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Fall related injuries: A retrospective medical review study in North India

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ABSTRACT

Introduction: Falls have been identified as a leading cause of injury-related morbidity and mortality in India. However, very little is known about the context and characteristics of such falls. The aim of this study was to describe the context and characteristics of fall related injuries in patients admitted to hospital for fall injury.
Methods: Medical records of patients presenting at the Emergency Department of the Nehru Hospital, Chandigarh, India between March 2008 and February 2009, were reviewed by trained investigators. All injury cases were identified and fall related injury cases were assigned an ICD 10, Chapter XX, External causes of morbidity and mortality code. A review of medical records was conducted to determine the context, nature and site of injury associated with a fall event.
Results: Ten percent (7049) of hospital emergency presentations were due to injuries, and falls were the second leading cause (20%, 1407). Seventy-six percent of the fall related presentations were in males. More than one third (36%) of the fall related presentations occurred in those aged 0–14 years old. Falls from building or structures (35%, 499) were the leading cause for all ages except for those older than 60 years, where same level falls due to slipping, tripping and stumbling (40%, 57) were predominant. Half of all the falls resulted in head injury. Nearly 10% of patients presenting for fall related injury died.
Conclusion: Fall related injuries are an important contributor to hospital emergency presentations, particularly falls from buildings in children, and slips and trips in older people. Given the high proportion of falls that resulted in head injury and death, there is a significant need to develop appropriate interventions to prevent such falls.

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Introduction

Falls are the second leading cause of injury mortality worldwide. The 2004 Global Burden of Disease and Injury study estimated that 11% of all unintentional injury deaths are due to falls.[1] The million death study, a nationally representative study for cause specific mortality in India, reports 25% of all unintentional injuries were due to falls.[2] In absolute numbers, 160,000 deaths due to unintentional fall injuries were estimated for the year 2005; only marginally less than road traffic injury deaths (185 000) for the same year.[2] Fall injuries also lead to significant disability in the population with an estimated 375 DALYs per 100,000 population in India.[1]

International research inidicates that the context, nature and severity of falls varies by age and gender.[3,4] A high fall injury prevelance is reported amongst children in low and middle income settings, and the limited literature suggests that these falls are from height.[5–7] There are very few studies which measure the incidenceon falls in India.[7,8]

Whilst there is mounting evidence of the high burden of fall-related injuries in the population, there is little understanding of the context and characteristics of these falls, which is essential for appropriate prevention and injury control programmes in India. The present study therefore aims to describe the context and characteristics of fall related injury cases presenting at a tertiary care hospital of North India.

Ethical considerations

The study was approved by the Ethics committee of the Post Graduate Institute of Medical Education (PGIMER), India and the Human Research Ethics Committee, University of Sydney, Australia.

Materials and methods

Study setting

The study was conducted at the Nehru Hospital, PGIMER, one of the three hospitals in Chandigarh, North India. Nehru hospital

Abbreviations: ICD, International Classification of Disease; PGIMER, Post Graduate Institute of Medical Education and Research; WHO, World Health Organisation.

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provides services ranging from primary to specialized care, and serves urban, semi-urban and rural populations from near and far districts of the neighbouring states of Punjab, Haryana, Uttar Pradesh, Himachal Pradesh, Jammu and Kashmir. The Emergency department receives more than 50,000 presentations each year.

Case record selection and study design

All records of injured patients who presented alive at the Emergency Department from 1 March 2008 to 28 February 2009, and were filed as medico legal cases, were reviewed. A *medico-legal* case is a case of injury or illness where the attending doctor, after eliciting history and examining the patient, judges that an investigation by law enforcement agencies may be required to establish responsibility for the injury in accordance with the law.[9,10] All injury cases are treated as medico-legal cases in most hospitals in India including at the Nehru hospital. The numbers of actual files reviewed were tallied against the register at medical records department.

