ADC Online First, published on June 9, 2012 as 10.1136/archdischild-2011-300997

Risk factors predisposing to pedestrian road traffic injury in children living in Lima, Peru: a case–control study

Jeffrey M Pernica,[1] John C LeBlanc,[2] Giselle Soto-Castellares,[3,4] Joseph Donroe,[3,5] Bristan A Carhuancho-Meza,[6] Daniel G C Rainham,[7,8] Robert H Gilman[3,9]

[1]Department of Pediatrics, McMaster University, Hamilton, Canada
[2]Department of Pediatrics, Dalhousie University, Halifax, Canada
[3]Asociación Benéfica PRISMA, Lima, Peru
[4]Department of Emerging Infectious Diseases, US Naval Medical Research Unit No. 6, Lima, Peru
[5]Fogarty International Center/Ellison Medical Foundation Research Fellow, Boston, Massachusetts, USA
[6]Instituto Nacional de Salud del Niño, Lima, Peru
[7]Institute of Population Health, University of Ottawa, Ottawa, Canada
[8]Environmental Science, Dalhousie University, Halifax, Canada
[9]Bloomberg School of Public Health, Johns Hopkins University, Baltimore, Maryland, USA

Correspondence to
John C LeBlanc, Department of Pediatrics, Psychiatry, Community Health and Epidemiology, Dalhousie University, IWK Health Centre, 5850 University Avenue, Halifax, Nova Scotia, Canada; John.LeBlanc@dal.ca

Accepted 17 April 2012

ABSTRACT

Objective To describe the epidemiology of pedestrian road traffic injury in Lima and to identify associated child-level, family-level, and school travel-related variables.

Design Case–control study.

Setting The Instituto Nacional de Salud del Niño, the largest paediatric hospital in the city.

Participants Cases were children who presented because of pedestrian road traffic injury. Controls presented with other diagnoses and were matched on age, sex and severity of injury.

Results Low socioeconomic status, low paternal education, traffic exposure during the trip to school, lack of supervision during outside play, and duration of outside play were all statistically significantly associated with case–control status. In multivariate logistic regression, a model combining the lack of supervision during outside play and the number of the streets crossed walking to school best predicted case–control status ($p<0.001$).

Conclusions These results emphasise that an assessment of children's play behaviours and school locations should be considered and integrated into any plan for an intervention designed to reduce pedestrian road traffic injury. A child-centred approach will ensure that children derive maximum benefit from sorely needed public health interventions.

What is known about this topic

- Globally, road traffic injuries (RTIs) are the second leading cause of death among older children and adolescents.
- The vast majority of global mortality and morbidity from road traffic accidents occurs in lower-income nations, where pedestrians are at much higher risk.
- Previous studies focus on high-risk spatial environments and largely for adult victims of RTIs. Very few studies in lower-income nations addressed risk factors in children.

What this study adds

- There are numerous play-related and school-travel-related variables that should be considered when planning strategies to reduce child road traffic injury.
- Supervision at play and the number of streets crossed during the daily trip to school were found to be more strongly associated with child pedestrian road traffic injury than socioeconomic status.

INTRODUCTION

Globally, road traffic injuries (RTIs) are the second leading cause of death in older children (aged 5–14) and young adults (aged 15–29), as well as the number one cause of death and disablement among individuals aged 3–35.[1–3] Eighty-five per cent of global mortality from RTIs (including 96% of all child deaths) and just over 90% of the morbidity measured in disability-adjusted life years is experienced in developing countries.[4] This is likely due in part to the fundamental differences in traffic patterns – and therefore RTIs – seen in developing countries. Most deaths and illnesses attributed to RTIs in developing nations occur in passengers, pedestrians and cyclists.[5] In Mexico, urban pedestrians have been found to account for more than 50% of all deaths recorded as motor vehicle collisions (MVCs).[6] This contrasts sharply with the situation in more motorised countries, where drivers are at highest risk of injury and death.[4] RTIs are no less of a problem in Peru than in most other lower-income countries[7]; the head of the Health Ministry's National Defence office was recently quoted as saying 'There are more deaths and disabilities [from road traffic injury] than [from] any other [cause].'[8]

The WHO World Report on Road Traffic Injury Prevention states that the 'principal risk factor for unprotected road users is the mixing of unprotected people with motor vehicles travelling at high speeds'[4]; accordingly, several investigators have attempted to define high-risk local and spatial environments.[6 9–12] It has been suggested that effective interventions to decrease pedestrian injury work principally through environmental modification[9 13]; however, to maximise the effectiveness of such an intervention, one should take into account the other factors that influence road traffic injury.

