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Characteristics of non-fatal fall injuries in rural India

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ABSTRACT

Background Little is known about the context, risk factors and severity of non-fatal fall-related injury in India.

Objective To report these data for a rural population in the East and West Godavari districts of the Indian state of Andhra Pradesh.

Methods In a cross-sectional population-based survey, 3686 participants aged ≥30 years (83.6% participation) selected by stratified random sampling were interviewed in 44 villages. Participants recalled injuries in the preceding 12 months that required them to stay away from their usual daily duties for at least 1 day irrespective of whether medical attention was sought for that injury.

Results The annual incidence of non-fatal fall-related injury based on a 3-month recall period was 3.30% (95% CI 2.54% to 4.05%) and 9.22% (95% CI 7.74% to 10.69%) for men and women, respectively, with the incidence increasing with age. For the most recent non-fatal fall-related injury, the home was the most common place of injury for women, and the farm for men, with the former more likely to fall while climbing up/down (20.9%) compared with the latter (10.3%). Most falls were at the same level (71.7%) and slipping was the most common cause of fall (40%). Limbs (legs, 55%; hand/arm, 33.3%) were the most commonly injured body part. Fifty-six per cent reported seeking treatment outside home for injury, of whom 74.6% were women; and 8.4% reported being admitted to a hospital.

Conclusion Falls are a significant public health problem facing women in rural India. Fall prevention strategies should be explored and implemented within the Indian context.

INTRODUCTION

Based on the Global Burden of Disease project, an estimated 424 000 people of all ages died from falls in the year 2004 globally.[1] Adults over the age of 70 years, women in particular, have significantly higher fall-related mortality rates compared with the younger population.[1 2]

In India, the Global Burden of Disease project estimated that 91 900 people of all ages died from falls in the year 2002.[1] Unintentional injuries are reported to be among the 10 leading causes of mortality in India though the relative contribution of the various types of injuries other than road traffic injuries is not clearly understood.[3] We have previously reported injuries to be the second leading cause of mortality in all ages in a rural region of the Indian state of Andhra Pradesh.[4] Falls were the second leading cause of mortality due to injuries after self-inflicted harm and were the leading cause of non-fatal injuries among adults in the rural population studied.[4] In addition to finding high non-fatal fall-related injury rates in older women, we also found high rates in younger women in this population, indicating the high level of risk encountered by women in rural India as they go about their usual household and agricultural tasks. To explore this in further detail, we undertook another study in this population to determine the incidence of non-fatal fall-related injuries and to assess gender differentials in the risk factors and characteristics of these injuries in the adult population aged ≥30 years.

METHODS

This study was carried out in 44 villages of East and West Godavari districts of the Indian state of Andhra Pradesh from October 2007 to May 2008. The average population of these villages was 3000, with the majority of adults engaged in agriculture and aquaculture. Ethics approval for this research was obtained from the ethics committees of the University of Sydney in Australia and the Gandhi Medical College and Hospital, Hyderabad, India. The research conformed to the principles embodied in the Declaration of Helsinki. Most participants provided written informed consent, and for those who could not read or write, the participant information sheet and consent form were explained by the trained interviewer and a thumb impression obtained.

In order to obtain an equal number of adults in each age group, we aimed to sample 50 men and 50 women from each village, distributed equally in the age groups 30–39 years, 40–49 years, 50–59 years and ≥60 years. All villages were mapped in a standardised manner to list all the households (people eating from the same kitchen), and the number of household members in the age groups 30–39 years, 40–49 years, 50–59 years and ≥60 years. All households with at least one adult aged 30 years or more were considered eligible for the study. The sampling was initiated to first sample adults aged ≥60 years. An identifier was placed on the list for all the households with at least one adult aged ≥60 years, and the number of these households was divided by 25 (sample size in each of the four age groups of interest) to obtain a sampling interval for these households. Systematic sampling with the first number drawn randomly was carried out using the sampling interval to sample 25 adults, man and woman alternately from the selected households, so as to sample only one adult aged ≥60 years from each sampled household. If more than one adult aged ≥60 years of the required sex was available in a household,

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the oldest was selected. If a man was sampled in one household and a woman was not available in the next sampled household, a man was selected in the next household and then women were sampled in the next two households to compensate. This sampling procedure was then repeated for those aged 50–59 years, 40–49 years and 30–39 years of age in order to arrive at the required sample for a village. No replacement was made if the sampled person was not available to participate in the study.

