

## ORIGINAL RESEARCH

# Fall Injuries in Nepal: A Countrywide Population-based Survey

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### Abstract

**BACKGROUND** An estimated 424,000 fatal falls occur globally each year, making falls the second leading cause of unintentional injury-related deaths after road traffic injuries. More than 80% of fall-related fatalities occur in low- and middle-income countries. Data from low-income South Asian countries like Nepal are lacking, particularly at the population level. The aim of this study was to provide an estimate of fall-injury prevalence and the number of fall injury-related deaths countrywide in Nepal and to describe the epidemiology of fall injuries in Nepal at the community level.

**METHODS** A countrywide cross-sectional study was performed in 15 of the 75 districts in Nepal using the Surgeons OverSeas Assessment of Surgical Need (SOSAS) survey tool. The SOSAS survey gathers data in 2 sections: demographic data, including the household's access to health care and recent deaths in the household, and assessment of a representative spectrum of surgical conditions, including injuries. Data was collected regarding an individuals' experience of injury including road traffic injuries, falls, penetrating trauma, and burns. Data included anatomic location, timing of injury, and whether health care was sought. If health care was not sought, the reason for barrier to care was included. Descriptive statistics were used to analyze the data.

**RESULTS** Of 2695 individuals from 1350 households interviewed, 141 reported injuries secondary to falls (5.2%; 95% confidence interval [CI], 4.4%–6.1%), with a mean age of 30.7 years; 58% were male. Falls represented 37.2% of total injuries ( $n = 379$ ) reported (95% CI, 32.3%–42.3%). Twelve individuals who suffered from a fall injury were unable to access surgical care (8.5%; 95% CI, 4.5%–14.4%). Reasons for barrier to care included no money for health care ( $n = 3$ ), facility/personnel not available ( $n = 7$ ), and fear/no trust ( $n = 2$ ). Of the 80 recent deaths reported, 7 were due to fall injury (8.8%; 95% CI, 3.6%–17.2%), and patients had a mean age of 46 years (SD 22.8). Surgical care was not delivered to those who died for the following reasons: no time ( $n = 4$ ), facility/personnel not available ( $n = 1$ ), fear/no trust ( $n = 1$ ), and no need ( $n = 1$ ).

**CONCLUSION** The Nepal SOSAS study provides countrywide, population-based data on fall-injury prevalence in Nepal and has identified falls as a crucial public health concern. These data highlight persistent barriers to access to care for the injured and the need to improve trauma care systems in developing countries such as Nepal.

**KEY WORDS** global surgery, falls, trauma, developing countries, Nepal

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SG and SKG were responsible for the drafting of the manuscript. ALK, SG, AR, and BCN were responsible for study design. SG and SD collected data in the field. SG, SKG, SD, AR, MS, ALK, BCN, and GPV were all responsible for the critical edits and revisions of the manuscript. All authors approved the final manuscript for publication. The authors have nothing to disclose.

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## INTRODUCTION

With growing empirical evidence, traumatic injuries have earned a position as a global health priority, claiming more than 5.8 million lives worldwide per year.<sup>1</sup> Within the realm of traumatic injuries, 424,000 fatalities per year are a result of fall injuries, second only to road traffic injuries for unintentional injury-related deaths.<sup>2</sup> Low- and middle-income countries (LMICs) experience 80% of fall-injury mortality worldwide.<sup>2</sup> Such global discrepancies in mortality highlight a considerable disparity of access to timely care for fall injuries, as adequate trauma systems are often deficient in LMICs.<sup>2,3</sup>

Although not all fall injuries are fatal, nearly 37.3 million fall injuries are severe enough to require medical attention annually and account for more than 17 million disability-adjusted life-years lost.<sup>2</sup> Although such estimates exist to quantify the effect of fall injuries worldwide and provide invaluable data to policymakers and public health authorities, much of this data has been extrapolated either from high-income countries or incomplete hospital-level data.<sup>4</sup> Hospital-based studies have limited generalizability in LMICs because many patients may be unable to access a hospital because of lack of availability, funds, transportation, or limited personnel.<sup>5,6</sup> Thus, the actual prevalence of fall injuries in LMICs is unknown, and community-level data capturing individuals unable to access hospital-level health care is lacking, particularly in LMICs.

