Assessment of home hazards for non-fatal childhood injuries in rural Nepal: A community survey

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ABSTRACT

Background

Unintentional injuries in and around the home are important causes of preventable death and disability among young children globally. In Nepal, there is a lack of data regarding home injuries and home hazards to guide the development of effective interventions for preventing childhood home injuries. This study aimed to determine the burden of unintentional home injuries in children <5 years in rural Nepal and quantify the injury hazards in their homes.

Methods

A survey was conducted in 740 households in rural areas of the Makwanpur district during February and March 2015. The primary carer reported home injuries which occurred in the previous 3 months and data collector observation identified the injury hazards. Injury incidence, mechanism and the proportion of households with different hazards were described. Multivariable logistic regression explored associations between the number and type of home hazards and injuries.

Results

Injuries severe enough to need treatment, or resulting in non-participation in usual activities for at least a day were reported in 242/1042 (23.2%) children <5 years. The mean number of injury hazards per household was 14.98 (SD = 4.48), range of 3 - 31. Regression analysis found an estimated increase of 31% in the odds of injury occurrence associated with each additional injury hazard found in the home (adjusted OR 1.31; 95% CI: 1.20 – 1.42).

Conclusions

A high proportion of young children in rural Nepal sustained injuries severe enough to miss a day of usual activities. Increased frequency of hazards was associated with an increased injury risk.

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INTRODUCTION

Globally, unintentional home injuries are a major cause of premature death and serious disability among children under five years.[1] These deaths impose a large economic burden on families and society [2], especially in low-and middle-income countries (LMICs). Rates of mortality related to injury among children in LMICs are 4 to 6 times higher than those in high-income countries (HICs).[3] Compared with adults, young children are a high-risk group for unintentional injuries.[2] Most injuries to children <5 years occur in the home environment in both LMICs[4, 5] and HICs.[1, 6] Low-income communities live in environments with a greater numbers of hazards.[3] The exposure of children to those hazards is likely to increase their risk of injury.

Some observational studies from LMICs have reported the frequency of hazards in the home that could potentially result in injury[7-12] but there has been little research reporting the injuries arising from such hazards. These studies revealed that there is a significant burden of home injury hazards in LMICs, representing an important opportunity for injury prevention. Environmental change in the home may limit a child's injury risk, either by eliminating the hazards or by using safety equipment and practices to restrict exposure to the hazards.[13] However, accurate information about the injury and the associated risk factors are essential in the design and implementation of effective home environmental change interventions.[14, 15]

Nepal is one of the 'least developed' countries of the world.[16] In the absence of robust death registration and injury surveillance systems, the burden of injury in Nepal has not been measured comprehensively. Household surveys and hospital data suggest that home injuries (e.g. falls, burns, poisoning and animal related injuries) are common among young children in Nepal.[17, 18] No studies have quantified the injury hazards in their homes or assessed the association between home hazards and injuries in children <5 years. To address this knowledge gap, this study aimed to describe the epidemiology of unintentional home injuries in children under 5 years, explore the prevalence of home environmental hazards and investigate the relationship between home environmental hazards and unintentional home injuries amongst children living in rural areas of Makwanpur district, Nepal.

METHODS

Study design

The study used a community-based, cross-sectional design, conducted in Makwanpur district, Nepal. This district was selected because of its geographical location (a predominantly rural district, four hours' drive from Kathmandu), the demographics of its population (similar to Nepal as a whole) and the fact that it has three distinct types of landscape (high hills, mid hills and lowland/plains) which are similar to most other districts of Nepal[17] outside of the mountains.[19]

Sample size

The sample size of 740 households was calculated, based on UN guidelines for household surveys.[20] Previously published research showed that 72% of households in a community survey in Pakistan had 6 or more injury hazards[11], and that having 6 or more hazards increases the risk of child injury.[21] Therefore, the proportion of homes with the indicator of interest in the sample size estimate was 72%. The Makwanpur district (area 2,426 km2) has a population estimated at 420,477 people living in 86,127 households. The proportion of the population aged 0-59 months (9%) and the average household size (4.88) was ascertained from the 2011 population census.[22] The design effect was 2.0, based on published guidelines for household surveys using cluster sampling.[20] The anticipated non-response rate was 10% based on the study conducted in Nepal[17] and described in the WHO guidelines.[23]

Sampling method

Multi-stage cluster sampling, with probability proportional to size (PPS) methodology, was applied as a sampling method.[20] A household was defined as a group of individuals living together and sharing the same kitchen. A household was eligible to be included in this study if there was at least one child aged 0-59 months and the family had been residing in that house for three or more months Simple random sampling was used to select the primary cluster (i.e. Village Developments Committees) and secondary cluster (i.e. Households) (figure 1).

Data collection tools

The data were collected using a structured two stage questionnaire. In the first stage, data were collected on the household residents and hazards in the home. The second stage was completed only for those households who reported an injury in a child under five years. A structured questionnaire, adapted from the WHO Guidelines[23], and a hazard checklist, adapted from a similar study conducted in Pakistan[11], were developed as data collection tools. The checklist included 32 possible hazards that could result in eight common injuries. The questionnaires and checklist were piloted before being used for data collection in the field. Data collectors were trained to complete the structured questionnaire and to assess the presence or absence of only those hazards included on the checklist.

Definitions used

Injury: The definition of injury used in this study was "any unintentional injury that occurred within the home environment and was severe enough to need treatment or resulted in non-participation in usual activities for at least a day". Unintentional injury is defined as any injury that occurred without any intent of self-harm, homicide, or suicide. A three month recall period was applied to achieve sufficient detailed information about non-fatal injuries and to minimise recall bias.[24] All the children aged <5 years in the sampled households were included in the study. If a child had sustained

more than one injury in the last three months, the respondent was asked to provide information about the one injury that they considered to be the most severe. *Home environment*: the kitchen, bathroom, bedroom or sleeping area, the courtyard, the rooftop and the immediate vicinity of the house. *Home hazard*: Anything that represents a physical or structural hazard that has the potential to cause injury.

Data collection process

A door-to-door survey was conducted by six trained data collectors during February and March 2015. Where possible, information was collected from the main caregiver of any child in the household. In the absence of a main caregiver, another member of the household providing care to the child/children provided information. If no adult members were at home during the first visit, these households were visited twice. If no one was at home for the second visit, an alternative household was selected for the survey. A household nearest to the sampled household was used as an alternative household. Verbal consent was obtained prior to the interview. With permission of the parent/carer, the data collectors who were trained to undertake home hazard assessments also visited each area of the house to identify and document the hazards for injury using the checklist. Unused areas of each household that had been locked continuously for the previous six months, or places designated for worship, were not observed.