Trained interviewers administered an injury questionnaire designed specifically for this study. The participants were asked to recall all injury episodes in the preceding 3, 6 and 12 month periods that required them to stay away from their usual daily duties for at least 1 day, irrespective of whether medical attention was sought for that injury. Injuries not limiting ability to perform usual duties for less than a day were not included in the study. In addition to the sociodemographic variables, details of the most recent injury sustained in the last 12 months (for those who reported more than one) were documented, including type and severity of injury, days needed for recovery, place where the injury occurred, activity at the time of injury, cause of injury, type of surface where injury occurred, use of alcohol and medical treatment of injury.

Data were entered into a Microsoft Access database and SPSS V.15 was used for statistical analysis. Fall-related injuries were defined according to the International Classification of Disease version 10,[5] and therefore injuries related to assault and self-harm, and fall from animals, burning buildings and transport vehicles, and fall into fire, water and machinery were excluded. Annual incidence for non-fatal fall-related injury was calculated using the 3-month recall period, and were adjusted for the age and sex distribution of the East and West Godavari districts' rural populations; the 95% CI included the design effect (DE) for the cluster sampling strategy.[6] Variables relating to the context, circumstances, type of injury sustained and treatment of the most recent fall-related non-fatal injury were assessed, and the differences in proportions were examined using the χ^2 test for significance. Multiple logistic regression was performed to assess the association of fall-related injury with age, gender, household income, occupation and physical activity. All variables were included simultaneously in the model.

RESULTS

Participation

Of the 4440 sampled participants aged ≥30 years, 3686 (83.8%) participated; 631 (14.3%) were not available/could not be contacted for interview, 76 (1.7%) refused to participate and 7 (0.2%) died before the interview. The average age of participants was 50.5 years (range 30–102 years); 1953 (53%) were women.

Non-fatal fall-related injury incidence

A total of 370 (10%) participants reported 431 non-fatal injury episodes in the past 12 months which required them to stay away from their daily usual duties for at least 1 day, irrespective of whether medical attention was sought or not. Among these 370 participants, 129 (34.9%) reported 137 episodes of fall-related injuries. The estimated overall annual incidence of non-fatal fall-related injury based on the 3-month recall period was 6.43% (95% CI 5.56 to 7.30%; DE 1.21); it was 3.30% (95% CI 2.54 to 4.05%; DE 1.00) for men and 9.22 (95% CI 7.74 to 10.69; DE 1.32) for women. Figure 1 shows the incidence for the various age groups.

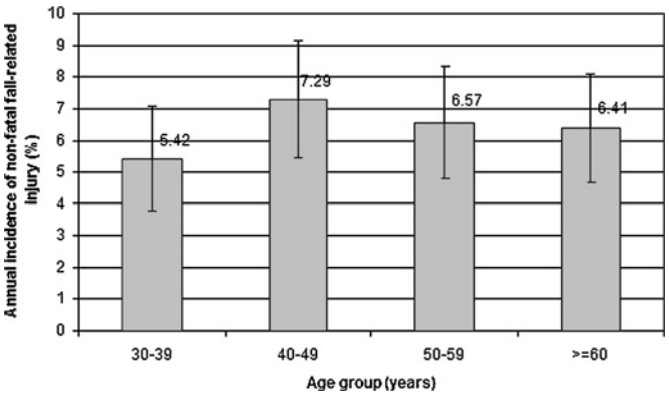


Figure 1 The estimated annual non-fatal fall-related injury incidence per 100 population based on a 3-month recall period for the different age groups among adults aged ≥30 years. Bars denote 95% CI.

Most recent non-fatal fall-related injury

Of the 129 participants who reported at least one non-fatal fall-related injury episode in the past 12 months, 120 reported the most recent non-fatal injury episode to be fall-related. Of these 120 participants (table 1), 67 (55.8%) reported sustaining this injury in the last 0–3 months, 21 (17.5%) in the last >3–6 months, and 32 (26.7%) in the last >6–12 months. The mean age of these 120 participants was 54.9 years (range 30–94 years). For women, the incidence of fall-related injury increased with increasing age ($p<0.05$; figure 2). No case of fall-related injury was reported for men in 30–39 years age group; the highest proportion was reported for the 50–59 years age group ($p<0.05$). With adjusted multiple logistic regression (table 1), women were nearly three times more likely to report fall-related