Surgeons OverSeas, a US-based nongovernmental organization, created a population-based surgical needs assessment tool, the Surgeons OverSeas Assessment of Surgical Need (SOSAS), to facilitate the investigation of the prevalence of surgical disease at a community level.<sup>7</sup> To date, SOSAS surveys have been executed countrywide in 3 low-resource settings: Rwanda (2011), Sierra Leone (2012), and Nepal (2014).<sup>8-10</sup> In Rwanda, 45% of all injuries reported were due to falls, the most common type of injury endured by the Rwandan population sampled.<sup>11</sup> Similarly, in Sierra Leone, falls were the most common cause of injuries, accounting for more than 40% of lifetime injuries.<sup>12</sup> SOSAS was executed in Nepal in 2014 given that countrywide community-level data regarding fall injuries was lacking outside of sub-Saharan Africa and enthusiastic local collaborators.

Nepal is a relatively small (147,181 km<sup>2</sup>) low-income country in South Asia, with a population of approximately 28 million.<sup>13</sup> Of Nepal's inhabitants,

25.2% live at or below the national poverty lines and the current life expectancy at birth is 68 years.<sup>13</sup> With 80% of Nepal's territory dominated by the dramatic peaks of the Himalayas in the north, only 43% of the population has access to all-weather roads; the inaccessibility of adequate transportation thus results in delays in providing timely health care.<sup>13,14</sup> Nepal's government has required that at least one primary health post be available in each Village Development Committee (VDC), the smallest administrative unit in Nepal. Subsequently, Nepal has more than 95 hospitals, including 8 tertiary care centers, 205 primary health care centers, and thousands of primary health care posts.<sup>15</sup> Although many health facilities exist in Nepal, qualified professionals often are unwilling to work in such low-resource settings given the lack of incentive, and therefore such facilities lack adequate resources and personnel to provide adequate care.<sup>16</sup> The objective of this study was to provide an estimate of fall-injury prevalence and the number of fall injury-related deaths countrywide in Nepal, and to describe the epidemiology of fall injuries at the community level in Nepal. Given the terrain, economic status, and health care restraints in Nepal, we hypothesized that fall injuries contributed greatly to the burden of overall injuries among Nepali people.

## METHODS

A nationally representative cross-sectional study was performed in Nepal using the SOSAS survey tool from May 25 to June 12, 2014. SOSAS is a cluster, randomized cross-sectional survey, described in more detail previously.<sup>17</sup> The SOSAS survey is divided into 2 sections. The first section collects demographic data regarding the household's access to health care and recent deaths in the household. If a household member died within the previous year, further questions regarding health care received, access to surgical care, barriers to surgical care, and death specifics were asked. For the second section, 2 household members were selected randomly; each member underwent a verbal head-to-toe examination of the following 6 anatomical regions:

1. face, head and neck,
2. chest and breast,
3. abdomen,
4. groin and genitalia,
5. back, and
6. extremities.

Verbal, self-reported data were collected regarding symptoms or experiences associated with a general range of surgical conditions, including wounds, masses, deformities, and burns; and injuries, including road traffic injuries, falls, penetrating trauma, blunt trauma, and burns. A fall injury was defined as “inadvertently coming to rest on the ground, floor or other lower level, excluding intentional change in position”; fall injuries worthy of being reported by respondents were included. Details including the timing and mechanism of an injury were sought, as well as the health-seeking behavior of the individual during the fall injury. Data collected included anatomic location, timing of injury, and whether health care was sought; if health care was not accessed, the reason for barrier to care was asked.

