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Kalpana Poudel-Tandukar, *University of Massachusetts - Amherst*

Shinji Nakahara

Masao Ichikawa

Krishna Poudel

Susumu Wakai

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Abstract

This study assessed the relationship between pedestrian activity at the time of injury, the type of vehicle involved and resulting activity limitation among school adolescents in the Kathmandu and Lalitpur districts of Nepal. A cross-sectional study of 1557 students in grades 6–8 across 14 schools was conducted using a self-administered questionnaire from August to September 2003. Twenty-three percent of adolescents reported pedestrian injuries, 38% were from urban and 21% from semi-urban areas. Adolescents were commonly injured by motorcycles and motor vehicles while crossing the road; however, while walking and playing, they were commonly injured by bicycles and motorcycles. Bicycles and motor vehicles were less likely to be involved in injury while crossing the roads and playing, respectively ($p < 0.001$). Activity was more likely to be limited for a longer period of time (>7 days) with injuries endured while crossing the road ($p < 0.001$). In urban areas, boys and girls were more likely to be injured while crossing the road and walking, respectively ($p < 0.05$), and both were commonly injured by motorcycles. In semi-urban areas, boys and girls were commonly injured while walking and were more likely to be injured by motorcycles and bicycles, respectively ($p < 0.05$). In both areas, more boys than girls were injured while playing. These findings have important implications for pedestrian safety interventions in poor countries.

Keywords: Injuries; Pedestrian; Adolescents; Injury mechanisms; Developing countries; Nepal

1. Introduction

Pedestrian injuries are a leading cause of global death and disease burden, with 65% of the 1.2 million annual road deaths involving pedestrians (World Bank, 2004). In contrast to the large proportion of vehicle occupant injuries that occur in developed countries, pedestrian injuries account for a much greater proportion (41–75%) of traffic fatalities in developing countries (Odero et al., 1997; Nantulya and Reich, 2002; Peden et al., 2004). This difference is mainly due to the level of exposure of vehicle occupants and pedestrians to traffic in developed and developing countries, respectively (Nantulya and Reich, 2002; Peden et al., 2004).

Pedestrian crashes are highly likely to result in pedestrian injury even at a low speed, due to the force exerted by the vehicle; however, the vehicle involved and pedestrian activity at the time of injury can also influence injury severity. Although research in developing countries has indicated the disproportionate number of children and young males injured in pedestrian traffic accidents (Mock et al., 1999b; Vasconcellos, 1999; Zargar et al., 2003; Montazeri, 2004; Razzak et al., 2004; Roudsari et al., 2004) as well as the common involvement of motor vehicles in pedestrian injuries (Mock et al., 1999b), no study has explored the association between pedestrian activity at the time of injury, the type of vehicle involved, and the resulting activity limitation. Such information would provide a basis for specific prevention interventions in poor countries. Thus, this study aimed to assess the above relationship among school adolescents in the Kathmandu and Lalitpur districts, Nepal.

2. Methods

2.1. Study site

We conducted a school-based cross-sectional study of students of 14 schools in urban and semi-urban areas in two (Kathmandu and Lalitpur) of the 75 districts in Nepal from 31 August to 15 September 2003. This study was conducted as part of the health programme of World Vision International, a non-governmental organization involved in executing health and development programmes in one municipality and three village development committees (VDCs, minimum local government units of Nepal) in Kathmandu and seven VDCs in Lalitpur. World Vision International currently runs school health programmes in 30 schools in these two areas based on the following criteria: schools in which health programmes are not conducted by any other organization, schools located in communities that include slum or marginalized areas, and schools willing to participate in the programme.

2.2. Participants

Participants were grade 6–8 students of the above 14 schools. The schools selected were chosen because they were accessible by motorable road, included at least six grades, and were interested in participating. Sixteen schools were excluded: nine were primary schools, two were not accessible by motorable road, and five were unable to participate because of other commitments.

One week prior to the survey, after receiving approval from each school's principal, all potential participants ($n = 1800$) were informed of the study aims in their respective classrooms. An informed consent form requiring either of their parent's signatures was also distributed. Of the total, 1557 participants voluntarily took part in the study with parental consent. Absentees on the day of survey were not followed up. The study protocol was approved by the research committee of the Institute of Medicine, Tribhuvan University, Nepal.

