# Investigation of the prevalent fall-related risk factors of fractures in elderly referred to Tehran hospitals

Ali A Jamebozorgi[1], Azam Kavoosi[2], Zahra Shafiee[3], Amir H Kahlaee[4], Mehdi Raei[5]

*Department of Occupational Therapy, Faculty of Rehabilitation, Shahid Beheshti University of Medical Sciences, Tehran, Iran.*

## Abstract

**Background**: Prevalence of fall-related mortality is rising in the elderly population. Falling is one of the causes of the murderous and non-murderous injuries in the elderly population which can lead to disability, dependence and decline of quality of life. Fractures constitute a major part of the fall-related injuries. The present study is designed to investigate the prevalence of fall-related risk factors of fractures in the Iranian elderly population.

**Methods:** This descriptive study was performed on 240 elderly adults (aged 72.24±8.81 years) referred to Tehran hospitals in 2011 with wrist, femoral and proximal humeral fractures, using a questionnaire designed for this purpose.

**Results:** Ninety four (39.2%) cases were males and 146 (60.8%) were females. Slipping was the most prevalent mechanism of falling with the rate of 26.9% followed by falling from height and falling outdoors. Femur was the most frequently injured site (57.5%) while wrist and humerus were the next sites to be injured. Only 7.5% of the cases lived in a safe environment while in 37.2% and 55.2% cases, home environment was partly safe and non-safe, respectively.

**Conclusion:** Fall-related fractures in the studied population is related to cardiovascular and musculoskeletal disorders, low level of physical activity and ignorance of safety principles but, the prevalence of neurologic diseases and drug and alcohol abuse, which have been mentioned as relevant risk factors in some studies, was very low in this population.

**Keywords:** Fall, Fracture, Elderly, Risk Factors.

## Introduction

Prevalence of falling and fall-related injuries and its mortality in the elderly population is increasing. One-third of the elderly experience falling at least once a year and two-third of them will have another fall in six months (1,2). Falling is one of the causes of the murderous and non-murderous injuries in the elderly population. Twenty to thirty percent of the elderly having moderate to severe fall-related injuries will be eventually stricken by disability, loss of independence in ADL (activities in daily living), decline of quality of life, early residence in elderly nursing centers, or even fall-related mortality (such as pulmonary embolism, infections, etc.) (3)

1. (**Corresponding author**), MSc, Occupational Therapy Department, Faculty of Rehabilitation, Shahid Beheshti University of Medical Sciences, Tehran, Iran. aas.bozorgi@yahoo.com
2. MSc Student, Occupational Therapy Department, Faculty of Rehabilitation, Shahid Beheshti University of Medical Sciences, Tehran, Iran. azam_ot@yahoo.com
3. MSc, Occupational Therapy Department, Faculty of Rehabilitation, Shahid Beheshti University of Medical Sciences, Tehran, Iran. shafiee69@yahoo.com
4. Assistant Professor, Physical Therapy Department, University of Social Welfare and Rehabilitation Sciences, Tehran, Iran. kahlaee@uswr.ac.ir
5. MSc of Biostatistics, Qom University of Medical Sciences, Qom, Iran. mehdi_r_d@yahoo.com

Falling is a multifactorial phenomenon. Previous studies have categorized the relevant factors as intrinsic and extrinsic risk factors. Gender, muscular weakness, history of falling, balance and gait impairment, sensory deficits such as somato-sensory, vestibular and visual (1,2,4,6,7) impairment, chronic disease such as Parkinson, cardiovascular diseases and arthritis, difficulty in ADL performance, depression, cognitive impairment, physical fitness and age more than 80 years (2,6), constitute intrinsic risk factors. Among extrinsic risk factors, drug abuse, environmental factors, alcohol overuse, ignorance of safety principles, use of inappropriate shoes, dressing, aiding instruments and home design and decoration, seem to be the most important ones (8,9). Fractures including pelvic, femoral, arm and forearm fractures constitute 42% of fall-related injuries. Fall-related fractures are the most prevalent causes of mortality in cases above 60 years old which can negatively affect their quality of life (3,5).

