









Original Research

# Characterisation of institutionalised Portuguese older adult fallers: is there a place for pharmacist intervention? A preliminary study

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## Abstract

**Background:** Falls are a major public health issue, given their prevalence and social impact. Older adults living in long-term care facilities (LTCF) are at greater risk of injury resulting from a fall due to multiple factors, such as nutritional, functional/cognitive impairment, postural instability, polypharmacy, and the presence of potentially inappropriate medications (PIMs). Medication management in LTCF is complex and often sub-optimal and might be crucial for falls. Pharmacist intervention is important, since they have a unique knowledge of medication. However, studies mapping the impact of pharmaceutical activities in Portuguese LTC settings are scarce. **Objective:** This study aims to assess the characteristics of older adult fallers living in LTCFs and examine the relationship between falling and several factors in this population. We also intend to explore the prevalence of PIMs and their relationship with the occurrence of falls. **Methods:** The study was conducted in two long-term care facilities for elderly people, in the central region of Portugal. We included patients aged 65 and older with no reduced mobility or physical weakness and with the ability to understand spoken and written Portuguese. The following information was assessed: sociodemographic characteristics, comorbidities, polypharmacy, fear of falling, functional, nutritional and cognitive status. PIMs were evaluated according to the Beers criteria (2019). **Results:** A total of 69 institutionalised older adults, 45 women and 24 men, with a mean age of  $83.14 \pm 8.87$  years were included. The prevalence of falls was 21.74%. Out of these, 46.67% (n=7) fell once, 13.33% (n=2) fell twice, and 40% (n=6) fell 3 or more times. Fallers were mainly women, had lower levels of education, were well nourished, had moderate to severe levels of dependence, and displayed moderate cognitive impairment. All adult fallers had a fear of falling. The main comorbidities of this population were related to the cardiovascular system. Polypharmacy was present in every patient, and at least one PIM was identified in 88.41% of the subjects. Fear of falling (FOF) and cognitive impairment (in subjects with 1 to 11 years of education) showed statistically significant associations with the occurrence of falls ( $p=0.005$  and  $p=0.05$ , respectively). No significant differences were found between fallers and non-fallers for any other factors. **Conclusions:** This present study is a preliminary contribution to characterise a group of older adult fallers living in Portuguese LTCFs and demonstrated that fear of falling and cognitive impairment are associated with the occurrence of falls in this population. The high prevalence of polypharmacy and PIMs emphasises the need for tailored interventions featuring the collaboration of a pharmacist to optimise medication management in this population.

**Keywords:** older adults; falls; pharmacist; polypharmacy; potentially inappropriate medications (PIMs); long-term care facilities

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## INTRODUCTION

Ageing is a physiological process resulting from morphologic and functional modifications, accompanied not only by physical but also by psychological and social changes.

The ageing ratio in Portugal has increased in the last decade. According to the Portuguese National Data Base (PORDATA),



in 2021, for every 100 young individuals (<15 years of age), 182.1 older adults lived in Portugal. Projections of the National Statistics Institute (INE) indicate an increase in this number, estimating that in 2060, for every 100 young individuals, 307 older adults will reside in Portugal.<sup>1</sup>

Ageing is accompanied by the emergence of geriatric syndromes, which are multifactorial health conditions that include fragility, incontinence, dementia, pressure ulcers and falls.<sup>2</sup> The growing number of older adults results in a higher incidence of chronic diseases and comorbidities that potentiate the occurrence of falls that contribute to morbidity and greater functional decline. Thus, older adults become incapable of performing day-to-day tasks and become dependent on others, often leading to their institutionalisation.