Such factors include pedestrians' social and economic determinants of health and their individual characteristics. Geographical areas characterised by low socioeconomic status and high population density have been found to have a higher incidence of pedestrian RTIs in the USA[14–17] and the UK.[18] At an individual level, age, male gender, low maternal education and low socioeconomic status have all been found to correlate with pedestrian injury risk.[9 10 15–17 19 20] However, gender difference was not found in a Ugandan cohort of 8165 children from 35 schools followed over three school terms, suggesting that sociodemographic factors may not generalise across widely divergent countries.[21] In a Mexican study, large family size was correlated with an increased risk of pedestrian RTIs in Mexico.[19] A case–control study nested in a cross-sectional survey of an urban shantytown of Lima, Peru identified the number of children per household and fewer hours in school as RTI predictors, but notably not the presence of poverty or low maternal education. The authors postulated insufficient power and lack of socioeconomic status variability in the surveyed shantytown for these insignificant results.[20]

Environmental factors for RTIs are important because they alter the risk of exposure to pedestrian–vehicle collisions and provide opportunities for intervention that do not rely on changing behaviour of pedestrians and drivers. A companion study of environmental factors in the same shantytown described previously identified increased traffic volume, vehicle speed, high street vendor density and absent lane demarcation as risk factors for RTIs.[20] A cross-sectional survey of Montreal first to fourth grade students examined characteristics of the journey from home to school that increased risk of injury. They found that the number of street crossings correlated strongly with RTIs as documented in police reports.[22]

In four developing countries, ignorance of traffic laws and risky behaviours on roadways (eg, ignoring traffic lights and crossing in the middle of the street) have also been linked with pedestrian RTIs.[6 9 12 23] Pedestrian inattention is also a major factor,[9] as is day of week and time of day.[8 9] Maladaptive behaviours (including hyperactivity and aggressiveness) have been linked with unintentional injury, at least in high-income nations and among adolescents.[24–27] In contrast, one case–control study conducted in the USA that examined psychosocial factors contributing to childhood pedestrian injury suggested that family-level factors were more important rather than child-level factors.[28] We found no studies from developing countries assessing the relationship of maladaptive behaviours in children to injury.

We therefore undertook this case–control study of children who presented to the emergency department (ED) of a busy hospital in Lima, Peru to elucidate child, family and community-level factors that increase the risk of pedestrian–vehicle collisions and that would provide insight into this problem in a developing country setting. We hypothesised that maladaptive behaviours, socioeconomic status including poverty and low parental education, being a street vendor, unsupervised play, and more traffic encountered by children on commonly walked routes (ie, to school) would be associated with pedestrian RTIs.

METHODS

A case–control study was undertaken between June 2005 and March 2006 with children who presented to the Instituto Nacional de Salud del Niño (INSN), the major tertiary care children's hospital in Lima, Peru and an important provider of secondary care. Potential cases consisted of all patients aged 2–17 years who either presented to the ED or were transferred to the Traumatology or the Neurosurgery Services of the INSN as a result of being struck by a motorised vehicle while engaged in pedestrian activities such as loitering, walking, running, or playing games afoot. No other activities were considered to be 'pedestrian activities'; for example, children injured while cycling were not included. There were no exclusion criteria. Four sex-matched and age-matched (plus or minus 6 months) controls were sought for each case; this ratio was chosen to maximise power. The control selection strategy depended on where the cases presented. For the cases presenting to the ED, the controls were patients also presenting to the ED during the study period with any non-surgical diagnosis, except acute asthma, diarrhoea of unknown aetiology and rhinitis/pharyngitis/sinusitis. Had patients with these very common diagnoses been included, the control population would have come primarily from the areas immediately adjacent to the hospital and would not have been comparable to the case population. The controls were also matched for hospitalisation status as a marker of severity of injury; that is hospitalised cases required hospitalised controls. Controls presenting with fractures, burns, or foreign bodies were excluded, as those diagnoses are often the result of unintentional injury. For cases transferred from other facilities to the INSN surgical wards, controls were paediatric patients transferred from other clinics or hospitals with surgical conditions not caused by unintentional injury.

