Original article

Risk factors and epidemiological profile of hip fractures in Indian population: A case-control study

CrossMark

Kaustubh Ahuja [a], Sagnik Sen [a, *], Dinesh Dhanwal [b]

[a] Maulana Azad Medical College, New Delhi, India
[b] NMC Specialty Hospital, Abu Dhabi, United Arab Emirates

A B S T R A C T

Objectives: This analytic retrospective case-control study was designed to analyze risk factors and the epidemiological profile of hip fractures among the Indian population with special importance to the mechanism of injuries.

Methods: Patients of hip fractures (n = 41) and age- and sex-matched healthy volunteers (n = 41) were interviewed by a questionnaire regarding the occurrence of the fracture, past history of diseases and long-term medication usage, past and physical activity, supplements, smoking, and alcohol intake. The data were tabulated using descriptive statistics and logistic regression was used to determine significant risk factors.

Results: Age group 60–69 was found to be most affected by hip fractures, though an early onset of fractures was noted in males. Falls due to slipping indoors from standing position was found very commonly. However, an increasing trend of falls was noted from lying down position in the older age groups which was more common during the morning and night hours. Logistic regression analysis for the detection of risk factors was applied to the various variables in the questionnaire. Active status in the past was inversely related (odds ratio [OR], 0.33; P < 0.05) to fracture risk while alternative medication usage in the past 1 year (OR, 4.086; P < 0.05) and significant alcohol consumption were directly associated with fracture risk (OR, 5.484; P < 0.05). A potential inverse relation of use of calcium supplements in the past 3 months and fracture risk (OR, 0.872) was seen, although this was not significant. A potential positive relation of smoking with hip fractures was also seen, but not found significant (OR, 2.204).

Conclusions: Hip fractures in the elderly population are on a rising trend especially in the Indian subcontinent due to a number of factors both hereditary and acquired. Simple measures like routine usage of bedside railing, wall-side railings at an appropriate height, high friction tiles inside rooms and washrooms, and adequate lighting indoors can play a significant role in reducing falls and hip fractures among the elderly.

© 2017 The Korean Society of Osteoporosis. Publishing services by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

1. Introduction

Osteoporotic hip fractures have become a major cause of morbidity and mortality in the adult and elderly population around the world. Hip fractures are becoming a matter of concern in Asia particularly because of a 2–3 times increase in their incidence in almost every country in the continent [1,2]. The incidence of hip fracture is estimated to rise from 1.66 million in 1990 to 6.26 million in 2050 [3]. Apart from an increasing urbanization throughout Asia, there has also been an increase in the proportion of the elderly population due to an increase in average life span [1,4]. With changing world population dynamics, it has been estimated that more than half of these fractures will be concentrated in Asia by the year 2050 and although the exact reason for this geographic distribution ispoorly understood, proposed contributing factors include genetic factors, less bone mineral content,

* Corresponding author. Maulana Azad Medical College, Bahadur Shah Zafar Rd, Balmiki Basti, New Delhi, Delhi, 110002, India.
E-mail address: riksag@gmail.com (S. Sen).
Peer review under responsibility of The Korean Society of Osteoporosis.

physical activity, aging population, and environmental factors such as diet and vitamin D levels. Risk factors for hip fracture include widespread Vitamin D and calcium deficiency, negligence towards osteoporosis, alcohol consumption, smoking, reduced physical activity levels, obesity, and migration status.

The purpose of this study was to identify and analyze the preceding events and subsequent mechanism of trauma and other risk factors responsible for hip fractures in Indian population and to compare these factors with healthy control population to study their contributory significance. To the best of our knowledge, the influence of these factors on hip fractures (intracapsular or extracapsular) and their significance in Indian population has not been studied extensively till to date. The understanding of these risk factors and their significance will help policy makers and health care providers to develop strategies and prioritize them to reduce the rising trend of hip fractures in India [5].

2. Methods

This analytic retrospective case-control study (level III evidence) was conducted in at a tertiary care center in New Delhi during the months of January 2014 to December 2014. Twenty-one men and 20 women patients (n = 41) aged 40 years and above admitted with radiologically detected intracapsular and extracapsular fractures of femur were included as cases. Sample size calculation was done using a prevalence rate of 152—400 fractures per 100,000 population [6] at a confidence interval of 95% and keeping α-error at 0.05 and both controls and cases were selected accordingly. Exclusion criteria held that patients having femur shaft fractures, pathological fractures (due to neoplasia, Paget disease, osteogenesis imperfecta, etc.), and road traffic accident cases with multiple fractures were going to be excluded from the study. An equal number of age and sex matched healthy controls were recruited from amongst the patient relatives attending various clinics of our hospital. Age matching was done within ±2 years of the age of the cases. The study was started only after obtaining clearances from the Institutional Review Board of Maulana Azad Medical College (F-1/IEC/MAMC/30/2/2012/141). All the subjects of the study gave their full, free and voluntary consent and the study adhered to the tenets of the Declaration of Helsinki. Subjects were interviewed using a structured pre-determined questionnaire (Supplementary material) about the following study variables.

2.1. Physiological data

Height, weight, and body mass index (BMI; kg/m^2) of cases and controls were measured.

2.2. Place and time of fracture

They were asked about the place of the occurrence of the trivial trauma which led to the fracture, whether it was indoors or outdoors. If indoors, they were asked if it had happened in the room or bathroom; if outdoors, whether in the market, road or the stairs. They were also asked to specify the timing of the trauma if it had happened during morning, day, evening or night hours.

2.3. Mode and cause of fracture

They were enquired about the mode of fall; from standing, sitting, lying down position or from a height, and also regarding the cause of fall; if it was due to a blackout, loss of balance or slipping.

2.4. History of weight loss

History of loss of weight, significant enough to loosen their clothes, in the last one year period before the trauma, was asked for.

