Original Article

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Prevalence of Falls and Its Association with Serum Vitamin D Levels in the Elderly Population of Amirkola City

S.R. Hosseini (MD)[1], A. Ahmadi Ahangar (MD)*[2], N. Ghanbari [3], A. Bijani (MD)[1]

1.Social Determinants of Health Research Center, Health Research Institute, Babol University of Medical Sciences, Babol, I.R.Iran
2.Movement Disorder Research Center, Health Research Institute, Babol University of Medical Sciences, Babol, I.R.Iran
3.Babol University of Medical Sciences, Babol, I.R.Iran

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ABSTRACT

BACKGROUND AND OBJECTIVE: Vitamin D deficiency is associated with reduced muscle strength, functional limitations and disability and can sometimes lead to falls in the elderly. This study was carried out to specify the prevalence of falls and its association with serum vitamin D levels in the elderly population of Amirkola city.

METHODS: This cross-sectional study is a part of Amirkola Health and Ageing Project (AHAP). Frequency of falls was studied in two stages. In the first stage, questions were asked about occurrence of falls over the last 12 months and in the second stage, a 6-month follow-up was carried out for the elderly. To obtain vitamin D levels, serum levels of 25-hydroxy vitamin D in morning blood samples of the elderly were measured.

FINDINGS: 1616 elderly people entered the study. The mean age was 69.37±7.42. Prevalence of falls for all elderly people, men and women was 17%, 14% and 22.4%, respectively over the last 12 months. With increasing age, the prevalence of falls increased in men ($p<0.001$) but no such relationship was observed in women. According to a 6-month follow-up, mean frequency of falls in women (17.43±98.25) was higher than men (7.63±36.49) ($p=0.012$). The mean serum vitamin D levels in elderly people without a history of falls over the last 12 months was 33.33±30.79 ng/mL, while it was 36.81±35.68 ng/mL in elderly people with a history of falls.

CONCLUSION: Prevalence of falls in older women was higher than men. There is no relationship between falls and serum vitamin D levels in men and women.

KEY WORDS: *Falls, The elderly, Vitamin D.*

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***Corresponding author: A. Ahmadi Ahangar (MD)**
Address: Social Determinants of Health Research Center, Health Research Institute, Babol University of Medical Sciences, Babol, I.R.Iran
Tel: +98 11 32199596
E-mail: ahmadiahangaralijan@yahoo.com

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Introduction

Rapid increase in the number and percentage of elderly people in recent years, a phenomenon metaphorically called "graying world", is a result of demographic transition. According to the World Health Organization (WHO), 590 million elderly people aged 60 and over lived around the world by 2000. This number is expected to reach 1.2 billion by 2025 and 70% of these people will be living in developing countries (1).

By 2020, the population of elderly people aged 60 and over (9.2% of the whole population) in Iran is anticipated to surpass the population under age 5 (8.5% of the whole population) (2). Projections indicate that by 2050, elderly people will constitute more than 21% of world population, whereas percentage of young population will decrease from 33% to 20%. Therefore, for the first time in human history, the elderly will outnumber children under age 5 by mid 21st century (3). The elderly population faces various challenges that impair their health and quality of life and there is an increasing social demand for addressing these issues (4).

Accidents are the fifth leading cause of death among the elderly and falls are the most prevalent accident in this category. 80% of hospital admissions (for the elderly) due to accidents are caused by falls (5-8). As defined by World Health Organization (WHO), falls are incidents that occur when a person falls on the ground or a lower level unintentionally (9). Falls and their damages are the main issues of the elderly. Each year, one-third to one-half of elderly population experience falls and half of them experience frequent falls (3, 10-14).