2.3. Data collection

Data were collected using a self-administered anonymous questionnaire administered in a classroom setting. Participants independently completed the questionnaire during a single school period (45 min). The questionnaire consisted of socio-demographic information, episodes of injury, mechanisms of and activities at the time of injury, types of injury sustained, treatment-seeking behaviours, and limitations of activity as a result of injury. The questionnaire was developed based on the advice of injury experts as well as published literature (Holder et al., 2001; Posner et al., 2002).

The questionnaire was pre-tested with 50 students from nearby schools. After completion of the survey, 15 of the test students were interviewed by one of the authors to assess comprehension of the questions and readability of the questionnaire. Minor changes were then made in the sentence structure of the questions to address identified limitations. The questionnaire was developed in English, translated into Nepali and back translated.

The survey was conducted by six trained field supervisors and one coordinator, all of whom received 1-day orientation. Participants were also orientated on the questionnaire and reminded that they were free to decline participation in the survey. They were requested to check for any missed questions and informed that they were not allowed to confer during administration of the survey. Two authors visited seven of the study schools to supervise the fieldwork.

2.4. Definition of variables

Pedestrian injury was defined as injury that occurred as a result of being hit by any type of road vehicle while travelling from one location to another regardless of where the collision took place, not while in a motor or other road vehicle, or while playing or working on a roadway or other area generally open to vehicular traffic (Stutts and Hunter, 1999). Only those injuries that prevented or limited school participation for at least 1 h were included. School adolescents are likely to sustain pedestrian injury, particularly during the lunchtime (Razzak et al., 2004). As students who sustain injury during this time may continue school from next day after having overnight rest unless their injury is very severe; the consideration of 1-day limitation criteria can exclude such injuries. Moreover, only those injury episodes that occurred in the last 3 months preceding the survey were included by using a short recall period (1–3 months) as recommended by previous studies (Harel et al., 1994; Mock et al., 1999a). This recall period is particularly useful for measuring non-fatal injuries and reducing the recall bias. The total number of injury episodes of those who responded positively was calculated, and of these, one injury per participant, whichever had the most notable effect on school participation, was included in the detailed analysis. Forty-five participants experienced more than one injury episode during the prior 3 months; however, as indicated above, only the most serious was considered.

Parental occupational status was categorised into formal, informal, or housewife. Regular employees of government or non-government institutions were grouped as formal, manual labour and running or assisting a household business as informal, and household work as housewife. Cities with a population of at least 100,000 and annual revenue of 20 million Nepali rupees (NRs; 1 US\$ = Rs 70.65 in January 2005) were classified as urban and all others as semi-urban.

2.5. Data analysis

Pedestrian activity at the time of injury, the vehicle involved, the degree of activity limitation, the injury sustained, and treatment-seeking behaviours were analysed by age, sex, place of residence, parents' education and occupation. The association between activities at the time of injury, the vehicle involved and degree of limitation were consequently examined. Results are presented in the form of cross-tabulations with proportions. The chi-square test was used to measure statistical differences between groups using SPSS software version 11.0.

Table 1

Participant characteristics ($n = 1557$)

	Urban, n (%)	Semi-urban, n (%)
Age group		
10–13	90 (42)	512 (38)
14–17	126 (58)	829 (62)
Gender		
Male	95 (44)	630 (47)
Female	121 (56)	711 (53)
Television ownership		
Yes	189 (88)	1182 (88)
No	27 (12)	159 (12)
Car ownership		
Yes	12 (6)	53 (4)
No	204 (94)	1288 (96)
Father's level of education ^a		
Illiterate	46 (23)	123 (10)
Primary	69 (34)	506 (40)
Secondary	43 (21)	308 (24)
High school and above	45 (22)	333 (26)
Father's occupation ^a		
Informal work	133 (66)	751 (59)
Formal work	70 (34)	519 (41)
Mother's level of education ^a		
Illiterate	106 (49)	810 (61)
Primary	67 (31)	375 (28)
Secondary	38 (18)	124 (9)
High school and above	4 (2)	20 (2)
Mother's occupation ^a		
Informal work	59 (28)	119 (9)
Formal work	20 (9)	92 (7)
Housewives	136 (63)	1118 (84)

^a Participants whose fathers or mothers were deceased were excluded.