2.5. Past and present physical activity

Participants were asked about the nature of physical activity they undertook during their 20 when they were of 20—30 years age and 30—40 years age and also in present times. The activities were walking, sitting, standing, squatting, and running/jogging. The response to each activity was scored according to time imparted daily towards that activity. Daily walking was graded as none = 0, 1—4 hours = 1, 5—8 hours = 2, 9—12 hours = 3, and >12 hours = 4, whereas sitting was graded as >12 hours = 0, 9—12 hours = 1, 5—8 hours = 2, 1—4 hours = 3, and none = 4 (considering increased hours of sitting as an indicator of inactivity, unlike in walking). Daily standing, squatting, and running/jogging were each graded as none = 0, 1—30 minutes = 1, 30—60 minutes = 2, and >60 minutes = 3. Scores for each activity were added. The total scores for the ages 20—30 and 30—40 were added and named 'total past physical activity score' (TPaPAS). Likewise, scores for each activity in the present were added and this total was doubled to match TPaPAS, the final value being named 'total present physical activity score' (TPrPAS). Tertiles of respectively the TPaPAS and the TPrPAS of the controls were determined and according to the tertile values both cases and controls were grouped into 6 categories, past inactive, past active, past very active, present inactive, present active, and present very active.

2.6. History of chronic disease and long-term medication usage

The questionnaire included a history of chronic illnesses like arthritis, diabetes mellitus, stroke, hypertension, epilepsy, thyroid illness, and asthma and also more than 6 months intake of drugs for diseases namely hypertension, heart disease, diabetes mellitus, asthma and epilepsy over the last 3 years. They were also asked about more than 6 months intake of thyroid hormone, steroids, sleeping tablets, hormone replacement therapy (HRT) (in women) and alternative medication usage over the last 3 years.

2.7. Smoking and alcohol intake

Participants were enquired about their smoking and alcohol intake history in the last 1 year.

2.8. Statistical analysis

Data analysis was done using IBM SPSS Statistics ver. 21.0 (IBM Co., Armonk, NY, USA). Descriptive statistics using bar charts and pie charts were used to describe the demographic profile of the study population and the details of the occurrences of the fractures. Univariate logistic regression analysis was done to determine the odds of having hip fracture with the variables cited above. Multiple logistic regression analysis was applied to the variables found significant in the univariate analysis, after applying Hosmer-Lemeshow goodness of fit to find the odds of hip fracture occurrence with these selected variables.

3. Results

### 3.1. Fracture characteristics

There were 42 men and 40 women in this study with 41 cases and 41 controls. The distributions of age, height, weight, and BMI in

Table 1
Demographic data of the study population.

Variable	Cases (n = 41)	Controls (n = 41)	P-value
Age, yr	62.04 ± 12.15	59.01 ± 13.18	0.282
Sex, male:female	21:20	21:20	
Height, cm	160 ± 0.97	162.1 ± 0.68	<0.001
Weight, kg	56.09 ± 8.35	61.42 ± 7.41	0.003
Body mass index, kg/m^2	21.97 ± 3.15	23.4 ± 2.79	0.032

Values are presented as mean ± standard deviation or number.

the study population are shown in Table 1. Distributions of fractures across the age groups are presented in Fig. 1. BMI was found to be statistically lower in the fracture group (P = 0.032). Overall, ages 60—69 showed the maximum burden of hip fractures (35.4%). The average age for the intracapsular fractures was 62.08 ± 11.9 years and that of extracapsular fractures was 62.02 ± 12.4 years. In males, 68.9% were extracapsular fractures and 31.1% were intracapsular, while in females, 56.9% were extracapsular and 43.1% were intracapsular. Fifty percent (50%) of intracapsular fractures occurred in the 60—69 age group for both males and females (Fig. 2). In females,
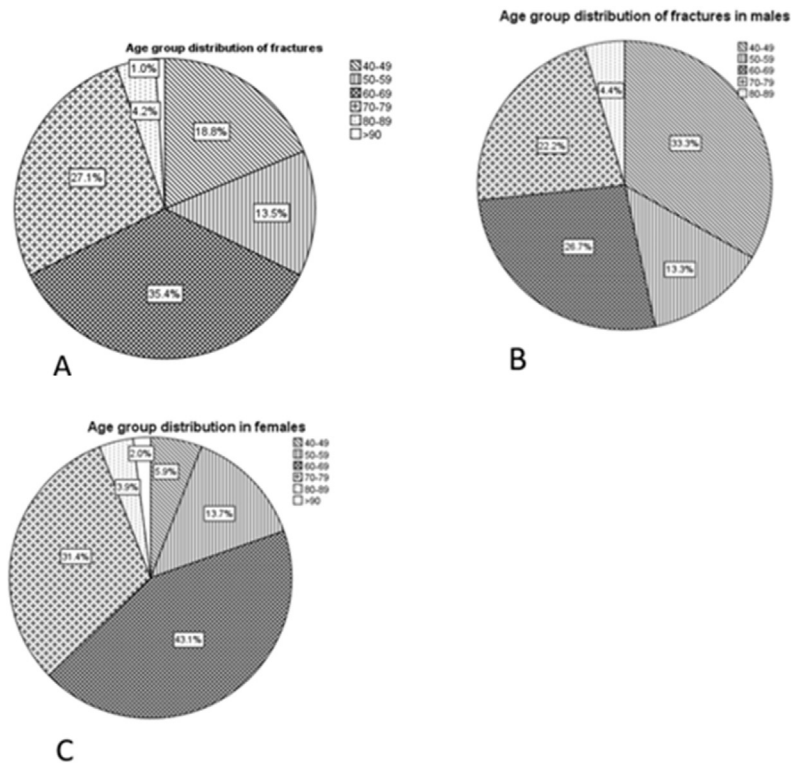
Fig. 1. (A) Age-wise distribution of fracture overall showing 35.4% of total fractures occurring in age group 60—69 years of age, (B) in males with 33.3% of fractures occurring in age group 40—49 years of age, and (C) in females showing 43.1% of total fractures in age group 60—69 years of age.
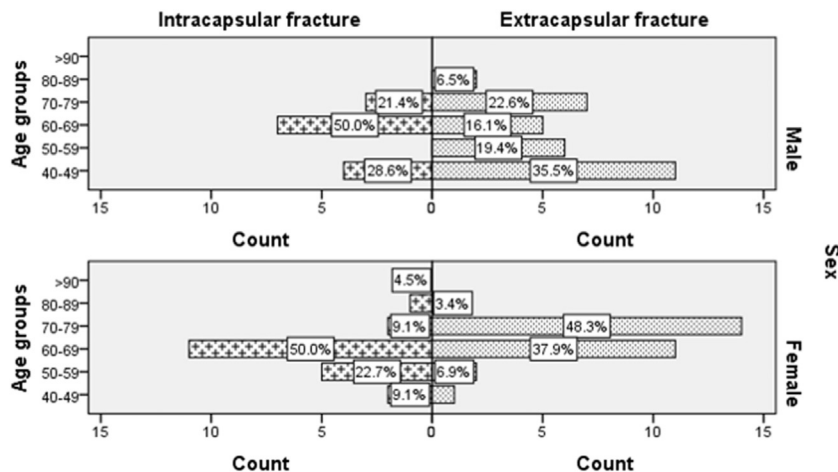
Fig. 2. Age-wise distribution of the type of fracture (intracapsular or extracapsular) in males and females.

