Fall determinants in the adult Portuguese: do chronic conditions change the risk of falling?

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ACTA REUMATOL PORT. 2019;44:288-295

ABSTRACT

Objectives: Falls are a major public health issue, given its prevalence and social impact. This study aimed to (1) characterize fallers in the adult Portuguese population as well as (2) identify if some chronic conditions are fall determinants.

Material and methods: Our data of 7403 adults (≥18 years) was retrieved from the phase 1 survey of EpiReumaPt, a representative sample of adult Portuguese population. We analyzed sociodemographic variables and the presence of chronic diseases, which was evaluated by self-report. Anxiety/depression symptoms were assessed using The Hospital Anxiety and Depression Scale (HADS). Fall was defined by the presence of a self-report fall in the previous 12 months to the interview. Univariate and multivariable logistic regression were used to assess fall determinants. Analyses were conducted in Stata v13.

Results: The estimated prevalence of falls in the Portuguese population is 24,1%. Women are at 2.12 times higher risk of fall than man (95% CI 1.79 – 2.51) and there's also a progressive increasing association between age and falls, with people with 75+ years having greater odds of falling (OR = 1.86 95% CI 1.49 – 2.31). Different chronic health conditions were identified as major determinants of falls in the Portuguese population. Neurologic (OR = 1.64 95% CI 1.17 – 2.32) and rheumatic (OR = 1.44 95% CI 1.18 – 1.74) diseases were significantly and independently associated with falls. Similar results were found for presence of anxiety (OR = 1.33 95% CI 1.04 – 1.71) or depression (OR = 1.61 95% CI 1.20 – 2.15) symptoms.

Conclusions: Our results allows us to have an overview of the determinants of falls in the Portuguese population, allowing us to know that women and elders are at greater risk. We have showed that some chronic diseases are associated with falls, in particular musculoskeletal diseases and mental diseases. Implementing specific and adapted prevention strategies might reduce the number and complications of falls ultimately improving Portuguese overall health.

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INTRODUCTION

Changes in the demographic scenario over the last years have resulted in an increasing of the elderly population globally and particularly in developed countries, such as Portugal[1]. Statistics from last national survey, *Census 2011*, revealed that the population with 65 or more years that lives in Portugal represents about 19% of the total population[2]. These numbers personify the reality of the aged country that we know, since in the last decade the number of older people increased about 19%[2]. Although the increasing of overall life span of people, due to progress in science and healthcare, is a notable achievement of society it is not without its downside[3]. Advanced age comes with biological changes such as loss of muscle mass and strength as well as increased risk of disability and dependency and an increase in comorbidities[1,4]. Consequently, falls in the geriatric population are a major public health issue[5] and a prevalent cause of morbidity[6]. Foremost, falls are the leading cause of fatal and nonfatal injuries amongst adults aged 65 years or over[7]. Falls are risk factors for fractures, cerebral and visceral hemorrhage, deterioration of quality of life and increased mortality[7], and make a substantial impact in healthcare costs[8].

To understand the challenge that a fall represents, we should know that falls are a multifarious phenomenon resulting from a complex interaction of factors[5,7,9]. The deficit of knowledge in this area is clear by the fact that less than half of the physicians are aware

of the circumstances of the fall[10] what makes them incapable of recognizing preventable risk factors[7]. These risk factors can be categorized as intrinsic or extrinsic[4]. Intrinsic risk factors come from the individual such as physiological changes related to ageing, diseases or use of medicines, while extrinsic are associated to environmental/behavioral circumstances[8, 11], as poor lighting at home or inappropriate footwear[12].

A common finding is that a history of falling is one of the strongest independent risk factors for additional falls[13]. Other fall determinants, besides age, have been identified in different studies: medications, impaired balance and gait, cognitive decline and executive dysfunction being some of them[8].

Various studies have investigated the most relevant determinants of falls in different cohort populations[14] to facilitate the creation of preventive strategies that ideally should address and handle as many risk factors as possible to amplify the effect[6, 12, 15]. Some chronic conditions have been associated with greater risk of falling and some of those are highly prevalent in Portugal[8].