The purpose of this study is to investigate the prevalent fall-related fractures risk factors in the elderly people referred to Tehran hospitals in the year 2011.

**Methods**

This descriptive study investigated the prevalence of fall-related fractures' risk factors in 240 elderly persons older than 60 years referred to Akhtar, Sina and Shafa hospitals in 2011 for the fractures of wrist, femur and proximal humerus. Non-fall fractures such as those following other traumas and pathologic carcinogenic and padget disease fractures were excluded from this study. The elderly meeting the requirements of the inclusion criteria were recruited into the study after getting familiar with the details of this study and signing the informed consent form approved by the medical ethics committee of Shahid Beheshti Medical University.

A special purpose questionnaire exploring the risk factors of fall-related fractures was filled by the examiner based on the pa-tients' medical records and their response to the questions about their living environment. The data extracted from the questionnaire were used to describe the studied variables by descriptive statistics. The questionnaire was developed based on the "Comprehensive Post-Fall Evaluation Tool" and included questions on intrinsic and extrinsic fall-related fractures' risk factors and was accompanied by a home checklist. The validity of the questionnaire was assessed as context validity. For this purpose, the first draft of the questionnaire was exposed to 10 specialists from different relevant fields of rehabilitation, orthopedics, neurology and ergonomics and their comments about the questionnaire were taken into account. To test the reliability of the questionnaire, the responses of 30 subjects in a 2 to 3 week interval to the included questions were compared.

The studied variables included intrinsic risk factors of sensory and cognitive deficits, disabilities, neurologic and orthopedic diseases, level of physical activity (ADL) and extrinsic risk factors of drug use (excluding vitamins and common cold drugs), use of narcotic substances, malnutrition and home environment hazards. Gender was also considered as a potential risk factor.

The medical history and records of all the elderly patients referred to the mentioned hospitals by wrist, femur and proximal humerus fracture as the chief complaint were studied. Those who met the inclusion criteria were recruited into the study and there was no sampling process. In cases of cognitive disorders (Alzheimer disease, dementia, etc. which were judged from the patients' medical records), the questionnaire was filled according to the statements of the patients' family members.

Osteoporosis was diagnosed with the confirmation of the specialist. The required and standard milk and dairy intake was considered as 3 glasses (750$^{cc}$) for adults (22). Appropriate home environment was considered as an environment with adequate lighting and firm handholds and stair rails. The subjects were considered as hypoactive

if having less than 4 hours of IADL (22). Body mass index (BMI) of less than 20, between 20 and 24.9 and above 25 were considered as thin, normal and fat, respectively (22). A home checklist was filled by the examiner (trained occupational therapist) to assess the home environment of the subjects. Fifteen questions were included in the checklist on stairs path and rails, home lighting, floor covering, bath equipment and shelves height. A positive score was denoted for each positive (appropriate) condition and no score for any negative condition. Each subject received a score between 0 and 15 based on his/her home environment. Those with scores less than 8 were considered as living in a non-safe home environment while, scores between 9 and 11 and scores above 11, were considered as partly safe and safe environments, respectively.

*Statistical analysis*
Mean, standard deviation and frequency

percentage of the data were used as central and dispersion indices to describe the findings of the study. SPSS version 18 was used as the statistical software.

**Results**
Two hundred and forty subjects with mean (± standard deviation) age and BMI of 72.24±8.81 years and 24.79±5.56 kg/m², respectively, with wrist, femur or proximal humerus fracture following a fall were recruited into the current study. Ninty four subjects (39.2%) were male and 146 (60.8%) were female. Table 1 illustrates the prevalence of different fracture sites based on the falling mechanism.

As shown in table 1, slipping was the most prevalent (62 cases, 26.9%) mechanism of falling followed by falling from height and falling occurring outdoors. Femur fracture was the most frequent one with the rate of 138 cases (57.5%) and wrist and proximal humerus were next prevalent ones.