Table 1 Association of select variables with fall-related injury among adults aged ≥30 years with multiple logistic regression

Variable	Total (3686)	Fall-related injury N (%)	Adjusted* OR (95% CI)
Age group (years)			
30–39	870	15 (1.7)	1.00
40–49	919	26 (2.8)	1.76 (0.92 to 3.36)
50–59	927	37 (4.0)	2.61 (1.41 to 4.84)
≥60	970	42 (4.3)	3.02 (1.56 to 5.85)
Sex			
Men	1733	29 (1.7)	1.00
Women	1953	91 (4.7)	2.83 (1.65 to 4.85)
Household monthly income categories (INR)†			
≤1200	1072	34 (3.2)	1.00
>1200–1500	890	28 (3.1)	1.31 (0.78 to 2.21)
>1500–2000	911	30 (3.3)	1.34 (0.80 to 2.23)
>2000	790	28 (3.5)	1.40 (0.82 to 2.36)
Occupation‡			
Unemployed	446	18 (4.0)	1.00
Housework	1219	59 (4.8)	1.11 (0.59 to 2.09)
Unskilled manual labour	1646	36 (2.2)	0.98 (0.49 to 1.97)
Others	351	7 (2.0)	1.08 (0.40 to 2.90)
Days with medium or heavy physical activity in a week‡			
0–6	608	27 (4.4)	1.03 (0.61 to 1.74)
7	3059	93 (3.0)	1.00

*Model adjusted for all other variables in table.
†INR denotes Indian Rupees; 1 US$=39.3 INR during study period; data missing for 23 respondents.
‡Data missing on occupation and days with physical activity for 24 and 19 respondents, respectively.

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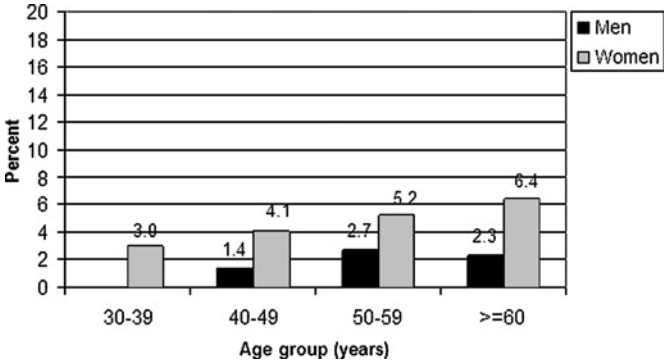


Figure 2 Distribution of the most recent non-fatal fall-related injury for the different age groups among men and women aged ≥30 years.

injury as compared with men (OR 2.83, 95% CI 1.65 to 4.85) and the odds of fall-related injury increased with increasing age. No other significant associations were identified in the model.

Table 2 details the severity, context and treatment of fall-related injuries. One-quarter of those with the most recent fall-related injury required 16 days or more to recover from the injury. The most common place of injury for women was the home and for men was the farm (p<0.001). Seventy-six (63.3%) respondents were walking when they fell; women were more likely to report a fall while climbing up/down (20.9%) as compared with men (10.3%). Most falls were at the same level (71.7%); slipping was reported to be the most common cause of fall (40%), followed by loss of balance (24.2%). Women were more likely to report a fall due to fainting/collapsing (20%) as compared with men (10.3%). Overall, 26 (21.7%) of the respondents reported wearing footwear at the time of fall with men more likely to be wearing footwear (34.5%) as compared with women (17.6%) (p=0.054). Those not wearing footwear (46.8%) were significantly more likely to slip as compared with those who were wearing footwear (15.4%; p=0.004). No significant differences were found in either the severity or context of fall-related injury across the various age groups among women. Table 3 details the context of fall-related injuries based on the place of fall. Falls while standing/sitting or climbing up/down and from steps were significantly more likely to occur at home. The floor was reported to be more likely to be slippery due to water in farms as compared with the other places of fall, though this was not statistically significant.

The limbs (legs, 55%; hand/arm, 33.3%) were the most commonly injured body part, followed by the head (10%) and back (9.2%) (figure 3). No significant differences were found in the injured body part between men and women, and across the various age groups among women. Fracture due to the fall was reported by 21 (23.1%), cut/wound by 20 (22%), sprain/swelling by 71 (78%) and minor bruises by 36 (39.6%) of women (not mutually exclusive). On the other hand, fracture due to the fall was reported by 2 (6.9%), cut/wound by 10 (34.5%), sprain/swelling by 25 (86.2%) and minor bruises by 8 (27.6%) of men (not mutually exclusive).

