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Fall-related injuries in a low-income setting: Results from a pilot injury surveillance system in Rawalpindi, Pakistan

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Abstract This study assessed the characteristics and emergency care outcomes of fall-related injuries in Pakistan. This study included all fall-related injury cases presenting to emergency departments (EDs) of the three teaching hospitals in Rawalpindi city from July 2007 to June 2008. Out of 62,530 injury cases, 43.4% ($N = 27,109$) were due to falls. Children (0—15 years) accounted for about two out of five of all fall-related injuries. Compared with women aged 16—45 years, more men of the same age group presented with fall-related injuries (50% vs. 42%); however, compared with men aged 45 years or more, about twice as many women of the same age group presented with fall-related injuries (16% vs. 9%, $P < 0.001$). For each reported death due to falls ($n = 57$), 43 more were admitted ($n = 2443$, 9%), and another 423 were discharged from the EDs ($n = 24,142$, 91%). Factors associated with death or inpatient admission were: aged 0—15 years (adjusted odds ratio [aOR] = 1.35), aged 45 years or more (aOR = 1.94), male gender (aOR = 1.15), falls occurring at home (aOR = 3.38), in markets (aOR = 1.43), on work sites (aOR = 4.80), and during playing activities (aOR = 1.68). This ED-based surveillance

Abbreviations: ED; emergency department; LMICs; low- and middle-income countries; SD; standard deviation; WHO; World Health Organization

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study indicated that fall prevention interventions in Pakistan should target children, older adult women, homes, and work sites.

1. Introduction

Injuries account for about 12% of the disease burden worldwide and have a major impact on the health system [1]. Out of 5 million deaths that were attributed to injuries in 2000, falls accounted for about 424,000 deaths, making it the second leading cause of unintentional injury deaths worldwide after road traffic injuries [1—3]. The Global Burden of Disease report has estimated that fall-related deaths have increased by 55% from 348,000 deaths annually in 1990 to about 540,000 deaths in 2010 [4]. More worrying is the fact that this burden was disproportionately distributed as more than 82% of fall-related mortality and 92% of disability adjusted life year (DALY) loss occurred in low- and middle-income countries (LMICs) [5].

Research conducted in developed countries showed that fall-related injuries were frequent in children, older adults, and occupational settings [6]. The economic costs of such injuries are overwhelming because of the high number of childhood injury visits, hospital care of the older adult population, and productivity losses [2,7—10]. The most immediate consequence of falls, however, is engaging available healthcare resources in dealing with injury problems that are amenable to prevention [11].

The situation in LMICs could be much worse where the burden of fall-related injuries might affect performance of the healthcare system more rapidly than high-income settings because of limited resources [12]. To date, few surveillance studies have been carried out to assess the impact of fall-related injuries in LMIC settings, in particular on emergency care systems that could be overwhelmed by the care of such injuries [13,14]. This lack of data on local injury problems could hamper appropriate resource allocation to prevent and control fall-related injuries in LMICs [15].

Pakistan is a low-income country with a population of over 160 million inhabitants [16]. One previous health survey conducted at the national level indicated that falls accounted for almost half of the injury incidence in the country and were more frequent in urban settings than rural settings [17]. Another national survey indicated that fall-related injuries were the most common mechanism of injuries after injuries that occur on roads [18,19]. Both surveys, however, lacked clarity about circumstances of fall-injuries because both classified all injuries occurring on roads as road traffic injuries. More worryingly, none of the previous studies had evaluated the impact of this burden on the healthcare system, in particular, the emergency care outcomes that could be used for monitoring healthcare burden of these injuries, as well as informing about preventive interventions [7,12,20]. The aim of this study is to assess the characteristics and emergency care outcomes of fall-related injuries in an urban setting in Pakistan.

2. Methods

2.1. Study setting and population

This prospective observational study was conducted in Rawalpindi city which had a population of 1.6 million in 2006 and an urbanization rate of around 4% [21,22]. An injury surveillance system was established at the emergency departments (EDs) of three teaching hospitals, namely: Holy Family Hospital, Benazir Bhutto Shaheed Hospital, and District Headquarter Hospital. A fall in the injury cases was defined as ''a sudden and unintentional change in position resulting in an individual landing at a lower level such as on an object, the floor, or the ground, with or without injury'' [23]. This definition was concordant with the Prevention of Falls Network Europe Consensus [24] and the International Classification of Disease W00—W19 [25]. All cases presenting to EDs over a period from July 1, 2007 to June 30, 2008 with a fall-related injury were included in the study. The questionnaire used in this study distinguished fall-related injuries from road traffic injuries, as the variable used for defining both mechanisms ensured that both events were recorded as mutually exclusive [26,27]. Ethical approval of the study protocol was obtained from Rawalpindi Medical College research ethics council before beginning the study.