The medical records were reviewed and data for fall injury was abstracted by two study investigators (JJ and AG) who had medical backgrounds and were trained in *International Classification of Disease*, *Version 10* (*ICD 10*). External causes of morbidity and mortality, codes W00–W19, X80 and Y01 were then assigned where applicable. A fall was defined as an event which results in a person coming to rest inadvertently on the ground or floor or other lower level.[11] Cases presenting within 30 days from the day of injury were included in the review. In accordance with ICD 10, falls from animals, burning buildings and transport vehicles, and falls into fire, water and machinery were excluded.

For cases where assignment of an ICD-10 code was unclear, the two reviewers discussed the case. If the reviewers could not reach a consensus, a senior physician, also trained in ICD coding adjudicated and assigned the final code. Only six medical histories required adjudication. These cases were primarily those where the hierarchy of events leading to injury was difficult to establish or incomplete medical history made it difficult to identify the underlying cause of injury. For example "fall from electric pole" with clinical presentation of fractures lower limb and electric burn or insufficient information like "fall from machine" resulting in amputation of finger required careful review and discussion before consensus.

Data collection tools used in this study was developed according to the medical history available in the medical records and taking into account the limitations of retrospectively collected data. The case report forms were designed to meet the WHO injury surveillance guidelines.[12] The following information was collected: socio-demographic details, context of injury, time and place of injury, activity at the time of injury, history of alcohol consumption, and date and time when first medical attention was sought. Information on anatomical site and nature of injury was recorded based on the medical notes of the treating physician. Details of the final disposition were recorded from the discharge sheet of the hospital. For cases resulting in death due to the fall injury, death certificates completed by a medical doctor were accessed to record medically certified cause of death, manner and details pertaining to the deceased.

Quality assurance

To ensure validity and reliability for data abstracted from medical records several processes were followed. During early stages of data collection, inter-observer agreement was checked based on a sequential series of 50 cases for key variables. The reviewers met to discuss differences in interpretation and reached consensus on interpretation of medical histories. At the conclusion of data collection, both reviewers reviewed a 10% random subset of the sample to determine inter-rater reliability. Kappa statistics were calculated to measure level of agreement for key variables.[13] The Kappa coefficient indicated excellent agreement for place of injury (0.85), activity at time of injury (0.97) and ICD codes (0.97), and good agreement for clinical diagnosis (0.63). External validity for ICD coding was also determined by recoding 10% of the cases by a third, gold standard investigator trained in ICD coding.[14] The agreement level was 72% between the gold standard reviewer and the study reviewer indicating good accuracy for ICD coding.

We also reviewed a sample of 500 randomly selected emergency cases which were missed though our review process of medico-legal cases only. The review identified no cases that met our study inclusion criteria.

Data management and analysis

Data were entered into a custom data base programmed in Visual Basic. In case of missing data, records were re-accessed and reviewed to search for missing information. On completion of data entry, 100% of data were independently re-entered for key variables to improve accuracy. Disagreement was found in 16% of the entries which were checked and corrected. Descriptive analyses were conducted using SPSS 17 (SPSS, Inc., Chicago, IL).

Results

During the review period, March 2008–2009 there were 73,645 emergency presentations; of these, 14% (10,075) were classified as medico-legal cases. After several attempts 1% (120) medical records of the 10,075 cases could not be accessed. Of the remaining 9955, we identified 75% (7049) injury cases, and 20% (1407) of these were fall injury cases.

The place of first medical attention was documented in 77% (1084) of fall injury records. First medical attention at the Nehru Hospital was sought by only 9% (98) cases. The mean difference between time of injury and time of presentation at the emergency department was almost 8 h (7 h 53 min). Nearly all injury cases were transported by a private vehicle, with only three brought in by an ambulance. Data on the person accompanying the injured were available for 69% (995) cases, of which 71% (712) were brought by family members and another 29% (283) by "others" like work colleagues, employers, and neighbours.