However, to our knowledge, no other study has truly explored the determinants of falls in the adult Portuguese population, particularly the impact that some chronic conditions might have in the occurrence of a fall. Therefore, we aim in this study to (1) characterize fallers in the adult Portuguese population as well as (2) identify if some chronic conditions are fall determinants.

MATERIAL AND METHODS

SAMPLE

To investigate the adult Portuguese population in terms of occurrence of falls and its association with non-communicable chronic diseases, symptoms of anxiety and depression and socio-demographic characteristics we used data from phase 1 of EpireumaPT survey.

EpiReumaPt project is a national, cross-sectional and population-based study that aimed to estimate the prevalence of Rheumatic and musculoskeletal diseases and determine their impact on function, quality of life, mental health and use of healthcare resources[4, 16]. The study included adults (≥18 years old) living in the community, in the Portugal mainland and islands (Azores and Madeira). Exclusion criteria were institutional residency and inability to speak Portuguese or to complete the assessment protocol. 10.661 participants were selected through a process of multistage random sampling and were interviewed at their household by trained examiners.

The interviews were conducted with a Computer Assisted Personal Interview (CAPI) system. To evaluate the occurrence of falls, individuals were questioned how many times have they fallen in the previous 12 months. Subjects were also asked if they had been previously diagnosed with some chronic disease (high cholesterol level, high blood pressure, rheumatic disease, allergy, gastrointestinal disease, cardiac disease, diabetes, thyroid disease, pulmonary disease, hyperuricemia, cancer, neurologic disease and hypogonadism). The presence of anxiety/depression was evaluated by the HADS Portuguese validated version. Information on sociodemographic variables: sex, age and Nomenclature of Territorial Units for Statistics (NUTS II: seven territorial units: Norte, Centro, Alentejo, Algarve, Lisboa e Vale do Tejo, Madeira and Azores) was also obtained in this phase.

CASE DEFINITION

To assess the existence of falls we asked the question: "How many times have you fallen in the last 12 months?" For our study, we only codified the answers as yes (for any number greater than 0) and no (for 0 times). 7340 individuals (68,9% of the participants) answered this question and were the subject of analysis of our study.

The HADS Portuguese validated version was applied. Individual anxiety and depression scores were calculated by summation of the appropriate seven items and thus can range from 0 to 21, with higher scores indicating higher levels of anxiety or depression, respectively.

ANALYSIS AND STATISTIC SOFTWARE

EpiReumaPT was designed to obtain a representative sample of the Portuguese population. To guarantee its representativeness, weighted proportions have, for this matter, been computed and are described elsewhere[17].

Descriptive data for each categorical variable was presented as the absolute frequency and the correspondent proportion, weighted. Same adjustment was done for the mean and standard deviation (SD) for each continuous variable. Continuous variables were compared using Student's *t*-test or ANOVA and nominal variables were compared using chi-square test.

To assess the determinants of falls, we first performed univariate analysis to approach relations be-

tween independent variables and outcome (report of fall(s)). When univariate analyses resulted in *p*-value < 0.1, those variables were included in the multivariable logistic regression models. Multivariable models were constructed using a backward selection method in which we progressively eliminated the variables without statistical significance. The previous referred independent variables were tested. Age, gender and NUTS II were forced to stay in the model and were used as adjustment variables. Goodness of fit of the multivariable regression model for the outcome falls has $p = 0.68$.

Significance level was set at 0.05. All analyses were weighted and executed using STATA IC version 13 (StataCorp. 2011. Stata Statistical So ware: Release 12. College Station, TX, USA: StataCorp LP).

ETHICAL ISSUES AND DATA PROTECTION

EpiReumaPT 1 study was performed following the principles established by the Declaration of Helsinki and revised in 2013 in Fortaleza. The study was reviewed and approved by the National Committee for Data Protection (Comissão Nacional de Proteção de Dados) and by the NOVA Medical School Ethics Committee. All participants provided informed consent to contribute in all phases of the study[2, 18].

Participants' confidentiality is safeguarded by the nonexistence of identifiers on the database (only unique ID participants' codes). Their names and contacts are stored separately from study data transmitted to the coordinating center. During EpiDoC 1 study, informed consent was signed. There will be absolutely no disclosure of individual health information to the public.