2.2. Data collection

Data were recorded on minimal dataset questionnaires for injury surveillance by the World Health

Organization (WHO) [26]. This one-page questionnaire was translated into Urdu and was back-translated into English to ensure consistency [28]. The questionnaire was filled through face-to-face interviews after the initial management of these patients and after obtaining informed consent. In each hospital, data collection was coordinated by the resident in surgery. Four data collectors from the attending hospital staff were nominated in each ED which ensured data collection 24 h a day. Questionnaires were then transferred to a central location every third day where they were verified by the principal investigators. These were then coded on an Excel® spread sheet by two data entry operators; 10% of the entries were checked by principal investigators.

2.3. Measurements

The variables included were age, gender, place, activity, nature, severity and outcome of the fall-related injury cases. Severity of injury was defined as mild, moderate, or severe according to the surveillance guidelines [26]. Outcome was defined as the discharge from the ED, admission to an inpatient surgical ward, or death at presentation or during the stay in the ED. The maximum period of stay in the ED was 24 h; further stay required inpatient admission. Intent of injury was defined as unintentional or intentional; the intent was further described as self-harm or assaults (interpersonal violence) [29].

2.4. Analysis

The age and gender distributions of fall-related injury cases were assessed according to three age categories: 0—15 years, 16—45 years and 45 years or more [26]. Age distribution of fall-related injuries in males and females was compared using chi-square test. A significant *P* value meant that for a given injury characteristic, e.g., site, activity, intent, severity, nature, or outcome, the age distribution was different between male and female cases. For assessing factors associated with adverse ED outcomes, the category of deaths was combined with inpatient admission because of fewer numbers. For this purpose, a logistic regression analysis with backward selection strategy was computed where all variables associated with ED outcomes (death or admission) with *P* value $\leqslant$0.20 were included in the analysis [30]. Statistical Package for Social Sciences Version 20.0 was used for these analyses.

3. Results

During the 12-month period, 62,530 people presented with injuries to EDs of the three teaching hospitals. Of these, 43.4% (*N* = 27,109) were fall-related injuries. The majority of these injuries were among males (75.0%; *N* = 20,280). The mean age of males was 21.2 years (SD = 16.8) and females was 24.7 years (SD = 19.9).

In males, fall-related injuries were sustained mostly at homes (45.8%) and on road sites (30.9%), whereas in females four out of five (80.1%) fall-related injuries occurred at home (Table 1). About half of injuries in females (49.1%) occurred during work activity compared with about a third in males (33.6%). A third of fall-related injuries in males (35.4%) and females (35.6%) occurred during playing. Almost all injuries were unintentional (99.8%) in males and females. About a third of injuries were of moderate severity in males (35.4%) and females (36.2%). About a third of injuries resulted in open wounds in males (37.8%) and females (31.5%); one in five injuries resulted in either a concussion or a fracture in males (12.1% and 10.0%, respectively) and females (11.9% and 13.4%, respectively).

Two out of five of the fall-injury cases were children (0—15 years); 42.1% were males and 41.9% were females (Fig. 1). Row proportions may not add to 100% because of missing values in < 0.5%. Compared with females aged 16—45 years, more males of the same age presented to the ED (49.5% vs. 42.2%); however, females aged 45 years or more were twice as likely to present with fall injuries than males of the same age (15.9% vs. 8.9% *P* < 0.001). Compared with female children, nearly two-thirds (64.3%) of fall-related injuries in male children (0—15 years) occurred at home. Male and female children accounted for almost all playing-related falls (90.4% in males and 93.8% in females). About three quarters of work site- and activity-related falls occurred in males and females aged 16—45 years. The severity of injuries, such as moderate or severe injury, as well as nature of injury, such as fractures, sprains, bruises and organ system injury, was significantly higher (*P* < 0.001) in women aged 45 years or more as compared with men of the same ages.