48.3% of extracapsular fractures occurred in ages 70—79 years as opposed to the 35.5% in males of ages 40—49 and 22.6% of ages 70—79 (Fig. 2).

3.2. Place, cause, mode, and timing of fractures

Fractures taking place indoors (59.4%) were higher than those occurring outdoors (40.6%). Falls indoors were reported to have occurred more commonly in the room (56.1%) than in the bathroom (43.9%) and outdoor injuries were more commonly occurring on the road (55.3%) followed by stairs (36.8%). Slipping was the more common cause of fall among indoor injuries (61.4%) in contrast to loss of balance (51.3%) in outdoor injuries (Fig. 3). In ages more than 50, slipping was the more common cause of fall leading to injury. Since there was only one patient of age 100, this data was not considered for analysis. Chance of fall due to loss of balance increased with age and was greatest in the ages more than 80 (50%) (Fig. 3). Fall from standing position remained the more common mode of fall throughout the ages (Fig. 4). Incidences of fall from lying down position increased above the age of 70. Moreover, incidences of falls from lying down position at night and at morning were found to be increased in the ages more than 70 as compared to ages less than 70 (66.7% fall at night in ages more than 70 as compared to 0% fall at night in ages less than 70; 16.7% fall in morning in ages more than 70 as compared to 0% fall in morning in ages less than 70).

3.3. Logistic regression analysis

Logistic regression was applied to the various factors under study to estimate the odds of having hip fracture and the results are presented in Table 2. There was no significant difference in the history of weight loss in the past year (odds ratio [OR], 1.932; P = 0.165) and medical therapy for chronic diseases (OR, 1.635; P = 0.27). Calcium supplements taken in past 3 months was associated with a potential negative association (OR, 0.872; P = 0.794) and smoking history in the past had a potential positive association (OR, 2.204; P = 0.111) but both did not reach statistical significance. Physically active in the past (OR, 0.33; P = 0.045), alternative medication usage in the past year (OR, 4.086; P = 0.045 and alcohol usage (OR, 5.484; P = 0.037) were the factors which were significantly associated.

4. Discussion

Over the last few decades, it has been realized that hip fractures due to osteoporosis is a major cause of disability and morbidity in the developed nations and similarly is being increasingly recognized as a huge cause of increased health burden and disability-adjusted life years in the developing countries.

The mean age of the fractures was 62.04 ± 12.15 years. Most fractures (46.6%) in males occurred in ages less than 60 years, while in females maximum fractures (43.1%) occurred in ages more than 60 (Fig. 1). In females, this finding is concordant with the fact that the bone mineral density (BMD) starts falling with increasing age and may or may not be associated with osteoporosis. Moreover, postmenopausal women on account of losing the protective effect of estrogen on bone mineralization, become more susceptible to osteoporosis. Estradiol and estrone have a positive correlation with bone mass in premenopausal women, but not in postmenopausal women [7]. Externally derived estrogen in the form of HRT among urban women may have a protective role towards fractures [8], however in India poor awareness and lack of acceptance of HRT among postmenopausal population can be a significant contributory factor to increasing fragility fractures.

