



Falls in Elderly with Plantar Changes

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Authors' contributions

This work was carried out in collaboration between all authors. Authors PSCF, SFC and TVFM designed the study, managed the literature searches, performed the statistical analysis, wrote the protocol, wrote the first draft of the manuscript and managed the analyses of the study. All authors read and approved the final manuscript.

Original Research Article

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ABSTRACT

Aims: The purpose of this study was to evaluate the prevalence of falls among older people with plantar changes in order to preserve their autonomy and independence.

Study Design: A cross-sectional, descriptive, analytical study was conducted based on a sample of elderly people.

Place and Duration of the Study: Department of Geriatrics and Gerontology at the Federal University of Sao Paulo/UNIFESP - Brazil, between March, 2007 and December, 2008.

Methodology: The study sample consisted of 100 elderly people of both genders, aged ≥ 60 years. After patients were included in the study, a search protocol was applied with the following information: demographic data (age, gender, race, marital status, housing, and education) and anthropometric data (height, weight, and body mass index (BMI)).

Results: The foot types and major injuries were: 83% had valgus feet, 52% had flat feet, 64% had skin lesions, 63% had lesions, and 53% had toenail deformities. Regarding the number of falls in the previous year, 40% did not report having fallen, 44% fell at least once, and 16% fell two or more times. The frequency of falls among older people with

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plantar changes in the present study (60%) was relatively higher than in other studies. About half of the general population will be affected by a change in the foot, and the incidence and severity increase with age.

Conclusion: Plantar changes were common among the elderly in this study and can directly affect the balance and gait cycle and, therefore, may be a contributing factor to functional disability and falls in the geriatric population.

Keywords: Falls; elderly; plantar changes; foot.

1. INTRODUCTION

Falls among elderly people are common and constitute a major public health concern. Every year, approximately $\frac{1}{3}$ of the population over 65 year old experience falls [1,2] and in many cases the problems caused by these falls have a significant detrimental effect on older people's independence and increase the demand on health services.

The occurrence of falls has a multifactorial etiology in involving the interaction between intrinsic (person-related) and extrinsic (environment-related) factors. The main risk factors found in the literature are: female gender, older age, chronic diseases, polypharmacy, previous history of falls, visual impairment, cognitive decline, and environmental factors.

Among the various causes of falls among the elderly, one is the changes in the foot. Garrow et al. [3] report that more than 80% of the population has some type of foot problem. Menz et al. [4] claim that the human foot is an important body part and plays a complex role in locomotion. It provides a single point of contact with the ground when walking, contributing to absorbing the impact after contact of the calcaneus up to the impulse with the hallux. Each of these functions requires a complex interaction of specific muscles and causes the weight shift of body movements. Therefore, deficiency can interfere with the walking gait mechanism and may thus be a contributing factor to the occurrence of falls among the elderly. Kiely et al. [5] emphasize that toe abnormalities, painful corns, and inappropriate shoes can impair walking and increase the risk of falls. As the foot provides the structure for static support and progression of the body during locomotion, it is reasonable to suggest that foot problems can contribute to postural instability and falls among the elderly [5].

The support diseases are degenerative joint disease (knee and hip osteoarthritis); disuse weakness and deconditioning, sequelae from fractures, and soft tissue diseases of the feet. Among these diseases, the elderly may have hyperkeratosis-associated infections, ingrown toe nails, calluses, plantar warts, ulcers, hallux valgus (bunion), and toe deformities. Wearing inappropriate shoes (high heels or tight) seems to importantly contribute to the formation of the last two problems.

Therefore, the purpose of this study was to evaluate the prevalence of falls among older people with plantar changes in order to preserve their autonomy and independence.

2. MATERIALS AND METHODS

A cross-sectional, descriptive, analytical study was conducted based on a sample of elderly people. Data were collected at the outpatient clinic of the Department of Geriatrics and

Gerontology at the Federal University of Sao Paulo/UNIFESP. The study sample consisted of 100 elderly people aged ≥ 60 years of both genders.

The inclusion criteria were: Foot pain intensity ≥ 30 mm in pain visual analog scale (VAS) at rest and/or movement for more than 3 months, understanding the study, and being motivated to participate in it. Subjects who reported pain radiating to the legs, who had lower limb amputation, and those unable to walk were excluded from this study.

