 years old or over, with a total of 2818 subjects in Spain. To assess functional independence, we used the Barthel index, administered as an interview. Information about the presence of 11 chronic health problems was collected by interview or review of their medical chart. Explanatory factor analysis was performed to assess associations between chronic health conditions.
Results: Diabetes mellitus and hypertension emerged as the pair of chronic health conditions that most affected functional status [OR 1.98; 95% CI (1.51–2.60)], followed by visual and hearing impairment. A synergistic effect was found ($p < 0.05$) for the cardiovascular disease and hypertension pair. Four multimorbidity groups emerged from the factor analysis: sensory and bone; cancer, lung and gastrointestinal; cardiovascular and metabolic; neuropsychiatric disorders. The neuropsychiatric disorders group was the most strongly associated with physical impairment [OR 4.94; 95% CI (2.71–8.99)], followed by the sensory and bones group [OR 1.90; 95% CI (1.56–2.31)].
Conclusion: Despite its low prevalence, the neuropsychiatric disorders group was most strongly associated with lower functional status. Analysis of the relationship between chronic medical conditions and functional status could be useful to develop primary health care strategies to improve functional independence in older people with comorbidities.

1. Introduction

Multimorbidity is a construct describing the presence of two or more diagnosable conditions that are present in the same individual at the same time or have a close temporal relationship [1–3]. Many health problems increase with aging and this, in addition to the current demographic trend, leads to the growing prevalence of multimorbidity in the general population. More than 25% of Europeans are likely to be at least 65 years old in 2040 [4]. Moreover, prevalence of multimorbidity in people aged 65 or more is about 70% and exceeds 80% for people of 80 years or older [5], which is probably a consequence of improved life expectancy. Increased multimorbidity leads to polypharmacy, intensified use of medical and social services, and activity and participation restrictions, making it a public health problem.

However, the lack of consensus regarding the number and type of health conditions that should be included in a multimorbidity measure makes it difficult to accurately estimate its prevalence. The presence of multiple chronic diseases is significantly associated with the worsening of many health outcomes, such as mortality, disability, hospitalizations, use of health care resources, quality of life, activity and participation restriction [6–8].

According to the International Classification of Functioning, Disability, and Health (ICF) model, activity and participation define a person's functional status, which includes communication, mobility, interpersonal interactions and self-care [9]. Being able to perform self-care functional tasks in everyday life is fundamental for community-dwelling people. As age increases, a certain reduction in the ability to perform

Abbreviations: ADL, activities of daily living; GI, gastrointestinal; O/E, observed/expected ratio; KMO, Kaiser–Meyer–Olkin coefficient; OR, odds ratio.

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daily activities is considered natural [10]. However, the presence of individual diseases, such as arthritis and arthrosis [11], stroke and diabetes [12], as well as the total number of chronic conditions [13], is independently associated with lower functional status. Moreover, specific combinations of diseases may have not only additive effects, but also synergistic ones. For instance, the co-occurrence of arthritis with visual impairment, cardiovascular disease with cancer, and lung disease with cancer all have additive as well as multiplicative synergistic effects on physical disability [14].

The objectives of this study are to assess the prevalence of multimorbidity conditions and to identify how individual chronic health conditions or multimorbidity groups affect independence in activities of daily living. A better understanding of the relationship between multimorbidity and functional status can enhance the interventions for community-dwelling older people with multiple chronic health diseases.

2. Method

Data from 2818 older adults were collected from two surveys on people of 65 years or older living in communities across Spain. The first included 1106 eligible subjects obtained by a geodemographically-based proportional multistage stratified sampling. Participants were interviewed about health and quality of life in their home. More details of this survey may be found in a previous publication [15]. Of the 1106 older adults, all agreed to participate and 214 were excluded from the analyses due to age (<65 years), making up a final sample of 892 subjects for this group.

The second survey included subjects enrolled in a multicenter study about falls in hospitals from the Basque Health Service (Osakidetza), aged 65 years or older. A total of 2825 patients who attended 1 of 6 public hospital emergency departments, after a fall with hip or wrist fracture, were enrolled. A final number of 1926 participants was considered suitable to be included in the analysis: 169 subjects did not give their consent to participate and 730 were also excluded due to incomplete or inconsistent data from questionnaires and/or serious physical or psychiatric problems. In a multicenter study of the Basque region, persons with moderate to severe dementia that were not able to answer the questionnaire were excluded. In the nationwide study, persons with a score of 5 or more in the Pfeiffer's Short Portable Mental status Questionnaire were excluded. Persons with early-stage dementia who could answer the questionnaire with some help from the interviewer were included [16]. In both surveys, all interviewers received specific training and were supervised by the research team.