RESULTS

In this study, we had 7430 participants with age ≥18 years, 1909 (25,69% of this sample) of those reported history of fall(s) in the last 12 months (Table I). This represents a prevalence of fall(s) of 24,1% when weighted to Portuguese population. Our results show a difference of 11% between the proportion of falls in women (30,2%) and men (19,2%) (p<0.001). We also observed that the percentage of falls in the population is higher in Alentejo and Centro regions (25,8% in both). Moreover, there's also a high percentage of falls in Norte (24,8%) and Azores (24,1%) regions. Our study could additionally show that the region in Portugal where the lowest percentage of falls is reported is Madeira (18,6%). There was also a progressive increase in the percentage of people that fall with age, it being 20,2% for people with 18-64 years, 29% in the 65-74 years group and achieving 37% in the population with 75+ years (p<0.001).

Two groups were formed within the Portuguese population: those who have an history of fall(s) and those who don't (Table I): the average age in the group with falls was higher than in the group without falls. Moreover, age was associated to greater risk of falls, it being 1.6 times higher for people with age between 65 and 74 years when compared with younger people. Greater association was found for people with 75+ years. Gender differences were found with women being 2.12 times at greater risk of falling than man. Other sociodemographic features, such as NUTS II, weren't related with statistically significant differences in the odds of falls (p=0.2657) in the Portuguese population. Furthermore, there was an association between the presence of some chronic conditions and the occurrence of falls in the Portuguese population. People with common diseases such as high blood pressure (HBP), diabetes mellitus (DM) or high cholesterol levels were associated with higher odds of falling. Moreover, our study allowed us to see that there were five main determinants of falls, which were independently and more strongly associated with the outcome in the univariate analysis and prevailed. In the multivariate model (adjusted to sex, age and NUTS II) (Table II): neurologic, mental and rheumatic disease, and presence of anxiety or depression symptoms.

We confirmed the key association between age and falls since there is an increased risk of fall with age and the elders are the ones at higher risk, it being 1.41 times greater for those with age ≥ 65 and <75 years and even bigger in the population with 75+ years.

DISCUSSION

Our results show that those who report fall(s) are more frequently women and are older than those who don't[18] and that those with 75+ years have the greatest fall risk of all, what can justify changes in preventive strategies regarding this age range.

In what concerns the association between chronic diseases and fall(s), we found that different health conditions increase the risk of fall, specially diseases that modify balance, gait or cognitive functions. This finding gains even more impact since we know that some

TABLE I. SOCIODEMOGRAPHIC CHARACTERISTICS AND CHRONIC DISEASES OF THE PORTUGUESE POPULATION WITH AND WITHOUT REPORT OF FALL(S)

	No report of fall(s)		Report of fall(s)			
	n	%	n	%	OR (CI 95%)	p-value
General sociodemographics	5521	75,9	1909	24,1	–	
Sex						< 0.001
Female	3237	69,8	1403	30,2	2.12 (1.79 – 2.51)	
Male	2284	83,1	506	16,9	–	
Mean age (± SD)	57,8 (± 11,78)		61,8 (± 13,27)		1.03 (1.02 – 1.03)	
Age group				< 0.001		
18 - 64	3514	79,8	952	20,2	–	
65 - 74	1175	71,0	501	29,0	1.61 (1.31-1.98)	
75+	832	63,0	456	37,0	2.31 (1.87-2.87)	
NUTS II						0.2657
Norte	1573	75,2	604	24,8	–	
Centro	1044	74,2	402	25,8	1.05 (0.88-1.26)	
Lisboa e Vale do Tejo	1191	78,1	351	21,9	0.85 (0.63-1.14)	
Alentejo	374	74,2	143	25,8	1.06 (0.83-1.34)	
Algarve	199	77,3	67	22,7	0.89 (0.64-1.24)	
Azores	507	75,9	177	24,1	0.96 (0.77-1.20)	
Madeira	633	81,4	165	18,6	0.69 (0.55-0.87)	
Chronic Diseases						
High blood pressure	2165	71,1	928	28,9	1.50 (1.26–1.78)	<0.001
Diabetes mellitus	754	67,6	364	32,4	1.60 (1.29–2.00)	<0.001
High cholesterol level	2104	72,0	865	28,0	1.41 (1.19–1.67)	<0.001
Pulmonary disease	336	64,4	178	35,6	1.83 (1.20 – 2.80)	0.0045
Cardiac disease	782	68,4	409	31,6	1.59 (1.25 – 2.03)	< 0.001
Gastrointestinal disease	1046	68,6	526	31,4	1.63 (1.33 – 1.99)	< 0.001
Neurologic disease	218	58,5	142	41,5	2.34 (1.63 – 3.39)	< 0.001
Mental disease	836	63,5	471	36,5	2.12 (1.68 – 2.69)	< 0.001