Although ageing does not mean illness, incapacity, or dependence, it involves physical, mental, and social changes. Several health problems become more prevalent, such as hearing, vision, and movement loss, cardiovascular diseases, strokes, malignancies, chronic and psychological disorders, like depression and dementia.<sup>3-5</sup> In order to reduce these inherent effects of ageing, elderly patients are usually subjected to multiple pharmacological treatments, with the risk of including potentially inappropriate medication (PIM). The physiological changes resulting from ageing affect pharmacokinetics and pharmacodynamics and increase the risk of drug interactions and adverse drug reactions (ADRs), such as dizziness and loss of balance that can result in falls.<sup>6</sup>

These comorbidities affect the autonomy of older adults, who often require assistance in performing day-to-day tasks. This assistance implicates support from their families, who are not always able to care for the elderly, especially families with low incomes who cannot afford the costs of medication, therapeutic equipment, and other needs of this population. However, other factors, such as lack of availability, may lead families to resort to institutionalisation.<sup>7</sup>

In Portugal, there are several social responses to support the elderly population: home supportive services, social centres, day and night centres, care homes, long-term care facilities (LTCF) and holiday and leisure centres. These responses aim to ensure basic needs and promote autonomy, social integration, and health in safe and stable environments.<sup>8</sup>

Portuguese legislation defines LTCF as establishments for collective, permanent, or temporary accommodation where the residents have social support and nursing care.<sup>9</sup> This legal document also defines the requirements and services available in these structures.<sup>10</sup>

A fall can be defined as an event that results in a person unintentionally resting on the ground or other lower supporting surface, not related to any medical incident or an external physical force.<sup>9</sup> Older adults face different health problems with diverse complexity, and those caused by falls negatively affect their quality of life and have psychological, physical, and social consequences. Furthermore, they have a tremendous economic burden on the individual, their family and society.<sup>11</sup>

In Portugal, between 2000 and 2013, for every 100 hospitalisations in individuals over 65 years old, three were caused by falls. In addition, for every 100 hospitalisations caused by falls, six resulted in death.<sup>12</sup> Even though most falls do not result in death, an older adult who survives a fall experiences significant morbidity and greater functional decline when compared to non-fallers. Furthermore, falls have an enormous psychologic impact, which can lead to fear of future falls and increased self-restriction, resulting in dependence and immobility, causing functional deficits, and increasing the risk of further falls.<sup>13</sup> Falls are a recurrent incident in individuals over 70 years of age, occurring three times more in institutionalised individuals than in individuals residing in their own homes.<sup>12</sup>

Data from recent studies associate intrinsic and extrinsic factors with falls.<sup>14,15</sup> The intrinsic factors are those that result from physiological changes inherent to ageing, diseases, and as a consequence of drug intake. On the other hand, the extrinsic factors include social and environmental hazards. The principal risk factors associated with falls in older adults are age, sex, functional impairment, poor nutritional status, gait impairment, mobility changes, sedentary lifestyle, loss of muscle mass, low visual acuity, cognitive impairment, chronic diseases, polypharmacy, and inadequate environment.<sup>16,17</sup>

The older adults most susceptible to falls are those with mobility and balance changes. According to the WHO, approximately 20% of the population aged over 70 years and 85% of those over 85 have mobility limitations or incapacity. Balance is a complex process of control of the gravity centre that involves several steps: reception and assimilation of sensory stimuli, programming, and execution of movements. The ageing process leads to modifications in this system that result in balance impairment.<sup>18</sup>

These limitations may be associated with comorbidities or other social, nutritional, or functional factors. The social factors that affect mobility are household, precarious financial situation, and lack of housing conditions. The reduction of functional reserve can also result in physiological and metabolic changes that lead to weakness and fragility.<sup>19</sup> Also, malnutrition in older adults can lead to a higher predisposition to develop health problems, a greater need for health care and a higher rate of morbidity and mortality.<sup>11</sup> Contrarily, adequate nutrition may contribute to decreasing the frequency of falls.<sup>20</sup>

Therefore, falls are a multifactorial geriatric syndrome, and medication is one of the factors that increase the risk of their occurrence. Pharmacists have in-depth knowledge and training in medication and their intervention can be crucial in screening and reducing fall risk.<sup>21</sup>

Several pharmacological classes are associated with increased fall risk. By conducting a thorough review, pharmacists can screen for this kind of medication, modify the patient's therapeutic profile by recommending safer alternatives, and educate the patient regarding fall prevention strategies and the risk that medications may have on falls. These interventions can lead to a safer use of medicines, reducing fall risk.<sup>22</sup> Some



studies conducted on older adults showed that the intervention of community pharmacists led to the discontinuation or decrease of the dose of medication associated with falls.<sup>23,24</sup>

A multidisciplinary approach is also important in order to assess the risk factors and effectively address them to prevent future falls. Research shows that by working with other healthcare professionals, pharmacists can provide individualised patient interventions and implement programs to assess the risk of falls and prevent their occurrence.<sup>22</sup>

These approaches are crucial to effectively prevent falls, decreasing serious fall-related injuries, loss of autonomy and dependence, and reducing hospitalisation, institutionalisation and associated public health costs.<sup>23</sup>

Comprehensive studies mapping the impact of pharmaceutical activities in a LTCF setting published in the scientific literature are scarce.