Data analysis

IBM SPSS Statistics for Windows, Version 22.0[25] was used for data analysis. Injury incidence and the proportion of households with hazards were analysed. The continuous data were assessed for normality distribution using the Shapiro-Wilk test in SPSS. The data were normally distributed as the statistic values were greater than 0.05 and therefore transformation was not required. Rates and proportions for child injuries were calculated and reported by age groups, gender and types of injury mechanisms. Multivariable logistic regression analysis was used to explore the association between having any home hazards and children sustaining any injury, controlled for family and home variables. Secondary analyses explored the association between the presence of specific hazards and children sustaining hazard-specific injuries. A p-value of less than 0.05 was considered as statistically significant.

RESULTS

The 740 households surveyed housed 4967 residents, 1042 (21%) of these were children aged <5 years, with an average number of 1.40 children per survey household. For data collection purposes, due to the adult household member not being available after two visits, 12 (1.6%) households were substituted with another households. The characteristics of the surveyed population is summarised in table 1.

Table 1 Characteristics of resident population surveyed

Surveyed population (total population = 4967)	n, (%)
Male	2469 (49.7)
Female	2498 (50.3)
Average number of members per HH (Mean, SD)	6.71 (2.6)
Surveyed households (total households = 740)	**n, (%)**
Household size	
Small size (≤ 4 people)	145 (19.6)
Medium size (5-8 people)	440 (59.5)
Large size (> 8 people)	155 (20.9)
Household ethnicity	
Dalit (the most disadvantaged ethnic group)	23 (3.1)
Disadvantaged Janajatis	534 (72.2)
Disadvantaged non-Dalit Terai caste group	0 (0.0)
Religious minorities	0 (0.0)
Relatively advantaged Janajatis	5 (0.7)
Upper caste groups	168 (22.7)
Others	10 (1.4)
Household monthly income and expenditure	
Income: Median (Minimum-Maximum)	Nepalese Rupees 14000 (1000-140000)
Expenditure: Median (Minimum-Maximum)	Nepalese Rupees 3500 (500-55000)
Number of children < 18 years	
1-2 children at home	298 (40.3)
3-4 children at home	307 (41.5)
> 4 children at home	135 (18.2)
Main caregiver in a household	
Mother	474 (64.1)
Father	7 (0.9)
Grandparents	246 (33.2)
Aunt, uncle or other adult relative(s)	5 (0.7)
Older siblings (brother(s) or sister(s))	8 (1.1)
Age of the caregivers responding to the survey?	
<20 years	41 (5.5)
20-29 years	280 (37.8)
30-39 years	143 (19.3)
40-49 years	96 (13.0)
50 years and above	180 (24.3)
Sex of the caregivers	
Male	42 (5.7)
Female	698 (94.3)
Main occupation of the caregivers	
Agriculture	561 (75.8)
Salary job/business (regular income)	22 (3.0)
Skilled/wage labour (irregular income)	6 (0.8)
Unemployed	129 (17.4)
Unable to work/elderly	22 (3.0)
Education of the caregivers	
Not able to read and write	348 (47.0)
Able to read and write	392 (53.0)

Note: The questionnaires for all 740 households were checked by a supervisor immediately after data collection and data collectors returned to participating households to complete any missing fields. This process resulted in no missing data for any fields.

Injury incidence

Overall, 31.4% (n=232/740) of households reported at least one child injury. The overall injury rate amongst children aged <5 years was 232.2 per 1000 children (95% CI: 206.9 - 259.1) (table 2). Injury rates were highest among children aged 36-47 months and lowest in children aged <12 months. The injury rate increased as age increased up to 47 months but at 48 months and older the rates fell. Overall, injury rates in male children were marginally higher than in female children but this difference was not statistically significant.

Table 2 Rates of child injury by age group and sex (Per 1000 children)

Variable name	Number of injured children <5 years in surveyed households	Total number of children <5 years in surveyed households	Injury rate (95% CI)
Age groups			
<12 months	21	162	129.6 (82.1 - 191.3)
12-23 months	53	227	233.5 (180.0 - 294.0)
24-35 months	48	187	256.7 (195.7 - 325.5)
36-47 months	66	218	302.8 (242.5 - 368.4)
48-59 months	54	248	217.7 (168.0 - 274.4)
0-59 months	242	1042	232.2 (206.9 - 259.1)
Sex			
Male	130	538	241.6 (206.0 - 280.1)
Female	112	504	222.2 (186.7 - 261.1)

The largest proportion of injury events occurred due to a fall (n=89, 37%), followed by fire, burns, scalds (n=67, 27%), cuts or crushes (n=53, 22%) and then animal-related injuries (e.g. bite, sting or hit by domestic or wild animal) (n=24, 10%). Only the proportion of fire-related injury, burns or scalds was slightly higher in female children (table 3).

Table 3 Number and proportion of child injuries by injury mechanism, age groups and sex

Injury mechanisms	Total	Age groups (months)					Sex	
	0-59 N=1042 n, (%)	<12 N=162 n, (%)	12-23 N=227 n, (%)	24-35 N=187 n, (%)	36-47 N=218 n, (%)	48-59 N=248 n, (%)	Male N=538 n, (%)	Female 504 n, (%)
Falls	89 (36.8)	5 (5.6)	16 (18.0)	14 (15.7)	37 (41.6)	17 (19.1)	47 (52.8)	42 (47.2)
Fire, burn or scald	67 (27.7)	12 (17.9)	23 (34.3)	15 (22.4)	9 (13.4)	8 (11.9)	33 (49.3)	34 (50.7)
Cut or crush	53 (21.9)	1 (1.9)	8 (15.1)	12 (22.6)	13 (24.5)	19 (35.8)	27 (50.9)	26 (49.1)
Animal-related	24 (9.9)	2 (8.3)	6 (25.0)	4 (16.7)	4 (16.7)	8 (33.3)	17 (70.8)	7 (29.2)
Other injuries*	9 (3.7)	1 (11.1)	0 (0.0)	3 (33.3)	3 (33.3)	2 (22.2)	6 (66.7)	3 (33.3)
Overall	242 (100)	21 (8.7)	53 (21.9)	48 (19.8)	66 (27.3)	54 (22.3)	130 (53.7)	112 (46.3)

"N" refers to the number of children in surveyed households and "n" refers to the number of children with an injury
*Other injury = 'Other injury' included blunt objects (n=5, 2.1%), near-drowning (n=1, 0.4%), machines or tools (n=1, 0.4%), suffocation or choking (n=1, 0.4%) and road or transport injury (n=1, 0.4%). Road or transport injury was defined in this study as those occurring on roads near the home.