Indian population is unique in a number of ways which predisposes it to a higher risk of generalized osteoporosis and osteoporotic hip fractures as compared to other parts of the world. Factors which determine peak bone mass can be hereditary or acquired including nutrition, smoking, and physical
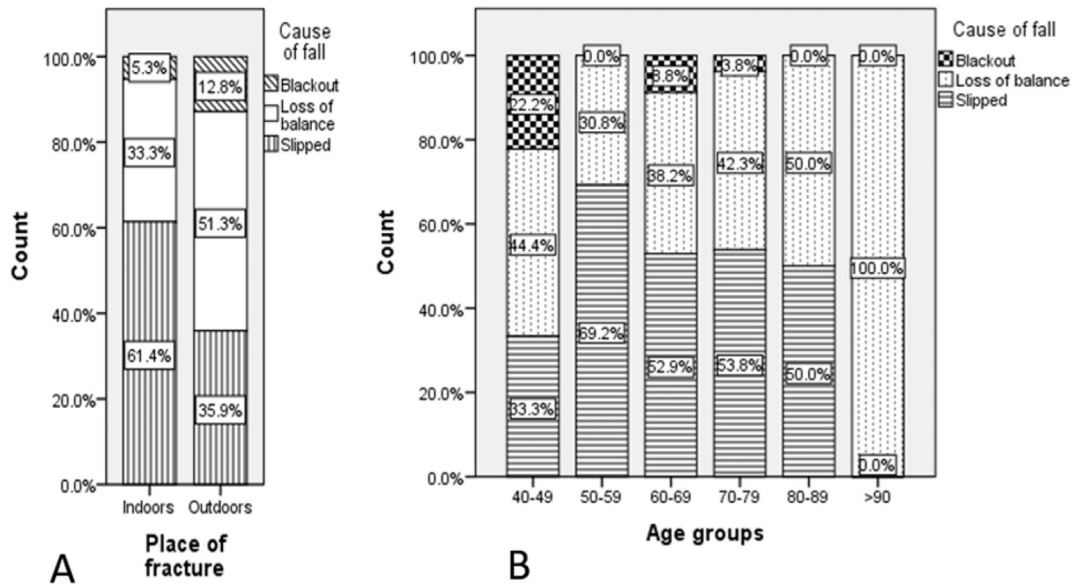
Fig. 3. (A) Causes of fall which led to fall indoors and outdoors. 61% of indoor falls were found to be due to slipping while 33.3% and 5% of falls are due to loss of balance and blackout respectively. (B) Causes of fall in different age groups. In 40—49 years of age loss of balance was the most common cause of fall (44.4%). In age groups 50—59, 60—69, and 70—79 years of age slipping was found to be the most common cause (69.2%, 52.9%, 53.8%, respectively). In age groups 80—89 years loss of balance and slipping were both 50% of the total falls.
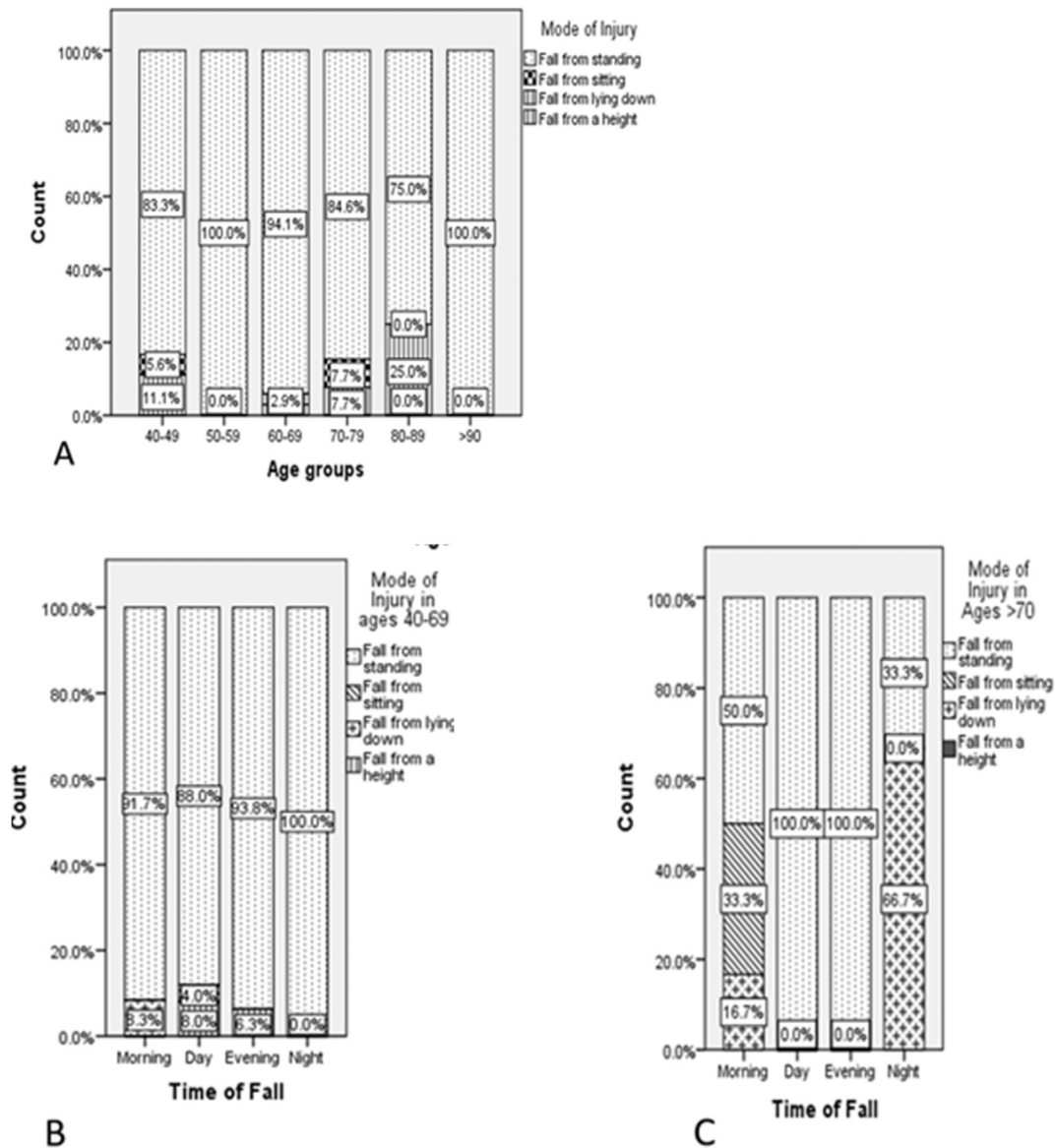
Fig. 4. (A) Mode of injury in different age groups. Fall from standing position was found to be the most common mode of fall across all age groups. (40–49 years, 83.3%; 50–59 years, 100%; 60–69 years, 94.1%; 70–79 years, 84.6%; 80–89 years, 75%; >90 years, 100%). (B) Mode of injury in the ages <70 years during the different times of the day. Fall from standing position was found to be the most common mode of fall irrespective of the time of fall (morning, 91.7%; day, 88.0%; evening, 93.8%; night, 100%). (C) Mode of injury in the ages >70 years during the different times of the day. Fall from standing position was found to be the most common mode of fall during morning (50%), day (100%), evening (100%) while falling from lying down position was the commonest mode of fall during night time (66.7%).

activity apart from aging, menopause and alcohol intake [9]. In a study by Nordin [10], it was found that maximum prevalence of hip fractures among Indian men was in age groups 30–39 years (25%) and 50–70 years (25%) in contrast to 56% of hip fractures occurring in 70–90 years in Finnish men which probably indicates earlier onset of osteoporosis in Indian men. Wong reviewed the prevalence of hip fractures in Singapore among major races and found the average age of hip fractures to be 58 years and 59 years among Indians and Malayans respectively in contrast to 63 years among Chinese which again indicates towards racial predilection of Indians for early onset osteoporosis [11]. Our observation of an increased number of fractures among younger males (<60 years) may be related to low peak bone mass formed during adolescent years coincident with the low vitamin

D levels and deficient dietary calcium of Indian population [12]. Earlier onset of osteoporotic fractures in males may also be explained by the low serum levels of the protective hormone, estrogen and although not accurately documented, a study by Amin et al. [13] has shown that men with low estradiol levels are at increased risk of getting a hip fracture. It is also known that there is a positive correlation between low estrogen levels and low BMD in elderly men.