Frequency of falls increases significantly with age and one out of three elderly people falls each year (15, 16). Falls in the elderly are associated with risk factors such as increasing age, disease status and environmental hazards; however, certain risk factors including muscle strength, walking ability and balance increase the risk of falls more than others factors (17). Vitamin D is a steroid hormone that was considered as a regulator of calcium and phosphorus metabolism for a long time. It was also believed that bones were the main target organs of this vitamin. However, recent studies have demonstrated that this vitamin plays different roles in body and that muscles and nervous system are the other target organs of this vitamin (18). Vitamin D affects the strength and function of muscles and influences falls in this way (17). Vitamin D deficiency affects weight-bearing muscles in the lower limb, which maintain balance and gait. Muscle weakness due to vitamin D deficiency is accompanied by feeling of heaviness in legs, difficulty in climbing up stairs and difficulty in standing up from a chair (19). Previous studies have demonstrated that vitamin D deficiency is associated with reduced muscle strength, myopathy, sarcopenia, functional limitations and disability, eventually leading to falls in the elderly (20-26).

Despite frequent falls in the elderly, no study has been carried out on the prevalence of falls and its association with vitamin D deficiency in elderly people aged 60 and over in Babol County. Therefore, this study was carried out to determine the prevalence of falls and its association with serum vitamin D levels in the elderly population of Amirkola city.

Methods

This cross-sectional study, a part of Amirkola Health and Ageing Project (AHAP), was carried out after being approved by the ethical committee of Babol University of Medical Sciences (27). All elderly people aged 60 and over were invited to the study according to the census records. Participants entered the study after being provided with preliminary descriptions and giving written consent in 2011-2012. Participants with incomplete files were excluded from the study.

In order to gather the required information, first a checklist including age, gender, serum vitamin D levels, occurrence or lack of occurrence of falls and frequency of falls was created. Frequency of falls was studied during two stages. In the first stage, the elderly were asked if they had experienced falls over the last 12 months and in the second stage, a 6-month follow-up was carried out for the elderly. In order to test vitamin D levels, active serum vitamin D levels (25-hydroxy vitamin D) were measured through laboratory evaluation of morning blood samples of the elderly using ELISA test in Cellular and Molecular Biology Research Center, Babol University of Medical Sciences. To interpret serum vitamin D levels, values lower than 20 ng/mL (50 nmol/l) were considered vitamin D deficiency, values between 21 to 29 ng/mL were considered inadequate and values higher than 29 ng/mL were considered adequate (28, 29). Data were analyzed using SPSS V.22 software, T-Test and Chi-Square test and $p<0.05$ was considered significant.

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Results

1616 elderly people entered the study; 883 men (54.64%) and 732 women (45.36%). The mean age of people under study was 69.37±7.42 years. Prevalence of falls for all elderly people, men and women was 17%, 14% and 22.4%, respectively over the last 12 months. The mean frequency of falls per individual with history of falls was 2.17±1.58 in men and 2.61±1.86 in women and significant difference was observed between genders (p=0.038).

The mean age of the elderly with history of falls and the elderly without history of falls over the last 12 months was 70.66±7.93 and 69.09±7.27 years, respectively and this difference was considered statistically significant (p=0.002). The highest frequency of falls in men and women was 1 time. Overall, the frequency of falls in women was higher than men, but no statistically significant relationship was observed (table 1).

Table 1 Gender-based frequency of falls in the elderly population of Amirkola city

Number of falls	Men N(%)	Women N(%)	All N(%)
1 time	58 (49.2)	67(42.7)	125(45.5)
2 times	26(22.0)	27(17.2)	53(19.3)
3 times	15(12.7)	23(14.6)	38(13.8)
4 times	6(5.1)	8(5.1)	14(5.1)
More than 5 times	13(11.0)	32(20.4)	45(16.3)

In this study, prevalence of falls in women (22.4%) was found to be significantly higher than men (14%) (p<0.001). Results of this study revealed that prevalence of falls in men increased with age (p<0.001), but no such relationship was observed in women (p=0.33). Over the last 12 months, highest frequency of falls belonged to men in 85-99 age group and women in 75-79 age group (Fig 1).

According to the 6-month follow-up of the population under study, prevalence of falls in all elderly people, men and women was 12.08%, 7.63% and 17.43%, respectively. The mean frequency of falls per individual with a history of falls was 1.50±0.69 in men and 2.23±2.80 in women and no significant difference was observed between genders.

During this 6-month follow-up, prevalence of falls in women was 56 times (7.8%) which was significantly higher than men (44 times, 5.1%) (p=0.012); however, no significant relationship was observed between prevalence of falls and gender. Moreover, highest frequency of falls in both genders belonged to 75-79 age group during this 6-month follow-up (table 2).