Fall-related injury cases accounted for 57 deaths during the study period. Out of all fall-related injury cases, approximately one tenth required inpatient admission: 8.9% in males and 9.4% in

Table 1 Characteristics of fall-related injuries presenting to the three teaching hospitals in Rawalpindi (Jul 2007—Jun 2008).

Age (in years) *N*	Males					Females					
	N	(%)	0—15 %	16—45 %	>45 %	*N*	(%)	0—15 %	16—45 %	>45 %	*P*[*]
Site											
— Home	9279	(45.8)	64.3	27.4	8.3	5471	(80.1)	43.5	40.6	15.9	<0.001
— School	724	(3.6)	82.4	15.3	1.2	243	(3.6)	88.3	10.6	0.5	0.09
— Roads	6257	(30.9)	22.1	69.9	8.0	734	(10.8)	26.9	54.4	18.9	<0.001
— Market	2026	(10.0)	19.8	69.5	10.8	203	(3.0)	15.5	58.0	26.4	<0.001
— Work site	1616	(8.0)	6.9	83.3	9.8	57	(0.8)	5.0	75.6	15.4	0.26
— Other	378	(1.9)	18.0	69.1	13.5	121	(1.8)	28.4	54.6	17.2	0.01
Activity											
— Work	6819	(33.6)	12.5	73.8	13.7	3352	(49.1)	10.0	66.4	23.7	<0.001
— Playing	7188	(35.4)	90.4	8.1	1.6	2429	(35.6)	93.8	4.7	1.4	<0.001
— Traveling	5083	(25.1)	15.8	75.5	8.9	609	(8.9)	17.4	60.4	22.1	<0.001
— Other	1190	(5.9)	32.2	50.7	17.0	439	(6.4)	32.6	37.3	30.2	<0.001
Intent											
— Unintentional	20,161	99.8	42.2	49.7	8.4	6794	99.8	42.0	42.2	16.1	<0.001
— Deliberate self-harm	12	0.1	71.0	83.8	14.2	4	0.1	50.0	50.0	0	0.88
— Assault	19	0.1	44.9	105.8	9.0	5	0.1	40.0	40.0	20.0	0.58
Injury severity											
— None	923	(4.5)	44.3	45.7	10.0	399	(5.8)	30.1	49.7	20.0	<0.001
— Mild	12,016	(59.3)	38.2	53.8	8.1	3907	(57.2)	41.9	44.1	14.0	<0.001
— Moderate	7171	(35.4)	47.9	43.5	8.6	2473	(36.2)	43.7	37.9	18.4	<0.001
— Severe	170	(0.8)	55.2	29.6	15.0	50	(0.7)	40.0	28.7	30.7	0.04
Nature of injury											
— Fracture	2017	(10.0)	48.2	39.4	12.6	915	(13.4)	30.3	42.7	27.2	<0.001
— Sprain/strain	908	(4.5)	29.1	59.8	10.9	604	(8.8)	18.0	61.4	20.3	<0.001
— Cut/bite/open wound	7670	(37.8)	39.2	53.1	7.8	2153	(31.5)	48.5	39.9	11.5	<0.001
— Bruise	1142	(5.6)	36.6	54.6	9.3	416	(6.1)	35.1	48.4	16.8	<0.001
— Concussion	2460	(12.1)	63.8	29.4	8.5	815	(11.9)	64.2	25.0	10.7	0.02
— Organ system injury	3602	(17.8)	37.4	55.0	4.7	1196	(17.5)	39.7	43.3	16.9	<0.001
— Other	2481	(12.2)	38.8	53.1	11.1	730	(10.7)	39.2	44.9	15.9	<0.001
Outcome											
— Discharged	18,081	(89.2)	40.4	51.5	8.2	6043	(88.5)	40.8	43.8	15.3	<0.001
— Admitted	1799	(8.9)	59.7	30.2	10.5	644	(9.4)	52.8	27.2	20.9	<0.001
— Died	40	(0.2)	42.6	50.3	17.0	17	(0.3)	50.5	33.8	12.9	0.60
— Other	360	(1.8)	37.9	53.0	9.0	125	(1.8)	41.2	34.5	25.4	<0.001

[*] Difference in age distribution between male and female for a given factor.

females. The likelihood of inpatient admission or death was significantly higher for those aged 0—15 years or 45 years or more than those aged 16—45 years (Table 2). Similarly, the likelihood of inpatient admission or death due to falls was higher in males than females, for falls occurring at homes, in markets, on work sites, or other sites than those on roads. Similarly, the likelihood of inpatient admission or death was higher for falls occurring during playing and other activities than those during traveling-related activities.