Vitamin D deficiency may be responsible for osteoporosis in the ages above 50 [14]. Khadgawat et al. [15] showed vitamin D deficiency to be 96.7% prevalent in Asian-Indian patients with fragility hip fractures. Vitamin D receptor gene polymorphism has also been considered as an important factor for the difference in peak bone mass achieved in different races [16]. Bhanushali

Table 2
Logistic regression analysis of various variables under the study.

Variable	Cases (n = 43)	Controls (%) (n = 43)	Odds ratio (95% CI)	P-value
Lost weight in the past 1 yr, yes	17	11	1.932 (0.886–4.213)	0.165
Past activity level				
Very active	13	15	0.433 (0.168–1.117)	0.146
Active	12	18	0.330 (0.130–0.853)	0.045
Inactive	16	8	1	
Present activity level				
Very active	14	18	0.454 (0.171–1.206)	0.311
Active	15	16	0.547 (0.205–1.458)	0.184
Inactive	12	7	1	
History of chronic diseases				
Diabetes, yes	5	4	1.285 (0.399–4.134)	0.724
Hypertension, yes	10	12	0.780 (0.342–1.775)	0.619
Epilepsy, yes	3	1	3.158 (0.456–21.877)	0.328
History of long-term drug usage				
Taking some sort of medication, yes	24	19	1.635 (0.785–3.402)	0.27
Drugs for hypertension, yes	8	12	0.586 (0.248–1.384)	0.306
Drugs for heart disease, yes	1	4	0.231 (0.035–1.511)	0.199
Drugs for diabetes, yes	5	3	1.759 (0.499–6.206)	0.461
Antitubercular therapy, yes	5	3	1.759 (0.499–6.206)	0.461
Alternative therapy, yes	10	3	4.086 (1.289–12.951)	0.045
Calcium tablets taken in past 3 mo, yes	9	10	0.872	0.794
Smoking, yes	16	9	2.204	0.111
Alcohol, yes	9	2	5.484	0.037

CI, confidence interval.

et al. [17] in a study found FF, Ff, and ff (3 genotypes identified for vitamin D receptor gene) frequency in Indian population to be 59%, 36%, and 5% and found considerable variations among different populations, although further studies establishing a relationship between these genotypes and peak BMD in Indian population are warranted.

Apart from genetics, nutrition also plays a major role in determining the peak bone mass. Calcium intake is positively correlated to peak bone mass at all ages [18]. Calcium intake among North American women was found to be 750 mg between 15 and 17 years of age and 500 mg over 65 years of age in contrast to Indian women with mean calcium uptake of 350 mg [19,20]. This low calcium could be due to a number of causes including expensive dairy products and poor bioavailability of calcium from foods and can lead to poor peak bone mass. Thus, low dietary calcium uptake in Indians predisposes them for poor bone mass and osteoporotic hip fractures.

Undernutrition in India is a major health issue among Indian pediatric population because of a number of factors. This may lead to poor peak bone mass which cannot be repaired during adolescence and ultimately lead to generalized osteoporosis and osteoporotic fractures in Indian population. Teotia and Teotia [21] reviewed 1300 Indian patients with protein energy malnutrition and found osteoporosis to be a uniform observation in their skeletal radiographs. Thus concluding apart from calcium and vitamin D, calories, protein, and minerals play an important role in achieving a peak bone mass.

Apple and Hayes [22] have observed that over 90% of hip fractures are associated with falls. The current study was designed to incorporate details of the nonfatal falls which led to the fragility fracture. Falls most commonly took place indoors and more commonly inside the room. Outdoor injuries were more commonly occurring on the road. Slipping was the more common cause of fall among indoor injuries while loss of balance was more common on the road. In ages more than 50, slipping was the more common cause of fall leading to injury. In a study conducted in the rural Indian population by Dandona et al. [23],

home was found to be the most common place of injury in women while in men the farm was a commoner place with slipping being the most common cause of fall. This data is important from the public health point of view in India as the place and time of falls determine how fast the patient is shifted to the nearest health center. Though fall from standing position remained the most common mode of fall across the ages, incidence of fall from lying down position increased above the age of 70, most probably due to the commonly preferred lying down position of choice in this age group. Moreover, falls from lying down position at night and at morning were found to be increased in the ages >70 as compared to ages <70. Chances of fall due to loss of balance increased with age and were maximum in the ages >80. This indicated the slowing effect of senility on the subjects. These findings are of interest because they indicate an interplay of a number of factors like poor vision, poor balance, neurological impairment, etc. with increasing age, which predisposed the subjects to an increased chance of falls during night and morning hours when they might be getting out of bed for going to the washroom. Mitchell et al. [24] showed that people having cataracts, musculoskeletal system, and connective tissue disorder and taking multiple drugs daily were the ones more likely to fall. In reference to our observations, routine usage of bedside railing in households having subjects of more than 70 years of age should be advocated. Also, wall-side railings at an appropriate height, high friction tiles inside rooms and washrooms and adequate lighting indoors can play a significant role in reducing falls among the elderly. Caregiver awareness, alertness and routine supplementation with walking and visual aids should also be practiced.

The odds ratio for significant weight loss in the last 1 year was 1.932 but it was not found to be significant. Literature has recorded weight loss to be significantly associated with loss of BMD and increased risk of hip fractures in both men and women [25].

Very active status in the past (OR, 0.433), very active status at present (OR, 0.454) and active status at present (OR, 0.547) were

not found to be significant, although their odds ratios were suggestive of inverse relation with fracture risk. This might be due to the fact that the population size compared is small. However, active physical activity status in the past was found to be significantly inversely related to hip fracture (OR, 0.33; P < 0.05). Very active and active past physical activity and recent active physical activity have all shown to be associated with markedly reduced risk of hip fracture against those with inactive physical activity in the study by Suriyawongpaisal et al. [26]. It has also been seen that moderate physical activity reduce the risk of fractures, but both extreme activity and inactivity seem to increase the risk of fractures by increasing chances of falls. Physical activity increases muscle mass thereby reducing rate of falls [27]. In this context it is mentionable that the study population was asked about the hours they put in squatting daily, as squatting seems to be a very common posture among the Indian population. Squatting supposedly makes pelvic girdle muscles stronger, hence decreasing the risk of falls. Physically active status may also be related to maintenance of BMD thereby reducing chances of osteoporosis and bone fragility, however, the extent of which has not been determined, and is a debatable issue in its own regard [28].