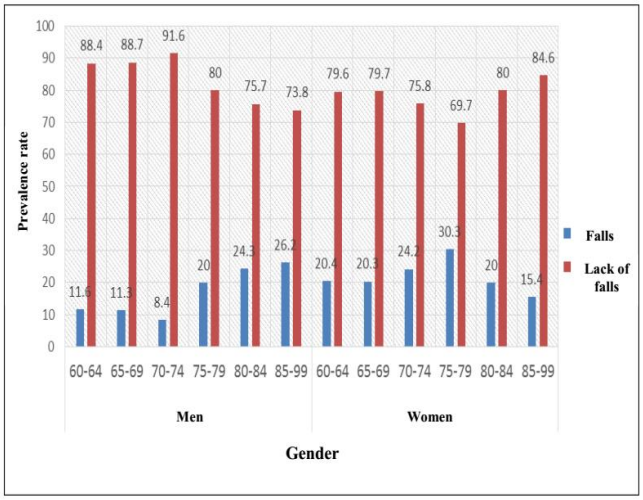


Figure 1. Age-based frequency of falls in the elderly population of Amirkola city over the last 12 month

Mean number of falls per 100 people was evaluated for one year. The results showed that the number of women (22.4%) with history of falls was more than men (14.04%) in one year. In addition, the number of falls in women (56.83%) was more than men (29.67%) (Fig 2).

Table 2 Age-based frequency of falls in the elderly population of Amirkola city during 6-month follow-up

Falls during 6-month follow-up	Lack of falls N(%)	Falls N(%)	P-value
Men's Age Group			
60-64	267(95.2)	14(4.8)	0.64
65-69	165(94.8)	9(5.2)	
70-74	146(17.8)	8(5.2)	
75-79	131(92.9)	10(7.1)	
80-84	63(95.5)	3(4.5)	
85-99	39(100)	0(0)	
Women's Age Group			
60-64	257(92.4)	21(7.6)	0.60
65-69	143(92.9)	11(7.1)	
70-74	119(93.7)	8(6.3)	
75-79	92(88.5)	12(11.5)	
80-84	39(90.7)	4(9.3)	
85-99	11(100)	0(0)	

In an evaluation of the relationship between serum vitamin D levels and falls, serum vitamin D levels in all elderly people was 34.31±31.62 ng/mL. The mean serum vitamin D levels in the elderly with a history of

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falls and the elderly without a history of falls over the last 12 months was 33.33±30.79 ng/mL and 36.81±35.68 ng/mL, respectively, and the difference was not statistically significant (p=0.127). The mean serum vitamin D levels in men with a history of falls and men without a history of falls over the last 12 months was 37.05±36.89 ng/mL and 31.06±26.94 ng/mL, respectively, and the difference was not statistically significant (p=0.08). Moreover, the mean serum vitamin D levels in women with history of falls and women without history of falls over the last 12 months was 36.62±34.85 ng/mL and 36.39±35.09 ng/mL, respectively and the difference was not statistically significant (p=0.94).

Percentage of falls over the last 12 months was higher in the elderly with serum vitamin D levels above 30 ng/mL, which was statistically significant (p=0.02). During the 6-month follow-up, the mean serum vitamin D levels in the elderly with a history of falls and the elderly without a history of falls was 35.05±31.92 ng/mL and 34.03±31.88 ng/mL, respectively, which was not statistically significant (p=0.75).

Furthermore, percentage of falls was lower in the elderly with serum vitamin D levels below 20 ng/mL compared with other groups and it was not statistically significant. In this study, no significant relationship was observed between prevalence of falls in men and women and serum vitamin D levels over the last 12 months (p=0.35 and p=0.17, respectively)(Fig 3). Likewise, no significant relationship was observed between falls in men and women and serum vitamin D levels during the 6-month follow-up.