3. Results

In both areas, the majority of participants were females from families owning a television (Table 1). The majority of fathers were literate and engaged in informal work. The majority of mothers were housewives, literate in urban and illiterate in semi-urban areas.

3.1. Injury status

A total of 23% (357/1557) of participants reported pedestrian injuries in the past 3 months (boys: 30% (215/725) and girls: 17% (142/832)). Of these, 39 were injured twice and 6 were injured thrice. Thirty-eight percent (81/216) of those injured were from urban areas and 21% (276/1341) were from semi-urban areas. The most common injuries were open wounds (70%) followed by sprains (14%), bruises (13%), and fractures (2%) (Table 2). Injury treatment was commonly sought at home (35%) and in private clinics (31%). The injury types and treatment-seeking behaviours in urban and semi-urban areas were not significantly different in proportion according to age, parents' education, and occupation (data not shown).

3.2. Activities at the time of injury

Participants in urban areas were commonly injured while crossing the road (43%), whereas in semi-urban areas injuries most commonly occurred while walking (49%). Activities at the time of injury tended to differ by place of residence ($\chi^2 = 4.88$, $p = 0.08$). In urban areas, activities at the time of injury differed by gender ($\chi^2 = 6.09$, $p = 0.04$): boys and girls were commonly injured while crossing the road and walking on the road, respectively (Table 2). In semi-urban areas, activities at the time of injury also tended to differ by gender ($\chi^2 = 5.01$, $p = 0.08$): although both boys and girls were commonly injured while walking, more than 25% of boys were injured while playing. In both areas, more boys than girls were injured while playing. Activities at the time of injury in urban and semi-urban areas were not significantly different in proportion according to age, parents' education, and occupation (data not shown).

3.3. Vehicles involved

In urban areas, motorcycles (48%) were commonly involved in pedestrian injuries, whereas in semi-urban areas, bicycles (41%) and motorcycles (41%) were equally involved. The vehicles involved in pedestrian injuries differed significantly by place of residence ($\chi^2 = 19.44$, $p < 0.001$). In urban areas, both boys and girls were commonly injured by motorcycles ($\chi^2 = 0.20$, $p = 0.90$) (Table 2), whereas in semi-urban areas, boys and girls were most likely to be injured by motorcycles and bicycles, respectively ($\chi^2 = 6.42$, $p = 0.04$). The vehicles involved in urban and semi-urban areas were not significantly different in proportion according to age, parents' education, and occupation (data not shown).

While walking and playing, participants were commonly injured by bicycles and motorcycles; however, while crossing the road participants were commonly injured by motorcycles and motor vehicles. Pedestrian injuries were less likely to involve bicycles and motor vehicles while crossing the road and playing, respectively, and this difference was statistically significant ($\chi^2 = 28.10$, $p < 0.001$) (Table 3).

3.4. Resulting activity limitation

The majority (67%) of participants could not participate in school for at least 1 day after injury. The resulting limitation differed significantly by the activity at the time of injury ($\chi^2 = 18.53$, $p = 0.001$), the vehicle involved ($\chi^2 = 11.61$, $p = 0.02$), and injury sustained ($\chi^2 = 87.19$, $p < 0.001$) (Table 4). The degree of activity limitation was not significantly different in proportion according to age, sex, place of residence, parents' education and occupation (data not shown).