Considering that falls are widespread in Portuguese older adults, especially in long-term care facilities (LTCF), our study aims to assess the characteristics of older adult fallers living in LTCFs and examine the relationship between falling and several factors (socio-demographic, clinical, physical, nutritional and cognitive characteristics) in this population. We also intend to explore the prevalence of potentially inappropriate medication (PIMs) and its relationship with the occurrence of falls.

## METHODS

### Study design and data collection

The present work is a cross-sectional study with patients of both genders between 65 and 97 years of age living in a long-term health care residence. Data were collected between May and June 2022.

We included in the study institutionalised older adults aged 65 and older with no reduced mobility or physical weakness and with the ability to understand spoken and written Portuguese. Participants must be able to provide their informed written consent and may choose to opt out of the study at any time.

The exclusion criteria were: (1) residing only temporarily in the institution or only for <3 months before the start study, (2) cognitive and behavioural deterioration suggesting an inability to understand or give informed consent or had a diagnosis of Alzheimer's disease and (3) decline to participate in the survey.

Considering these criteria, 69 participants were eligible and took part in this study.

This study was conducted in two institutions in the central region of Portugal. Both long-term care facilities (LTCF) have several social responses and provide the following services: accommodations, nourishment, hygiene care, medical and nursing care, laundry, daily animation activities, psychosocial support/monitoring, travel for medical appointments, and church service.

A pharmacist collected data by filling out validated

questionnaires, which were used to interview the older adults and the nursing teams. After the data collection, the individuals were divided into two groups: fallers (with at least one fall in the last year) and non-fallers (no record of falls over the previous 12 months).

### Socio-demographic data, body mass index (BMI), number of falls and fear of falling

Socio-demographic data such as age, gender, educational level, and marital status were collected through individual interviews with the participants.

The body mass index (BMI) was calculated according to the formula  $\text{weight (kg)}/(\text{height(m)})^2$ . The nursing team provided the height. When there was no record, patients were measured standing against a wall, looking straight ahead and barefoot with a measuring tape. Weight was measured with a digital scale. The BMI was used to classify an individual as underweight ( $<18.5\text{kg/m}^2$ ), normal weight ( $18.5\text{-}24.9\text{kg/m}^2$ ), overweight ( $25\text{-}29.9\text{kg/m}^2$ ), or obese ( $\geq 30\text{kg/m}^2$ ).<sup>25</sup>

Participants were also asked how many times they fell in the last year and the result of the fall (whether or not hospital admission was required). Fear of falling was assessed using the question "Are you afraid of falling (yes/no)?" The nursing team confirmed the answers. For this study, we considered a fall to be a "sudden unintentional change in position causing one to land on a lower level", as per the World Health Organization (WHO) definition.

### Functional assessment

Functional assessment was conducted using the Barthel Index, validated for Portuguese older adults. The questionnaires were applied individually to each participant, and the answers were confirmed by the nursing team. The score ranges from 0 to 100, where 0 corresponds to maximum dependence, and 100 corresponds to total independence.<sup>26</sup> A score of 0 to 20 indicates total dependency, 21 to 60 indicates severe dependency, 61 to 90 indicates moderate dependency, and 91 to 99 indicates slight dependence.

### Nutritional assessment

The nutritional assessment was carried out using the Mini-Nutritional Assessment, validated for Portuguese older adults, by an individual interview with the participants, and the nursing team confirmed the answers. Subjects with a score between 18 and 24 points were considered to have a normal nutritional status, those between 11 and 17.5 were at risk of malnutrition, and those with less than 11 were considered malnourished.