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TABLE I. CONTINUATION

	No report of fall(s)		Report of fall(s)			
	n	%	n	%	OR (CI 95%)	p-value
Rheumatic disease	1799	66,4	933	33,6	2.17 (1.80–2.60)	< 0.001
Thyroid disease	527	68,4	259	31,6	1.52 (1.22–1.89)	< 0.001
Allergies	1106	70,5	483	29,5	1.42 (1.17–1.71)	< 0.001
Cancer	271	65,2	117	34,8	1.78 (1.00–3.01)	0.0460
Hypogonadism	55	64,8	24	35,2	1.73 (0.97–3.08)	0.0585
Hyperuricemia	433	72,4	188	27,6	1.26 (1.00 – 1.58)	0.0476
Symptoms of						
Anxiety	649	62,2	428	37,8	2.14 (1.78 – 2.59)	< 0.001
Depression	409	55,1	319	44,9	2.87 (2.21–3.74)	< 0.001

All percentages and means were weighted to correct for population representativeness
NUTS II: Nomenclature of Territorial Units for Statistics; SD: standard deviation; OR: Odds Ratio; CI 95%: 95% Confidence Interval

of the conditions we analyzed are highly prevalent in Portugal, especially amongst the elders: such as hypertension (57.3%), rheumatic disease (51.9%), hypercholesterolemia (49.4%) and diabetes (22.7%)[4,19,20].

The association between DM and falls has been explored by diverse authors[16] and not only diabetic complications such as retinopathy or polyneuropathy[21, 22] contribute to falls but also the occurrence of hypoglycemic episodes can cause an event. Thus, tight management of pharmacologic therapy in diabetics can decrease the risk of falls in these patients[22].

Similarly, we saw that people who reported an history of cancer were at higher risk of falling. Greater association has been found with prostrate and breast cancer[23]. Our research also identified an association between HBP, cardiac disease and fall(s). Ageing comes with cardiovascular modifications[16] such as impaired response to orthostatic changes what increases the risk of orthostatic hypotension in hypertensive older people. Also, anti-hypertensive drugs, such as diuretics, often cause electrolyte disorders which contributes for arrhythmias and decreased mobility which, in turn, are risk factors for falls[2, 24].

The decline in concentration of sex steroids in serum that happens with ageing contributes to low muscle mass and strength, impaired balance and falls[25]. Other hormonal impairments, such as in thyroid diseases, are also associated with dysfunction in tissues: neurological and musculoskeletal systems included what can result in disturbance of gait and ultimately falls[26].

The major fall determinants that we found were neurologic, mental and rheumatic disease and presence of anxiety or depression symptoms. These results show that these health conditions are a key factor in the multifactorial challenge that a fall represents. Depression and anxiety are growing conditions in Portugal[27] and some studies estimate that depressive symptoms increase the risk of falls by almost 50%[28] which is compatible with our results. An important question is which of the events causes the other because they frequently co-exist and it is possible that one's restriction of physical activity after a fall can cause depressive symptoms. However, while an observational study as ours fails to know if a fall precedes the depressive symptoms or the contrary, others have shown that the presence of depressive symptoms precedes and may contribute to subsequent fall(s)[29].