Parents or guardians of study participants gave their written consent under a protocol approved by the ethics committees of Dalhousie University, the Asociación Benéfica PRISMA (an associated non-governmental organisation), and the INSN. Assent was sought from children with sufficient capacity. A structured questionnaire was administered by a trained study nurse with questions relating to child demographics; the socioeconomic status of the family; education level of the parents; family structure; details relating to the child's trip to school; details relating to the child's play routines; and the Eyberg Child Behaviour Inventory (ECBI), an instrument designed to screen for disruptive behaviours.[29–32] A validated Spanish translation of the ECBI was used.[33] For cases only, descriptions of the RTI were obtained.

Formal sample size calculations were not possible due to the absence of relevant previous studies. Homes, schools and injury sites of the cases were identified using a Garmin GPS 72 device (Garmin International, Olathe, Kansas, USA) and distances between injury site and home or school were calculated using those coordinates. Statistical analysis was performed using Stata Intercooled V.11 (StataCorp). Conditional logistic regression (Stata procedure 'clogit') was used for bivariate and multivariate analyses. Multivariate conditional logistic regression models were constructed using the variables hypothesised a priori to be important; if there were several variables measuring a construct thought to be associated with RTIs (such as low socioeconomic status), the one with the lowest p value in bivariate analyses was selected. A forward stepwise strategy was used where the variables were added manually and only those retained that led to a statistically significant change in the model deviance (–2 log likelihood) by χ^2 testing at the 0.05 level.

RESULTS

A total of 251 participants were entered into the study. Fifty-four cases were enrolled along with 197 controls. Cases and controls came from all regions of the city of Lima. Forty-six cases had four controls, two cases had three controls, one case had two controls, and five cases had one control. The study period (June 2005–Nov 2006) ended before all controls for all cases could be enrolled. The median age of the cases was 7.5 years (IQR 4.9 years–10.3 years) (table 1). Nine (17%) of the cases were transferred from other healthcare facilities. Forty-one per cent of the cases had a head injury. Fifty-seven per cent of the cases were injured while walking to a specific destination, primarily home, to a friend's home, or to the park while 15% of the cases were injured on their routine trip to school. Slightly more than one-third of the parents of the cases reported that they had not previously thought that the injury location was dangerous. The median distance from the home to the injury site was 163 m (IQR 30–1422 m) and the median distance from the school to the injury site was 785 m (IQR 246–1362 m).

Forty-five per cent of the children aged under 5 did not attend daycare/preschool and therefore had no school-travel-related information. All children aged under 5 were excluded from the case–control analysis because of major differences in traffic exposure from those aged 5 and older. There remained 181 children aged 5 and older all of whom attended school. Unfortunately, there were insufficient preschoolers to allow for a separate analysis of this important group.

Table 2 presents the OR for each predictor without controlling for other predictors. From the socioeconomic status/family structure domain, the covariates that best predicted case–control status were less than two windows in the home and low paternal education (ie, did not complete secondary school). Many school-travel variables had relatively large ORs but only the number of streets crossed on the walk to school was statistically significantly associated with case–control status. From the play domain, the degree of adult supervision during outside play had a large effect as well as substantial predictive power. In addition, playing outside more than 1 h per day on average during the week was a statistically significant predictor for RTIs. As only one study participant reported being a street vendor we could not assess how this type of activity related to RTI risk. There was no association between disruptive behaviours and case–control status as measured by the ECBI; the mean ECBI scores of the cases and the controls were 87 and 85 respectively with SDs of 27 and 29 respectively.