Of the total 242 injury events, 43.8% (n=106) occurred inside the home and 56.2% (n=136) occurred outdoors but within the immediate vicinity of the home. Fires, burns or scalds were found to be the most frequent (58.5%) injury event among all 106 injury events occurred inside the home whereas falls were found to be the most frequent (47.8%) among all 136 injury events that occurred outside the home but within the immediate vicinity of the home.

Injury hazards in the home environment

Across all surveyed households (n=740), the mean number of injury hazards was 14.98 (SD = 4.48, range = 3-31). The prevalence of hazards in the home varied across different types of injury (table 4). It was recorded that 98.1% households did not have protective railings on stairs or ladders. The windows in 83.6% households and the balconies in 50% households lacked a protective barrier. Cooking stoves were within the reach of children in 98.4% households and 42.2% household did not have a barrier or door between the sleeping and cooking areas. About 80 to 83% households had sharp

or hard protruding components and breakable objects within the reach of young children. Common poisoning hazards, including a child's ability to access alcoholic beverages, were found in 91.5% households, agricultural chemicals or fertilizers in 61.5% households and fuels in 44.4% households. Plastic bags were within the reach of child in 52.2% households. Outside the home, cattle sheds were reported to be fenced in less than 10% of households and more than 95% households had accessible ponds, lakes and streams.

Table 4 Prevalence of home injury hazards by injury type (N = 740 households)

Child home injury hazard	Applicable Cases n	Hazard present n (%)
Hazards for fall		
Protective handrails absent along both sides of stairs or ladder	727	713 (98.1)
Window without protective guards or rails	660	552 (83.6)
Balcony without protective bars or rails	276	138 (50.0)
Walking area with items cluttering passageway, including telephone or electrical cords and other obstacles	653	53 (8.1)
Baby walkers accessible to child aged <18 months	437	33 (7.6)
Hazards for fire-related injury, burns or scalds		
Cooking stoves within reach of the child	740	728 (98.4)
Lack of barrier or door between sleeping and cooking areas	736	315 (42.8)
Flammable items such as matches, lighters and fuels (e.g. paraffin or kerosene) within reach of the child	736	310 (42.1)
Kerosene lamps or candles within reach of the child when in use	319	111 (34.8)
Hot irons or other appliances (e.g. hair straighteners) within reach of the child	107	21 (19.6)
Hazards for cuts or crush injuries		
Sharp or hard protruding components (e.g. big stones or pieces of wood, woodpiles, old machinery etc.) within reach of the child	735	609 (82.9)
Breakable objects (e.g. bottles or any dishes made by glass or mud etc.) within reach of the child	686	545 (79.4)
Sharp equipment designed for agriculture purpose (e.g. axe, sickle, spade etc.) within reach of the child	738	458 (62.1)
Sharp items such as knives, scissors, razors etc. within reach of the child	740	413 (55.8)
Hazards for animal injury		
Cattle sheds without adequate fencing	713	646 (90.6)
Hazards for drowning		
Unprotected bodies of water (pond, lake, stream etc.) near the house (within 100 meters)	320	307 (95.9)
Open holds or vats designed to feed cattle within reach of the child	696	606 (87.1)
Open container of water or other liquids within reach of the child	733	613 (83.6)
Ditches or pool of water around the house within reach of the child	380	198 (52.1)
Hazards for poisoning		
Alcoholic beverages within reach of the child	508	465 (91.5)
Agricultural chemicals or fertilizers within reach of the child	550	338 (61.5)
Fuels (e.g. kerosene, cooking oil, petrol, diesel, gas etc.) within reach of the child	732	325 (44.4)
Cleaning products, chemicals, bleaches, acids and detergents within reach of the child	590	159 (26.9)
Poisonous plants within reach of the child	263	48 (18.3)
Medicines and vitamins within reach of the child	479	74 (15.4)
Hazards for electric shock		
Electrical cables within reach of the child	611	77 (12.6)
Electrical switches or plug points within reach of the child	610	49 (8.0)
Unsafe electric wiring	607	34 (5.6)
Hazards for suffocation or choking		
Plastic bags within reach of the child	659	344 (52.2)
Small food items such as peanuts, beans, seeds or grains etc. within reach of the child	651	324 (49.8)
Small objects such as marbles, coins, buttons, toys, small loose and spare batteries within reach of the child	688	272 (39.5)

[#] *Percentage refers to dichotomous response (yes or no).*

Within reach of child is defined as if hazard was present on the floor, <1-meter height, or in unlocked cabinet/drawer. Out of child reach was defined as a hazard above 1-meter height, or that was in locked cabinet/drawer/storeroom. The proportion of households possessing a given hazard was calculated with exclusion of cases that were not applicable to the study. For example, houses without a balcony were not assessed for whether the household possessed protective railings around the balcony. A photograph of a typical wooden Nepali home is presented in the supplementary figure S1.

Association between home hazard and child injury

The regression analysis to explore the association between home hazards and reported child injury included 233 injury cases and 800 non-injury cases. The nine (4%) of injuries categorised as "other injuries" were excluded due to the small numbers of specific injury types. A positive association between the number of home hazards and number of children with an injury was found for both any hazards and for specific hazards. There was an estimated increase of 31% in the odds of a child sustaining an injury with each additional injury hazard found in the home (AOR 1.31; 95% CI: 1.20 - 1.42). Similar associations, but with increased ORs, were obtained for falls, fires, burn or scald injuries and for cut or crush injuries (table 5).

Table 5 Association between number of home hazards and number of children with injury

Number of hazards [a]	Number not injured	Number injured	OR (95% CI) [b]	AOR (95% CI) [c]	P-value
Any hazard	No injury (n=800)	Any injury (n=233)	1.21 (1.13, 1.29)	1.31 (1.20, 1.42)	<0.001
Fall	No fall (n=944)	Fall (n=89)	2.03 (1.67, 2.45)	2.19 (1.77, 2.70)	<0.001
Fires, burn or scald	No burn (n=966)	Burn (n=67)	2.41 (1.72, 3.38)	2.45 (1.72, 3.49)	<0.001
Cut or crush	No cut/crush (n=980)	Cut/crush (n=53)	2.48 (1.72, 3.57)	4.72 (2.44, 9.13)	<0.001

[a] *Per one unit increase in the number of home hazards, measured on a continuous scale.*
[b] *Adjustment for clustering effect at household level was achieved using clustering standard error.*
[c] *Adjusted for family and home variables (presented in the supplementary tables S1- S4).*

DISCUSSION

This is the first study in Nepal to explore the injury risk for children <5 years old of a range of different hazards found in homes in rural communities. In summary, this study found that 23.2% of young children in rural Nepal sustained injuries severe enough to miss a day of usual activities. An increased frequency of injury hazards in the home was found to be associated with an increased risk of child injury.