Among the 120 people reporting most recent fall-related injury, 67 (55.8%) reported seeking treatment for it at a clinic/hospital or with a traditional healer, of whom 50 (74.6%) were women (table 2). Forty-four (65.7%) had sought treatment within 3 h of the fall, 10 (14.9%) between 3 and 6 h, 6 (9%) between 6 and 24 h, and the rest more than 24 h later. Overall, 10 (8.4%) people reported being admitted to a hospital for the fall-related injury, of whom 9 (90%) were women. Among the 10 people admitted to a hospital, 1 (10%) was admitted for less than a day, 6 (60%) for a day, and one (10%) each for 2, 10 and 20 days. Among the nine women admitted to a hospital, 1 (11.1%) was aged 40–49 years, 3 (33.3%) were aged 50–59 years and 5 (55.6%) were aged ≥60 years.

DISCUSSION

We found falls to be a significant cause of non-fatal injury for women, with an annual incidence of 9.2% for fall-related injury, which required them to stay away from their daily usual duties for at least 1 day irrespective of whether medical attention was sought for that injury. The annual incidence of non-fatal fall-related injury in women was nearly three times higher than men in this rural population in the Indian state of Andhra Pradesh. We used a recall period of 3 months to estimate the annual incidence of non-fatal fall injuries as recall bias is a major limitation for data on non-fatal injuries, and less severe injuries in particular are underestimated with longer recall periods.[7 8]

Worldwide, women are more likely than men to suffer non-fatal injuries due to fall, including in India.[2 9–17] As expected, the fall-related injuries increased with increasing age for both women and men. We did not find any significant association of fall-related injuries with household income or occupation, suggesting that people across the different socioeconomic strata suffer from these injuries. No significant association was found with the duration of medium or heavy physical activity in a given week in our study, possibly because the measure of physical activity used was not sensitive enough to capture the differences in various levels of physical activity.

Homes have previously been reported to be an important setting for fall-related injuries,[2 15 18–23] as also found in our study for both women and men. Falls on the same level and on stairs while walking or climbing up/down were the most common types of falls at home, and the majority of these were caused by slipping or loss of balance. When carried out by a trained professional and targeted at high-risk groups, home assessment and modifications may be effective in reducing falls.[24 25] However, all previous research on prevention of falls in the home has been carried out in high income country settings, and the relevance to low income settings is unknown. Detailed assessment of homes will be necessary to arrive at the possible environmental factors that need modification and to recommend preventive strategies to reduce the risk of fall in this rural population. We did not find significant differences in the context of falls at home for women of different age groups in our study.

Farms were the other common place of falls for men in this rural population. This is not surprising since the majority of men in this rural area are engaged in agriculture. Slipping because of water on the floor was the major cause of fall in farms, followed by loss of balance. As reducing the risk of slipping by removal of water may not be feasible in a farm setting, appropriate individual and environmental interventions at local level will need to be explored to reduce such a risk.

Fainting/collapsing was reported to be a significant cause of falls by women as compared with men in this rural population. Though we did not assess the reasons for this, fainting/collapsing can suggest poor general health status[2 26] or use of certain medications.[2 24 27] Though only 22% of those with fall-related injury reported that they were wearing footwear at the time of fall, we found that men were twice as likely to be wearing footwear as compared with women, and that those wearing footwear were less likely to report fall due to slipping. It is quite common in rural India for people to not wear footwear

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Table 2 Severity, context and treatment of the most recent non-fatal fall-related injury among adults aged ≥30 years