Forward stepwise logistic regression analysis yielded a parsimonious model with two variables statistically significantly associated with case–control status: supervision at play and the number of streets crossed on the way to school (table 3). No other variable created a statistically significantly better fitting model although the variable less than two windows in the dwelling yielded an almost statistically significantly better model (p=0.057) with, however, little impact on the ORs for the other model predictors: adult supervision and number of streets crossed. Frequent lack of adult supervision during outside play increased the odds of being a case by 4.4 times. The number of streets crossed while walking to school showed a significant dose–response relationship, with those in the highest-risk category – the participants who crossed more than five streets on their walking trip to school – having nine times the odds of being a case rather than a control.

Although transferred patients came from other hospitals within the Lima metropolitan district, they might have differed in severity of injury or other characteristics from those who presented directly to the ED. We therefore recalculated bivariate and multivariate ORs for predictors of RTI after excluding them. This reduced the number of subjects for the multivariate model from 110 to 90, producing substantially the same point estimates though with wider CIs (results available on request).

Table 1 Description of cases and circumstances surrounding their road traffic injuries

	n (%), unless otherwise noted
Age (years)	
Median	7.5
IQR	4.9–10.3
Boys	32 (59)
Type of injury*	
Head injury	22 (41)
Multiple injuries	27 (50)
Single fracture	6 (11)
Injuries on school days	27 (50)
Time of injury:	
06:00–12:00	11 (20)
12:00–18:00	27 (50)
18:00–24:00	16 (30)
24:00–06:00	0 (0)
Activity when injured	
Walking to specific destination	31 (57)
Home-school travel†	8 (15)
Street vending	1 (2)
Other (playing, loitering, etc.)	22 (41)
Parents or children who had not thought the injury site dangerous prior to the injury	19 (35)
Median distance from home to injury site (m)	163
Median distance from school to injury site	785

*Some participants had both multiple injuries and head injuries.
†This referred to either going to school from home or returning home from school.

DISCUSSION

This study demonstrates that pedestrian road traffic injury among children and adolescents in Lima commonly occurs in proximity to the home and that, among individual-level risk factors, play-related behavioural factors and school-travel-related factors are most important in predicting RTI.

There are numerous reports of the association between lower socioeconomic status and pedestrian RTI.[14–16 20] Increased crowding[16 20] and low parental education levels are commonly reported to be linked to child pedestrian RTIs.[15 16 20] We found similar associations but these were overshadowed in importance by the lack of adult supervision at play, a factor for RTI rarely reported in the literature. Play-related covariates are typically not captured in large population-based injury datasets. However, the strong inverse relationship we found between the degree of parental supervision and child pedestrian RTI was also noted in a case–control study done in Montreal almost 30 years ago.[34]

One would expect that variables related to school travel would predict pedestrian RTI. Donroe *et al.* showed that in a particular shantytown in Lima pedestrian RTIs were associated with afternoon schooling and inversely related to the length of time spent in school.[20] In contrast, and in a more diverse sample of Lima residents, we found small statistically insignificant associations with these variables but a strong association with the number of streets crossed on the way to school,

Table 2 Bivariate analyses. Predictors for which model fit (change in −2 log likelihood) is significant ($\alpha \leq 0.05$) by χ^2 testing are in bold. ORs are cases/controls

Variable	OR	95% CI	p (Wald)
Socioeconomic status and family structure-related variables			
Less than two windows in home	**3.56**	**(1.58 to 8.01)**	**0.002**
Does not own home	1.24	(0.57 to 2.69)	0.582
Monthly family income (US$ equivalent)			
<70	ref		all >0.05
70–143	0.60	(0.13 to 2.74)	
143–700	0.57	(0.14 to 2.40)	
>700	0.34	(0.03 to 4.10)	
Mother did not complete secondary school	1.90	(0.88 to 4.07)	0.100
Father did not complete secondary school	**2.66**	**(1.12 to 6.30)**	**0.026**
Number of inhabitants/room	1.28	(0.98 to 1.67)	0.072
Single parent family	1.57	(0.65 to 3.79)	0.311
School travel-related variables			
Walks to school (at least partway)	1.53	(0.58 to 4.01)	0.386
Accompanied by adult on walk to school	0.33	(0.09 to 1.18)	0.089
Number of streets crossed walking to school			
1–2	**ref.**		
3–4	**2.85**	**(0.92 to 8.79)**	**0.068**
5+	**6.98**	**(1.84 to 26.4)**	**0.004**
Number of streetlights passed on walk to school	1.52	(0.87 to 2.65)	0.139
Duration of trip to school	0.99	(0.95 to 1.03)	0.708
Begins school in am (vs at noon)	0.42	(0.15 to 1.18)	0.100
No. hours spent in school	0.87	(0.60 to 1.28)	0.487
Play-related variables			
Plays in street	1.24	(0.51 to 3.00)	0.632
Plays in parks	0.49	(0.19 to 1.25)	0.136
Often not supervised by an adult during outside play	**4.21**	**(1.85 to 9.61)**	**0.001**
Plays more than 1 h outside during the average weekday	**2.18**	**(1.01 to 4.69)**	**0.047**
Plays more than 1 h outside during the average weekend day	1.05	(0.44 to 2.52)	0.906
Behaviour-related variables			
ECBI: 10-point change*	1.03	(0.90 to 1.18)	0.636