Injury incidence

While the incidence of injury in children <5 years reported in this study (23.2%) is broadly similar to some studies conducted in other LMICs[26, 27], other studies have found both higher[9, 28, 29] and lower rates.[11, 30] The most likely reasons for such differences may be due to the different ages of the children studied, different recall periods, study areas (e.g. rural vs urban), living circumstances, cultural practices and different socio-economic conditions of the sampled households. Studies with longer recall periods tended to have lower rates of injury; older events are more likely to be forgotten, leading to an underestimation of the true rate.

In the current study, injury incidence in male children (24.1%) was only marginally higher than in female children (22.2%), which is similar to findings from Iran[30], Egypt[31] and Turkey[32] In contrast, several studies in other LMICs have demonstrated differences by gender greater than could have occurred by chance.[28, 33] The rates of injuries for different age groups were similar in other

studies compared to this study[30, 34] and the peak in injury rate at 47 months was also supported by earlier studies.[31, 32] Similar to the findings of this study, in other studies, falls and burns were reported as the most frequent injury mechanisms.[28, 30, 31]

Injury hazards in the home environment

This study found a substantial number of hazards in most of the surveyed households (mean of 14.98 hazards, range = 3-31 hazards). A community based study in China, which investigated home injury hazards amongst toddlers (24-47 months), reported similar findings with mean home hazards of 12.29 (SD = 6.39) and a range of 0-36 hazards.[12] However, the prevalence of home hazards reported in the study were based on parent reported data, not objective observation. Parents may have been reluctant to report high numbers of hazards for fear their home would be considered unsafe. This may have resulted in an underestimate of the true number of hazards.

This study observed that 98% of households had unprotected stairs or ladders. Similar findings were reported in one Indian study[10] but in other studies, the proportion of households with either unsafe or no railings was much lower, between 23-25%.[9, 29] In the current study, 84% of households had unprotected window rails and 50% had unprotected balconies. Similar findings were reported from Karachi, Pakistan[11] but the study from Egypt found these hazards in only 6 to 8% households.[29] This is likely to be due to differences in housing construction between the countries: homes in Pakistan are more likely to be similar to those in Nepal and those in Egypt more likely to be different.

Most cooking in the rural areas of Nepal is on open fires using firewood, often at ground level. In this study, 98% households had cooking stoves within the reach of the child. A recent systematic review also highlighted that the use of open fires for cooking was the most common hazard leading to burn injuries in the Nepalese population.[35] This differs to most other studies conducted in similar settings, where only about half, or less, of the households had open fires that children could reach.[9-11]

This study found that sharp or hard protruding components (e.g. big stones or pieces of wood, woodpiles, old machinery etc.) were within the reach of children in most surveyed households (83%). These objects were not reported as potential hazards for cut or crush injuries in any study from LMICs.

In Nepal, there was a greater proportion (52%) of bodies of water that were accessible to children that were near to the home, and were therefore potential drowning hazards than in neighbouring country such as India (32-36%).[8, 9] This study found that open containers of water (or other liquids) were within the reach of a child in 84% of households. In contrast, only 18 to 48% households in Pakistan had this drowning hazard in their home environment.[11]

Alcoholic beverages were not reported as a potential poisoning risk in any other study from LMICs, possibly because they were not perceived as risks, or the households sampled did not consume

alcohol. This study found that agricultural chemicals or fertilizers were within the reach of the child in 62% households. This may be due to the lack of lockable cupboards for storage or poor safety practices in Nepalese households, as also seen in other LMICs.[8, 10, 11] Similar to the study in Pakistan [36], there was a high risk of paraffin poisoning in Nepalese children as 44% households had such fuels within the reach of child. The proportion of households with suffocation and choking hazards found in the current study was similar to the studies conducted in China[12], India[9] and Pakistan.[11]

Association between home hazard and child injury

In line with the result of this study, an Indian study reported a positive relationship between the number of home injury hazards and child injury incidence.[9] The study showed that the odds of having an injury increased by 55% with each additional injury hazard found in the home (AOR 1.55; 95% CI: 1.3 - 1.8), adjusted for confounding variables. Positive associations between increasing numbers of home hazards and increasing numbers of injuries have also been found in HICs including New Zealand[21] and Canada.[37]

In contrast, studies from Australia[38], Egypt[31] and the UK[39] did not show positive relationships between numbers of hazards and numbers of injuries once confounding factors were adjusted for. The reasons might be that the children in these countries were less likely to be exposed to the hazards or the potential impact of hazards to the children were moderated or reduced. It is important to note that household may have many hazards but whether or not the child interacts with that hazard determines if they are at risk of injury.

Strengths and limitations

The findings of this study increase our understanding of the impact of home injury hazards on child injuries in rural households of Nepal. One limitation was the length of the recall period for child injury. Whilst three months recall periods are useful in the collection of detailed information regarding non-fatal injury, a longer recall period would have allowed inclusion of seasonal injuries such as those that occur during the monsoon. However, longer recall periods risk caregivers forgetting some injuries.[40] The hazard assessment was carried out at the time of the survey, so it is possible that the household could have contained a different number and types of hazards at the time any injury event occurred.

In many studies, poisoning, drowning, suffocation and choking have been reported as causes of mortality and morbidity in preschool children. In this study, no injury events were reported due to poisoning and drowning, and one event of suffocation or choking was reported. The reported incidences of poisoning, drowning and suffocation or choking may be true, and the incidence estimate valid for this sample. Alternatively, there may have been under-reporting of these injury types, possibly by the parents not wanting to share information of these events if they were uncomfortable

reporting them, or that because these injuries did not leave visible marks, they were less well remembered or not considered as injuries. The lack of drowning cases might have been due to the fact that the data were collected during the dry season and the recall period used.

CONCLUSIONS

This study found a significant burden of injuries that occurred in the home to young children: falls, fire, burn or scald, cut or crush injuries were the most common types of injuries reported. This study also revealed that, as the number of home hazards increased, the odds of children with injury also increased, even after adjustment for confounding factors. These findings suggest that addressing the number of injury hazards in rural Nepalese homes may be effective in reducing home injuries in children. Injury prevention initiatives should consider the development and evaluation of interventions to reduce the number of hazards in the home.

What is already known on the subject?