Three times more males than females presented with an injurious fall and the type of fall differed according to age. One-thirds of all presentations due to falls were amongst the age group 0–14 years (Table 1) and falls from a height, building or structure were the main cause (51%, 261). Presentations were least frequent for the age group of 60 years and beyond (10%, 141), with 38% (53) falls due to slipping, tripping and stumbling. Falls were reported to be unintentional in 84% (1182) cases, with only 2% (28) resulting from intentional self-harm. Intent was not recorded in 14% (197) of the cases.

For those aged over 18 years, acute use of alcohol before the fall event was reported in 13% (116) cases and only two of these were females. A history of alcohol consumption was not recorded in 87% (779) medical histories.

Context

Most falls (70%, 983) occurred at home, followed by the workplace (5%, 69), the road (4%, 56), and 'other places' (10%, 145). The most common keywords identified from the medical history were "fall from 1st/2nd floor balconies or roof" for 71%; that is 364 of all falls were coded as W13 (Fall from; out of or through building or structure). The place of injury was not recorded in 11% (154) of the cases.

Table 1
Age and sex distribution by type of fall for emergency hospital presentations, Nehru Hospital, 2008–2009.

Type of fall	Age (years)										
	0–14		15–34		35–59		60 and beyond		All ages		
	Male (%)	Female (%)	Male (%)	Female (%)	Male (%)	Female (%)	Male (%)	Female (%)	Male (%)	Female (%)	Total (%)
Fall on same (W01–W05, W18)	25 (7)	9 (6)	31 (10)	12 (17)	61 (20)	23 (32)	35 (36)	22 (51)	142 (14)	66 (20)	218 (17)
Fall from furniture and other falls from one level to another (W07–W08)	79 (22)	40 (27)	69 (22)	11 (16)	73 (23)	10 (14)	21 (22)	5 (13)	242 (22)	66 (20)	308 (21)
Fall on or from stairs, steps ladder (W10, W11)	58 (16)	18 (12)	53 (17)	14 (21)	66 (21)	12 (18)	19 (20)	7 (16)	196 (18)	51 (15)	247 (18)
Fall on or from building or scaffolding (W12, W13)	180 (50)	81 (54)	112 (37)	22 (32)	74 (24)	11 (15)	15 (15)	[a]	381		
(35)	118										
(35)	499										
(35)											
Fall from tree (W14)	7 (2)	[a]	30 (10)	5 (7)	20 (6)	8 (11)	[a]	[a]	59 (5)	15 (5)	74 (5)
Unspecified fall (W19)	12 (3)	[a]	8 (3)	[a]	18 (6)	7 (10)	6 (6)	[a]	44 (4)	17 (5)	61 (4)
All falls	361 (100)	151 (100)	303 (100)	68 (100)	312 (100)	71 (100)	98 (100)	43 (100)	1074 (100)	333 (100)	1407 (100)

[a] Note n in these cells is less than 5; estimates may be statistically unreliable due to small cell size.

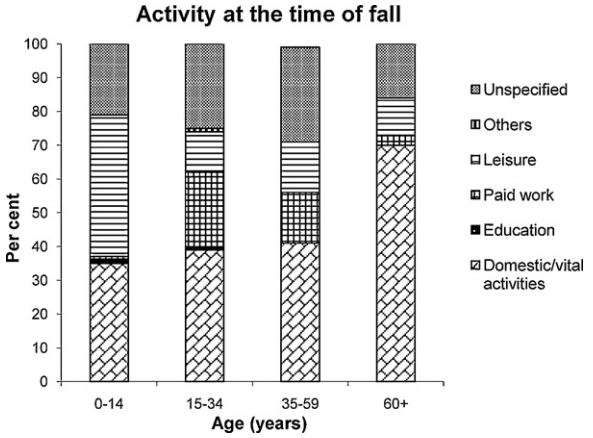


Fig. 1. Activity at time of fall leading to emergency hospital presentation at Nehru Hospital, 2008–2009.
Proportional distribution of emergency hospital presentations at Nehru Hospital for all ages by activity at the time of fall, 2008–2009.