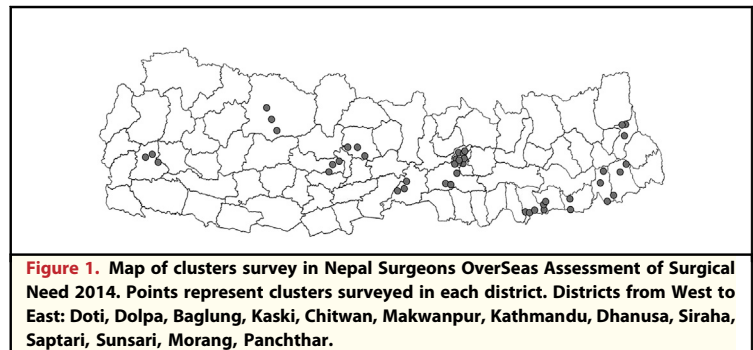
Questions regarding disability from each fall injury were asked. Forms of disability evaluated included the following:

- The fall injury was not disabling.
- The respondent felt ashamed after the fall injury.
- The respondent was unable to work after the fall injury.
- The respondent required help for transportation.
- The respondent required help with activities of daily living after the fall injury.

Additionally, a physician performed a visual physical examination, excluding the groin and anterior chest in females.

Nepal consists of 75 administrative districts. Two-stage cluster sampling was performed. The initial stage randomly selected 15 of the 75 districts proportional to population. The second stage randomly selected 45 VDCs, with 3 VDCs chosen per district after stratification for urban and rural population distribution. Two rural and 1 urban VDC were chosen per district (Fig. 1). This sampling methodology was based on the Demographic and Health Surveys in Nepal.<sup>15</sup>

In all, 100 Nepali medical interns, doctors, and students conducted surveys throughout the country. Interviewers began at a central location and sampled every fifth household within a selected VDC; 30 households per VDC were sampled, with a sample size of 1350 households countrywide. All interviewers were trained in a standardized way, with only physicians performing the visual physical examination. Practice interviews were held by the field supervisor before data collection to ensure adequacy of interview and physical exam. All surveys were verbally administered in Nepali and the responses were recorded in English via paper



surveys; appropriate verbal consent was obtained from each respondent. Sample size estimation was calculated from a prevalence of unmet surgical need of 5%, reported in a pilot study of SOSAS in Nepal in January 2014.<sup>18</sup>

Institutional Review Board approval was obtained from the Nepal Health Research Council in Kathmandu, Nepal, and Nationwide Children’s Hospital in Columbus, Ohio. Funding for the study was provided by Surgeons OverSeas and the Association for Academic Surgery Global Research Fellowship Award.

Data were analyzed in STATA 13.0 (StataCorp, College Station, TX, USA). Estimated proportions of fall injuries were reported with respective 95% confidence intervals (CIs) and were compared by sex, age, village type (rural or urban), occupation, education, and literacy using univariate analyses performed with  $\chi^2$  tests. Odds ratios of falls among various covariates were calculated with a logistic regression model.

## RESULTS

In all, 2695 individuals were surveyed in 1350 households with a response rate of 97%. There were 379 injuries reported by 354 individuals (13.1%; 95% CI, 11.9%–14.5%). Of these injuries, 142 were due to falls (37.5%) in 141 individuals (5.2% of respondents, 95% CI, 4.4%–6.1%) with a mean age of 30.7 years (95% CI, 27.4–34.1). Demographic data of respondents who reported at least 1 fall injury in his or her lifetime are shown in Tables 1 and 2.

The age group with the highest percentage of fall injuries was adults aged 25 to 54 years (45.1%), followed by children aged 0 to 14 years, (21.4%). Individuals aged 65 years and older sustained 5.9% of the fall injuries reported. This age group, however, had the highest proportion of persons who had

**Table 1. Demographic Data of Respondents Who Reported Lifetime Fall Injury**

Demographic	Frequency	Percent	Proportion	Crude Odds Ratio (95% CI)	P value
<b>Village type</b>					
Rural	90	63.83	5.01 (4.05–6.12)	1 (Ref)	0.46
Urban	51	36.17	5.68 (4.26–7.40)	1.14 (0.80–1.63)	
Total	141	100.0			
<b>Sex</b>					
Male	82	58.2	5.72 (4.57–7.05)	1 (Ref)	0.23
Female	59	41.8	4.68 (3.58–5.99)	0.81 (0.57–1.14)	
Total	141	100			
<b>Age category (y)</b>					
0–14	33	21.41	5.72 (3.97–7.94)	1 (Ref)	0.13
15–24	35	20.33	6.39 (4.49–8.77)	1.12 (0.69–1.84)	
25–54	52	45.08	4.28 (3.21–5.57)	0.74 (0.47–1.15)	
55–64	8	7.31	4.06 (1.77, 7.84)	0.69 (0.32, 1.54)	
≥65	13	5.86	8.23 (4.45–13.66)	1.45 (0.76–2.88)	
Total	141	100			