- Unintentional injuries in young children commonly occur in or around the home
- Few publications have reported both injury hazards and injury incidence in low income countries
- The burden of unintentional home injuries among the children under 5 years is higher than other age groups of children in Nepal.

What this study adds:

- Falls, burns and scalds and cut or crush injuries were the most commonly occurring injuries in and around the home in children under 5 years in Nepal.
- Increased frequency of injury hazards in the home is associated with an increased risk of child injury.
- Interventions to reduce injury hazards in rural Nepalese homes may reduce child injuries and should be evaluated.

Ethics approval Study approval was obtained from the Ethical Review Board (ERB) of the Nepal Health Research Council (NHRC), Nepal and the Faculty Research Ethics Committee (FREC) of the University of the West of England (UWE Bristol), United Kingdom.
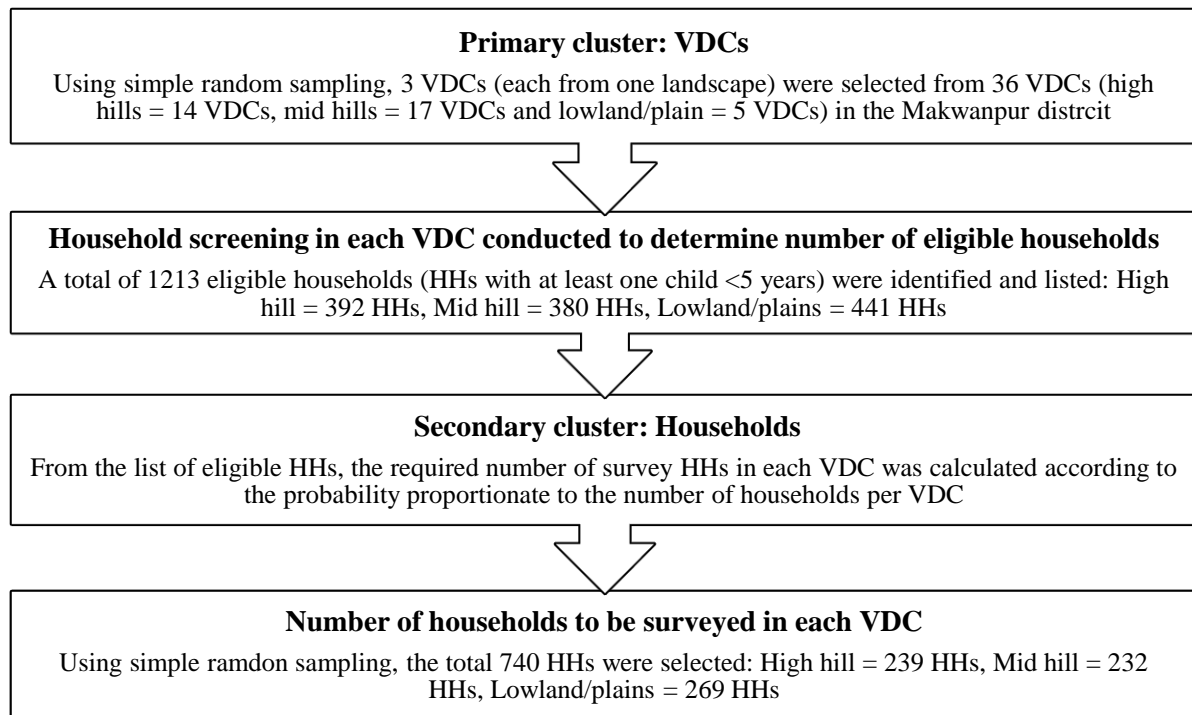
References:

1. Sengoelge M, Hasselberg M, Laflamme L. Child home injury mortality in Europe: a 16-country analysis. *Eur J Public Health* 2011;21:166-70.
2. Lao Z, Gifford M, Dalal K. Economic cost of childhood unintentional injuries. *Int J Prev Med* 2012;3:303-12.
3. Peden M, Oyegbite K, Ozanne-Smith J, *et al. World report on child injury prevention.* Geneva, Switzerland: World Health Organization 2008.
4. Hyder AA, Sugerman DE, Puvanachandra P, *et al.* Global childhood unintentional injury surveillance in four cities in developing countries: a pilot study. *Bull World Health Organ* 2009;87:345-52.
5. Fatmi Z, Kazi A, Hadden WC, *et al.* Incidence and pattern of unintentional injuries and resulting disability among children under 5 years of age: results of the National Health Survey of Pakistan. *Paediatr Perinat Epidemiol* 2009;23:229-38.
6. Gulliver P, Dow N, Simpson J. The epidemiology of home injuries to children under five years in New Zealand. *Aust N Z J Public Health* 2005;29:29-34.
7. Chaudhari V, Srivastava R, Moitra M, *et al.* Risk of domestic accidents among under five children. *The Internet Journal of Family Practice* 2008;7.
8. Mirkazemi R, Kar A. Injury-related unsafe behavior among households from different socioeconomic strata in Pune city. *Indian J Community Med* 2009;34:301-05.
9. Banerjee S, Paul B, Bandyopadhyay K, *et al.* Domestic unintentional injury of 1 to 5-year-old children in a rural area of West Bengal, India: a community-based study. *Tanzan J Health Res* 2016;18:1-8.
10. Parmeswaran G, Kalaivani M, Gupta S, *et al.* Assessment of home hazards for childhood injuries in an urban population in New Delhi. *Child Care Health Dev* 2016;42:473-77.
11. Khan UR, Chandran A, Zia N, *et al.* Home injury risks to young children in Karachi, Pakistan: a pilot study. *Arch Dis Child* 2013;98:881-16.
12. Qiu X, Wacharasin C, Deoisres W, *et al.* Characteristics and predictors of home injury hazards among toddlers in Wenzhou, China: a community-based cross-sectional study. *BMC Public Health* 2014;14:638.
13. Morrongiello B, Ondejko L, Littlejohn A. Understanding toddlers' in-home injuries: II. Examining parental strategies, and their efficacy, for managing child injury risk. *J Pediatr Psychol* 2004;29:433-46.
14. Kendrick D, Mulvaney C, Ye L, *et al.* Parenting interventions for the prevention of unintentional injuries in childhood. *The Cochrane database of systematic reviews* 2013;28:CD006020.
15. Phelan K, Khoury J, Xu Y, *et al.* A randomized controlled trial of home injury hazard reduction: the HOME injury study. *Arch Pediatr Adolesc Med* 2011;165:339-45.
16. OECD. *DAC List of ODA Recipients*. 2019 [cited 2019 27 June]; Available from: http://www.oecd.org/dac/financing-sustainable-development/development-finance-standards/DAC_List_ODA_Recipients2018to2020_flows_En.pdf.
17. Pant PR, Towner E, Ellis M, *et al.* Epidemiology of unintentional child injuries in the Makwanpur District of Nepal: a household survey. *Int J Environ Res Public Health* 2015;12:15118-28.
18. Bhatta S, Pant P, Mytton J. Usefulness of hospital emergency department records to explore access to injury care in Nepal. *Int J Emerg Med* 2016;9:21.
19. Osrin D, Mesko N, Shrestha BP, *et al.* Implementing a community-based participatory intervention to improve essential newborn care in rural Nepal. *Trans R Soc Trop Med Hyg* 2003;97:18-21.
20. United Nations *Designing household survey samples: practical guidelines.* New York: United Nations Publications 2008: 227.
21. Keall MD, Baker M, Howden-Chapman P, *et al.* Association between the number of home injury hazards and home injury. *Accid Anal Prev* 2008;40:887-93.