4. Discussion

This study presented for the first time the full age and gender spectrum of fall-related injuries in a large sample of patients presenting to EDs in Pakistan. The study showed that falls resulted in a significant number of ED visits, even more than road traffic injuries [27], in the three teaching hospitals over the study period. Most of those affected from fall-related injuries were relatively young, and children accounted for a significant proportion

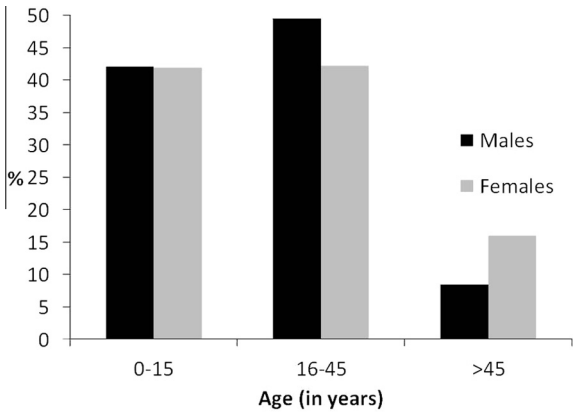

Fig. 1 Age and gender-wise distributions of fall-related injuries in Rawalpindi city.

of such injuries. Children and females were mostly injured at home, whereas males aged 16—45 years were injured on road sites. Most of the children were injured while playing, whereas young and older adults were injured during work activities. Fractures and concussions were commonly observed in children and older adults after open wound presentations. For each reported death due to falls, 43 more were admitted, and another 423 were discharged from EDs. Factors associated with inpatient admission or death were being children or men aged 45 years or more, injuries occurring at homes, roads, markets or work sites, and during playing.

This study had several limitations. First, this study was conducted in tertiary care hospitals, thus a significant number of mild to moderate injury patients consulting private health care services could not be accounted here [16]. Another study where an alternate source for reporting specific injuries was possible using the same data, e.g., assaults, showed that EDs reporting in the three hospitals accounted for about 33—43% of all assault-related injuries in Rawalpindi [31]. Secondly, outcome was recorded in the ED and

Table 2 Factors associated with emergency department (ED) outcomes of fall-related injuries in Rawalpindi city (Jul 07—Jun 08).

	Discharged from ED		Admitted		Died		P^*	Death or admission vs. discharge from ED	
	N	(%)	*N*	(%)	*N*	(%)		aOR†	95% CI
Age (in years)							<0.001		
— 0—15	9769	40.5	1404	57.5	26	45.6		1.35	1.18—1.56
— 16—45	11,953	49.6	715	29.3	22	38.6		1	
— >45	2402	9.9	324	13.3	9	15.8		1.94	1.68—2.30
Gender							0.20		
— Female	6043	25.1	644	26.4	17	29.8		1	
— Male	18,081	74.9	1799	73.6	40	70.2		1.15	1.04—1.27
Place of injury							<0.001		
— Roads	6614	52.31	212	8.7	8	14.0		1	
— Home	12,619	52.3	1846	75.6	35	61.4		3.38	2.78—4.10
— School	932	3.8	32	1.3	0	0.0		0.64	0.43—0.96
— Market	2088	8.7	99	4.0	5	8.8		1.43	1.11—1.84
— Work site	1471	6.1	186	7.6	5	8.8		4.80	3.75—6.14
— Other	409	1.7	68	2.8	4	7.0		4.82	3.57—6.52
Activity at time of injury							<0.001		
— Traveling	5381	22.3	177	7.2	7	12.3		1	
— Work	9237	38.3	771	31.6	23	40.4		0.93	0.74—1.15
— Playing	8154	33.8	1297	53.1	17	29.8		1.68	1.34—2.12
— Other	1352	5.6	198	8.1	10	17.5		1.91	1.49—2.44
Intent							<0.001		
— Unintentional	23,997	99.5	2430	99.5	55	96.5		1	
— Intentional	30	0.1	7	0.3	2	3.5		0.25	0.11—0.55
— Unknown	97	0.4	6	0.2	0	0		0.15	0.05—0.47

aOR — adjusted odds ratio.

* Association of factors with deaths of admissions vs. discharged from ED.