Past history of chronic diseases and usage of medications for such diseases over a prolonged time may be associated with an increased risk of undiagnosed osteoporosis. Glucocorticoids, androgen therapy for prostate cancer, calcineurin inhibitors, anti-retroviral drugs, selective inhibitors of serotonin reuptake, anti-convulsants, loop diuretics, heparin, oral anticoagulants, and proton pump inhibitors are some of the drugs which have been implicated to increase the risk of osteoporosis [29,30]. Prolonged oral glucocorticoid, i.e., greater than 3 months at a stretch has been shown to increase the risk of fracture by about 50%. In our study, although people having diabetes and epilepsy were found to have a potential direct relationship to hip fracture, the data was not significant, mostly because of the insufficient study population. A similar finding was obtained for people using drugs for diabetes and tuberculosis; again the data was insufficient for analysis due to small population size. Taking some form of medication for long term was found to be potentially directly related to having hip fracture, although not significant. However, usage of some form of alternative medicine (Ayurveda, Unani, Siddha, and Homoeopathy) was significantly related to increased incidence of fracture (OR, 4.086; P < 0.05).

Calcium supplements are being prescribed to women of post-menopausal age to prevent osteoporosis. In the study, data showed that there was a potential inverse relation of use of calcium supplements in the past 3 months and fracture risk (OR, 0.872), but this was not significant. Calcium supplementation has been highly debated over the past decade, mainly due to the cardiovascular side effect of calcium. Many recent studies have failed to show beneficial effects of calcium supplements on prevention of fracture [31,32]. In the deficient population, vitamin D and calcium supplementation together have been documented to have a beneficial role, while either given alone or in the absence of deficiency, the results are unsatisfactory [33]. Hence such therapy should be started only after proper patient selection and indications for usage [34].

Smoking has been associated with increased risk of fractures in previous studies. In the present study, again there is a potential positive relation with hip fractures, but not found significant (OR, 2.204). In a study by Baron et al. [35], it has been seen that smoking is associated with a direct increase in fracture risk and that too related to the duration of smoking and not to the amount of smoking. Moreover, the risk decreased with the duration of cessation of smoking. However, till now understanding of the effect of alcohol intake on fracture risk is incomplete. Baron et al. [35] showed that moderate alcohol drinking seemed to increase BMD. The work by Yin et al. [36] also showed that ingestion of red wine prevented bone resorption in older men, while the same was true with beer drinking among women. However, the association was weak [35]. The current study revealed that alcohol drinking was significantly associated with an increased risk of fractures (OR, 5.484; P < 0.05). A similar association has been observed by Jha et al. [37] but not significant.

One of the few limitations of this study is the limited sample size which affected the statistical significance of few variables which were found to be relevant in existing literature like smoking, alcohol consumption and calcium and vitamin D supplementation. Another limitation of the study is recall bias. Although high-quality questionnaires and well-trained interviewers were employed with comparable extended time given for each case and control but as with any other case control study, a possibility of a recall bias is there.

In the existing literature, there is only one study where the risk factors leading to osteoporotic hip fractures in India have been studied but no study has considered the past physical activity and present activity scoring in such explicit detail to the best of our knowledge. Moreover, no study has delineated in such detail the exact nature and cause of falls in an age-wise distribution. Also, this study included both men and women in the study in contrast to previous studies which concentrated on postmenopausal women. Hip fractures and osteoporosis is on an increasing trend in the Asian population and is an important public health problem. With our study, we tried to study in detail the place, time, cause and mode of hip fractures in patients with an aim of laying down some important public health guidelines which could play an important role in reducing the prevalence of osteoporosis and the prevalence of hip fractures in already osteoporotic individuals in India.

5. Conclusions

Hip fractures in the elderly population are on a rising trend especially in the Indian subcontinent due to a number of factors both hereditary and acquired like smoking, alcohol, low physical activity in present and past, chronic medication or illness. Some factors specific to the Indian population include undernutrition, vitamin D deficiency, lack of awareness about nutrient supplementation, and hormone replacement therapy in postmenopausal women and genetic predilection for early onset osteoporosis. In reference to our observations about the place and mode of injury, simple measures like routine usage of bedside railing, wall-side railings at an appropriate height, high friction tiles inside rooms and washrooms, and adequate lighting indoors can play a significant role in reducing falls among the elderly. Hip fractures in elderly have innumerable risk factors and despite our earnest efforts, few factors may still remain untouched. However, our current observations and inferences may be extrapolated and used by policy makers, healthcare providers, and caregivers in general to adopt various practices to combat the upgoing rates of hip fractures in India.

Conflicts of interest

No potential conflict of interest relevant to this article was reported.

Supplementary material

Questionnaire for Osteoporosis Study

No._____

Strictly private and confidential

From hospital directory
1. Name   :
2. Date of admission :
3. Sex   : M = 1, F = 2
4. Age   :
5. Date of birth   :
6. Address   : _____

7. Hospital number (CR No.) :
8. Contact No.   :

9. Trauma leg   : R = 1, L = 2
10. Neck femur fracture
 (As diagnosed by radiologist from X –ray): Yes = 1, No = 2
11. What is your height? _____feet_____inches = _____ inches
12. What is your weight? _____kg _____ g = _____kg
Have you lost weight in the past one year? Yes = 1, No = 2

Nature of fracture
13. Where did it happen?
 Indoor = 1, Outdoor = 2
14. Where did the fracture occur indoors?
 Room = 1, Bathroom = 2
15. Where did the fracture occur outside?
 Market = 1, Footpath = 2, Stairs = 3
16. When you broke the bone, what did you undergo?
  1. Fall from standing
  2. Fall from sitting
  3. Fall from lying
  4. Fall from a height
  5. Road traffic accident
17. What time of the day did it occur at?
 Morning = 1, Day = 2, Evening = 2, Night = 4
18. Do you remember the accident? Yes = 1, No = 2
19. If yes, was the fall caused by a: -
  1. Blackout
  2. Loss of balance
20. Did you have pain after fracture? Yes = 1, No = 2
21. What other injuries did the fall cause?
  1. Bruising
  2. Severe soft tissue injury
  3. Mild soft tissue injury
  4. Fracture elsewhere