22. Central Bureau of Statistics, *National Population and Housing Census 2011 (National Report)*. 2012, National Planning Commission, Central Bureau of Statistics: Kathmandu, Nepal.
23. Sethi D, Habibula S, McGee K, *et al. Guidelines for conducting community surveys on injuries and violence.* World Health Organization Geneva 2004.
24. Harel Y, Overpeck MD, Jones DH, *et al.* The effects of recall on estimating annual nonfatal injury rates for children and adolescents. *Am J Public Health* 1994;84:599-605.
25. IBM Corp, *IBM SPSS Statistics for Windows, Version 24.0*. 2019, Armonk, NY: IBM Corp
26. Bashour H, Kharouf M. Community-based study of unintentional injuries among preschool children in Damascus. *East Mediterr Health J* 2008;14:398-405.
27. Alptekin F, Uskun E, Kisioglu AN, *et al.* Unintentional non-fatal home-related injuries in Central Anatolia, Turkey: frequencies, characteristics, and outcomes. *Injury* 2008;39:535-46.
28. Shriyan P, Prabhu V, Aithal KS, *et al.* Profile of unintentional injury among under-five children in coastal Karnataka, India: a cross-sectional study. *Int J Med Sci Public Health* 2014;3:1317-19.
29. Abd El-Aty NS, Moftah FM, Ibrahim HDF, *et al.* Assessment of Knowledge and Practice of Mothers toward Home Accidents among Children Under Six Years in Rural Areas in Assiut Governorate (2003). *Ass. Univ. Bull. Environ. Res* 2005;8:11–28.
30. Rezapur-Shahkolai F, Afshari M, Moghimbeigi A, *et al.* Home-related injuries among under-five-year children and mothers' care regarding injury prevention in rural areas. *Int J Inj Contr Saf Promot* 2017;24:354-62.
31. Kamal NN. Home unintentional non-fatal injury among children under 5 years of age in a rural area, El Minia Governorate, Egypt. *J Community Health* 2013;38:873-79.
32. Erkal S. Identification of the number of home accidents per year involving children in the 0-6 age group and the measures taken by mothers to prevent home accidents. *Turk J Pediatr* 2010;52:150-57.
33. Eldosoky R. Home-related injuries among children: knowledge, attitudes and practice about first aid among rural mothers. *East Mediterr Health J* 2012;18:1021-27.
34. Erkal S, Safak S. Determination of the risks of domestic accidents for the 0-6 age group in the Tuzlucayir Village Clinic neighborhood. *Turk J Pediatr* 2006;48:56-62.
35. Tripathee S, Basnet SJ. Epidemiology of burn injuries in Nepal: a systemic review. *Burns Trauma* 2017;5:10.
36. Manzar N, Saad SMA, Manzar B, *et al.* The study of etiological and demographic characteristics of acute household accidental poisoning in children-a consecutive case series study from Pakistan. *BMC Pediatr* 2010;10:28.
37. LeBlanc JC, Pless IB, King WJ, *et al.* Home safety measures and the risk of unintentional injury among young children: a multicentre case–control study. *CMAJ* 2006;175:883-87.
38. Osborne JM, Davey TM, Spinks AB, *et al.* Child injury: Does home matter? *Social Science & Medicine* 2016;153:250-57.
39. Pearce A, Li L, Abbas J, *et al.* Does the home environment influence inequalities in unintentional injury in early childhood? Findings from the UK Millennium Cohort Study. *J Epidemiol Community Health* 2012;66:181-88.
40. Hang HM, Byass P, Svanström L. Incidence and seasonal variation of injury in rural Vietnam: a community-based survey. *Saf Sci* 2004;42:691-701.

Figure legends

Figure 1 Sampling method: Multistage cluster sampling

Primary cluster: VDCs

Using simple random sampling, 3 VDCs (each from one landscape) were selected from 36 VDCs (high hills = 14 VDCs, mid hills = 17 VDCs and lowland/plain = 5 VDCs) in the Makwanpur distrcit

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Household screening in each VDC conducted to determine number of eligible households

A total of 1213 eligible households (HHs with at least one child <5 years) were identified and listed: High hill = 392 HHs, Mid hill = 380 HHs, Lowland/plains = 441 HHs

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Secondary cluster: Households

From the list of eligible HHs, the required number of survey HHs in each VDC was calculated according to the probability proportionate to the number of households per VDC

Number of households to be surveyed in each VDC

Using simple ramdon sampling, the total 740 HHs were selected: High hill = 239 HHs, Mid hill = 232 HHs, Lowland/plains = 269 HHs

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Note: HHs = Households, VDCs = Village Development Committees

Supplementary materials

Figure S1 A typical wooden Nepali home in rural area of Nepal

Figure taken by an author with the permission of household member to use in publication

Table S1 Univariable logistic-regression results for the association between any injury and potential confounding variables