The study started after approval of the research project (CEP0274/07) by the Ethics Committee in Research of the Federal University of São Paulo/UNIFESP. The authors performed all data collection and clinical assessments themselves in the period from March 2007 to December 2008. After patients were included in the study, a search protocol was applied with the following information: demographic data (age, gender, race, marital status, housing, and education) and anthropometric data (height, weight, and body mass index (BMI)). This variable was categorized using the classification criteria by Lipschitz, [6] which considers higher reference values for the elderly than for adults.

Data were collected about skin and nail lesions, vascular abnormalities, and toe deformities, besides the type of arch (cavus or flat) and foot type (varus, valgus, or equinus). The question about falls was: "Last year, did you suffer any fall?" Subjects who answered positively were asked about the number of falls, classification of the lesion (severe, moderate, or no injury), whether there was a fracture related to the fall, place where the fall happened, and period of the day (morning, afternoon, evening, or late night). The intrinsic risk factors for falls such as medication use, visual impairment, hearing loss, labyrinthitis, osteoporosis, osteoarthritis, diabetes mellitus, hypertension, urinary incontinence, reading habit, alcoholism, and muscle weakness in the lower limbs, and extrinsic risk factors such as inadequate lighting, presence of loose rugs, slippery floors, stairs or steps, presence of animals and toys, lack of handrails, electric and telephone wires, steep sidewalks or streets, poorly adapted public transport, and construction on public walk ways were also evaluated.

Finally, subjects were inquired about the type of shoe frequently worn (mule, slippers, sneakers, sandals, and tomboy) and regular physical exercise.

3. RESULTS

The sample consisted of 100 elderly people selected according to demographic data and had a 43% prevalence of the age group of 60-70 years followed by 39% of the age group 71-80 years. The majority of the sample was female (85%) and white (60%) and it was observed that 50% of the elderly were married. Regarding housing, 85% reported living with at least one person, while regarding the level of education, 48% reported knowing how to read and write (Table 1).

The average height was 1.58 m (SD 0.09) ranging between 1.38 and 1.82m, while the average weight was 67.1kg (SD 13.0) ranging between 36 and 102kg. The average BMI was 26.4kg/m² (SD 4.3) ranging between 17 and 36. Based on the BMI classification, according to Lipschitz [6] 73% of the elderly in the study sample were healthy, 20% were obese, and 7% were malnourished.

Regarding the feet evaluation to identify the types and most common injuries, there relevant findings that were 83% had valgus feet, 52% had flat feet, 64% had skin lesions, 63% had nail lesions, and 53% had toe nail deformities. Table 2 lists all the items assessed.

Table 1. Sociodemographic data

Age (years)	%
60-70	43%
71-80	39%
81-90	16%
91-100	2%
Gender	
Female	85%
Male	25%
Race	
White	60%
Black	20%
Yellow	14%
Brown	6%
Marital status	
Married	50%
Widowed	32%
Single	12%
Divorced	4%
Separated	2%
Dwelling	
Lives with at least one person	85%
Lives alone	15%
Education	
Can read and write	48%
College student; Graduate	23%
Elementary school	20%
Illiterate	8%
Does not know	1%

Table 2. Feet evaluation

Foot injuries	%
Skin injuries	64%
Nail injuries	63%
Vascular lesions	15%
Toe deformities	53%
Plantar arch type	
Flat foot	52%
Cavus foot	48%
Foot type	
Valgus foot	83%
Varus foot	16%
Equinus foot	1%

The subjects were inquired about the regular practice of physical exercise at least three times a week for 30 to 40 minutes. 43% of the elderly do not do physical activity and 57% reported regular physical activity.

The occurrence and circumstances of the falls was investigated and the subjects were asked about the number off all sin the previous year. 40% said they had not fallen, 44% fell at least once, and 16% fell two or more times (Fig. 1).