4. Discussion

This study revealed that adolescents in Kathmandu and Lalitpur were commonly injured by motorcycles and motor vehicles while crossing the road and by bicycles and motorcycles while walking and playing on the road. While crossing the road, bicy-

Table 2
Mechanisms and characteristics of pedestrian injury by place of residence and gender ($n = 357$)

	Urban		<i>p</i> -Value	Semi-urban		<i>p</i> -Value
	Male (<i>n</i> = 48), <i>n</i> (%)	Female (<i>n</i> = 33), <i>n</i> (%)		Male (<i>n</i> = 167), <i>n</i> (%)	Female (<i>n</i> = 109), <i>n</i> (%)	
Activity at the time of injury						
Walking on the road	15 (31)	17 (52)	0.04	75 (45)	59 (54)	0.08
Crossing the road	21 (44)	14 (42)		49 (29)	34 (31)	
Playing on the road	12 (25)	2 (6)		43 (26)	16 (15)	
Vehicle involved						
Motorcycle	23 (48)	16 (49)	0.90	79 (47)	35 (32)	0.04
Bicycle	9 (19)	5 (15)		63 (38)	51 (47)	
Motor vehicle	16 (33)	12 (36)		25 (15)	23 (21)	
School activity limitation						
Less than 1 day	15 (31)	9 (27)	0.11	52 (31)	43 (39)	0.27
1–7 days	21 (44)	21 (64)		83 (50)	51 (47)	
More than 7 days	12 (25)	3 (9)		32 (19)	15 (14)	
Injury						
Open wound	31 (65)	23 (70)	0.01	114 (68)	83 (76)	0.15
Sprain	13 (27)	2 (6)		27 (16)	8 (7)	
Bruise	3 (6)	8 (24)		21 (13)	16 (15)	
Fracture	1 (2)	0 (0)		5 (3)	2 (2)	
Health-seeking behaviour						
Home	14 (29)	15 (45)	0.20	51 (31)	46 (42)	0.22
Private clinics	23 (48)	9 (27)		53 (32)	26 (24)	
Hospital	6 (13)	3 (9)		32 (19)	20 (18)	
No treatment	5 (10)	6 (18)		31 (19)	17 (16)	

cles were less likely to be involved in pedestrian injuries; however, while playing on the road motor vehicles were less likely to be involved. Adolescents in urban and semi-urban areas were commonly injured while crossing the road and walking on the road, respectively. Girls in semi-urban areas were more likely to be injured by bicycles, and in both areas, more boys than girls were injured while playing on the road. Activity was more likely to be limited for a longer period (more than 7 days) when the injury was sustained while crossing the road.

Different vehicles are likely to be involved in pedestrian injuries depending on the pedestrian activity at the time of injury and subsequent exposure to traffic. For example, pedestrians are more likely to be hit by motorcycles than motor vehicles while crossing the road because of the higher number of motorcycles compared to motor vehicles and the subsequent increased frequency of exposure. In addition, crossing the road without checking for oncoming vehicles or while running (Kandela, 1993; Khan et al., 1999) further increases the risk of vehicle-pedestrian crashes. On the other hand, pedestrians walking along

the road are more likely to be hit by bicycles, as bicyclists are forced to ride on or near pedestrian sidewalks due to the lack of cycle lanes on mixed traffic roads. Pedestrians are also more likely to be hit by motorcycles while walking on the road because of frequent exposure as mentioned above.

In Nepal, adolescents commonly play on narrow bumpy side roads along which motor vehicles, but not motorcycles and bicycles, are forced to slow down. Therefore, while playing, adolescents are perhaps less likely to be hit by a motor vehicle than by a motorcycle or bicycle.

Table 4
Mechanisms and characteristics of pedestrian injury by activity limitation ($n = 357$)

	Activity limitation			<i>p</i> -Value
	Less than 1 day, <i>n</i> (%)	1–7 days, <i>n</i> (%)	More than 7 days, <i>n</i> (%)	
Activity at the time of injury				
Walking on the road	55 (33)	91 (55)	20 (12)	0.001
Crossing the road	40 (34)	44 (37)	34 (29)	
Playing on the road	24 (33)	41 (56)	8 (11)	
Vehicle involved				
Motorcycle	51 (33)	73 (48)	29 (19)	0.02
Bicycle	41 (32)	74 (58)	13 (10)	
Motor vehicle	27 (36)	29 (38)	20 (26)	
Injury				
Open wound	90 (36)	133 (53)	28 (11)	<0.001
Sprain	4 (8)	23 (46)	23 (46)	
Bruise	25 (52)	20 (42)	3 (6)	
Fracture	0 (0)	0 (0)	8 (100)	

