12. Hutchinson, T., Kloeden, C., Lindsay, V. Countermeasures to the problem of accidents to intoxicated pedestrians. Journal of Forensic and Legal Medicine, 17(3), 115-119, 2010.
13. Sarkar, S., Kaschade,C., de Faria, F. How well can child pedestrians estimate potential traffic hazards? Transportation Research Record, 2003, 1828, 38-46. Washington DC, USA, Transportation Research Board.
14. Tabibi, Z., & Pfeffer, K. Choosing a safe place to cross the road: The relationship between attention and identification of safe and dangerous road-crossing sites. Child: Care, Health and Development, 2002, 29(4), 237-244.
15. Demetre, J., & Gaffin, S. The salience of occluding vehicles to child pedestrians. British Journal of Educational Psychology, 1994, 64, 243-251.
16. Leadbetter, C. Road smart children. In K Smith, B Aitken & R Grzebieta (Eds.). Proceedings of the Conference on Pedestrian Safety, 1998, pp. 53-66), Melbourne, Australia.
17. Victorian Injury Surveillance Unit. Driveway run-over or back-over injury among children aged 0-14 years: January 2005 to December 2010 (6 years). Monash University, 2011
18. European Transport Safety Commission (ETSC). Safety of pedestrians and cyclists in urban areas. 1999. Brussels, Belgium, ETSC
19. Wramborg, P. The new approach to traffic planning and street design. Proceedings Velo City Conference, 2004, Paris, France.
20. Yeates, M. 60, 50, 40km/h – which is safest? Australian Cyclist, 2001, March issue.
21. ANCAP (2008). Annual Safety Review 2008 Crash Testing for Safety: Australian New Car Assessment Proram. (www. Ancap.com.au)
22. Anderson, R., & Doecke, S. An analysis of head impact severity in simulations of collisions between pedestrians and SUVs/work utility vehicles, and sedans', Traffic Injury Prevention, 2011, 12, 388–397.
23. Zeedyk, M., Wallace. L., Spry, I. Stop, look, listen and think? What young children really do when crossing the road. Accident Analysis and Prevention, 2002, 34, 43-50.
24. Whitebread, D., & Neilson, K. The contribution of visual search strategies to the development of pedestrian skills by 4-11 year old children. British Journal of Educational Psychology, 2000, 70, 539-557.
25. Oxley, J., Congiu, M., Whelan, M., D'Elio, A., Charlton, J. Teaching young children to cross roads safely. Proceedings 52nd Association for the Advancement of Automotive Medicine (AAAM), Conference, San Diego, October 5-8, 2007.
26. Thompson, J., Tolmie, A., Mamoon, T. Road accident involvement of children from ethnic minorities: A literature review. Road Safety Research Report 19, 2001. Department for the Environment, Transport and the Regions, London, UK.
27. Muir, C., Devlin, Oxley J., et al. Parents as role models in road safety. Monash University Accident Research Centre Report 302, 2010.

Analysis of child pedestrian deaths and serious injuries in Malaysia

by Jennifer Oxley[1], Anne Jamaludin[2], Marilyn Johnson[1]

[1]Monash University Accident Research Centre (MUARC), Monash Injury Research Institute (MIRI), Monash University, Melbourne

[2]Monash University Accident Research Centre (MUARC Malaysia), Monash University, Sunway, Malaysia

Abstract

Vulnerable road users are at increased risk in many middle-income countries, largely due to rapid motorisation without associated road safety infrastructure initiatives and programs. Pedestrians are one of the most vulnerable road user groups, particularly young children. While crash patterns and causes of collisions amongst pedestrian are established in developing countries, less is known about crash patterns, types and contributing factors to pedestrian trauma in Malaysia. Analyses of fatal and serious injury child pedestrian crashes were undertaken by examining the police-reported crash database. The results identified high rates of pedestrian deaths overall, and high rates of serious injury amongst young children. Young children were at highest risk in rural areas, on major roads with relatively high speed limits and while they were playing on or attempting to cross the road without the aid of crossing facilities. Passenger vehicles and motorcycles were the most frequent striking vehicle. These findings have significant implications for countermeasures to address priority child pedestrian trauma issues in Malaysia including improved road design and reduced speeds on rural roads, as well as supporting education and enforcement initiatives.