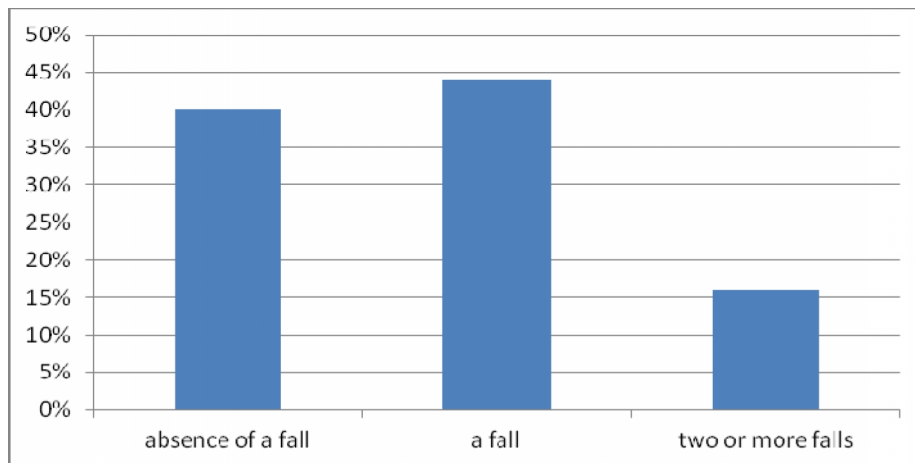


Fig. 1. Occurrence and number of falls

Falls were reported by 60% of the subjects: 44 patients (73%) fell once, and 16 (27%) fell two or more times. The consequences were classified as: no injuries (55%), moderate (27%), and severe (18%). Only 22% had fractures related to the fall in the previous year and most falls occurred at home (53%) and outdoors (47%). Of those who fell at home, 28% were in their own bedroom, 22% in the bathroom, 16% in the kitchen, 16% on the balcony, 9% in the living room, and 9% in the hallway. 52% of the falls happened in the afternoon, 32% in the morning, 13% in the evening, and 3% late at night. Table 3 shows the distribution of intrinsic risk factors for falls.

Table 3. Intrinsic risk factors for falls

	Yes (%)	No (%)	Unknown (%)
Medication use	93%	7%	0%
Visual impairment	92%	8%	0%
Hearing impairment	48%	52%	0%
Labyrinthitis	39%	51%	10%
Osteoporosis	54%	21%	25%
Osteoarthritis	60%	10%	30%
Diabetes mellitus	17%	67%	16%
High blood pressure	69%	27%	4%
Urinary incontinence	55%	45%	0%
Read frequently	52%	48%	0%
Muscle weakness in lower limbs	52%	48%	0%
Alcohol consumption	7%	93%	0%

The most common extrinsic risk factors for falls in the house hold were: 19% reported the presence of slippery floors, 12% inadequate lighting, and 11% the presence of stairs/steps. Out of the home, 14% reported the steep sidewalks or streets, 11% poorly adapted public transport, and 6% construction on public walkways (Table 4).

Table 4. Extrinsic risk factors for falls

Household	Yes (%)	No (%)
Inadequate lighting	12%	88%
Presence of loose rugs	6%	94%
Slippery floors	19%	81%
Presence of stairs	11%	89%
Presence of animals/toys	3%	97%
Lack of handrails	10%	90%
Presence of telephone and electrical wires	1%	99%
Outdoors		
Sidewalks or streets with large gaps	14%	86%
Poorly adapted public transport	11%	89%
Construction on public walkways	6%	94%

Of the types of shoes frequently worn by the elderly, 29% reported wearing sneakers, 29% tomboy, 22% sandals, 15% slippers, and 5% mule.

4. DISCUSSION

The prevalence of falls among older people with plantar changes in the present study (60%) was relatively higher than in other studies. A study by Reyes-Ortiz [7] shows that such prevalence varies according to the countries investigated, ranging from 21.6% in Bridgetown, Barbados to 34.0% in Santiago, Chile, while Montevideo, Uruguay had a prevalence of falls among the elderly of 27.0%. In Eastern countries, the prevalence of falls is lower: About 15% of seniors fall once a year [8].

The variations found in the prevalence of falls may be due to several factors that behave differently among different countries, e.g., living conditions and social and cultural aspects. An important fact is that the elderly in developed countries have better medical care and, therefore, are more protected against the occurrence of falls. [8] In Brazil, according to the Medical Information System of the Ministry of Health, between 1979 and 1995, about 54,730 people died due to falls, 52% of whom elderly, being 39.8% from 80 to 89 years old. [9].

With aging, the feet change, they enlarge and lose their foot pads. Most foot-related diseases result from a muscle imbalance and overload problems can also occur due to systemic diseases, gait changes, mistreatment of the feet, or even trauma, as well as local conditions such as corns, hallux valgus, and deformities, dysfunctions that can be easily diagnosed [10].