### Cognitive assessment

The Portuguese version of the Mini-Mental-State Examination (MMSE) was used to assess cognitive impairment. The questionnaire consists of 30 questions, divided into seven categories, to evaluate specific cognitive functions, such as orientation in time and space, word registration, attention and calculation, word recall, language, and visual construction. Subjects with scores below 15 (if they were illiterate), 22 (if



they had between 1 to 11 years of schooling) or 27 (if they had more than 11 years of education) were considered to have cognitive impairment.<sup>27,28</sup>

### Comorbidities, therapeutic profile, polypharmacy and PIM

Regarding the comorbidities, older adults were asked about previous diagnoses, which were confirmed by the nursing team. The diagnosed diseases were then classified according to the International Classification of Diseases for Mortality and Morbidity Statistics, 11<sup>th</sup> Revision (ICD-11).

Medication history was also collected. The medicines used by the participants were grouped according to the Portuguese pharmacotherapeutic classification, which follows the ATC (Anatomical Therapeutic Chemical) classification system.

Polypharmacy was considered to exist when an individual took five or more medicines daily. Time-limited medications such as antibiotics were excluded from the calculation of the total number of drugs taken by each patient. Furthermore, supplements and vitamins that do not need a prescription (e.g., calcium, multivitamin) were also not counted. However, supplements that require a prescription, such as vitamin B12 and potassium chloride, were included.

We used the most recent version of the Beers Criteria (2019) to assess potentially inappropriate medications (PIMs) independently of patient diagnosis or conditions, as the individual clinical history was not provided. Two independent authors (C.F. and V.B.) performed this classification. Any discrepancies were solved by consensus meetings between the authors.

### Statistical analysis

We used IBM SPSS Statistics version 28.0.1.1 for our statistical analysis. Descriptive statistics were used to describe the basic features of the data in a study, expressing data in percentage, average, frequency, and standard deviation for all variables. The association between the occurrence of falls and the variables in the study was analysed using the Chi-square test. A level of significance of  $p \leq 0.05$  was considered for all statistical analyses.

### Ethics

The study was approved by the Ethics Committee of the Polytechnic Institute of Viseu (Ref. 01/sub/2021) and conformed to the provisions of the Declaration of Helsinki (as revised in Brazil 2013). All participants gave their written informed consent to participate in the study. The reporting of this study conforms to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement.<sup>29</sup>

## RESULTS

Out of 131 individuals initially screened, 11 were under age 65. The other 51 presented reduced mobility, thus resulting in the exclusion of 62 individuals. The final sample consisted of 69 institutionalised older adults.

### Falls and fear of falling

Of the older adults taking part in the study, 21.74% (n=15) had fallen in the 12 months preceding the study. They experienced a total of 43 falls. Out of these, 46.67% (n=7) fell once, 13.33% (n=2) fell twice, and 40% (n=6) fell 3 or more times, as shown in Figure 1.

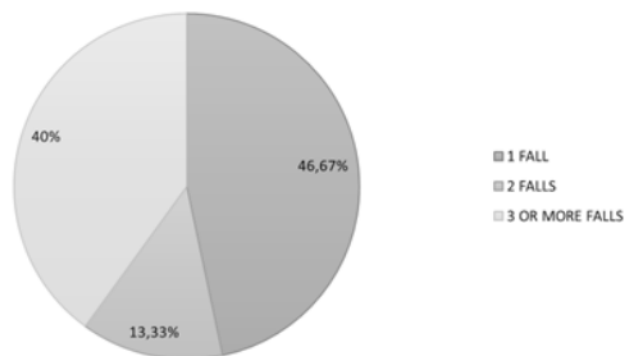


Figure 1. Number of falls among the participants

Figure 2 displays the distribution of falls among the participants. Older adults aged 86 years presented more falls than others (3 vs 1, respectively,  $p=0.005$ ).