Table 1. Prevalence of wrist, femur and proximal humerus fractures based on falling mechanism

| | Fracture Site | Wrist | Humerus | Femur | Total |
|---|---|---|---|---|---|
| | | Number (percent) | Number (percent) | Number (percent) | Number (percent) |
| | Fall from height | 24(27.3%) | 0(0%) | 36(26.8%) | 60(26.1%) |
| | Falling outdoors | 14(15.9%) | 1(12.5%) | 24(17.9%) | 39(17%) |
| Falling Mechanism | Slipping | 31(35.2%) | 4(50%) | 27(20.1%) | 62(26.9%) |
| | Getting out of bed | 2(2.3%) | 0(0%) | 10(7.5%) | 12(5.2%) |
| | Bathing | 15(17%) | 2(25%) | 13(9.7%) | 30(13%) |
| | Changing clothes | 0(0%) | 0(0%) | 8(6%) | 8(3.5%) |
| | Ankle sprain | 0(0%) | 0(0%) | 4(3%) | 4(1.7%) |
| | Stumbling | 2(2.3%) | 1(12.5%) | 12(9%) | 15(6.5%) |

Table 2. Prevalence of wrist, femur and proximal humerus fractures based on medical conditions

| variable | Wrist | Humerus | Femur | Total |
|---|---|---|---|---|
| | Number (percent) | Number (percent) | Number (percent) | Number (percent) |
| Diabetes | 17(34%) | 4(8%) | 29(58%) | 50(100%) |
| Hypertension | 45(37.8%) | 5(4.2%) | 69(58%) | 119(100%) |
| Hypotension | 12(42.9%) | 1(3.6%) | 15(53.6%) | 28(100%) |
| Bone fracture | 36(51.4%) | 3(4.3%) | 31(44.3%) | 70(100%) |
| osteoporosis | 66(48.2%) | 6(4.4%) | 65(47.4%) | 137(100%) |
| Parkinsonism | 1(25%) | 0(0%) | 3(75%) | 4(100%) |
| dementia | 1(12.5%) | 1(12.5%) | 6(75%) | 8(100%) |
| Stroke | 0(0%) | 1(8.3%) | 11(91.7%) | 12(100%) |
| epilepsy | 1(33.3%) | 0(0%) | 2(66.7%) | 3(100%) |
| Visual deficiency | 67(39.2%) | 7(4.1%) | 97(56.7%) | 171(100%) |
| Auditory deficiency | 12(21.1%) | 0(0%) | 45(78.9%) | 57(100%) |

Table 3. Prevalence of some musculoskeletal, neurologic and psychological disorders in the studied cases

| variable | Number (percent) | variable | Number (percent) |
|---|---|---|---|
| Previous bone fracture | 70(29.9%) | Knee pain | 126(55.3%) |
| dislocation | 25(10.9%) | Psychological problems | 14(5.9%) |
| osteoporosis | 137(59.3%) | Attention disorders | 59(25.5%) |
| Arthritis | 125(56.8%) | Orientation disorders | 20(8.7%) |
| Muscular atrophy | 14(6.2%) | Memory deficit | 53(23.1%) |
| Limited ROM | 30(13.9%) | | |

Another factor studied in this project was the prevalence of some potentially related medical conditions in the elderly patients the result of which is demonstrated in Table 2.

Table 3 shows the prevalence of musculoskeletal, neurologic and psychological disorders in the studied subjects. Six patients with psychological disorders had depression and three had the diagnoses of anxiety.

Narcotics and alcohol use, nutritional state, and physical activity level of the subjects are demonstrated in Tables 4 and 5, respectively.

Evaluation of the safety conditions within home environment of the patients revealed that only 18 (7.5%) subjects lived in a safe environment while, 90 (37.2%) and 132 (55.2%) cases had a partially safe and non-safe home environments, respectively.

**Discussion**

Fractures (including fall-related ones) are among major causes of disability and mortality in the elderly subjects. The rate of such fractures is increasing which emphasizes the need to explore its prevention (1). The very

first step towards this goal might be the recognition of interfering factors. This study was performed to investigate the relevant factors contributing to such fractures in the elderly Iranian population.

60.8% of the subjects were female; and males constituted 39.2% of the patients of our study. Kato et al. in a study on 6420 elderly subjects reported that female elderly subjects both have more falling rate and in case of falling, are more susceptible to fracture (23). The reason might be osteoporosis, muscular weakness and lower level of physical activity in women comparing men.