The mechanism of depression being a cause of falls

TABLE II. DETERMINANTS OF FALL(S). MULTIVARIABLE MODEL

Determinants	OR (CI 95%)	p-value
Sex (F)	1.60 (1.34-1.92)	<0.001
Age Group		
65-74	1.41 (1.16-1.72)	0.001
75+	1.86 (1.49-2.31)	<0.001
Nuts II		
Centro	0.97 (0.79-1.18)	0.741
Lisboa	0.94 (0.70-1.26)	0.672
Alentejo	1.03 (0.79-1.35)	0.816
Algarve	0.87 (0.61-1.25)	0.446
Azores	0.99 (0.78-1.25)	0.931
Madeira	0.74 (0.56-0.95)	0.018
Chronic Diseases		
Neurologic Disease	1.64 (1.17-2.32)	0.005
Rheumatic Disease	1.44 (1.18-1.74)	<0.001
Mental Disease	1.54 (1.12-2.12)	0.008
Symptoms Of		
Anxiety	1.33 (1.04-1.71)	0.023
Depression	1.61 (1.20-2.15)	0.002

NUTS II: Nomenclature of Territorial Units for Statistics; OR: Odds Ratio; 95% CI: 95% Confidence Interval

is still uncertain and two possible pathways have been suggested: first, there is evidence showing that postural abnormalities when standing (such as looking down) prompt falls[30] and second, antidepressant use has been linked as a primary cause of falls[31].

Previously, anxiety was recognized as an independent determinant of falls[32]. The ways in which anxiety contributes to falls vary: people with anxiety can have a slower gait speed or may focus more internally than externally, consequently paying less attention to obstacles and falling[33,34]. As with depressive symptoms, its uncertain is if anxiety represents a cause or a consequence of falls but the most probable is the existence of a positive feedback loop with anxiety increasing falls and falls increasing anxiety[34].

Our results showed that the presence of a medical diagnose of a rheumatic condition is associated with falls. This association has been established for prevalent rheumatic diseases such as osteoarthritis, rheumatoid arthritis[35] and ankylosing spondylitis[36]. Osteoarthritis is one of the most common muscle-skeletal pathologies in the elderly and is associated with reduced balance, postural inability and impaired movement[37]. The same gait alterations are found in patients with rheumatoid arthritis or ankylosing spondylitis. These traits are known risk factors for falls which endorse the higher fall rates found in people with these conditions.

Our multivariable model displayed that mental diseases are independent determinants of falls in the Portuguese population, what has been previously reported for psychiatric conditions such as schizophrenia or bipolar disorder[38] in other populations. People with mental diseases tend to have cognitive and psychomotor impairment as well as affected cerebellar function[39] and use psychotropic drugs[40].

Falls in neurologic patients have been studied before and it has been established that the prevalence of falls is nearly twice as high in these patients compared with people of similar age[39] what has correspondence with our findings. Amongst the neurologic diseases which have been linked to falls are Parkinson Disease (PD)[41], Alzheimer's disease and stroke[42]. Patients who have suffered a stroke are at greater risk of falling during acute care and rehabilitation what can be explained by the presence of lesions of pyramidal tract, cerebellar infarct and cortical atrophy or posterior vascular dementia[43]. The association between PD and falls is one of the best studied and falls are acknowledged as one of the most incapacitating features of DP[44].

The primary strength of this study is its large sample size, population-based sampling. However, our study also has some limitations, starting with being a cross-sectional one. This design only allows us to take conclusions of association between falls and variables but not of causality. Other possible limitation is that we used self-reported data, what shows high specificity but lower sensitivity, especially for chronic conditions, what can underestimate the magnitude of its relationship with falls. Likewise, although the participants

were asked to only refer doctor-diagnosed conditions, it's impossible to be sure of the clinical support of the self-reported conditions. Regarding our outcome, self-reported falls may not be completely factual what can jeopardize our results.

CONCLUSION

We found that the elders, particularly with 75+ years, and women are at greater risk, which is comparable to findings in other populations. Our study also identified some chronic conditions that have an association with falls, with greater impact being for neurologic, rheumatic and mental disease and the presence of anxiety or depressive symptoms. Physicians should be aware of the greater risk that these patients face and be more proactive informing them how to prevent a fall and how to react when it happens. These findings can be important to create tailored to individual preventive strategies that address the mechanisms involved in falls in these patients, therefore decreasing their fall rates and improving their overall health. We suggest further exploration of the association between each chronic condition and falls in next studies to understand better why these patients fall. It would also be an interesting approach to evaluate possible differences between one-time fallers and recurrent fallers, what was not the scope of our study.

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