Introduction

Each year an estimated 1.3 million people die on the world's roads [1]. Even more alarming is the injury rate associated with road trauma: each year up to 50 million people are injured or disabled worldwide in road traffic crashes [2]. The World Health Organization (WHO) also reports that a high proportion of these deaths and injuries (up to 90%) occur in low- and middle-income countries, and this proportion is increasing.

In many middle-income and developing countries, vulnerable road users are at increased risk and these groups include pedestrians, cyclists and motorcyclists, and the young and elderly. Pedestrians are one of the most vulnerable road user groups, largely due to their lack of protection and limited biomechanical tolerance to violent forces when impacted by a vehicle.

Malaysia is a rapidly developing country and the level of motorisation has increased dramatically in the last two decades. In Malaysia, the number of registered per 100,000 population has increased by 71.1% from 1994 (36,986) to 2007 (63,319) [3]. This rate ranks Malaysia as one of the highest motorised middle-income countries in the world, with a rate higher than many high-income countries (UK: 56,489; France: 6477;

Sweden: 6031 [1]). However, the vehicle mix is very different in Malaysia. While in high-income countries motorcycles comprise an average of 7% of the vehicle fleet, in Malaysia motorcycles comprise 47% of all registered vehicles [1].

In association with this increase in motorisation, Malaysia has experienced high levels of road trauma, in the order of approximately 24 deaths per 100,000 population. This rate is significantly higher than road fatality rates in many high-income countries; for example, in Australia the road fatality rate in 2010 was 6.12 per 100,000 population [4]. While motorcycle-related trauma comprised the great majority of death and serious injury in this country, other vulnerable groups account for a substantial proportion of trauma: pedestrian trauma represented approximately 10% of all road deaths [1]. In 2010 alone, over 2600 people were involved in a police-reported pedestrian crash, and over 600 of these involved a fatality. Moreover, one of the main pedestrian groups most at risk is young children. Children are highly vulnerable due to their small stature and physical vulnerability. In addition, children may be at increased risk due to the fact that they are still at a developmental stage of specific functional processes and key perceptual skills concerning traffic including choosing safe locations and gaps in the traffic to cross.

In Malaysia, children aged 5 to 9 years are more likely to be killed as a pedestrian (43.5%) than as any other road user group. For children aged 1 to 4 years, most deaths occur as a car occupant (36.7%), followed by pedestrian collision (30.1%) [5]. For children aged 6 to 8 years, the trend of pedestrian injury around school areas decreased from 1997 to 2004; however, there has been a dramatic increase in injuries from 2005[6]. While researchers report that there are inconsistencies in the provision of a safe environment for students as pedestrians around schools, they also acknowledge that there are limitations in the police data and potentially technical errors that may affect the data [6].

The causes of pedestrian crashes are undoubtedly complex and poorly understood. Internationally, several explanations have been offered to account for the over-representation of children in serious injury and fatal pedestrian crashes and these generally include vulnerability, behavioural aspects and road and vehicle design [7-9].

Children are highly vulnerable due to their small stature and physical vulnerability. Young children may have difficulty seeing over parked cars and other obstacles, and are in turn easily obscured by them and therefore difficult for drivers to detect [10-11]. International research suggests that, due still developing cognitive, attentional, perceptual and visual skills, young children are less competent in traffic than older children and adults; this consequently increases their unpredictability and overall risk as pedestrians [7-9]. For younger children (under 7 years old), difficulties are experienced in various situations including high traffic locations, choosing a safe location to cross, judging safe gaps in traffic, being distracted by irrelevant information, attending strategically to traffic in complex traffic situations and controlling impulsive reactions. For children aged 7 years or older, the abilities necessary to interact safely in traffic improve markedly in a number of important aspects but, for many children, these abilities may not be fully developed until they are at least 11 to 12 years of age.