Noting the mechanism of falling, slipping was the most frequent one. Falling from height, falling in the bathroom, stumbling, falling while getting out of the bed, while dressing and following ankle sprain was the order of other frequent mechanisms. About one fifth of the falls occurred outdoors. These finding are compatible with those of Formiga et al. who found 70% of the falls occurring indoors. One reason might be that the elderly people spend most of their time indoors (20).

Table 4. Medication, drug abuse and alcohol consumption rate in the studied cases

| Variable | Number (percent) | Variable | Number (percent) |
|---|---|---|---|
| smoking | 59(25.4%) | Drug abuse | 11(4.8%) |
| Alcohol consumption | 2(0.9%) | medication | 113(47.7%) |

Table 5. Rate of dairy uptake and physical activity in the studied cases

| Variable | Number (percent) | Variable | Number (percent) |
|---|---|---|---|
| Regular dairy uptake | 156(68.1%) | Nutrition and digestion disorders | 64(28.1%) |
| Level of dairy uptake (number of glasses) | One (58.2%) Two (35.4%) | Regular exercise | 67(29.3%) |
| | Three (5.7%) Four (0.6%) | Physical activity more than 4 hours | 26(12.2%) |

The most frequent site of fracture following falls, was femur which is consistent with some other studies (15,18). Niktab reported that pelvic fracture constitutes half of all fall-related fractures in elderly subjects (22). One possible explanation for the frequent incidence of femur and pelvic fractures in the elderly subjects might be the mechanism of their falls and how they react to falling. These subjects are usually incapable of showing an efficient compensatory response to balance perturbations due to their functional disabilities and slow reactions. For example, they might not be able to utilize outstretching their arms to prevent falling on their legs as fast as younger adults do. Thus, it is not surprising that wrist fractures are not so common in this group of subjects.

Bases on our findings, about one fifth of the subjects were stricken by diabetes type II. Other studies have revealed that diabetes can increase fracture risk by 1.4 to 1.7 times without altering BMI. Diabetes affects the osseous tissue by different mechanisms such as obesity, sedimentation in collagen fibers, renal dysfunction, microangiopathy and chronic inflammation (25,27).

More than half of the subjects had cardiovascular problems in their medical history. Most of the studies such as that of Hansen, have introduced cardiovascular disorders as important fall-related fractures' risk factors (21). In the presence of such diseases, cerebral circulation might be corrupted. This can lead to reduced consciousness and loss of balance, the result of which can be falling (28). Other researchers have shown that male and female patients with sub-clinical cardiovascular diseases are in risk of losing bone mass, osteoporosis and fracture, 6 and 4 times more than healthy people, respectively (29).

The results of this study are compatible with those introducing osseous disorders and arthritis and muscular weakness as major risk factors of fall-related fractures (11-14). Any disorders in the musculoskeletal system may lead to instability and increased risk of falling. Osteoporosis, which is so prevalent in the elderly, is usually accompanied by balance disorders, reduced range of motion and pain.

All these factors make the osteoporotic subjects more vulnerable to fall. It has been shown that patients with history of previous falls are more likely (up to three times) to experience future falls. This might be originated from multiple intrinsic factors (2,3, 24,26). Formiga et al reported that 22% of patients with femoral fracture had a history of previous fall.

Almost all of the subjects in our study were free from neurologic disorders. A previous study in Iran had claimed that, due to the low rate of neurologic diseases in the elderly with history of fracture following fall, these factors might not be considered as relevant risk factors (22). It should be noted that this relationship might be different in elderly with other characteristics such as being significantly older since there are studies suggesting neurologic disorders as relevant risk factor for fall-related fractures (2,3,31). It is worth noting that patients with sensory or motor neurologic dysfunction are reluctant to participate in physical activities and tend to perform motor tasks with lower speeds. These accommodations can reduce the risk of fracture in these patients. This is not controversial with the significance of accurate function of the neural system to maintain balance and prevent falls but is indicative of compensatory motor strategies utilized by these patients in expense of loss of normal function, agility and independence. Otherwise, misdiagnosis might be another factor to consider in this regard.