Variable	Men (%) N=29	Women (%) N=91	Total (%) N=120
Recovery days from injury			
≤7 or less	7 (24.1)	32 (35.2)	39 (32.5)
8–15	8 (27.6)	14 (15.4)	22 (18.3)
16–30	3 (10.3)	11 (12.1)	14 (11.7)
>30	2 (6.9)	13 (14.3)	15 (12.5)
Still recovering at the time of interview	9 (31.0)	20 (22.0)	29 (24.2)
Disabled	0	1 (1.1)	1 (0.8)
Place of fall*			
Home	12 (41.4)	58 (63.7)	70 (58.3)
Road	3 (10.3)	17 (18.7)	20 (16.7)
Farm	13 (44.8)	8 (8.8)	21 (17.5)
Place of work other than farm	1 (3.4)	4 (4.4)	5 (4.2)
Other	0	8 (4.4)	4 (3.3)
Activity at the time of fall			
Standing/sitting	5 (17.2)	10 (11.0)	15 (12.5)
Walking	17 (58.6)	59 (64.8)	76 (63.3)
Running	2 (6.9)	2 (2.2)	4 (3.3)
Climbing up/down	3 (10.3)	19 (20.9)	22 (18.3)
Others	2 (6.9)	1 (1.1)	3 (2.5)
Type of fall			
Same level	20 (69.0)	66 (72.5)	86 (71.7)
From steps	3 (10.3)	17 (18.7)	20 (16.7)
From one level to another (other than steps)	6 (20.6)	8 (8.8)	14 (11.6)
Cause of fall			
Tripped over an object	3 (10.3)	14 (15.4)	17 (14.2)
Slipped	12 (41.4)	36 (39.6)	48 (40.0)
Lost balance	9 (31.0)	20 (22.0)	29 (24.2)
Fainted/collapsed	3 (10.3)	20 (20.0)	23 (19.2)
Others	2 (6.9)	1 (1.1)	3 (2.5)
Floor			
Slippery due to water	10 (34.5)	25 (27.5)	35 (29.2)
Slippery due to soapy water	0	1 (1.1)	1 (0.8)
Slippery due to other material	0	4 (4.4)	4 (3.3)
Not slippery	19 (65.5)	61 (67.0)	80 (66.7)
Carrying object/load at the time of fall			
No	19 (65.5)	60 (65.9)	79 (65.8)
Object with water	3 (10.3)	8 (8.8)	11 (9.2)
Other object/load	7 (24.1)	23 (25.3)	30 (25.0)
Alcohol consumption <1 h prior to injury			
Yes	2 (6.9)	1 (1.1)	3 (2.5)
No	27 (93.1)	90 (98.9)	117 (97.5)
Sought treatment outside home for injury			
Yes	17 (58.6)	50 (54.9)	67 (55.8)
No	12 (41.4)	41 (45.1)	53 (44.2)

*χ^2 test for significance, $p<0.001$.

at home or outside the home unless they are going a long distance away from home. It may be useful to explore whether use of proper footwear can reduce the incidence of falls due to slipping in this rural population.

As expected, the limbs were the most common body part injured due to falls in this population, with more women than men reporting fractures.[14 16 23 28] Injury to the head was reported by 10% of those injured. Falls have been previously reported to be the second leading cause of traumatic brain injuries in the hospital setting in India, contributing to 20–30% of total traumatic brain injuries.[23 29] With 67.5% of the injured reporting 8 days or more to recover from the injury, the burden of fall-related injury is substantial in this population. This burden is further highlighted by the fact that a little over half of those injured had sought medical treatment for injury outside the home (mostly women); this is a little higher than the 48% reported previously for older women from the Indian state of Kerala.[16] Overall, 8% of the injured were admitted to hospital due to fall-related injury in our study, with the majority of them being women, again underscoring the gender differential in non-fatal fall-related injuries.

A variety of interventions are available to prevent falls and to reduce the severity of fall-related injuries in developed country settings.[2 24 27 30 31] With increasing evidence of falls being a major cause of injury burden in developing country settings,[4 9 14–16 18 19 22 23 32 33] research is needed to explore, tailor and adapt effective interventions for the populations in developing countries based on the risk factors and context

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Table 3 Context of the most recent non-fatal fall-related injury based on the place of fall among adults aged ≥30 years