There may also be socio-economic differentials in child pedestrian casualty rates. Some argue that, in the UK, children from lower socio-economic status backgrounds are at an increased risk of pedestrian injury, perhaps up to five times greater than children from higher socio-economic backgrounds [12-13]. Similar findings are reported in Sweden [14]. Whether this is due to behavioural factors on the part of the pedestrian or driver, or other environmental factors, is yet to be determined.

The safety of pedestrians and cyclists is also compromised to a large extent by the design and operation of the road-transport system, which is generally designed for vehicles and, for the most part, seems to be unforgiving for the most vulnerable road users. Overly assertive attitudes by drivers, failure to acknowledge the rights of pedestrians and fast speeds of drivers in areas of high pedestrian activity greatly increase the potential for crashes and, more importantly, the injury consequences once a collision occurs [15-16].

While international research has identified some contributing risk factors, there is little known about the nature and extent of child pedestrian crashes and their contributing factors in the Malaysian context. This paper addresses child pedestrian trauma in Malaysia and is a first attempt at understanding the overall child pedestrian trends, crash experience and crash types and to identify some contributing factors to fatal and serious injury crashes. It is expected that this information will provide valuable input into prioritising road safety initiatives aimed at reducing trauma amongst child pedestrians in Malaysia.

Method

An analysis was conducted of all police-reported pedestrian crashes that resulted in a pedestrian death or serious injury for the period from 2007 to 2010 inclusive.

Data

The pedestrian crash data were obtained from the Malaysian Institute of Road Safety Research (MIROS) Road Accident Analysis and Database System (M-ROADS). In Malaysia, all police-reported crashes are entered into M-ROADS. The M-ROADS database is populated by collision information collected by the Royal Malaysian Police and the data is managed and maintained by the MIROS. All identified pedestrian fatal and serious injury crashes between 2007 and 2010 (inclusive) were extracted from the database and a range of data variables were selected for examination and included: driver and pedestrian variables, site and crash characteristics, and broad injury outcomes. Table 1 provides a list of the selected and available variables for examination.

Table 1. Selected data variables

Variables	
Age of driver	Collision responsibility
Gender of driver	Seatbelt wearing/ helmet wearing
Types of road	Location of trauma on the victim/driver
Condition of the road	Age of pedestrian injured
Location of the road	Gender of pedestrian injured
Weather condition during collision	Severity of injuries on pedestrian
Speed limit of location	Body region injured
Time of collision	Behaviour of pedestrian before collision
Day of collision	Location of pedestrian before collision
Type of vehicle involved in the collision	Driver error

Data analysis

Descriptive statistics are provided for all summary data of the variables as per Table 1. In additon, Chi-square tests were conducted to determine if there were any statistically signficant differences bewten the data variables.

Results

During the period 2007 to 2010, there were over 4640 pedestrian collisions. Figure 1 presents the number of collisions over this time period and shows that the numbers of fatalities and serious injuries have remained fairly stable during 2007 and 2010, while the number of minor injuries has increased since 2008.

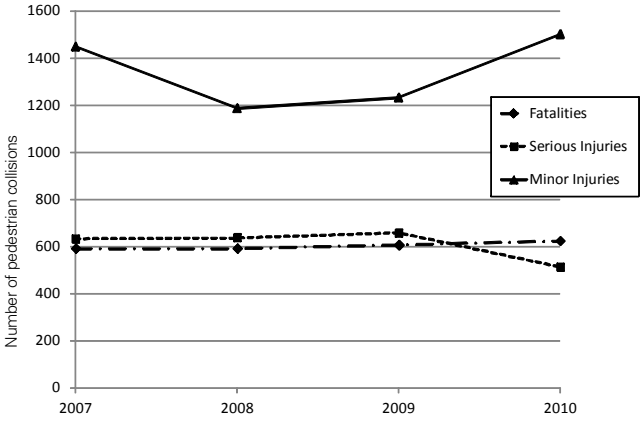

Figure 1. Number of pedestrian injury collisions (2007-2010)

Pedestrian characteristics

This section presents some of the characteristics of collisions, including vehicle and driver factors, crash types, and road/environmental characteristics. Figures 2 and 3 show the rates of fatal and serious injury pedestrian collisions by age group and some clear injury outcome, age group and gender differences are noted.