Visual and auditory disorders were prevalent in our patients which is compatible with the previous studies (10,12,13). The most important role of these sensory systems is to determine the body posture and its relation to the environment and recognizing the challenging factors in the environment. That is why any disorders in these systems may perturb body stability and increase the risk of falling and fracture (2,32).

The most prevalent cognitive disorder in the studied subjects was attention deficit. Other psychological disorders such as depression, orientation and memory deficits were also present with lower rates. Cognitive disorders like reduced level of attention, disturbed

judgment, depression and anxiety, might all affect body balance both directly and indirectly (by reducing physical activity level and becoming secluded) (1,2).

Smoking and drug abuse can reduce BMD and increase fracture risk. In this study, the rates of smoking and drug abuse were 25% and 5%, respectively which is comparable with other studies (7,22). The rate of alcohol consumption was almost zero while some other studies have reported different results. This noticeable difference might go back to religious believes in Iran which keeps people away from alcohol consumption. Another probability to be considered is that some patients might not have reported this item in full honesty because of cultural considerations.

Almost half of the patients reported consuming drugs. Several studies have shown a strong relationship between drug use (more than 4 types) and fall-related fractures (33). The most relevant ones have been reported to be anti-depressants and psychotic drugs. It should be considered however that, most of these studies were descriptive, retrospective and controlled which makes them unable to yield cause and effect relationship. Some researchers believe that this relationship goes back to the co morbidities present in these patients for which drugs are prescribed, not the drug effect itself (20).

Only less than half of the subjects were taking more than one glass of milk a day. In Niktab's study, it was also reported that Iranian elderly with history of falling and fracture, dairy consumption is less than what is believed to be needed (22). Regular calcium supplement uptake was not as recommended in most of the patients, either. There are studies denying any significant difference between calcium uptake in elderly with fall-related fractures and matched controls (22). It should be noted that calcium uptake level might reflect the need for its supplementary consumption and indirectly point to the problems such as low BMD in those taking more calcium. Since BMD is not measured in our patients, direct judgment is not possible here.

Less than one third of the studied patients reported regular physical activities prior to falling and fracture. Physical activity is a major part of healthy life style and preventive programs for the elderly which keeps neuro-muscular performance, balance and reactive responses efficient (1,2,7,23). Keegan et al has reported that regular physical activity can reduce the risk of fall-related fractures (7). Since many fractures have been reported to occur during strenuous or secondary physical activity, it is worth mentioning that some physical activities have the potential to increase fall risk.

According to the findings of this study, home environment was unsafe in more than half of the patients and only 7.5% of the patients with fracture were living in safe homes. Previous studies have also emphasized the role of home environment safety in the determination of fall risk (13,16,17,22). Since most falls occur during common daily activities such as transitions and more than half of them occur indoors, standardizing home environment based on safety rules, is a major part of the preventive fall program (8,11,19). Some of the risk factors in this regard are floor obstacles, wires and cables in the path, small rugs which can easily move, lack of proper handhelds in the bathrooms and staircases, slippery bathroom and kitchen floors, inappropriate furnishing and lighting.

## Conclusion

The findings of the current study reveal that risk factors of fall-related fractures in elderly population resident in Tehran are mostly the same ones as mentioned in other elderly populations. These factors include cardiovascular and musculoskeletal disorders, low level of physical activity and unsafe home environment; but neurologic diseases and alcohol consumption rates were so lower than those reported in most other studies that we cannot suggest them as suspicious risk factors for fall-related fractures in the studied population.

## References

1. Lookabaugh H, Esdale A. Comprehensive fall prevention for community-dwelling older adults. michigan department of community health, chief administrative officer. Jean Chabut, RN. 2005: 6-71.

2. Edelberg HK. Evaluation and Management of Fall Risk in older Adult. New York, 2006: 11(10):1-40.

3. Stevens J.A, Curse P.S, Finkelstein EA, Miller TR. The Costs of Fatal and Nonfatal Falls among Older Adults. Injury Prevention, 2006, 12: 290-50

4. Lemier M, Silver I. Falls among Older Adults: Strategies for pervention. Washington State Department of Health, 2008: 4-22.