*A 10-point change was used to provide more clinically useful OR.
ECBI, Eyberg Child Behaviour Inventory.

Table 3 Multivariate model for road traffic injuries using forward stepwise regression, p=0.0005. *n*=110 after dropping 25 subjects that did not contribute to model

	OR	95% CI	p (Wald)
Often not supervised by an adult during outside play	4.44	(1.48 to 13.3)	0.008
Number of streets crossed walking to school			
1–2	ref.		
3–4	4.45	(1.24 to 16.0)	0.022
5+	9.45	(2.16 to 41.3)	0.003

a sensible proxy measure for exposure to motor vehicles and one shown to correlate strongly with injuries at least in a city in a developed country.[22] We found a threefold difference in odds of RTIs for those not accompanied by an adult on the walk to school that was not statistically significant and we also noted that the number of windows in the dwelling, a statistically significant predictor of RTIs in the bivariate analysis, was not retained in our multivariate model. Both of these potentially important factors should be assessed in future studies with sufficient power to detect important effects should they exist.

There was no association seen (OR=1.03) for a 10-point change in ECBI score and pedestrian RTI in our sample. This may be because the instrument did not perform well in the Peruvian urban context, or because disruptive behaviours truly did not significantly impact risk of pedestrian RTIs. The latter is certainly plausible; it may be that 'baseline risk' is high enough in this low-income urban highly motorised context that the contribution from disruptive behaviour is minimal.

There were numerous strengths of this study. The prospective nature of data collection permitted the collection of data that would have been impossible to abstract retrospectively and minimised recall bias. It was also conducted in the principal children's hospital in Lima, drawing from neighbourhoods across Lima and therefore had more heterogeneous predictors than in studies conducted in homogeneous neighbourhoods; this increases the possibility of finding important predictors and it increases generalisability to other major developing country urban centres. Internal validity was preserved by meticulous attention to the epidemiology of RTIs at the INSN and to strict case and control definition to ensure that the controls and cases were drawn from the same referent population, minimising the major problem with hospital-based case–control studies. We addressed the potential problem of referred-in cases differing from cases presenting directly to the hospital by conducting analyses with and without these cases. Results were similar and we retained referred-in cases to maximise power.

There were also limitations to the present study. The sample size, while reasonable given the difficulty of conducting the study in this setting, yielded wide statistically insignificant CIs for potentially important variables such as being accompanied by an adult on the walk to school or markers of wealth such as the number of windows in a dwelling. Our study instrument, excluding the previously validated Eyberg instrument, was piloted prior to use for language and comprehension but its validity was not formally assessed prior to this study. Some of the play-related variables may have been difficult to answer accurately, and test–retest reliability was not measured due to lack of resources.

This study has important ramifications for those who wish to design interventions to prevent child trauma in major urban Latin American centres. It is notable that the most important factors predicting pedestrian RTIs in our paediatric study population – the degree of adult supervision during outside play and the number of streets crossed on the way to school – have no relevance to the prevention of adult RTIs; again, the adage 'children are not little adults' holds true. It is likely that environmental factors (road type, road usage, law enforcement, etc.) predisposing to paediatric pedestrian RTIs differ from those that affect adult pedestrian RTIs. This must be taken into account by policymakers when reviewing local epidemiology of pedestrian RTIs to determine which areas need intervention soonest.