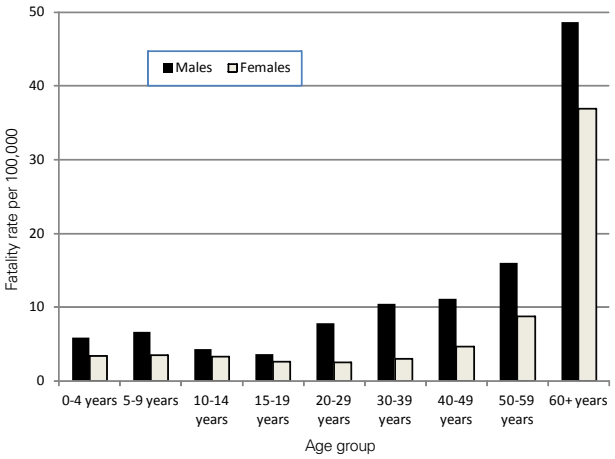

Figure 2. Rate of pedestrian fatalities by age group and gender (per 100,000 population) 2007-2010

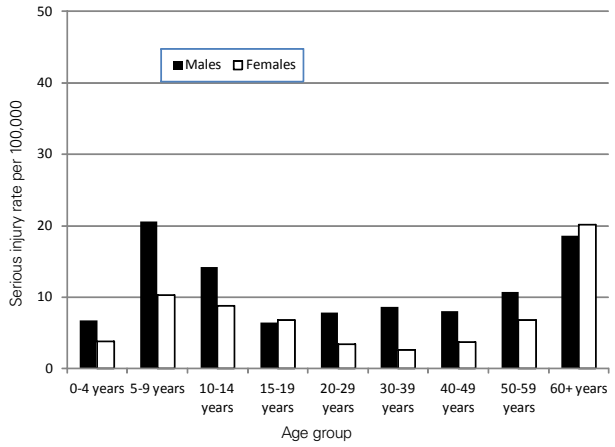

Figure 3. Rate of pedestrian serious injuries by age group and gender (per 100,000 population) 2007-2010

With regard to fatal pedestrian collisions (Figure 2), an effect of age group on fatality rate was found, $x^2_{(8)}=26.92$, $p<0.01$. By far, older adults (aged 60 years and older) were at highest risk of a fatal outcome compared with younger age groups. Children under nine years of age were at slightly higher risk than older children. Moreover, in all age groups, males were more likely than females to be killed as a pedestrian.

With regard to serious injury collision rates (Figure 3), an effect of age group was also found, $x^2_{(8)}=39.83$, $p<0.001$. However, the pattern was quite different to that of fatality rates. High risk age groups were children aged between 5 and 14 years, and older adults aged 60 years and over. Similar to fatality rates, males were more likely than females to sustain a serious injury as a result of a pedestrian collision amongst most age groups, except for those aged 60 years and older, and adolescents aged between 15 and 19 years.

All subsequent analyses presented here focus on child pedestrians aged 14 years and under. Pedestrian behaviour prior to the crash event was examined. Table 2 shows the pedestrian action, for child pedestrians aged 14 years and below only, by collision severity and age group.

Almost two-thirds of children involved in a collision were recorded as showing negligence while crossing, while approximately one-third of children were walking or playing on the road when the collision occurred. There was no effect of collision severity; however, a significant effect of age group was found, $x^2_{(12)}=66.08$, $p<0.001$. The most common pre-crash behaviour for all children was negligence related to road crossing, followed by walking or playing on the road.

Table 2. Recorded pedestrian action by collision severity and age group

	Collision Severity		Age Group		
	Fatality	Serious Injury	0-4 years	5-9 years	10-14 years
Negligence while crossing	62.0	67.1	50.0	71.7	66.4
Walking or playing on road	34.4	29.9	46.1	26.1	29.2
Did not use crossing facility	1.9	2.4	1.2	1.7	3.9
Medical disorder	1.1	0.3	1.9	0.3	0.0
Intoxicated	0.6	0.1	0.8	0.0	0.2
Doing sport	0.0	0.2	0.0	0.2	0.2

Driver and vehicle characteristics

A number of vehicle and driver characteristic variables were extracted and examined. Figure 4 shows the type of vehicle involved in fatal and serious injury crashes amongst children 14 years and under.