Variable	Place of fall				p Value†
	Home (%) N=70	Road (%) N=20	Farm (%) N=21	Other* (%) N=9	
Activity at the time of fall*					<0.001
Standing/sitting	13 (18.6)	1 (5)	1 (4.8)	0	
Walking	37 (52.9)	18 (90)	15 (71.4)	6 (66.7)	
Running	2 (2.9)	0	2 (9.5)	0	
Climbing up/down	18 (25.7)	1 (5)	0	3 (33.3)	
Others	0	0	3 (14.3)	0	
Type of fall†					0.057
Same level	46 (65.7)	17 (85)	18 (85.7)	5 (55.6)	
From steps	18 (25.7)	1 (5)	0	1 (11.1)	
From one level to another (other than steps)	6 (8.5)	2 (10)	3 (14.3)	3 (33.3)	
Cause of fall					0.004
Tripped over an object	7 (10)	7 (35)	2 (9.5)	1 (11.1)	
Slipped	31 (44.3)	1 (5)	11 (52.4)	5 (55.6)	
Lost balance	19 (27.1)	5 (25)	4 (19)	1 (11.1)	
Fainted or collapsed	13 (18.6)	7 (35)	2 (9.5)	1 (11.1)	
Others	0	0	2 (9.5)	1 (11.1)	
Floor					0.222
Slippery due to water	18 (25.7)	3 (15)	11 (52.4)	3 (33.3)	
Slippery due to soapy water	1 (1.4)	0	0	0	
Slippery due to other material	3 (4.3)	0	0	1 (11.1)	
Not slippery	48 (68.6)	17 (85)	10 (47.6)	5 (55.6)	
Carrying object/load at the time of fall					0.389
No	49 (70)	14 (70)	12 (57.1)	4 (44.4)	
Object with water	6 (8.6)	3 (15)	1 (4.8)	1 (11.1)	
Other object/load	15 (21.4)	3 (15)	8 (38.1)	4 (44.4)	

*Includes place of work other than farm.
†χ^2 test for significance.

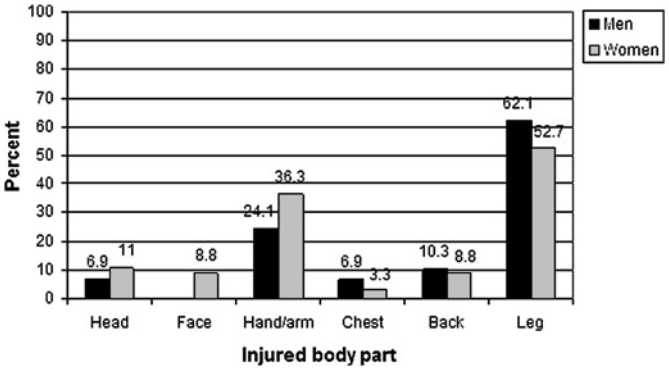


Figure 3 Distribution of the injured body part (not mutually exclusive) for the most recent non-fatal fall-related injury for among men and women aged ≥30 years.

assessment such as those presented in this paper to reduce the burden of fall-related injuries.

The latest National Health Policy of India envisages the need to identify specific programmes targeted at improving women's health and has committed funding for such programmes.[3 4] As falls are emerging as a significant public health problem facing women, and with increasing ageing population, policies and programmes related to prevention, reduction and rehabilitation of fall-related injuries among women in India are urgently needed.[2] Other than increasing incidence of fall-related injuries with increasing age, we did not find significant differences in the risk factors, context and severity of falls across women of different ages in this population, thereby indicating the need to target adult women at high-risk of these injuries across the age groups.

In conclusion, non-fatal injuries due to falls disproportionately affected women in this Indian population. With the ageing of the population in India, it is likely that the burden of fall-

What is already known on the subject

- Falls are emerging as a significant public health problem in developing countries.
- Women are affected by non-fatal falls more than men.
- Little population-based data on the incidence, risk factors and context of non-fatal falls is available from India.

What this study adds

- The annual incidence of non-fatal fall-related injury was 6.43 per 100 persons in the rural population in India.
- The incidence of non-fatal fall-related injury was three times higher in women as compared with men.
- Half of those injured sought medical treatment outside the home, the majority of them being women.
- Gender differentials were found in the risk factors, context and severity of non-fatal fall-related injury that could inform further understanding of how to prevent falls.

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related injuries will increase unless preventive actions are taken. More research is therefore needed to develop informed interventions and to implement them in the communities in order to reduce the burden of fall-related injuries in India.

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Competing interests None.

Ethics approval This study was conducted with the approval of the ethics committees of the University of Sydney in Australia and the Gandhi Medical College and Hospital, Hyderabad, India.

Contributors RD designed the study, analysed the data, and wrote the first draft of the manuscript; GAK managed data and contributed to data analysis and interpretation; RI, RJ, BN and LD contributed to the design and data interpretation. All authors contributed to the manuscript.

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