No apparent seasonal trends were observed for injurious falls presentations at the hospital. Falls occurred between noon and 6 pm for 42% (591) cases, followed by 22% (310) cases in the evening up until midnight. Leisure activity, 41% (210) was the predominant fall related activity for those aged 0–14 years (Fig. 1); for all other age groups, personal hygiene activities like bathing, and domestic work were the chief activity of the injured at the time of fall. Work related fall injuries accounted for 22% (82) fall injuries in the age group of 15–34 years and 17% (65) fall injuries in the age group 35–59 years.

Clinical characteristics

Falls from a height resulted in head injuries in 460 (50%) cases. Almost half (49%) of the head injuries were severe (Glasgow Coma Score ≤ 8) in nature and one third (149) of these cases died. The majority of head injuries were amongst children (0–14 years, 67%, 408) and males (76%, 703). Fractures were reported in 19% (176) of all head injury cases with parietal and frontal bone fractures the most common bone structures affected (Table 3). Fall from, out of or through building or structure accounted for 36% (332) of head injuries.

The second most common site of injury was the face, followed by the spine and lower limbs (Table 2). Most facial injuries were lacerations, (47%; 134/286) and maxillofacial fractures (24%, 70/286). Vertebral fractures were observed in 66% (123/187) cases, and 40% (74) of these fractures were at the level of C4–C5. Quadriplegia and paraplegia after injury was diagnosed in 113 cases. Patients presenting with multiple injuries were 35% (461). Of the 1407 fall-related presentations, 66% (924) were diagnosed with a head injury (Table 2).

Outcomes of falls

Ten percent of the cases died (143) of these 68 patients died within 24 h of presentation. Almost two-thirds of the cases (63%, 881) were treated in the emergency department and then

Table 2
Site of injury and age distribution in falls injury cases, Nehru Hospital, 2008–2009.

Site of injury	Age (years)				
	0–14 (%)	15–34 (%)	35–59 (%)	60+ (%)	All ages
Head	408 (67)	214 (39)	226 (40)	76 (38)	924 (48)
Face	103 (17)	91 (17)	76 (14)	16 (9)	286 (15)
Upper limb	53 (9)	49 (9)	45 (8)	17 (9)	164 (9)
Thorax	[a]	16 (3)	33 (6)	10 (6)	63 (3)
Abdomen	3 (0.5)	20 (4)	7 (1)	[a]	34 (2)
Spine	11 (2)	69 (12)	85 (15)	22 (11)	187 (10)
Pelvis	[a]	26 (5)	24 (4)	15 (8)	66 (3)
Lower limb	25 (4)	51 (9)	53 (9)	30 (15)	159 (8)
Others	[a]	14 (2)	14 (3)	[a]	34 (2)
Multiple	113 (100)	150 (100)	152 (100)	46 (100)	461 (100)

[a] Note n in these cells is less than 5; estimates may be statistically unreliable due to small cell size.

Table 3
Details of head injuries ($n = 924$) amongst falls injury cases, Nehru Hospital, 2008–2009.

	Cases	Percentage
Lesion[a]		
Scalp lesions	60	4
Cerebral concussion/contusion	652	46
Haemorrhage	451	32
Fractures	264	18
Severity-Glasgow Coma Score for all cases[b]		
Severe (≤8)	452	49
Moderate (9–12)	199	21
Minor (≥13)	273	30

[a] 5% of the cases suffered multiple injuries hence percentages add up to >100%.
[b] GCS are first documented at the Nehru hospital.

Table 4
Final disposition of falls injury cases, Nehru Hospital, 2008–2009.