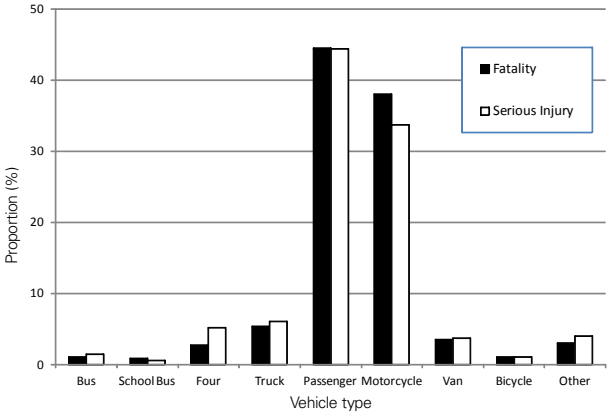

Figure 4. Type of vehicle involved in child pedestrian collisions by collision severity

The majority of fatal and serious injury collisions occurred as a result of a collision with a passenger car or motorcycle. Trucks and four-wheel-drive vehicles accounted for approximately 8% of fatalities and 11% of serious injuries. Analyses also revealed that half of drivers/riders involved in collisions were experienced drivers/riders, having their licence for over five years, while 34% were less experienced, having their full licence for less than five years. 15% of drivers/riders were unlicensed.

The analyses also revealed that a relatively high proportion of collisions (16% of fatalities and 18% of serious injury outcomes) were 'hit-and-run' collisions, where the driver/rider left the scene of the collision. This variable was further analysed by vehicle type (Figure 5) and revealed that passenger car/taxi drivers were more likely to leave the scene of a collision than drivers of other vehicles.

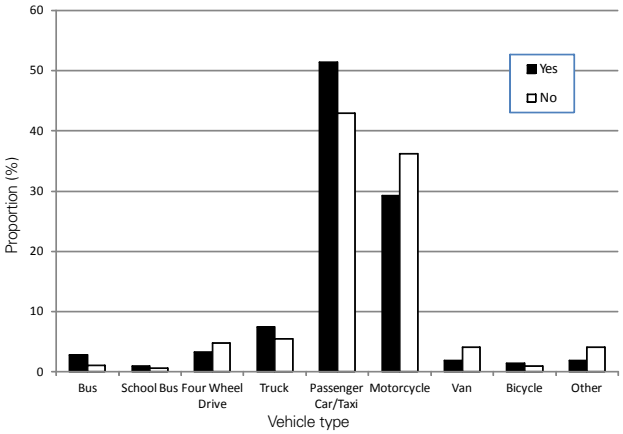

Figure 5. Proportion of hit-and-run collisions by vehicle type

In terms of driver/rider errors, for those where information was available, drivers/riders were deemed 'not guilty' in the majority of cases (72% for fatalities and 76% for serious injury collisions). In a small number of police reports, specific driver behaviours were recorded: over passenger (over the legal number of passengers or pillion riders) (5.8%), driver/rider negligence (3.5%) and speeding (3%).

Environmental characteristics

A number of road, location and timing characteristic variables were also extracted and examined by collision severity and age group. These are presented in Table 3.

The majority of collisions occurred in rural areas and in townships, and there was a significant effect of location by collision severity, $x^2_{(4)}=17.00$, $p<0.01$. A high proportion also occurred on federal or state roads and where there was no traffic control. There was no clear pattern of collisions with regard to speed limit.

Injury outcome

As noted above, young children were over-involved in serious injury crashes. Figure 6 shows proportions of fatalities and serious injuries by age group for children 14 years and below.