† Hosmer and Lemeshow test $P = 0.15$.

patients were not followed to their discharge. Thus, these figures might underestimate the deaths due to fall-related injuries. Nonetheless, this study showed that ED surveillance could be a useful tool to identify burden and research priorities for specific types of injuries [26]. A more comprehensive trauma registry in low-income settings appeared to be essential for formalizing policies to reduce injury burden [13,15].

The study results were consistent with the previous work in Pakistan and other LMICs that falls were one of the leading mechanisms of injuries [17,32—34]. Since no recent census had been carried out in this city, incidence and age standardized rates could not be calculated in this study. Nevertheless, several demographic factors associated with adverse ED outcomes were identified in this study. Notably, findings showed a higher involvement of younger age groups in fall-related injuries than older adults which could be attributed to the demographic trends as the median age in Pakistan is about 20 years [16]. Similarly, this study showed that males accounted for about four out of five fall-related injuries, a trend also noted in other regional studies [14]. There could be several possible explanations for these findings. For instance, the cultural role of males as breadwinners could increase their likelihood of being involved in risk-taking activities, e.g., working at heights without proper gear or involved in reparation work at homes without precautionary measures [19]. Previous studies in Pakistan noted that male vendors were at a significant risk for road traffic injuries in Pakistan [19,35]. In addition, males might enjoy a higher access to emergency services than females, i.e., in case of injury they would likely be transported to an ED than their female counterparts [19,36]. Gender differences have indeed been reported by a study on cultural determinants of ambulance use in Karachi, Pakistan [37].

A worrisome finding from the analysis of age and gender analyses was that a higher proportion, more than two times, of fall injuries occurred in older women, i.e., age >45 years than men of the same age group. The more severe consequences of fall injuries — notably fractures, concussions, bruises and organ system injuries — indicated that older Pakistani women were more vulnerable to such outcomes than men of the same age groups. Previous work had shown that older women were twice as likely to sustain fractures as males of the same age [10]. Poor nutritional status and a decrease in bone mass in women, especially in the five years following menopause, might explain this severe injury outcome compared with men [38]. Screening of women for predisposing factors and awareness campaigns focusing on such problems might decrease the incidence of fall-related injuries in older Pakistani women [39].

Another important study finding was that about two thirds of fall-related fatalities occurred at homes. The proportion of other adverse outcomes, such as hospital admission, was also two times higher than the one reported in New Zealand where about one third of fall-related injuries occurred at homes [40]. These findings suggested that hazards at homes might not be perceived adequately by the residents. Other studies on home health hazards in Pakistani children showed that most hazards for injuries including falls go unappreciated by the parents and could potentially increase chances for falls [41,42]. This study showed that the older population might also be at a higher risk for home hazards for falls, and could require special interventions, including awareness to prevent such injuries [10,43].

This study showed that most of fall-related injuries in children occurred while playing either at homes or schools. In similar settings, this could be explained by lack of safety measures, as in unattended children and children flying kite at roof top [20,44]. Factors predisposing to child injuries had rarely been investigated in Pakistan and, currently, there are no ongoing injury prevention programs for children [17,45—47]. The high incidence of fall injuries while playing indicated the need for more supervision during playing and identification of specific risk factors for these injuries in Pakistani children [46].

A significant proportion of falls in the adult age group resulted during work-related activities in this study. Undoubtedly, unsafe work practices are adopted due to financial constraints and related factors in Pakistan [35]. Workers' safety remains an important problem and occupational injuries, particularly the incidence of fall-related injuries, had not been investigated in Pakistan [22]. The poor outcome of such injuries shown in this study indicated that a surveillance study of occupational injuries might be required in Pakistan to guide policy-making [9].

5. Conclusion

Fall-related injuries resulted in a relatively high burden on the healthcare system in this urban setting. Further analyses revealed that future research and prevention efforts should focus on fall-related injuries in childhood, at the home,

and during work activities [2,8,9]. Moreover, epidemiological methods could illustrate underlying mechanisms of such injuries and help in the development of appropriate preventive measures [15]. Finally, ED surveillance of fall-related injuries in childhood and due to work could provide useful information to prevent and control the increasing burden of fall-related injuries in LMICs like Pakistan [26].

Contribution of Authors

UF, MM, and JSK collected the data. JAB and JAR performed analysis and interpretation of results. JAB took the lead in manuscript writing. All authors participated in the critical revision of this manuscript. The final manuscript was seen and approved by all the authors.

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Competing interest

No competing interests were identified for any of the authors.

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