5. Schwartz AV, Nevitt MC, Brown BW. Increased falling as a risk factor for fracture among older women, the study of osteoporotic fractures. Am J Epidemiol. 2005, 161:180-185.

6. Northridge ME, Nevitt Mc, Kelsey JL, Link B. Home Hazards and Falls in the Elderly, the Role of Health and Functional States. Am J. Public Health, 1998, 85(4): 509-515.

7. Keegan TH, Kelsey JL., King AC., et al. Characteristic of Fallers Who Fracture of The Foot, Distal Forearm, Proximal Humerus, Pelvis, And Shaft of the Tibia/Fibula Compared with Fallers Who do not Fracture. Am J Epidemiol. 2004,159:192-203.

8. Grisso J.A, Kelsey J.l, Strom Bl, Chiu Gy, et al. Risk factors for falls as a cause of hip fracture in women. the northeast hip facture study group. New England Journal of Medicine 1991; 324(19); 1326-31.

9. Van Helden S, Wyers CE, Dagnelie PC, Van Dongen Mc, Willems G, et al. Risk of falling in patients with a recent fracture. BMC Musculosklet Disorder, 2007, 8: 55.

10. Gabell A, Simons MA. Fall in the healthy elderly: Predisposing causes: Department of Geriatric medicine. 1985: 28(7); 965-975.

11. Blake A.J, Morgan K. Falls by Elderly people at home: Prevalence and associated factors. Oxford journal Age and Aging. 1988. 17(6): 365-372.

12. Lipsitz LA, Jonsson PV, Kelley MM, Koestner JS. Causes and correlates of recurrent falls in ambulatory frail elderly. J. Gerontol. 1991 Jul; 46(4): 14-22.

13. Lach HW, Reed AT, Arfken CL, Miller JP. Falls in the elderly: Reliability of a classification system. J Am Geriatr Soc. 1991 Feb; 39(2) :197-202.

14. Graafmans W, Ooms ME, Hofstee HM, Bezemer PD, Lips P. Falls in the elderly: A prospective study of risk factors and risk profiles. Am J epidemiology .1996 Jun; 143(11):1129-1136.

15. Tromp AM, Smit JH, Deeg DJH, Bouter LM, Lips P. Predictors for falls and fractures in the longitudinal ageing study Amesterdam. J Bone Miner Res. 1998; 13: 1932-1939.

16. Niino N, Tsuzuku S, Ando F, Shimokata H. Frequencies and circumstances of falls in the national institute for longevity sciences, Longitudinal Study of aging,2000.

17. Asakawa Y, Takahashi R, Kagawa J. Falling accidents among metropolitan elderly resulting in emergency ambulance transfer. 2001 Jul; 38(4): 534-9.

18. Stalenhoef P. A risk model for prediction of recurrent falls in community- dwelling elderly, A prospective cohort study. J. of clinical epidemiology, 2002; 55(11): 1088-1094.

19. Monaco MD, Vallero F, Toma ED, Lauso LD, et al. A Single Home Visit by an Occupational Therapist Reduces the Risk of Falling After Hip Fracture in Elderly Women. J Rehabil Med, 2008; 40: 446-450.

20. Formiga F, Navarro M, Daso E, Chivte D, Ruiz D, et al. Factors Associated With Hip Fracture-Related Falls Among Patients With A History of Recurrent Falling Bone,2008: 43; 941-944.

21. Hansen RD, Fiatarone MI, Singh NA. Methodology and Baseline Characteristics for the Sarcopenia and Hip Fracture Study. J. of Gerontology, 2009.No.5; 568-575.

22. Nick taba A, Moridy D, A Study of the Causes of the Fractures of Hip in Elderly People Hospitalized In Kerman, Journal of Rehabilitation ,1380; 7, 39-46.

23. Kato R, Takagi C, Sakurai N, hoshi T.Risk factors for falls and survival after falling in elderly people in a community.Nihon koshu eisei zasshi,2012 May; 59(5):305-14.

24. Fitzgerald G, Boonen S, Compston JE, Pfeilschifter J, Hooven FH. Differing risk profiles for individual fracture sites: Evidence from the global longitudinal study of osteoporosis in women. J Bone Miner Res, 2012 May; 10:102-114.