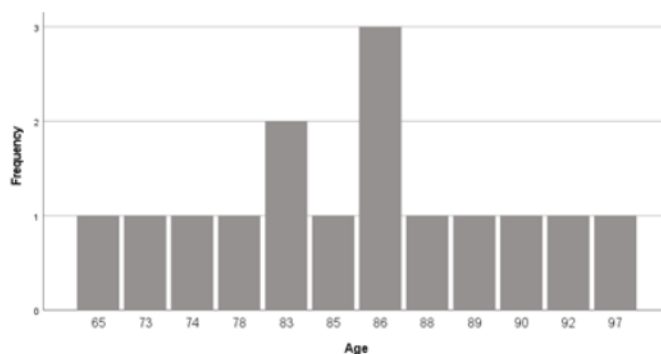


Figure 2. Distribution of falls at different ages

As for fear of falling (FOF), 71.02% (n=49) admitted being afraid of falling. Of these, 21.74% (n=15) had at least one fall in the 12 months before the study. While 100% of fallers were afraid of falling (n=15), in the group of non-fallers, this rate dropped to 62.96% (n=34). The occurrence of falls and fear of falling are significantly associated, according to the Chi-square test ( $p=0.005$ ).

### Socio-demographic, nutritional, functional and cognitive characteristics of the participants

The final sample consisted of 69 institutionalised elders, 65.2% (n=45) of whom were females. The average age of the participants was 83.14 8.87 years, ranging from 65 to 97 years of age. In female older adults, the mean age was 84.84 7.40 years, ranging between 70 and 97 years. In males, the mean age was 79.96 10.57 years and ranged between 65 and 96.

In the group of fallers, the average age was 83.67 8.20 years, ranging from 65 to 97 years, and 75% of this population was

over 78 years.

Most participants were illiterate (60.9%, n=42), widowers (46.4%, n=32), and had normal weight (71%, n=49). In the group of fallers, 60% (n=9) were female, 53.3% (n=8) were illiterate, 46.7% (n=7) were married, and 73.3% (n=11) had normal weight. The socio-demographic and physical characteristics of the subjects are summarised in Table 1.

None of the socio-demographic characteristics we analysed displayed a significant association with falls, according to the chi-squared test ( $p>0,05$ ).

As for the functional status of the participants, fallers were either classified as having severe (40%) or moderate (60%) dependence levels. Unlike in the group of fallers, 9.26% of non-fallers were slightly dependent, whereas 7.40% were completely independent. However, no significant differences in functional status were found between fallers and non-fallers ( $p>0.05$ ) and functional status was not associated with the occurrence of falls ( $p=0.396$ ).

Regarding nutritional status, only 3.70% of the non-fallers appeared to be at risk of malnutrition. However, 17.5% to 50.5% of the older adult residents living in long-term care facilities were either malnourished or at risk of malnutrition. Similarly to functional status, nutritional status was not associated with falls ( $p=0.449$ ).

The prevalence of fallers with cognitive impairment is higher when compared to non-fallers. An association was found between the occurrence of falls and cognitive impairment in the group of older adults with 1 to 11 years of schooling ( $p=0.050$ ).

#### Comorbidities and presence of PIMs among fallers and non-fallers

The most prevalent diseases in our sample were those of the circulatory system (BA00-BE2Z) (76.8%), followed by mental, behavioural or neurodevelopment disorders (6A00-6E8Z) (37.7%).

There was a high rate of participants with comorbidities

Table 1. Sociodemographic, nutritional, functional and cognitive characteristics of institutionalized older adult participants in the study (n=69)