Final disposition	0–14 (%)	15–34 (%)	35–59 (%)	60+ (%)	All ages
Treated and discharged	418 (82)	205 (55)	192 (50)	66 (47)	881 (63)
Admitted and discharged	44 (8)	106 (29)	109 (29)	39 (27)	298 (21)
Left against medical advice	20 (4)	24 (6)	23 (6)	18 (13)	85 (6)
Died	30 (6)	36 (10)	58 (15)	19 (13)	143 (10)

discharged (Table 4). Amongst those admitted to hospital, 66% (911) required a stay of less than 24 h, 26% (349) stayed 1–14 days, and 8% (79) stayed for over 14 days. Six percent of cases (85) left against medical advice. Amongst survivors the mean length of hospital stay was 3 days for hospitalized falls.

The manner of fall related death was recorded on death certificates as natural in 23% (33), accidental in 36% (56), intentional/suicide in less than 1% (2) and as pending investigation in 36% (51) of deaths related to fall. The cause of death was classified in these cases as head injury for 49% (70) deaths, falls in 27% (38), spinal injuries in 9% (13) and cardiac arrest in 4% (7) deaths. Cause of death was not recorded on 11% (16) of death certificates. Severity of non-fatal injury was categorised based on days of hospitalisation. The ratio of death, serious injuries (requiring hospitalization of over 24 h) and minor injuries (hospitalization of less than 24 h), due to falls was 1:2:6.

Discussion

In this review of injury presentations to a large urban hospital in North India, fall-related injuries contributed a substantial burden of injury. Falls were the second leading cause of hospitalization due to an injury, and led to hospitalization of more than 14 days in 21% and death in 10% of all fall related injury presentations. One third of the falls presentations were amongst children, 35% of falls were from building or structure (half of these were amongst children) and the majority of the falls occurred at home.

The strengths of the study are the steps taken to standardize data collection and ensure quality in accordance with STROBE guidelines for observational studies.[15] We used ICD-10 coding, attempting to make data standardized and comparable. Standard operating procedures, quality cheques and training were rigorously followed during data collection. Further, we ensured both internal and external validity for ICD coding, reconciliation for key variables and double data entry.

It is important to note that the results from the study are not generalizable to fall injuries in the population. Data were collected from medical records of patients who presented at the Nehru Hospital, a referral centre for the region. More than 90%of the cases were referred, and it is therefore likely that fall cases with serious injuries are over represented. Secondly, as the data were collected retrospectively from medical records, we were unable to verify information contained in the records.

No data were available from the medical facility accessed immediately after injury. Ideally we would have this information to accurately document the injuries sustained, especially, the assessment of head injury severity, which should be judged within 6 h of the event.[16] There were gaps in information in hospital records and medical certification of deaths due to missing data for several key variables; similar gaps were also observed in medical certification of deaths. Despite these limitations hospital data provides a valuable source of information on site and nature of fall related injuries and temporal factors associated with these falls.

We have documented variations in context of fall injuries by age and sex. *Paediatrics* (0–14 years) presentations due to falls comprised a large proportion (36%) off all-related injuries treated at the hospital, most resulting from fall from a building or structure. Cases of falls amongst boys were three times higher than in girls. These findings are in agreement with previous studies from low and middle income settings.[5,7,17] Adapting multi-faceted programmes like "Children can't fly" for increased awareness on risk of fall from buildings and enforcement of building regulations could prove to be an effective intervention to prevent falls in younger ages.[18] Although this case series from a tertiary referral centre might over-represent severe head injuries, previous literature has reported head injuries due falls as the leading cause of death amongst children.[19]

Although there are difficulties in comparisons due to varied definitions and methods of ascertainment of falls used across studies, a higher incidence of falls and related mortality amongst males than females, particularly in the age group of 14–59 years, has been previously reported from India.[7,17] Recent results from a rural adult population aged 30 years and beyond were unique in reporting higher incidence of falls amongst females in the age group of 30–59 years.[8] Thesefall events amongst women were associated with same level falls or falls from stairs/ladder at home.[4] Most work-related fall injuries in the present study were in the working age group of 15–59 years and amongst males. The majority of these falls were at construction sites reflecting the predominantly urban population. Similar occupation-related risk factors amongst urban men have been previously reported in the Bengaluru injury surveillance study.[7] Likewise falls on farms have been reported as the most common place of falls for men in previous literature in rural India, although mainly due to falls from same level, perhaps reflecting differences in activity in agricultural settings compared to urban areas.[8]