25. Lu FP, Chan DC, Kuo HK, Wu SC. Sex differences in the impact of diabetes on the risk of geriatric conditions. Geriatr Gerontol int, 2012 jun; 10:1-2.

26. Harada A. Assessment of fall risk and fall prevention. Clin Calcium, 2012 Jun; 22(6):852-6.

27. Dominguez LJ, Muratore M, Quarta E, Zagone G. Osteoporosis and diabetes. Reumatismo, 2004; 56(4):235-41.

28. Gerber Y, Melton LJ, Weston SA, Roger VL. Association between myocardial infarction and fractures: an emerging phenomenon. Circulation, 2011; 124(3):297-303.

29. Den UY, Nurmohamad MT, Van LH, Raterman HG. Sub clinical cardiovascular disease is associated with increased bone loss and fracture risk. Arthritis Res Ther, 2011; 13(1):R5.

30. Antapur P, Mahomed N, Gandhi R. Fractures in the elderly: when is hip replacement a necessity? Clin interv Aging, 2011; 6:1-7.

31. Weerdesteyn V, Niet M, Geurts AC. Falls in individuals with stroke. J Rehabil Res Dev, 2008;

29

45(8):1195-213.

32. Lord SR. Visual risk factors for fall in oldere people. Age Ageing, 2006; 35(2): 42-45.

33. Daal JO, Lieshout JV. Falls and medications in the elderly. J of medicine, 2005; 63(3).

34. Riggs BL, Melton LJ, Robb RA, Camp JJ, et al. Population –Based Analysis of the Relationship of Whole Bone Strength Indices and Falls-Related Loads to Age And Sex-Specific Patterns of Hip and Wrist Fractures. J Bone, 2006, 315-322.

35. Huang TT, Liang SH, et al. A randomized clinical trial of the effectiveness of a discharge planning intervention in hospitalized elders with hip fracture due to falling. J Clinical Nwisinglu.2005, 1193-1201.19.

36. Gregory A, Elmer PJ, Smith DH. Older women with fractures: patients falling through the cracks of guideline recommended osteoporosis screening and treatment. J Bone and Joint Surgery, 2003, 2294-2302.

37. Rucker D, Rowe BH, Johnson JA, Steiner IP, et al. educational intervention to reduce falls and fear of falling in patients after fragility fracture: results of a controlled pilot study. Preventive Medicine, 42(2006), 316-319

38. Lopes KT, Costa DF, Santos LF, Castro DP, Baston AC. prevalence of fear of falling among a population of older adults and its correlation with mobility, dynamic balance, risk and history of falls.

Rev. Bras Fsioter, 2009:13(3):223-229.

39. Lauritzen JB. Hip fracture: incidence, risk factors energy absorption and prevention. Bone, 1996. 18: 65-75.

40. Fiatarone MA, Singh NA, Hansen RD, Finnegan TP, Allen BJ. Methodology and hip fracture study: a 5-year prospective study. Journal of Gerontology, Biol Sci, 2009, 5, 568-574.

41. Bradley D. Lloyd, Dominique A .Williamson, Nalin A. Singh, et al. Recurrent and injurious falls in the year following hip fracture: a prospective study of incidence and risk factors from the sarcopenia and hip fracture study. Journal of Gerontology, 2009, 559-609.

42. De Quaker J, Tubing L, and Rutten P. Relative risk fracture for osteoporotic fracture: a pilot study of the meds questionnaire. Clinical Rheumatology, 2005; 10: 49-53.

43. Kanis J.A, Mcclosky EV. Evaluation of the risk of hip fracture. Bone, 2007; 127-132.

44. Jansen I. Heymsfield SB, Baumgartner Run, Roots R. Fracture prevention with vitamin d supplementation: a meta-analysis of randomized controlled trails. JAMA 2005, 293:2257-2264.

45. Vallas B.J, Wayne SJ, Romero LJ, Baumgartner RN, Garry PJ. Fear of falling and restriction of mobility in elderly fallers. Age and Ageing, 1997, 26:189-193.