The results of this study should be used in the design of interventions. We are not suggesting that with more adult supervision there would be no children injured in vehicle crashes; rather, we feel that an assessment of the local population's play behaviours and school locations should be considered and integrated into any plan for a multifaceted intervention. For example, if there is a particular location where the incidence of pedestrian RTIs is high, before an expensive elevated pedestrian walkway is built, one should ask questions such as: How can we create protected safe play space in the area to make it easier for community adults to supervise their children? Where are the local schools in relation to the high-risk location? How can we design this intervention to make it easier for children to get to school and not obstruct pedestrian flow? Are there educational initiatives that can be promulgated through the local schools to encourage children (and their parents) to take alternate routes to school? A specific child-oriented mindset is important to ensure that paediatric populations derive maximum benefit from public health interventions in an effort to decrease the substantial morbidity and mortality accruing from road traffic injury.

Contributors J M P designed the study, acquired funding, verified data collection, did the analysis, and was the principal author of the manuscript. J C L supervised and contributed to the design, acquired funding, supervised the data analysis and co-wrote the manuscript. G S C and J D supervised local data collection and reviewed the manuscript. G S C and B A C M obtained local epidemiology data needed for study design and were instrumental in integrating the study processes into the INSN ED. DGCR conceived the GIS study protocol and did all GIS-related analysis. R H G was instrumental in conceiving the study idea, verifying the study design, facilitating data collection, and reviewed the manuscript.

Acknowledgements The authors would like to thank Lilia Cabrera for her substantial assistance with the study.

Funding IWK Health Centre Research Office, Halifax, NS, Canada. The American Academy of Pediatrics.

Competing interests None.

Ethics approval Research ethics boards of Dalhousie University, the Asociación Benéfica PRISMA (an associated NGO), and the Instituto Nacional de Salud del Niño.

Provenance and peer review Not commissioned; externally peer reviewed

Data sharing statement Additional unpublished data accessible upon request.