| Parameters                        |  | Non-Fallers<br>(n=54)<br>n (%)                                    | Fallers<br>(n=15)<br>n (%)                   | Total<br>(n=69)<br>n (%)   | p-Value   |       |
|-----------------------------------|--|---|--|--|-----------|-------|
| Age                               |  | 83.00 (9.12)  | 83.67 (8.20)                                 | 83.14 (8.87)   | 0.256     |       |
| Gender                            | Feminine<br>Masculine  | 36 (66.7)<br>18 (33.3)  | 9 (60)<br>6 (40)                             | 45 (65.2)<br>24 (34.8)   | 0.632     |       |
| Educational level                 | Illiterate<br>Primary Education<br>Basic Education (2º cycle)<br>Basic Education (3º cycle)<br>Secondary Education<br>Higher Education | 34 (63.0)<br>9 (16.7)<br>5 (9.3)<br>1 (1.9)<br>3 (5.6)<br>2 (3.7) | 8 (53.3)<br>6 (40)<br>-<br>-<br>1 (6.7)<br>- | 42 (60.9)<br>15 (21.7)<br>5 (7.2)<br>1 (1.4)<br>4 (5.8)<br>2 (2.9) | 0.373     |       |
| Marital status                    | Single<br>Married<br>Widower   | 13 (24.1)<br>12 (22.2)<br>29 (53.7)                               | 5 (33.3)<br>7 (46.7)<br>3 (20.0)             | 18 (26.1)<br>19 (27.5)<br>32 (46.4)                                | 0.055     |       |
| BMI                               | Underweight<br>Normal<br>Overweight<br>Obese   | 5 (9.2)<br>38 (70.4)<br>8 (14.8)<br>3 (5.6)                       | 2 (13.3)<br>11 (73.3)<br>1 (6.7)<br>1 (6.7)  | 7 (10.1)<br>49 (71.0)<br>9 (13.1)<br>4 (5.8%)                      | 0.740     |       |
| Nutritional status                | At risk<br>Well nourished  | 2 (3.7)<br>52 (96.3)  | 0<br>67 (97.1)                               | 2 (2.9)  | 0.449     |       |
| Functional status (BI)            | Independent (100)  | 4 (7.40)  | 0  | 4 (5.8)  | 0.396     |       |
| Minimally dependent (score 91-99) | 5 (9.26)   | 0   | 5 (7.25)                                     |  |           |       |
| Moderate dependent (score 81-59)  | 25 (46.3)  | 9 (60)  | 34 (49.3)                                    |  |           |       |
| Severe Dependency (score 21-60)   | 20 (37.0)  | 6 (40)  | 26 (37.7)                                    |  |           |       |
| Total Dependency                  | 0  | 0   | 0  |  |           |       |
| MMSE                              | 11years of school  | With cognitive impairment (<27)                                   | 1 (1.9)                                      | 1 (6.7)  | 2 (2.9)   | 0.248 |
|                                   |  | Without cognitive impairment (≥27)                                | 3 (5.6)                                      | 0  | 3 (4.4)   |       |
|                                   | 1-11 years of school   | With cognitive impairment (<22)                                   | 8 (15)                                       | 6 (40)   | 14 (20.3) | 0.050 |
|                                   |  | Without cognitive impairment (≥22)                                | 9 (16.7)                                     | 0  | 9 (13.0)  |       |
|                                   | Illiterate   | With cognitive impairment (<15)                                   | 18 (33.3)                                    | 5 (33.3)   | 23 (33.3) | 0.942 |
|                                   |  | Without cognitive impairment (≥15)                                | 15 (27.8)                                    | 3 (20)   | 18 (26)   |       |

BMI= Body mass index; BI= Barthel index; MMSE= Mini Mental State Assessment; in brackets (%)



(multiple coexisting pathologies) in both groups, fallers and non-fallers. However, the presence of comorbidities was not associated with the occurrence of falls ( $p=0.321$ ). (Figure 3)

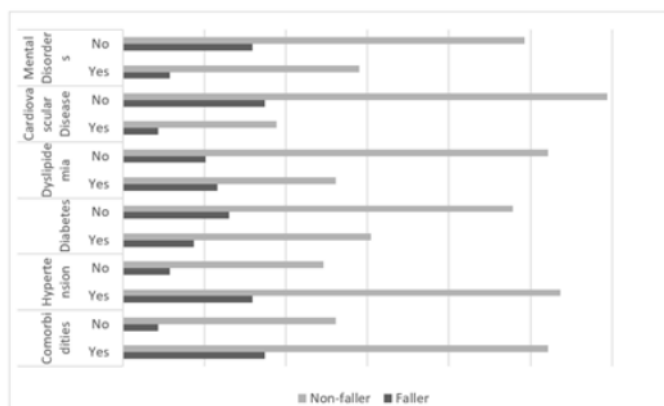


Figure 3. Comorbidities between fallers and non-fallers

All the participants in the study take five or more medicines, resulting in a 100% prevalence of polypharmacy. We also found a very high frequency of potentially inappropriate medications (PIM), with 88.41% ( $n=61$ ) of all subjects using at least one PIM, a number which rose to 93.33% when considering only the fallers. The distribution of PIMs according to the groups defined in the Beers Criteria can be found in Table 2. Nevertheless, no statistically significant associations were found between the presence of PIMs and the occurrence of falls. (Table 2)

## DISCUSSION

In this study, we examined the relationship between the risk of falls and several factors (socio-demographic, clinical, physical, nutritional, and cognitive characteristics) in a population of institutionalised older adults, which included 69 participants aged 65 or over.