Worldwide, in population-based studies, the incidence of falls is reported to be higher amongst females and most of these falls are amongst women aged 60 years and older, including in India.[2,20–23] Same level falls due to slipping, tripping and stumbling were the leading cause in this age group as was also reported from population derived mortality data.[2,24] The falls we report in older people resulted in a familiar spectrum of orthopaedic injuries, mostly pelvic and lower limb fractures, resulting in death in 13%of fall injuries in this age group. Nearly two thirds of the falls occurred at home, particularly for the older age group of 60 years and older. This finding is supported by previous studies that identified the home as the most common place of falls.[7,19,25] Assessment and modification to the environment, particularly at home could prove to be an effective intervention for same level falls.[26] Previous literature reports risk factors like poor vision, the role of other co-morbidities or medications amongst older adults.[26–29]

Results from a recent systematic review have reported that alcohol might be an important risk factor for falls amongst the

young and middle aged adults.[30] The studies identified in the review were all from high income countries and found alcohol consumption within 6 h prior to the fall in 14–53% of cases.[30] In the present study, acute alcohol consumption was reported in 13% of cases and there was no information confirming or refuting alcohol consumption prior to injury for the remaining case histories. It is likely that there is significant under-reporting of alcohol consumption so care must be taken in interpretation of these findings. The role of alcohol in unintentional injury is best evaluated in future etiological research.

Conclusion

Falls were the second leading cause for injury related presentations to hospital in this study. The gaps in the present study highlight the need for standardized and complete recording of data for reliable estimation of all cause morbidity and mortality in the population. Efforts need to be made in improving the quality of data available from medical records through training of medical practitioners and other personnel involved in ICD coding and certification.

Replication of this study in other sites and using data collected prospectively from other parts of the country will enable better understanding of context of falls in India. The data presented in this paper provides important information on the context, nature and severity of injuries sustained due to falls and provides direction for falls prevention and in planning of post injury trauma care. An intervention in the form of targeted fall injury prevention programme for falls from buildings or structures amongst younger ager groups and same level falls amongst older adults is needed.

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Competing interests

We declare that we have no conflicts of interest.