sustained a fall injury: 8.2% of individuals 65 and older sustained a fall injury in his or her lifetime. Of the individuals who sustained fall injuries, 46.4% self-reported their occupation as “unemployed,” 17.9% as “self-employed,” 15% as a “homemaker,” and 13.6% as a “farmer” (Table 2). Further information regarding occupational environment was not obtained during this study.

Using a logistic regression model, fall injuries showed correlations with the male gender (odds ratio [OR], 0.88 if female;  $P = 0.48$ ), the elderly

(65 years or older) and adults (aged 15–24 years; OR 1.08;  $P = 0.78$ ; OR 1.42;  $P = 0.33$ , respectively), and an urban village setting (OR, 1.15;  $P = 0.46$ ), although no association appeared to be statistically significant in this data set.

The most commonly affected anatomic site was the extremities (73.2%), with the upper extremities (hand/thumb, fingers, lower arm, upper arm) involved in 52.1% of fall injuries ( $n = 74$ ; Table 3). Among the 141 individuals who sustained a fall injury, 12 reported a fall within the previous

**Table 2. Education and Occupation of Respondents Who Reported Lifetime Fall Injury**

Demographic	Frequency	Percent	Proportion	Crude Odds Ratio (95% CI)	P value
<b>Occupation (N = 2690)</b>					
Unemployed	65	46.43	5.86 (4.55–7.41)	1 (Ref)	0.13
Homemaker	21	15.0	3.82 (2.38–5.78)	0.64 (0.39–1.05)	
Domestic helper	1	0.71	1.61 (0.04–8.66)	0.26 (0.36–1.93)	
Farmer	19	13.57	6.40 (3.90–9.81)	1.10 (0.65–1.86)	
Self-employed	25	17.86	5.81 (3.80–8.46)	0.99 (0.62–1.59)	
Government	3	2.14	2.19 (0.45–6.27)	0.36 (0.11–1.16)	
Nongovernment	6	4.29	5.71 (2.13–12.02)	0.97 (0.41–2.30)	
Total	140	100			
<b>Education (N = 2692)</b>					
None	34	24.11	4.05 (2.82–5.62)	1 (Ref)	0.083
Primary	48	34.04	6.81 (5.06–8.92)	1.73 (1.10–2.72)	
Secondary	41	29.08	5.62 (4.07–7.55)	1.41 (0.86–2.25)	
Tertiary	17	12.06	4.74 (2.78–7.47)	1.18 (0.65–2.14)	
Graduate	1	0.71	1.67 (0.04–8.94)	0.40 (0.05–2.98)	
Total	141	100			
<b>Literacy (N = 2692)</b>					
Illiterate	40	28.37	4.70 (3.38–6.35)	1 (Ref)	0.39
Literate	101	71.63	5.49 (4.49–6.63)	1.18 (0.81–1.71)	
Total	141	100			

**Table 3. Anatomic Location of Fall Injuries**

Anatomic Location	Injuries Due to Falls, n (%)
Extremities	104 (73.2)
Face, head, and neck	31 (21.8)
Back	4 (2.8)
Chest	2 (1.4)
Abdomen	1 (0.7)
Groin	0 (0.0)
Total	142 (99.9)*

\* 99.9, not 100 due to rounding.

month for which they were unable to access surgical care (8.5%; 95% CI, 4.5%–14.4%). Barriers to care included lack of money for health care (n = 3), unavailable facility/personnel (n = 7), and fear or lack of trust (n = 2). Of the 142 fall injuries reported, 19% resulted in the inability to work as before the injury; 1.4% felt ashamed after sustaining the fall injury, and 1.4% required help with daily living. The fall injury was not disabling in 76.8% of fall injuries reported.