When analysing the age of the fallers, it varied from 65 to 97 years old, but the vast majority were over 78 years old. The higher frequency of falls occurred between 83 and 86 years of

age. In our sample, we were not able to find an association between age and the occurrence of falls. However, most studies show that the fall risk increases with advancing age.<sup>32</sup> Some studies have demonstrated that this risk can be significantly reduced with exercise programmes.<sup>33</sup> This can be explained by the characteristics of the ageing process with a decrease in muscle strength, mobility and balance, functional, nutritional and cognitive changes, as well as the prevalence of chronic diseases, all factors that increase the predisposition to the occurrence of falls.<sup>34</sup>

Both the group of fallers and the group of non-fallers had a high number of comorbidities, and it was not possible to establish an association between them and the occurrence of falls. Nevertheless, in the group of fallers, those who fall more have more comorbidities. These results are in accordance with recent studies that identified a high prevalence of comorbidities in hospitalised older adults due to falls.<sup>35</sup>

The higher predominance of females in our study group is coherent with the data obtained in the 2021 Portuguese census. According to the census, for every 100 women, there are 90.7 men. The number of men tended to be significantly lower than the number of women over the age of 65.<sup>36</sup>

In the present study, there is a higher number of females in the group of fallers, as is the case in other studies, which also demonstrate a greater number of female fallers.<sup>34,37</sup> However, gender did not seem to affect the occurrence of falls.

Although the prevalence of falls was higher in illiterate individuals, there is no significant difference in the occurrence of falls between these and individuals with primary education. However, in the group of non-fallers, there are more individuals with higher levels of education when compared to the fallers. This is also in agreement with the results of other studies, in which there is a greater risk of falls in individuals with lower education.<sup>34,38</sup>

Several studies have investigated physical health, gait and balance, and their relationship with falls in older adults. It is known that being physically healthy is associated with a lower risk of falling.<sup>39,40</sup> However, other factors lead to falls,

Table 2. Presence of PIM among fallers and non-fallers

|  | Non-faller n (%) | Faller n (%) | Total n (%) | p-value |
|--|------------------|--------------|-------------|---------|
| Do not use PIM   | 7 (12.96%)       | 1 (6.67%)    | 8 (11.59%)  | 0.500   |
| Use PIM  | 47 (87.04%)      | 14 (93.33%)  | 61 (88.41%) |         |
| Do not use PIM to be avoided   | 24 (44.44%)      | 6 (40%)      | 30 (43.48%) | 0.759   |
| Use PIM to be avoided  | 30 (55.56%)      | 9 (60%)      | 39 (56.52%) |         |
| Do not use PIM to be avoided, unless indicated for a confirmed diagnosis | 50 (92.59%)      | 14 (93.33%)  | 64 (92.75%) | 0.922   |
| Use PIM to be avoided, unless indicated for a confirmed diagnosis        | 4 (7.41%)        | 1 (6.67%)    | 5 (7.25%)   |         |
| Do not use PIM with the need to assess therapy duration                  | 28 (51.85%)      | 9 (60%)      | 37 (53.62%) | 0.576   |
| Use PIM with the need to assess therapy duration                         | 26 (48.15%)      | 6 (40%)      | 32 (46.38%) |         |
| Do not use PIM to be used with caution                                   | 19 (35.19%)      | 7 (46.67%)   | 26 (37.68%) | 0.417   |
| Use PIM to be used with caution  | 35 (64.81%)      | 8 (53.33%)   | 43 (62.32%) |         |

and the literature has shown that social factors, including marital status, have a significant impact on the health of this population and can contribute to the occurrence of falls.<sup>41,42</sup> A study including 100 older adults suggested that the marital status of individuals impacts their health, with single, divorced, or widowed subjects experiencing more adverse health effects when compared to married people.<sup>41</sup> In this study, most of the older adult fallers were married. However, if we add single, divorced, and widowed older adults, we get a similar rate. Thus, in this study, we did not find an influence of marital status on the occurrence of falls.