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References

1. World Health Organisation. *The global burden of disease: 2004 update*. Geneva, Switzerland: WHO; 2008. [accessed 20.11.03].
2. Jagnoor J, Suraweera W, Keay L, Ivers R, Thakur JS, Gururaj G, Jha P for the Million Death Study Collaborators. Mortality from falls in India. *Bull World Health Organ*. [Published online 21.08.11].
3. Masud T, Morris RO. Epidemiology of falls. *Age Ageing* 2001;**30**(4):3–7.
4. Vish NL, Powell EC, Wiltsek D, Sheehan KM. Pediatric window falls: not just a problem for children in high rises. *Inj Prev* 2005;**11**(5):300–3.
5. Hyder A, Sugerman D, Ameratunga S, Callaghan J. Falls among children in the developing world: a gap in child health burden estimations? *Acta Paediatr* 2007;**96**:1394–8.
6. Peden M, Oyebite K, Hyder AA, Branche C, Ozanne-Smith J, Rahman FA. *World report on child injury prevention*. Geneva: World Health Organization; 2009.
7. Gururaj G, Sateesh V, Rayan A. *Bengaluru injury/road traffic injury surveillance programme: a feasibility study*. Bengaluru: National Institute of Mental Health and Neuro Science; 2008.
8. Dandona R, Kumar G, Ivers R, Rohina J, Neal B, Dandona L. Characteristics of non-fatal fall injuries in rural India. *Inj Prev* 2010;**16**:166–71.
9. Chandrachud YV, Manohar VR. *The Indian penal code*. 31st Enlarged Ed. Nagpur: Wadhwa and Company Law Publishers; 2006. p. 228.
10. Dogra TD, Rudra A. *Lyons medical jurisprudence & toxicology*. 11th Ed. Delhi Law House; 2007. p. 367.
11. World Health Organisation. *International statistical classification of disease and related health problems, tenth revision (ICD-10)*. http://www.who.int/classifications/icd; 1994 [accessed 19.04.11].
12. World Health Organization. Holder Y, Corporation E. *Injury surveillance guidelines*; 2001.
13. Landis J, Koch G. An application of hierarchical kappa-type statistics in the assessment of majority agreement among multiple observers. *Biometrics* 1977;**33**:363–74.
14. Viera A, Garrett J. Understanding interobserver agreement: the kappa statistic. *Fam Med* 2005;**37**:360–3.
15. Von Elm E, Altman D, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP. The strengthening the reporting of observational studies in epidemiology [STROBE] statement: guidelines for reporting observational studies. *Gac Sanit* 2008;**22**:144–50.
16. Pal J, Brown R, Fleiszer D. The value of the Glasgow Coma Scale and Injury Severity Score: predicting outcome in multiple trauma patients with head injury. *J Trauma* 1989;**29**:746–8.
17. Mohana D, Kumarb A, Varghesec M. Childhood injuries in rural north India. *Int J Inj Contr Saf Promot* 2010;**17**:45–52.
18. Spiegel CN, Lindaman FC. Children can't fly: a program to prevent childhood morbidity and mortality from window falls. *BMJ* 1995;**1**:194–8.
19. Gururaj G. Epidemiology of traumatic brain injuries: Indian scenario. *Neurol Res* 2002;**24**:24–8.
20. Tinetti ME. Preventing falls in elderly persons. *N Engl J Med* 2003;**348**:42–9.
21. Navaratne K, Fonseka P, Rajapakshe L, Somatunga L, Amertunga S, Ivers R, *et al.* Population-based estimates of injuries in Sri Lanka. *Inj Prev* 2009;**15**:170–5.
22. Sattin R, Lambert H, Deborah A, Rodriguez JG, Ros A, Baccheli S, *et al.* The incidence of fall injury events among the elderly in a defined population. *Am J Epidemiol* 1990;**131**:1028–37.
23. Johnson SJ. Frequency and nature of falls among older women in India. *Asia Pac J Public Health* 2006;**18**:56–61.
24. Krishnaswamy B, Usha G. Falls in older people: national/regional review India. *World Health Organization and Department of Geriatric Medicine Madras Medical College and Government General Hospital Chennai City, Tamil Nadu State, India*. http://www.who.int/ageing/projects/SEARO.pdf; 2010 [accessed 22.10.10].
25. Sathiyasekaran BW. Population-based cohort study of injuries. *Injury* 1996;**27**:695–8.
26. Cumming RG, Thomas M, Szonyi G, Salkeld G, O'Neill E, Westbury C, *et al.* Home visits by an occupational therapist for assessment and modification of environmental hazards: a randomized trial of falls prevention. *J Am Geriatr Soc* 1999;**47**:1397–402.
27. Ivers RQ, Cumming RG, Mitchell P, Attebo K. Visual impairment and falls in older adults: the blue mountains eye study. *J Am Geriatr Soc* 1998;**46**:58–64.
28. Leipzig RM, Cumming RG, Tinetti ME. Drugs and falls in older people: a systematic review and meta-analysis: I. Psychotropic drugs. *J Am Geriatr Soc* 1999;**47**:30–9.
29. Gillespie L. Preventing falls in elderly people. *BMJ* 2004;**328**:653–4.
30. Kool B, Ameratunga S, Jackson R. The role of alcohol in unintentional falls among young and middle-aged adults: a systematic review of epidemiological studies. *Inj Prev* 2009;**15**:341–7.