REFERENCES

1. **The Global Burden of Disease: 2004 update.** Geneva: World Health Organization, 2008.
2. **Mohan D.** Road safety in less-motorized environments: future concerns. *Int J Epidemiol* 2002;**31**:527–32.
3. **Peden M**, McGee K, Krug M (eds). Injury: a leading cause of the global burden of disease, 2000. Geneva: World Health Organization, 2002.
4. **Margie Peden**, Richard Scurfield, David Slee, *et al*. (eds.) World report on road traffic injury prevention. Geneva: World Health Organization, 2004.
5. **Nantulya VM**, Reich MR. The neglected epidemic: road traffic injuries in developing countries. *BMJ* 2002;**324**:1139–41.
6. **Híjar M**, Trostle J, Bronfman M. Pedestrian injuries in Mexico: a multi-method approach. *Soc Sci Med* 2003;**57**:2149–59.
7. **Zegeer CV**, Bushell M. Pedestrian crash trends and potential countermeasures from around the world. *Accid Anal Prev* 2012;**44**:3–11.
8. **Fraser B.** Pedestrians at risk in Peru. *Lancet* 2011;**377**:543–4.
9. **Al-Shammari N**, Bendak S, Al-Gadhi S. In-depth analysis of pedestrian crashes in Riyadh. *Traffic Inj Prev* 2009;**10**:552–9.
10. **Harruff RC**, Avery A, Alter-Pandya AS. Analysis of circumstances and injuries in 217 pedestrian traffic fatalities. *Accid Anal Prev* 1998;**30**:11–20.
11. **DiMaggio C**, Durkin M. Child pedestrian injury in an urban setting: descriptive epidemiology. *Acad Emerg Med* 2002;**9**:54–62.
12. **Khan FM**, Jawaid M, Chotani H, *et al*. Pedestrian environment and behavior in Karachi, Pakistan. *Accid Anal Prev* 1999;**31**:335–9.
13. **Roberts IG.** International trends in pedestrian injury mortality. *Arch Dis Child* 1993;**68**:190–2.
14. **Braddock M**, Lapidus G, Gregorio D, *et al*. Population, income, and ecological correlates of child pedestrian injury. *Pediatrics* 1991;**88**:1242–7.
15. **Rivara FP.** Child pedestrian injuries in the United States. Current status of the problem, potential interventions, and future research needs. *Am J Dis Child* 1990;**144**:692–6.
16. **Chakravarthy B**, Anderson CL, Ludlow J, *et al*. The relationship of pedestrian injuries to socioeconomic characteristics in a large Southern California County. *Traffic Inj Prev* 2010;**11**:508–13.
17. **Cottrill CD**, Thakuriah PV. Evaluating pedestrian crashes in areas with high low-income or minority populations. *Accid Anal Prev* 2010;**42**:1718–28.
18. **Green J**, Muir H, Maher M. Child pedestrian casualties and deprivation. *Accid Anal Prev* 2011;**43**:714–23.
19. **Celis A**, Gomez Z, Martinez-Sotomayor A, *et al*. Family characteristics and pedestrian injury risk in Mexican children. *Inj Prev* 2003;**9**:58–61.
20. **Donroe J**, Tincopa M, Gilman RH, *et al*. Pedestrian road traffic injuries in urban Peruvian children and adolescents: case control analyses of personal and environmental risk factors. *PLoS ONE* 2008;**3**:e3166.
21. **Nakitto MT**, Mutto M, Howard A, *et al*. Pedestrian traffic injuries among school children in Kawempe, Uganda. *Afr Health Sci* 2008;**8**:156–9.
22. **Macpherson A**, Roberts I, Pless IB. Children's exposure to traffic and pedestrian injuries. *Am J Public Health* 1998;**88**:1840–3.
23. **Kandel P.** Road accidents in Jordan. *Lancet* 1993;**342**:426.
24. **Lalloo R**, Sheiham A, Nazroo JY. Behavioural characteristics and accidents: findings from the Health Survey for England, 1997. *Accid Anal Prev* 2003;**35**:661–7.
25. **Jelalian E**, Alday S, Spirito A, *et al*. Adolescent motor vehicle crashes: the relationship between behavioral factors and self-reported injury. *J Adolesc Health* 2000;**27**:84–93.
26. **Lin MR**, Chang SH, Pai L, *et al*. A longitudinal study of risk factors for motorcycle crashes among junior college students in Taiwan. *Accid Anal Prev* 2003;**35**:243–52.
27. **Stevenson MR**, Palamara P. Behavioural factors as predictors of motor vehicle crashes: differentials between young urban and rural drivers. *Aust N Z J Public Health* 2001;**25**:245–9.
28. **Christoffel KK**, Donovan M, Schofer J, *et al*. Psychosocial factors in childhood pedestrian injury: a matched case-control study. Kid's'n'Cars Team. *Pediatrics* 1996;**97**:33–42.
29. **Boggs SR**, Eyberg S, Reynolds LA. Concurrent validity of the Eyberg Child Behavior Inventory. *J Clin Child Psychol* 1990;**19**:75–8.
30. **Webster-Stratton C**, Eyberg SM. Child temperament: relationship with child behavior problems and parent–child interactions. *J Clin Child Psychol* 1982;**11**:123–9.
31. **Robinson EA**, Eyberg SM. The dyadic parent–child interaction coding system: standardization and validation. *J Consult Clin Psychol* 1981;**49**:245–50.
32. **McNeil CB**, Eyberg S, Eisenstadt TH, *et al*. Parent–child interaction therapy with behavior problem children: generalization of treatment effects to the school setting. *J Clin Child Psychol* 1991;**20**:140–51.
33. **Fernandez de Pinedo R**, Gorostiza Garay E, Lafuente Mesanza P, *et al*. (Spanish version of ECBI (Eyberg Child Behavior Inventory): measurement of validity). *Aten Primaria* 1998;**21**:65–74.
34. **Pless IB**, Verreault R, Tenina S. A case-control study of pedestrian and bicyclist injuries in childhood. *Am J Public Health* 1989;**79**:995–8.

Risk factors predisposing to pedestrian road traffic injury in children living in Lima, Peru: a case–control study

Jeffrey M Pernica, John C LeBlanc, Giselle Soto-Castellares, et al.

Arch Dis Child published online June 9, 2012
doi: 10.1136/archdischild-2011-300997