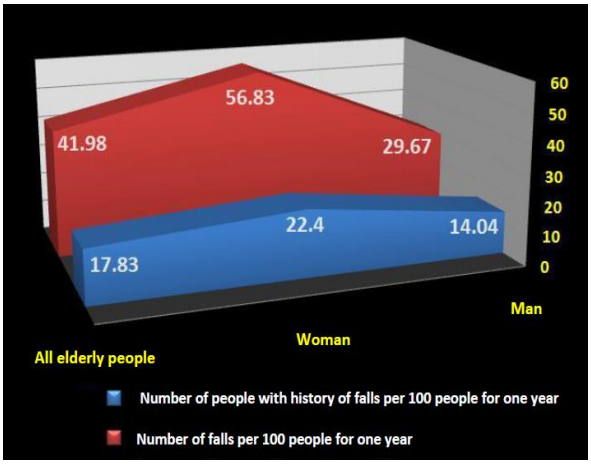


Figure 2. Frequency and number of falls per 100 people for one year

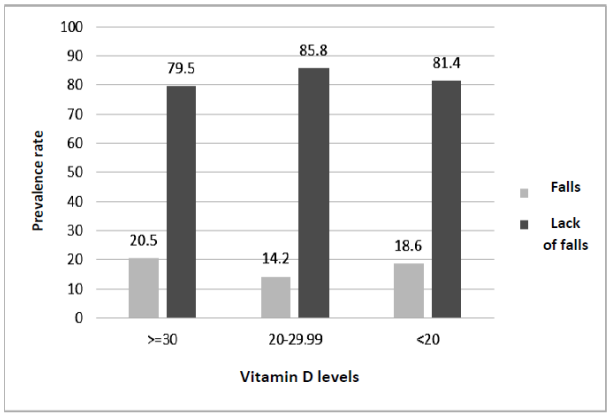


Figure 3 Prevalence of falls based on serum vitamin D levels over the last 12 months

Discussion

According to the results of this study, prevalence of falls for all elderly people, men and women was 17%, 14% and 22.4%, respectively over the last 12 months and the mean frequency of falls per individual with a history of falls was 2.17±1.58 in men and 2.61±1.86 in women and significant difference was observed between genders. Furthermore, prevalence of falls in men increased significantly with age, whereas no such relationship was observed in women.

Highest frequency of falls belonged to men in 85-99 age group and women in 75-79 age group. Evaluation of the relationship between serum vitamin D levels and falls in the elderly revealed that mean serum vitamin D levels in the elderly with a history of falls and the elderly without a history of falls over the last 12 months was 33.33±30.79 ng/mL and 36.81±35.68 ng/mL, respectively, and the difference was not statistically significant.

However, percentage of falls over the last 12 months was higher in the elderly with serum vitamin D levels above 30 ng/mL, which was statistically significant. Gender differences have been mentioned as biological risk factors by World Health Report (WHR) (30). Similarly, study of Akbari Kermani et al. has mentioned gender differences as socioeconomic risk factors (31). In this study, prevalence of falls in women was 1.6 times more than men over the last 12 months. This ratio reached 2.28 during the 6-month follow-up. Higher frequency of falls in women was also observed in the study of Coimbra et al. (15). In the study of Ghanbari et al., prevalence of falls in women was also significantly higher than men (32). Results of this study regarding differences in frequency of falls in

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men and women are similar to some other studies including study of Yu et al. in Japan (33), Gostynski et al. in Switzerland (34), Assantachai et al. in Thailand (35) and Von Heideken Wagert et al. in Sweden (36), all of which confirmed higher frequency of falls in women. This may be due to more physical problems in women. Elderly women in our society work alongside men and have poorer health status compared to men due to frequent childbirths and lack of care. Still, Nurmi et al. have demonstrated that total cases of falls in men were more than women and although men were more active, they experienced falls at lower ages compared with women. Howerver, in the study of Nurmi (37), mean age of men with a history of falls was lower than women with a history of falls and this increased men's risk of falling since they have more responsibility in the home and outside the home. Kerzman et al. have also indicated higher prevalence of falls in women. They have mentioned physical condition as a factor for prevalence of falls in addition to gender. They have demonstrated that imbalance, vertigo, neurological disorders, asthenia and psychological disorders such as confusion and Alzheimer are the significant risk factors for falls in the elderly (38).