Potential confounding variables	No injury N = 800 n (%)	Any injury N = 233 n (%)	Adjusted for clustering at household level		
			Odds ratio (95% CI)	P-value	Wald test P value
Siblings under 18 years					
0 siblings	88 (79.3)	23 (20.7)	…	…	0.713
1-4 siblings	635 (77.5)	184 (22.5)	1.11 (0.68, 1.80)	0.678	
> 4 siblings	77 (74.8)	26 (25.2)	1.29 (0.69, 2.42)	0.424	
Caregiver's age (years)					
≤ 30	376 (76.0)	119 (24.0)	…	…	0.265
> 30	424 (78.8)	114 (21.2)	0.85 (0.64, 1.13)	0.265	
Caregiver's education level					
Not literate	334 (74.1)	117 (25.9)	…	…	0.007
Reading & writing ability	181 (75.7)	58 (24.3)	0.94 (0.64, 1.31)	0.626	
School education	285 (83.1)	58 (16.9)	0.58 (0.41, 0.82)	0.002	
Caregiver's occupation					
Employed/able to work	622 (77.1)	185 (22.9)	…	…	0.577
Unemployed/unable to work	178 (78.8)	48 (21.2)	0.91 (0.64, 1.28)	0.577	
Family size					
≤ 4 people (small)	135 (75.8)	43 (24.2)	…	…	0.368
5-8 people (medium)	462 (76.6)	141 (23.4)	0.96 (0.65, 1.42)	0.830	
> 8 people (large)	203 (80.6)	49 (19.4)	0.76 (0.48, 1.20)	0.234	
Family members over 18 years of age					
≤ 2 people	304 (74.0)	107 (26.0)	…	…	0.027
> 2 people	496 (79.7)	126 (20.3)	0.72 (0.54, 0.96)	0.027	
Ethnic groups*					
Underprivileged	629 (78.7)	170 (21.3)	…	…	0.076
Privileged	171 (73.1)	63 (26.9)	1.36 (0.97, 1.92)	0.076	
Household income per month in 2 quantiles (NRs.)					
Q 1 (NRs. 1000-10,000)	431 (77.9)	122 (22.1)	…	…	0.678
Q 2 (NRs. 1000-1,40,000)	369 (76.9)	111 (23.1)	1.06 (0.80, 1.42)	0.678	
No. of floors in the house					
1-2	536 (78.6)	146 (21.4)	…	…	0.214
3	264 (75.2)	87 (24.8)	1.21 (0.90, 1.63)	0.214	
House ownership					
Owner-occupied	770 (78.2)	215 (21.8)	…	…	0.013
Rented	30 (62.5)	18 (37.5)	2.15 (1.17, 3.64)	0.013	
House age					
≤ 20 years	577 (78.0)	163 (22.0)	…	…	0.504
> 20 years	223 (76.1)	70 (23.9)	1.11 (0.82, 1.51)	0.504	
No. of rooms					
1-3	583 (78.0)	164 (22.0)	…	…	0.447
4-10	217 (75.9)	69 (24.1)	1.13 (0.82, 1.55)	0.447	
*Ethnic groups like Dalit and Disadvantaged Janajatis made up the 'underprivileged' category. Relatively advantaged Janajatis and Upper caste groups made up the 'privileged' category					

Table S2 Univariable logistic-regression results for the association between fall-related injury and potential confounding variables

Potential confounding variables	No fall N = 944 n (%)	Fall N = 89 n (%)	Adjusted for clustering at household level		
			Odds ratio (95% CI)	P-value	Wald test P value
Siblings under 18 years of age					
0 siblings	101 (91.0)	10 (9.0)	…	…	0.950
1-4 siblings	748 (91.3)	71 (8.7)	0.96 (0.48, 1.92)	0.905	
> 4 siblings	95 (92.2)	8 (7.8)	0.85 (0.31, 2.37)	0.757	
Caregiver's age (years)					
≤ 30	448 (90.5)	47 (9.5)	…	…	0.343
> 30	496 (92.2)	42 (7.8)	0.81 (0.52, 1.26)	0.343	
Caregiver's education level					
Not literate	412 (91.4)	39 (8.6)	…	…	0.590
Reading & writing ability	215 (90.0)	24 (10.0)	1.18 (0.68, 2.05)	0.560	
School education	317 (92.4)	26 (7.6)	0.87 (0.52, 1.45)	0.588	
#Caregiver's occupation					
Employed/able to work	728 (90.2)	79 (9.8)	…	…	0.013
Unemployed/unable to work	216 (95.6)	10 (4.4)	0.43 (0.22, 0.83)	0.013	
Family size					
≤ 4 people (small)	157 (88.2)	21 (11.8)	…	…	0.076
5-8 people (medium)	549 (91.0)	54 (9.0)	0.74 (0.42, 1.28)	0.247	
> 8 people (large)	238 (94.4)	14 (5.6)	0.44 (0.22, 0.90)	0.024	
Family member over 18 years of age					
≤ 2 people	370 (90.0)	41 (10.0)	…	…	0.216
> 2 people	574 (92.3)	48 (7.7)	0.75 (0.48, 1.18)	0.216	
#Ethnic group*					
Underprivileged	744 (93.1)	55 (6.9)	…	…	0.001
Privileged	200 (85.5)	34 (14.5)	2.30 (1.43, 3.69)	0.001	
Household income per month in 2 quantiles (NRs.)					
Q 1 (NRs. 1000-10,000)	512 (92.6)	41 (7.4)	…	…	0.148
Q 2 (NRs. 1000-1,40,000)	432 (90.0)	48 (10.0)	1.39 (0.89, 2.16)	0.148	
No. of floors in the house					
1-2	633 (92.8)	49 (7.2)	…	…	0.026
3	311 (88.6)	40 (11.4)	1.66 (1.06, 2.60)	0.026	
House ownership					
Owner-occupied	907 (92.1)	78 (7.9)	…	…	<0.001
Rented	37 (77.1)	11 (22.9)	3.46 (1.73, 6.91)	<0.001	
House age					
≤ 20 years	677 (91.5)	63 (8.5)	…	…	0.855
> 20 years	267 (91.1)	26 (8.9)	1.05 (0.64, 1.70)	0.855	
#No. of rooms					
1-3	694 (92.9)	53 (7.1)	…	…	0.006
4-10	250 (87.4)	36 (12.6)	1.89 (1.19, 2.98)	0.006	

*Ethnic groups like Dalit and Disadvantaged Janajatis made up the 'underprivileged' category. Relatively advantaged Janajatis and Upper caste groups made up the 'privileged' category

A positive association of caregiver's occupation, ethnic group and no. of rooms to the outcome "Falls" is observed. These observed associations could be related to the level of supervision. For example, children whose caregivers were unemployed or unable to work (elderly) may be more likely to stay at home and thus have more time to supervise the

children. This may reduce the risk of fall-related injury in comparison to children whose caregivers were employed or able to work. Similarly, privileged families may be more likely to have bigger homes with larger numbers of room or stories, and this may limit the caregiver's ability to supervise children that are mobile and may increase the risk of falls on stairs or from balconies. The same rationale may explain the increased risk of fall-related injuries in children living in households with 4-10 rooms when compared to children living in households with 1-3 rooms. These observed univariable associations should not be over interpreted as they were not consistently found across other types of injuries and therefore need to be tested in future studies.