Of the 1350 households surveyed, 80 deaths were reported within the previous year. Of these deaths, 7 were a result of a fall injury (8.8%; 95% CI, 3.6%–17.2%). The mean age of the deceased was 46 years. Surgical care was not delivered to those who died secondary to a fall injury; reasons included a lack of sufficient time (n = 4); facility/personnel unavailable (n = 1); fear/lack of trust (n = 1); and a lack of perceived need for surgical care (n = 1). Thus, of the 80 deaths reported, 6 may have been averted with appropriate access to surgical care (7.5%; 95% CI, 2.8%–15.6%).

## DISCUSSION

To our knowledge the Nepal SOSAS study provided the first national population-based assessment on fall injury prevalence in Nepal, identifying fall injuries as a major public health concern. The findings revealed a nonfatal fall-injury prevalence of 5.23% and a fatal fall-injury prevalence of 8.8%. Extrapolating these results to the current population of Nepal, the prevalence of nonfatal fall injuries in Nepal can be estimated at 1.47 million. Using the most recent crude death rate, we estimate that nearly 16,600 deaths are due to falls annually in Nepal and that about 14,130 deaths from fall injuries may have been avoided with appropriate access to surgical care.<sup>13,19</sup>

Our findings emphasize the high prevalence of fall injuries in Nepal at a population level and are comparable with previously reported fall-injury

data in this region of the world. A hospital-based study was conducted in Kathmandu regarding traumatic injuries; the epidemiologic spectrum of physical trauma was observed over a period of 1 year at Kathmandu University Hospital and its various outreach centers in the community. Fall from height was the most common mode of injury presenting to the emergency department, followed by road traffic incidents.<sup>20</sup> Furthermore, a morbidity and mortality survey conducted in rural India revealed that 20% of fatal injuries were due to falls, and that fall injuries were the leading cause of nonfatal injuries (38%).<sup>21</sup> The present study equally suggested that fall injuries are the most common type of injury endured in the Nepali population, at 37.5% of injuries reported—with road traffic injuries (19.8%) and burns (14.2%) following—and is the leading cause of fatal injury (8.8%).

Existing data indicate that fall injuries are a affliction of the elderly, with estimates suggesting that nearly 28% to 35% of people aged 65 or older fall each year.<sup>22,23</sup> Our results are not unique in that the age category with the highest proportion of fall injuries was those aged 65 years and older (8.2%), followed by adults aged 15 to 24 (6.39%), and children aged 0 to 14 (5.72%). With nearly 80% of the world's elderly population living in developing countries, it seems reasonable, both in a moral and an economic sense, to retain an older persons' capacity so they remain a fundamental resource to their family and community.<sup>24,25</sup> The Nepal Demographic Health Survey revealed that 5.5% of Nepal's population is 65 years or older, and 5.8% of the study population is aged 65 or older; the two therefore correspond appropriately.<sup>15</sup>

However, this should not undermine the burden of fall injuries in the other age categories mentioned. Although limited empirical data exploring childhood falls in the developing world exist, the World Health Organization (WHO) ranked falls as the leading cause of injury burden in those aged 0 to 4 years. Furthermore, an injury survey in China reported that for every child death from a fall, there were 4 cases of permanent disability, 37 cases requiring hospitalization, and 690 who sought care or missed at least 1 day of school or work.<sup>26,27</sup> Thus, a thorough understanding is needed of the specific contributors to fall injuries for all age groups; contributions include the influence of diet (malnutrition and obesity), hazardous environments in daily life, school and work, a lack of accessible transportation and safety equipment, and inadequate health services.<sup>24</sup>

Despite a dearth of robust fall injury data in developing countries, increasing global interest has inspired such reports as the WHO's Global Report on Falls Prevention, which recommends that "the design and implementation of culturally-appropriate, evidence-based interventions that will significantly reduce the number of falls" be a priority action.<sup>28</sup> The translation of fall-injury prevention strategies in developing countries is unfortunately made incredibly challenging by competing demands for acute health issues, shortages of health care providers, and limited availability of resources and personnel.<sup>3,26</sup> Furthermore, fall-prevention strategies in the developed world were not created with developing countries' circumstances in mind, nor have they been tested in such countries.<sup>24</sup>