Bumin et al. have shown that people with history of falls have more risk factors (including postural changes in blood pressure, knee weakness, hearing impairment, impaired lower limb coordination and leg disorders) compared with people without a history of falls (39). In the present study, there was a significant relationship between prevalence of falls in men and their age; therefore, prevalence of falls increased with age. Prevalence of falls in women did not increase significantly with age. Highest frequency of falls belonged to men in 85-99 age group and women in 75-79 age group. Results were a little different in the 6-month follow-up; highest frequency of falls in both genders belonged to 75-79 age group during this 6-month follow-up. Study of Salarvand et al. have shown that highest frequency of falls belongs to 70-74 age group and lowest frequency belongs to people over age 85. There was a significant difference between the elderly with a history of falls and those without a history of falls in terms of age (40).

In the study of Fuller, highest death rate due to falls belonged to people aged 75 and over. As people age, they consume more medicine and they will suffer from more sensory and cognitive disorders. This increases the incidence of falls in the elderly (41). In the study of Iranfar et al., most falls occurred in 80-89 age group and the frequency of recurrent falls in this group was higher than other age groups (30). According to the study of Jafarian Amiri et al., there was a significant relationship between incidence of falls and age, such that people aged 75 and over experienced falls 2.5 times more than people under 75 (42).

Higher frequency of falls in older people may be due to visual disorders, movement disorder, cognitive disorders, asthenia, chronic diseases and other factors. As people age, the function of physiological systems related to balance weakens and this influences the stability of body (30). Frequency and repetition of falls increase as people get older. This result is in accordance with results of Von Heideken Wagert et al. on people aged 85 and over (36). In the present study, mean serum vitamin D levels in the elderly with a history of falls was more than the elderly without a history of falls, but the difference was not significant. Moreover, no significant relationship was observed between prevalence of falls in men and women with difference serum vitamin D levels over the last 12 month. In this study, both genders significantly suffered from vitamin D deficiency. Similar to our study, vitamin D deficiency was reported for both genders in the study of Saidnia et al. (43).

Factors such as cutaneous pigment level, insufficient dietary intake of vitamin D, genetic factors like vitamin D receptor polymorphisms, low daily calcium intake and difference in lifestyle factors like working under direct sunlight, type of clothing or even disorders in receiving and producing vitamin D are the causes of vitamin D deficiency in both genders. Similar to our study, no significant relationship was observed between falls and serum vitamin D levels in the study of Yousefian et al. (44).

What matters most about the elderly is the fact that different studies indicate high prevalence of vitamin D deficiency and more serious complications of this deficiency in this age group. Muscle weakness, osteoporosis, falls and subsequent fractures, high risk of colorectal and prostate cancers are some significant complications of vitamin D deficiency (18). In our study, vitamin D levels in 92.9% of the elderly were below 20 ng/mL. Al Faraj et al. in a study on Saudi adults, 90% of whom were women, have reported this percentage to be 83, which was lower than our result (45). According to the present study, a high percentage of the elderly suffer from vitamin D deficiency. This may be due to their inability to

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exercise outside the house and benefit from sunlight. Previous studies have shown that due to limited resources of vitamin D in nature, nutrition is not a reliable source for obtaining this vitamin.

Exposure to sunlight causes our skin to produce vitamin D and this is an alternative way to obtain vitamin D. Cultural factors such as type of clothing are other causes of vitamin D deficiency, since they prevent skin exposure to sunlight (46). Results of the study demonstrated that most elderly people have experienced one to three falls over the last 12 months. In the study of Morris et al., 28-35% of people aged 65 and over and 32-42% of people aged 65 and over has experienced one or more falls (47). Not studying confounding variables such as diets and dietary supplements were some of the limitations of this study. It is suggested that a study be carried out considering underlying diseases and medicines used and investigate factors (such as calcium) that influence imbalance in order to gain a better knowledge about the risk factors in the life of the elderly.

Prevalence of falls in elderly women of Amirkola was more than men. Prevalence of falls in men increased with age, but no such relationship was observed in women. People aged 75 and over are more exposed to falls. In this study, no relationship was observed between falls and serum vitamin D levels.

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