Table 3. Road, location and environmental characteristics of child pedestrian crashes by collision severity and age group

	Collision Severity		Age Group		
	Fatality	Serious Injury	0-4 years	5-9 years	10-14 years
Speed Limit					
50km/h	22.9	21.2	24.9	21.3	20.2
70km/h	22.3	25.1	23.1	24.5	25.4
80km/h	9.1	10.1	8.2	9.2	11.9
90km/h	11.7	12.8	12.1	12.8	12.4
110km/h	2.3	2.2	2.8	1.6	2.6
Other	31.7	28.6	28.8	31.1	27.6
Control Type					
Zebra Crossing	0.5	0.4	0.0	0.0	0.5
Railway Crossing	0.3	0.1	0.4	0.2	0.0
Yellow crossing line or box	5.0	2.8	3.9	3.1	3.3
No traffic control	90.5	92.6	91.5	89.8	88.8
Police or other	3.7	3.9			
Location Type			10.9	8.4	8.0
Major City	7.1	9.5	16.3	15.9	16.2
Small City	16.4	16.0	18.5	20.3	20.8
Town	26.6	17.3	54.3	55.4	54.9
Rural	49.9	57.2			
Road Type			4.2	3.9	3.1
Highway	3.1	4.0	34.0	33.8	37.0
Federal Road	35.2	34.5	20.6	25.1	23.9
State Road	19.4	25.4	33.3	25.1	27.9
Urban Road	32.4	28.1	7.8	8.4	8.1
Other	9.8	8.1			
Area Type					
Housing Area	23.1	22.7	24.1	21.9	23.2
Office Area	8.6	8.4	6.7	10.0	7.3
Shopping Area	6.8	6.7	5.6	4.6	6.6
Industrial/ building Area	5.7	4.4	3.2	4.4	6.4
Bridge	1.6	1.5	1.8	1.1	1.9
School	4.7	6.0	6.7	6.1	4.3
Other	49.6	50.3	51.8	50.2	50.2

Significant age group differences were found, $x^2_{(2)}=48.69$, $p<0.001$. The youngest children (aged 4 years and below) were more likely than older children to be killed as a result of a pedestrian collision.

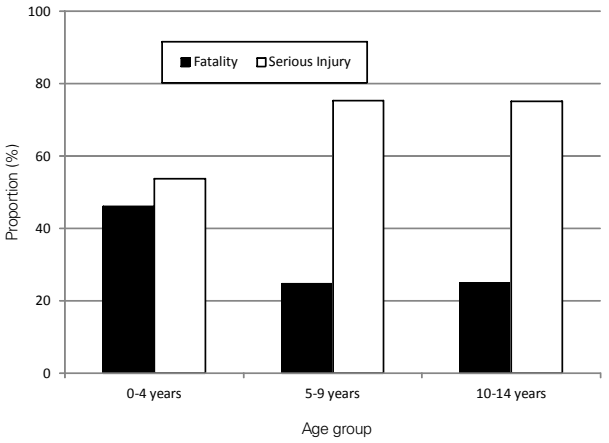

Figure 6. Pedestrian injury severity by age group

Overall, the most frequent body region injured was the head and neck region, followed closely by lower extremities (as shown in Table 4). Younger children were more likely than older children to sustain head/neck injuries, while older children were more likely than younger children to sustain lower extremity injuries, $x^2_{(16)}=38.31$, $p<0.01$. Not surprisingly, children who were killed were more likely to have sustained a head/neck injury or multiple injuries compared with children who sustained a serious injury, while children sustaining a serious injury were more likely to have sustained lower extremity injuries, $x^2_{(16)}=38.31$, $p<0.01$.

Table 4. Body region injured by injury severity and age group

	Collision Severity		Age Group		
	Fatality	Serious Injury	0-4 years	5-9 years	10-14 years
Head/Neck	77.1	27.7	49.6	40.0	39.1
Chest/Thorax	4.1	3.4	4.7	2.5	3.4
Upper Extremities	1.1	7.9	4.3	4.7	8.7
Lower extremities	1.1	51.7	26.4	41.6	37.2
Multiple	16.6	9.3	14.0	10.7	10.6

Discussion

Children worldwide are at substantial risk of death and serious injury as a result of a pedestrian collision [1]. Pedestrians, and especially children, are at high risk of injury, largely due to their vulnerability, lack of protection and limited biomechanical tolerance to violent forces if hit by a vehicle. In low and middle income countries, especially, vulnerable road users constitute a high proportion of road trauma [2].