Previous medical history

22. Have you ever broken your hip before?   :   Yes = 1, No = 2
     If yes: -

     How old were you when it happened? <40 = 1, >40 = 2

23. Have you ever broken your wrist?   :   Yes = 1, No = 2
     If yes: -

     How old were you?   _____ years   <40 = 1, >40 = 2

24. Have you ever had:

   1. Arthritis   :   Yes = 1, No = 2
   If yes:
      i. How old were you when it was diagnosed?   <40 = 1, >40 = 2
      ii. Immediately after it, did it stop you walking
       without help from someone else? :   Yes = 1, No = 2

   2. Diabetes   :   Yes = 1, No = 2
   If yes:
      i. How old were you when it was diagnosed?   <40 = 1, >40 = 2
      ii. Immediately after it, did it stop you walking
       without help from someone else? :   Yes = 1, No = 2

   3. Stroke event   :   Yes = 1, No = 2
   If yes:
      i. How old were you when it was diagnosed?   <40 = 1, >40 = 2
      ii. Immediately after it, did it stop you walking
       without help from someone else? :   Yes = 1, No = 2

   4. Thyroid illness   :   Yes = 1, No = 2
   If yes:
      i. How old were you when it was diagnosed?   <40 = 1, >40 = 2
      ii. Immediately after it, did it stop you walking
       without help from someone else? :   Yes = 1, No = 2

   5. Asthma   :   Yes = 1, No = 2
   If yes:
      i. How old were you when it was diagnosed?   <40 = 1, >40 = 2
      ii. Immediately after it, did it stop you walking
       without help from someone else? :   Yes = 1, No = 2

25. Are you on any of the following drugs?
   1. Diuretics (water tablets)   :   Yes = 1, No = 2, DK = 3
     If yes, for how long?   <1, 1 – 2, >3
   2. Thyroid hormone   :   Yes = 1, No = 2, DK = 3
     If yes, for how long?   <1, 1–2, >3
   3. Steroids   :   Yes = 1, No = 2, DK = 3
     If yes, for how long?   <1, 1–2, >3
   4. Sleeping tablets   :   Yes = 1, No = 2, DK = 3
     If yes, for how long?   <1, 1–2, >3
   5. Hormone Replacement Therapy   :   Yes = 1, No = 2, DK = 3
     If yes, for how long?   <1, 1–2, >3
   6. Anti-epileptics   :   Yes = 1, No = 2, DK = 3
     If yes, for how long?   <1, 1–2, >3
   7. Anti-tubercular therapy   :   Yes = 1, No = 2, DK = 3
     If yes, for how long?   <1, 1–2, >3
   8. Alternative medicine   :   Yes = 1, No = 2, DK = 3
     If yes, for how long?   <1, 1–2, >3

History of physical activity

Age	20–30 years	30–40 years	Current
Daily average walking			
Daily average sitting			
Daily average standing			
Daily average squatting			
Daily average jogging/ running			

Walking time: Subsequent break down was by none = 0, 1–6 hr = 1, 7–12 hr = 2, 13–18 hr = 3, 19–24 hr = 4.

Sitting time broken down into 4 levels: none = 4, 1–30 min = 3, 31–60 min = 2, >60 min = 1.
Standing time broken down into 4 levels: none = 0, 1–30 min = 1, 31–60 min = 2, >60 min = 3.
Squatting time broken down into 4 levels: none = 0, 1–30 min = 1, 31–60 min = 2, >60 min = 3.
Running/jogging time broken down into four levels: none = 0, 1–30 min = 1, 31–60 min = 2, >60 min = 3.

Supplements

Have you been taking any supplements (vitamins, minerals, etc.) in the form of pills, capsules, tonics or tablets within the past 3 months?

TYPE OF SUPPLEMENT	RESPONSE	NUMBER PER DAY
Calcium	Yes = 1, No = 2	
Vitamin D	Yes = 1, No = 2	
Iron	Yes = 1, No = 2	

Smoking history (as applicable)

RESPONSE [Yes = 1, No = 2]	
Started smoking at (age)	<20 = 1, 20–30 = 2, 30–40 = 3
Mode(s) of smoking	Bidi = 1, Cigarette = 2
Stopped?	Yes = 1, No = 2
If stopped smoking, how many years back?	<5 = 1, 5–10 = 2, >10 = 3

Alcohol intake history (as applicable)

RESPONSE [Yes = 1, No = 2]	
Started drinking at (age):	<20 = 1, 20–30 = 2, 30–40 = 3
Amount of drink consumed per sitting:	<1 glass = 1, >1 glass = 2
Stopped?	Yes = 1, No = 2
If stopped drinking, how many years back?	<5 = 1, 5–10 = 2, >10 = 3

References

[1] Patel MC, Chandra M, Lo JC. Mortality following hip fracture in Chinese, Japanese, and Filipina women. Am J Manag Care 2016;22:e358—9.

[2] Lau EM. The epidemiology of osteoporosis in Asia. IBMS BoneKEy 2009;6:190—3.

[3] Cooper C, Campion G, Melton 3rd LJ. Hip fractures in the elderly: a world-wide projection. Osteoporos Int 1992;2:285—9.

[4] Kannus P, Parkkari J, Sievänen H, Heinonen A, Vuori I, Järvinen M. Epidemiology of hip fractures. Bone 1996;18(1 Suppl):57S—63S.

[5] Dhanwal DK, Dennison EM, Harvey NC, Cooper C. Epidemiology of hip fracture: worldwide geographic variation. Indian J Orthop 2011;45:15—22.

[6] Dhanwal DK, Siwach R, Dixit V, Mithal A, Jameson K, Cooper C. Incidence of hip fracture in Rohtak district, North India. Arch Osteoporos 2013;8:135.