As for BMI, although studies<sup>43,44</sup> link the extremes of classification of body mass index, especially in cases of obesity, to a greater risk of falls since it has a negative effect on balance, agility, strength, and flexibility, in this study, the majority of the fallers had a normal weight. Therefore, it was impossible to correlate BMI with the risk of falls.

Additionally, an assessment of the nutritional status was performed, and the results revealed that most of the participants, fallers and non-fallers, had normal values in the nutritional evaluation. Although some studies suggest an association between malnutrition and an increased risk of falls,<sup>45,46</sup> we could find no statistical association between the two in our sample.

Functional status was another variable evaluated in this study. Our findings showed that in the group of fallers, the levels of independence varied between severe and moderate, whereas the group of non-fallers also included individuals with only a slight degree of dependence or total independence. We did not find a significant relationship between functional status as evaluated per the Barthel index and the occurrence of falls, although other studies have shown an association between a higher level of dependence and a higher risk of falls.<sup>47</sup>

As for cognitive assessment, despite a higher prevalence of cognitive impairment in fallers, we only found a statistically significant association between the occurrence of falls and cognitive impairment for subjects with 1 to 11 years of schooling. These results are in accordance with other studies, in which the prevalence of falls is higher in cognitively impaired older people when compared with those with normal cognition.<sup>48</sup>

In this study, fear of falling (FOF) is higher in older adults who have already fallen, which is coherent with a previous study that evaluated this variable.<sup>49</sup> Although FOF is superior in fallers, there is still a high prevalence in the non-fallers group. A relationship between a higher FOF and lower levels of physical activity has been identified in institutionalised older adults.<sup>50</sup>

A study conducted in Portugal showed that most patients had at least one PIM in their pharmaceutical profile, which is consistent with the data obtained by other researchers.<sup>51</sup> Another study, also conducted in the Portuguese population, found that the pharmacological groups of PIMs with the highest prescription were anxiolytics, more precisely derivatives of benzodiazepines, antidepressants, antipsychotics and proton-pump inhibitors.<sup>52</sup> Although the literature associates

medication use with increased risk of falls,<sup>53,54</sup> we found no significant relationships between the presence of PIMs and the occurrence of falls.

This study presents several limitations, the most relevant of which is the small sample size, which limits the applicability of these results to the general population. There are also some uncertainties regarding the pharmacotherapeutic profile of some users. This information is often supplied by the caregivers or the patients themselves when entering the nursing home and may be subject to errors. Another crucial point is that this study was conducted in the central region of Portugal in homes within the same geographical area, meaning that many participants may share the same prescribing physician. Within nursing homes, there are similarities between prescriptions, which can also be considered a limitation. We intend to continue our research in other long-term care facilities in order to obtain a more robust and diverse sample and minimise these limitations.

The long-term care facilities (LTCF) where the study was conducted have good conditions, with a multidisciplinary team, guaranteeing good care and monitoring of the older adults. In addition to the physician and nursing team, they also have periodic visits by a physiotherapist who works individually with the older adults who need intervention. In one of the LTCFs, there is also the intervention of a community pharmacist, who prepares individualised medication for the older adults every 15 days. As for the other LTCF, the nursing team prepares the medication. We believe that these conditions and close monitoring contributed to the low prevalence of falls in the studied population. Considering these data, it would be important to conduct studies in other long-term care facilities that do not have this type of assistance.

## CONCLUSIONS

This study allowed us to characterise a group of Portuguese older adults living in LTCFs. We found that fear of falling was significantly associated with the occurrence of falls. We also found a statistically significant association between falls and cognitive impairment for subjects with 1 to 11 years of schooling. No other factors were found to be associated with the occurrence of falls in our population.

Although they did not appear to influence the occurrence of falls in our sample, our study showed that polypharmacy was ubiquitous and that the prevalence of potentially inappropriate medication was very high in both fallers and non-fallers. This emphasises the need for tailored interventions featuring the collaboration of a pharmacist to optimise medication management in this population.

## CREDIT AUTHOR STATEMENT

Carina Ramos Ferreira – Writing – Original Draft, Review & Editing; Conceptualization; Validation; Investigation



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Conceptualization

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## CONFLICTS OF INTEREST

The authors declare that there are no conflicts of interest.

Maria João Reis Lima – Supervision, Review & Editing

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