Regarding the plantar assessment of patients, 52% had flat feet. In 2003, a study by Greisberger et al. [11] found that the degree of deformity and bone loss in the joints of the mid foot and rear foot are not related to age. Two studies [12,13] involving patients between 18 and 65 and between 16 and 65 years old showed no relationship between age and arch height. Another survey conducted by Staheli et al. [14] evaluated 882 feet of children and adults and found that flat feet are more common in children, while in adults the prevalence is within the normal range, even if the average of the arch indices increased again after 30 years of age. However, in a study with adults in 2001, Manfio [15] reported 13% of women and 5% of men with flatfeet and 5% of women and 6% of men with hollow legs, showing that

flat feet was more common among women. Possible causes of women suffering more from foot problems would be wearing high-heels and pointy shoes.

Toe deformities are common among the elderly and appeared in 53% of the sample, while hallux valgus is the most common change. The big toe plays an essential role in the development of the step. Individuals with moderate to severe hallux valgus have a significant reduction in speed and stride length when walking on uneven surfaces, which contributes to instability and risk of falls in the elderly population. [16] It is often found in older women and in most cases the cause is wearing inadequate shoes. [17] Many of the individuals analyzed in this study had some type of injury, with 64% having skin lesions and 63% having nail lesions. A study by Dollinis [18] reported that the presence of calluses and blisters on the feet was an independent risk factor for falls, suggesting that other changes may be risk factors for falls.

A survey conducted in Thailand by Chaiwanichsiri et al. [19] in 2009 showed that 14% of elderly respondents reported suffering from foot pain and that falls were more frequent in those who reported pain, occurring in 29.5% of women and 12.9% of men. Falls were more common among women, especially those who had pain due to plantar fasciitis, calluses, valgus foot, and metatarsalgia [20].

Among the intrinsic factors that predispose the elderly to falls, the emergence of diseases that cause a reduction in physical capacity can lead to postural control deficits and impact balance. The main pathological conditions that increase the risk of falls are cardiovascular, neurological, endocrine, musculoskeletal, genitourinary, psychiatric, and sensorial disorders. [21,22].

Continued medication use, also an intrinsic cause, was reported by 93% of the subjects in this study and is mentioned by Blake et al. [22] in 1988, Evci et al. [23] in 2006, and Ziere et al. [24] in 2006. Robbins [25] in 1989 described drug use as a potential risk factor, especially regarding the use of polypharmacy. 54% of the individuals reported osteoporosis, however, there are still few studies that specifically examine the relationship between osteoporosis and the risk of falls. A study by Arnold et al. [26] evaluated the risk factors for falls in a group of women over 60 years old with a history of osteoporosis, and it showed a prevalence of falls of 30% in a period of six months, while half the sample had recurrent falls. Another factor of great importance is the visual loss reported in 92% of the sample in the present study. Elderly people with visual impairment have more difficulty in performing everyday tasks, contributing to functional decline, which, according to Lamoureux, [27] contributes to a progressive and gradual decline, forcing the elderly to adapt the way they do their activities.

Identifying the place where the episode took place is of paramount importance to identifying its cause. A study by Campbell et al. [28] in a community found that 51% of the elderly suffered falls, mostly at home (44%).

For other extrinsic factors, the role of the shoes is very important. If inadequate, they can increase the chances of instability such as slipping and tripping, regardless of whether the environment is indoors or outdoors. [29] In tropical regions, slippers are often preferred, at times because they are flexible and able to easily accommodate any painful foot deformities. Leveille et al. [30] compared wearing shoes with the risk of falls and found that 90% of the elderly chose pants that were too long or too wide in relation to the size of their feet or shoes that were narrower than the foot, causing calluses, pain, and wounds. Despite being

classified as an extrinsic risk factor for falls, the type of shoe can upset the balance of the elderly, thus becoming unstable foundations of the body [31,32].

6. CONCLUSION

Plantar changes were common among the elderly in this study, and can directly affect balance and gait cycle and, therefore, may be a contributing factor to functional disability and falls among the geriatric population.

CONSENT AND ETHICAL APPROVAL

All Author of the manuscript "Falls in Elderly with Planter Changes" declare that written informed consent was obtained from all presents or guardians for publication of this study.

All authors hereby declare that the research was reviewed and approved by the appropriate Ethics committee and were therefore carried out in accordance with the ethical standards laid down in the Declaration of Helsinki 1964.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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