Primary prevention tactics must be tailored for developing countries, as environmental risks such as open street gutters, a lack of seating on buses, slippery banana-bark mats, and sidewalks cluttered with vendors' wares are not necessarily commonly seen in the developed world.<sup>29–32</sup> Once a fall injury occurs, accessible and appropriate health care should be readily available. From our results, 57% of the deaths resulting from falls were because there was insufficient time before death to travel to a health care facility. Similarly, a review of surgical admissions to a hospital in Nepal revealed that patients who presented late for treatment did so because of difficult geographic access to health facilities and because primary health services did not have the appropriate capacity to deliver care, with a lack of trained personnel and limited resources.<sup>14</sup> The Nepal Community Emergency Preparedness Group has proposed an emergency medical services plan that encourages building navigable roads to increase access to the mountainous regions, without which, rescue services would be unable to reach injured individuals within a reasonable amount of time.

Hospital-based capacities to provide trauma care in Nepal should be strengthened—including staffing specialized medical and surgical personnel and stocking appropriate resources to provide such care. Trauma capacity at the hospital level in developing countries, however, is grossly insufficient and will require dedicated public health interventions to improve.<sup>3</sup> Substantial evidence exists in high-income countries to show that the establishment of trauma systems significantly decreases injury-related mortality. It has been demonstrated that the lack of such trauma systems in LMICs results in patients with life-threatening but potentially treatable injuries having up to 6 times higher a

chance of dying in a country with no organized trauma system.<sup>33,34</sup>

The spectrum of necessary interventions to prevent fall injuries and to decrease the morbidity and mortality of such injuries is vast, requiring the dedication and commitment from multiple key stakeholders across various fields: government officials (decision makers), health care providers and administrators, community leaders, the research community, and nongovernmental agencies must come together to make fall injuries in developing countries such as Nepal a public health priority.

This study inevitably has limitations. The Nepal SOSAS study was a cross-sectional survey methodology and limitations inherent to all cross-sectional studies and randomization assumptions apply. Given the resources available, only 15 of Nepal's 75 districts were randomly sampled proportional to population. Thus, less densely populated districts may have not been sampled, resulting in a sampling bias away from the more rural districts where accessible health care is sparse. Furthermore, the account of deaths within the previous year relied on household members' memory of events; subsequently, recall bias may have occurred for this estimation. The crude death rate calculated from our study is 5.85 deaths per 1000 persons, and the 2012 reported crude death rate from Nepal was 6.7 deaths per 1000 persons; although recall bias is possible, our study possibly underestimates the deaths reported.<sup>13,19</sup> Also, given this is a household population-based survey, a standardized injury severity score for each fall injury could not be assessed. To offset this limitation, we reported data on the respondents' perceived disability. Furthermore, this study did not address more in-depth questions regarding one's occupation, a critical factor when planning for fall prevention.

The median age of the study population who sustained fall injuries was 30.7 years; given that individuals in this age group tend to be productive members of society, our data may suggest that many fall injuries occur at the workplace. More information regarding work-related fall injuries is necessary to develop thorough intervention and effective intervention plans. Future studies regarding fall injuries in Nepal should address this limitation to aid in prevention and treatment strategies. Finally, the SOSAS survey had been previously criticized for relying on self-reported verbal data. The Nepal SOSAS survey incorporated a visual physical examination component performed by physicians to improve the SOSAS tool. The observed agreement between the verbal self-reported data and the visual physical examination

was high, at 94.6%—helping to validate the SOSAS tool.<sup>10</sup> Thus, despite the limitations in this study, we are confident that our findings represent fall injuries in Nepal appropriately and provide baseline estimates for fall-related injuries in Nepal. Future surveys should be conducted to confirm these initial findings and help monitor changes of fall-related injuries in Nepal.

## CONCLUSION

The Nepal SOSAS study provided countrywide, population-based data on fall injury prevalence in Nepal, identifying falls as a crucial public health concern. These data highlight persistent barriers to access to care for the injured and the need to improve trauma care systems in developing countries such as Nepal.

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