[7] Corina M, Vulpoi C, Brănişteanu D. Relationship between bone mineral density, weight, and estrogen levels in pre and postmenopausal women. Rev Med Chir Soc Med Nat Iasi 2012;116:946—50.

[8] Michaëlsson K, Baron JA, Farahmand BY, Johnell O, Magnusson C, Persson PG, et al. Hormone replacement therapy and risk of hip fracture: population based case-control study. The Swedish Hip Fracture Study Group BMJ 1998;316:1858—63.

[9] Heaney RP. Bone mass, nutrition, and other lifestyle factors. Am J Med 1993;95(5A):29S—33S.

[10] Nordin BE. International patterns of osteoporosis. Clin Orthop Relat Res 1966;45:17—30.

[11] Wong PC. Femoral neck fractures among the major racial groups in Singapore: incidence patterns compared with non-Asian communities. II. Singap Med J 1964;4:150—7.

[12] Gupta A. Osteoporosis in India: the nutritional hypothesis. Natl Med J India 1996;9:268—74.

[13] Amin S, Zhang Y, Felson DT, Sawin CT, Hannan MT, Wilson PW, et al. Estradiol, testosterone, and the risk for hip fractures in elderly men from the Framingham Study. Am J Med 2006;119:426—33.

[14] Agrawal NK, Sharma B. Prevalence of osteoporosis in otherwise healthy Indian males aged 50 years and above. Arch Osteoporos 2013;8:116.

[15] Khadgawat R, Brar KS, Gahlo M, Yadav CS, Malhotra R, Guptat N, et al. High prevalence of vitamin D deficiency in Asian-Indian patients with fragility hip fracture: a pilot study. J Assoc Physicians India 2010;58:539—42.

[16] Morrison NA, Qi JC, Tokita A, Kelly PJ, Crofts L, Nguyen TV, et al. Prediction of bone density from vitamin D receptor alleles. Nature 1994;367:284—7.

[17] Bhanushali AA, Lajpal N, Kulkarni SS, Chavan SS, Bagadi SS, Das BR. Frequency of fokI and taqI polymorphism of vitamin D receptor gene in Indian population and its association with 25-hydroxyvitamin D levels. Indian J Hum Genet 2009;15:108—13.

[18] Teotia SP, Teotia M. Female osteoporosis — a preventive breakthrough-national context. In: Pathak LA, editor. Postgraduate medicine. Mumbar (India): The Association of Physicians of India; 2004. p. 302—12.

[19] United States National Center for Health Statistics. Dietary intake findings United States 1971-1974. Vital and Health Statistics-Series 11-No. 202. DHEW Publication number (HRA) 77—1647. Hyattsville (MD): U.S. Department of Health, Education, and Welfare; 1977.

[20] Vaishnava H, Rizvi SN. Metabolic bone disease. In: Ahuja MM, editor. Progress in clinical medicine. New Delhi (India): Arnold-Heinemann; 1981. p. 585—600.

[21] Teotia SP, Teotia M. Lack of biochemical and histomorphometric evidence for vitamin D-deficiency rickets in children with protein energy malnutrition. In: Teotia SP, Teotia M, editors. Urolithiasis society of India. Chandigrah: Metabolic bone and stone disease current-research; 1991. p. 14—7.

[22] Apple DF, Hayes WC, editors. Prevention of falls and hip fractures in the elderly. Rosemont (IL): American Academy of Orthopaedic Surgeons; 1994.

[23] Dandona R, Kumar GA, Ivers R, Joshi R, Neal B, Dandona L. Characteristics of non-fatal fall injuries in rural India. Inj Prev 2010;16:166—71.

[24] Mitchell RJ, Watson WL, Milat A, Chung AZ, Lord S. Health and lifestyle risk factors for falls in a large population-based sample of older people in Australia. J Saf Res 2013;45:7—13.

[25] Ensrud KE, Ewing SK, Stone KL, Cauley JA, Bowman PJ, Cummings SR, et al. Intentional and unintentional weight loss increase bone loss and hip fracture risk in older women. J Am Geriatr Soc 2003;51:1740—7.

[26] Suriyawongpaisal P, Rajatanavin R, Takkinstien A, Wanvarie S, Apiyasawat P. Thai Osteoporosis Study Group. Physical activity and risk factors for hip fractures in Thai men. Southeast Asian J Trop Med Public Health 2001;32:196—203.

[27] Karlsson M. Exercise increases muscle strength and probably prevents hip fractures. Lakartidningen 2002;99:3408—13.

[28] Moayyeri A. The association between physical activity and osteoporotic fractures: a review of the evidence and implications for future research. Ann Epidemiol 2008;18:827—35.

[29] Briot K, Roux C. Drug-induced osteoporosis: beyond glucocorticoids. Curr Rheumatol Rep 2008;10:102—9.

[30] Mazziotti G, Canalis E, Giustina A. Drug-induced osteoporosis: mechanisms and clinical implications. Am J Med 2010;123:877—84.

[31] Kurabayashi M. Is calcium supplement useful in aged persons? Calcium supplement doesn't reduce the fracture and vascular risk in aged persons. Clin Calcium 2012;22:736—9.

[32] Reid IR. Osteoporosis treatment: focus on safety. Eur J Intern Med 2013;24:691—7.

[33] López-Torres Hidalgo J, Grupo ANVITAD. Effect of calcium and vitamin D in the reduction of falls in the elderly: a randomized trial versus placebo. Med Clin Barc 2014;142:95—102.

[34] Ringe JD. The effect of Vitamin D on falls and fractures. Scand J Clin Lab Investig Suppl 2012;243:73—8.

[35] Baron JA, Farahmand BY, Weiderpass E, Michaëlsson K, Alberts A, Persson I, et al. Cigarette smoking, alcohol consumption, and risk of hip fracture in women. Arch Intern Med 2001;161:983—8.

[36] Yin J, Winzenberg T, Quinn S, Giles G, Jones G. Beverage-specific alcohol intake and bone loss in older men and women: a longitudinal study. Eur J Clin Nutr 2011;65:526—32.

[37] Jha RM, Mithal A, Malhotra N, Brown EM. Pilot case-control investigation of risk factors for hip fractures in the urban Indian population. BMC Musculoskelet Disord 2010;11:49.