Table S3 Univariable logistic-regression results for the association between fire-related/burn/scald injury and potential confounding variables

Potential confounding variables	No burn N = 966 n (%)	Burn N = 67 n (%)	Adjusted for clustering at household level		
			Odds ratio (95% CI)	P-value	Wald test P value
Siblings under 18 years					
0 siblings	104 (93.7)	7 (6.3)	…	…	
1-4 siblings	766 (93.5)	53 (6.5)	1.03 (0.45, 2.32)	0.947	0.988
> 4 siblings	96 (93.2)	7 (6.8)	1.08 (0.38, 3.10)	0.881	
Caregiver's age (years)					
≤ 30	459 (92.7)	36 (7.3)	…	…	0.323
> 30	507 (94.2)	31 (5.8)	0.78 (0.48, 1.28)	0.323	
Caregiver's education level					
Not literate	414 (91.8)	37 (8.2)	…	…	
Reading & writing ability	227 (95.0)	12 (5.0)	0.59 (0.29, 1.19)	0.143	0.147
School education	325 (94.8)	18 (5.2)	0.62 (0.35, 1.10)	0.101	
Caregiver's occupation					
Employed/able to work	757 (93.8)	50 (6.2)	…	…	0.466
Unemployed/unable to work	209 (92.5)	17 (7.5)	1.23 (0.70, 2.16)	0.466	
Family size					
≤ 4 people (small)	165 (92.7)	13 (7.3)	…	…	
5-8 people (medium)	562 (93.2)	41 (6.8)	0.93 (0.47, 1.82)	0.824	0.587
> 8 people (large)	239 (94.8)	13 (5.2)	0.69 (0.31, 1.54)	0.366	
Family member over 18 years of age					
≤ 2 people	377 (91.7)	34 (8.3)	…	…	0.059
> 2 people	589 (94.7)	33 (5.3)	0.62 (0.38, 1.02)	0.059	
Ethnic group*					
Underprivileged	747 (93.5)	52 (6.5)	…	…	0.957
Privileged	219 (93.6)	15 (6.4)	0.98 (0.55, 1.77)	0.957	
Household income per month in 2 quantiles (NRs.)					
Q 1 (NRs. 1000-10,000)	511 (92.4)	42 (7.6)	…	…	0.118
Q 2 (NRs. 1000-1,40,000)	455 (94.8)	25 (5.2)	0.67 (0.40, 1.10)	0.118	
No. of floors in the house					
1-2	638 (93.5)	44 (6.5)	…	…	0.949
3	328 (93.4)	23 (6.6)	1.02 (0.61, 1.70)	0.949	
House ownership					
Owner-occupied	921 (93.5)	64 (6.5)	…	…	1.000
Rented	45 (93.8)	3 (6.3)	0.96 (0.30, 3.07)	FE 1.000	
House age					
≤ 20 years	691 (93.4)	49 (6.6)	…	…	0.773

> 20 years	275 (93.9)	18 (6.1)	0.92 (0.54, 1.59)	0.773	
No. of rooms					
1-3	697 (93.3)	50 (6.7)	...	...	0.653
4-10	269 (94.1)	17 (5.9)	0.88 (0.51, 1.53)	0.653	
*Ethnic groups like Dalit and Disadvantaged Janajatis made up the 'underprivileged' category. Relatively advantaged Janajatis and Upper caste groups made up the 'privileged' category					

Table S4 Univariable logistic-regression results for the association between cut/crush-induced injury and potential confounding variables

Potential confounding variables	No cut N = 980 n (%)	Cut N = 53 n (%)	Adjusted for clustering at household level		
			Odds ratio (95% CI)	P-value	Wald test P value
Siblings under 18 years of age					
0 siblings	106 (95.5)	5 (4.5)	...	...	
1-4 siblings	779 (95.1)	40 (4.9)	1.09 (0.42, 2.81)	0.861	0.440
> 4 siblings	95 (92.2)	8 (7.8)	1.79 (0.56, 5.64)	0.324	
Caregiver's age (years)					
≤ 30	470 (94.9)	25 (5.1)	...	...	0.910
> 30	510 (94.8)	28 (5.2)	1.03 (0.60, 1.78)	0.910	
Caregiver's education level					
Not literate	422 (93.6)	29 (6.4)	...	...	
Reading & writing ability	223 (93.3)	16 (6.7)	1.04 (0.56, 1.94)	0.891	0.022
School education	335 (97.7)	8 (2.3)	0.35 (0.16, 0.77)	0.009	
Caregiver's occupation					
Employed/able to work	771 (95.5)	36 (4.5)	...	...	0.063
Unemployed/unable to work	209 (92.5)	17 (7.5)	1.74 (0.97, 3.13)	0.063	
Family size					
≤ 4 people (small)	172 (96.6)	6 (3.4)	...	...	
5-8 people (medium)	570 (94.5)	33 (5.5)	1.66 (0.69, 3.99)	0.258	0.504
> 8 people (large)	238 (94.4)	14 (5.6)	1.69 (0.64, 4.42)	0.288	
Family member over 18 years of age					
≤ 2 people	388 (94.4)	23 (5.6)	...	...	0.576
> 2 people	592 (95.2)	30 (4.8)	0.85 (0.49, 1.48)	0.576	
Ethnic group*					
Underprivileged	758 (94.9)	41 (5.1)	...	...	0.998
Privileged	222 (94.9)	12 (5.1)	1.00 (0.52, 1.92)	0.998	
Household income per month in 2 quantiles (NRs.)					
Q 1 (NRs. 1000-10,000)	527 (95.3)	26 (4.7)	...	...	0.497
Q 2 (NRs. 1000-1,40,000)	453 (94.4)	27 (5.6)	1.21 (0.70, 2.09)	0.497	
No. of floors in the house					
1-2	645 (94.6)	37 (5.4)	...	...	0.547
3	335 (95.4)	16 (4.6)	0.83 (0.46, 1.51)	0.547	
House ownership					
Owner-occupied	934 (94.8)	51 (5.2)	...	...	1.000
Rented	46 (95.8)	2 (4.2)	0.80 (0.19, 3.32)	FE 1.000	
House age					
≤ 20 years	703 (95.0)	37 (5.0)	...	...	0.761

> 20 years	277 (94.5)	16 (5.5)	1.10 (0.60, 2.00)	0.761	
No. of rooms					
1-3	705 (94.4)	42 (5.6)	…	…	0.247
4-10	275 (96.2)	11 (3.8)	0.67 (0.34, 1.32)	0.247	
*Ethnic groups like Dalit and Disadvantaged Janajatis made up the 'underprivileged' category. Relatively advantaged Janajatis and Upper caste groups made up the 'privileged' category					