Table 3
Vehicle involved and activity at the time of injury ($n = 357$)

	Activity at the time of injury			<i>p</i> -Value
	Walking on the road, <i>n</i> (%)	Crossing the road, <i>n</i> (%)	Playing on the road, <i>n</i> (%)	
Vehicle involved				
Motorcycle	61 (37)	62 (52)	30 (41)	<0.001
Bicycle	72 (43)	21 (18)	35 (48)	
Motor vehicle	33 (20)	35 (30)	8 (11)	

Activity is more likely to be limited for a longer period of time with injuries arising from crossing the road. One reason for this is perhaps because if hit by a vehicle when crossing the road the force exerted is greater due to the higher speed. In addition, the common involvement of motorcycles and motor vehicles in injuries that occur while crossing the road is also likely to result in the longer period of activity limitation.

Compared to semi-urban residents, urban residents are more frequently exposed to traffic. Urban roads in Nepal typically contain a large variety and intensity of motorized and non-motorized vehicles as well as pedestrians. People living in urban areas cross such roads more frequently than those living in semi-urban areas because of the higher road density, and frequent exposure to wide roads with limited crossing facilities and unrelenting traffic might therefore increase the risk of injury among urban residents. In contrast, roads in semi-urban Nepal are narrow with no sidewalks and numerous roadside businesses that make them even narrower, forcing pedestrians to walk in the path of the traffic. Such road environments might therefore result in the increased risk of injury while walking among semi-urban residents.

Boys in Nepal spend twice as much time playing than girls (Yamanaka and Ashworth, 2002), commonly outside the house (Anderson and Mitchell, 1984), with their choice of characteristically more energetic games causing them to run, climb, and roam freely (Anderson and Mitchell, 1984). Moreover, Nepalese houses, in general, do not have enough space for such games, and therefore, boys are likely to play on the road, placing them at more risk of injury.

In semi-urban areas, bicycles are more commonly used for transportation than in urban areas, and bicyclists frequently travel small lanes in between houses where motor vehicle traffic is less heavy. Since girls rather than boys tend to use such roads more often than arterial roads, they are possibly more likely to collide with bicycles.

In this study, we also examined population-based injury data regardless of treatment-seeking behaviours. The majority of participants did not go to hospital despite limited activity after injury, therefore suggesting that hospital and community-based studies that include injuries requiring hospital care do not necessarily reflect the reality in countries where many people make limited use of such health facilities. As stated by WHO (2004), community-based surveys allow collection of detailed information of particular injuries and might be the only source of information in settings where hospital-based data and vital statistics do not exist or are unreliable.

Despite its findings, this study has a number of limitations. First, only one injury per participant, the injury resulting in the longest activity limitation, was considered, thus reducing recall bias in collecting detailed information on the mechanism and activities of injury but preventing detailed analysis of all injury episodes. Second, those students who were absent on the survey date were not followed up. However, this was not thought to have significantly affected the findings since domestic reasons or illnesses such as a cold, fever or diarrhoea were reported by teachers as the common reasons for absence. Moreover, no deaths or permanent disabilities due to injury were reported dur-

ing the preceding year. Finally, our study relied on self-reports, with no method to independently validate the veracity. However, this was not thought to have significantly affected the findings since the school children selected were aged 11–15 and were able to give detailed accounts of the circumstances of their injuries (Curie et al., 1996). Self-reported data obtained through population-based surveys is important for studying injury circumstances in developing countries due to incompleteness of injury data and low utilization of health facilities (Mock et al., 1997). Nevertheless, because this study was based in schools in marginalized areas, our results can be generalized to poor adolescent populations in Kathmandu since the road environments, life-styles, and education systems do not significantly differ between such settings.

In conclusion, this study indicated differences in adolescent activities at the time of injury and the vehicles involved in these injuries by gender, place of residence, and the degree of activity limitation. Such information is useful in designing prevention interventions such as provision of crosswalks and pedestrian islands in urban areas and measures to separate pedestrians from bicyclists and other traffic in semi-urban areas.

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