For our analysis, the following information was used: age, gender, educational level, functional status and the presence of chronic conditions. Subjects with cognitive impairment that could affect their ability to complete the survey were excluded, as well as those who did not consent to participate. The questionnaire was administered through structured interviews. In the Basque survey, the collection of data was performed during the first week after they had fallen.

The Barthel Index was used in both studies to assess functional status [17]. This 10 item assessment measures the patients' ability to perform the activities of daily living (ADL) and their mobility. Items include feeding, moving from wheelchair to bed and back, grooming, transferring to and from a toilet, bathing, walking on a level surface, going up and down stairs, dressing, and continence of bowels and bladder. The score ranges between 0 and 100, where a higher score indicates a better functional ability. In both samples the usual functional status was assessed and in particular for the Basque sample, the Barthel index was assessed retrospectively for the period immediately before the fracture.

Regarding chronic medical conditions, the 11 diseases investigated in this study were the diseases which appeared in both surveys: bone disease (arthritis, arthrosis, osteoporosis), visual impairment (cataracts, glaucoma, low visual acuity), hearing impairment, dementia (Alzheimer's disease and other forms), Parkinson's disease, pulmonary disease (chronic bronchitis, asthma), cardiovascular disease (myocardial infarction, varices, heart failure, cerebrovascular disease), diabetes mellitus, hypertension, cancer, and gastrointestinal (GI) disease (ulcers, liver disease, hemorrhoids). The diagnoses were collected from the medical record for the multicenter study of the Basque region and from self-report for the nationwide one.

The study adhered to the Declaration of Helsinki principles and was approved by the ethics committee of the Carlos III Institute of Health and the ethics committees of all participating hospitals. All participants gave informed consent and patient anonymity was preserved.

2.1. Statistical analysis

To analyze the relationship between functional status and multimorbidity, several logistic regression models were run. The dependent variable was functional status, dichotomized into "completely independent" (100) and "not completely independent" (0–99) due to the non-normal distribution of the data and the high percentage of well-functioning participants in the two samples. Therefore, participants were categorized into two groups: those completely independent, and those needing some help for at least one activity of daily living [18,19]. Individual diseases and their relation with functional status were evaluated after adjusting for possible confounding factors such as age, gender, educational level and other comorbid conditions.

To determine the most prevalent pairs of co-occurring conditions, the expected prevalence was computed as (prevalence of disease A) × (prevalence of disease B) [20]. Moreover, the observed/expected ratio (ratio O/E) was computed as (observed prevalence)/(expected prevalence). A logistic regression model was run for each of the most prevalent pairs, adjusting for all other single conditions and confounding factors. The presence of a multiplicative synergistic effect was assessed through potential two-way interactions, which were added to the main effects model using a forward stepwise process. A statistically positive significant interaction indicated a synergistic association, in which having both diseases was associated with an essentially higher risk of disability than expected by multiplying disease-specific risks.

To analyze how health conditions are grouped together, an exploratory factor analysis with principal components was used [21], which allows that a medical condition can load onto several factors or multimorbidity groups. The KMO measure of sampling and Bartlett's test of sphericity were performed to investigate sampling adequacy for conducting factor analysis. Instead of conventional Pearson correlations, we used the tetrachoric correlation matrix, which leads to greater content validity in dichotomous data [22]. The rotation method used was the oblique direct oblimin, which allows factors to be associated with each other. A factor loading limit of 0.40 was used to define the association of variables to a factor. The resulting factors can be interpreted as multimorbidity groups where each factor loading represents the association of the disease with a group. Subjects were assigned to a group if they were diagnosed with at least 2 of the diseases included in the group. Multimorbidity groups overlap when a person is assigned to two or more groups. A multiple logistic regression analysis, adjusted for age, gender, education level and all the other groups, was conducted to evaluate the impact of multimorbidity groups in functional impairment. Finally, another logistic regression model was performed to assess how overlapping groups influenced functional status.

All regression models were controlled for source of data (nationwide vs. Basque region), which was not significant. SAS Version 9.2 (Cary, NC: SAS Institute Inc.) was used to calculate the tetrachoric matrix and the rest of the statistical analyses were made with IBM SPSS Statistics for Windows, Version 20.0 (Armonk, NY: IBM Corp.).

3. Results

The total sample presented a mean ± standard deviation age of 77.9 ± 7.8 years and 75.5% were female. Fourteen percent reported