This paper presents the findings from an examination of the pedestrian fatal and serious injury crash data in Malaysia. The study aim was to better understand the nature and extent of child pedestrian collisions by identifying contributing factors to injury collision involvement and injury outcomes. The findings of this study highlighted both expected and unexpected findings which may have implications for the development of effective measures to reduce pedestrian-related trauma in Malaysia.

The overall finding was that the high level of death amongst pedestrians who are involved in a collision did not reduce significantly between 2007 and 2010. The overall numbers of pedestrian deaths during this period was high and comparable to numbers of serious injury pedestrian collisions. This was an unexpected finding, and contrary to the general trend in many developed countries, where fatality rates are generally significantly lower than injury rates. Furthermore, the findings revealed that, while older pedestrians were at high risk of death, children under 14 years of age, particularly males, were at high risk of serious injury.

Although comparable pedestrian fatality data was reported for the year 2007 by both M-ROADS (600) and the WHO report (628) [1], road user crashes are likely to be under-reported as found in international crash data analyses [17-18].

Generally, the causes of crashes are complex and multi-factorial, and this analysis confirms this. However, there were some significant findings. Overall, the findings suggested that young children were at risk of collision while they were walking or playing on the road, while, for older children, the main factor was negligent crossing. Moreover, the majority of pedestrian collisions occurred in rural areas, on major roads with relatively high speed limits and where there was no traffic control. This contrasts greatly to findings of pedestrian trauma in developed countries, where most collisions occur in large cities, in urban areas and on roads with relatively low speed zones [19-20].

In comparison with developed countries, but not surprising given the high use of motorcycles in Malaysia, the findings revealed that a high proportion of pedestrian collisions, both fatalities and serious injuries (38% and 35%, respectively), resulted from a collision with a motorcycle. Interestingly, however, the majority of drivers/riders were reported to be 'not at fault'. However, there was a substantial proportion of 'hit-and-run' collisions (approximately 16%), where responsibility cannot be determined. Passenger vehicle/taxi drivers were more likely to leave the scene of a collision than other vehicle operators. Moreover, approximately two-thirds of children were reported as being 'negligent while crossing', and this was more likely amongst older children. These findings raise important issues related to reporting. In any collision involving a vulnerable road user, they are more likely to be injured than the driver/rider and often unable to provide information to attending police about pre-collision behaviours or collision responsibility. This appears to be the case here, and especially among older children who may be unaccompanied by an adult.

Attribution of blame to young children was not as common as for older children, suggesting that an accompanying adult or older child may have been able to provide information on behalf of the injured pedestrian. In any case, these findings may overstate the responsibility of the child.

The findings regarding injury patterns revealed effects of injury severity and age group. It was not surprising to find that head/neck was the most frequently injured body region amongst fatalities, while lower extremity injuries comprised the majority serious injury collisions, given the severe outcomes of head injury. It was also interesting to note that younger children were more likely to sustain a head/neck injury compared with older children; this may be attributed, in part, to their smaller stature. Given height differences, it may be more difficult for drivers/riders to see younger children and therefore they may not take actions to slow down to avoid a collision, thereby colliding at relatively high speed. It may be that shorter children may be at increased risk of head impact compared with taller children [20].

The findings from this analysis raise a number of potential opportunities for countermeasures to address the high rate of pedestrian trauma and especially death and injury to children in Malaysia. The key issues that should be addressed to reduce child pedestrian deaths and serious injuries are rural collisions on major high speed roads, and collisions between pedestrians and passenger vehicles as well as motorcycles.

Rural roads and roads in small towns in Malaysia rarely provide footpaths for pedestrians, or crossing facilities. Moreover, speeds are relatively high on many of these roads. Engineering countermeasures have the potential to quickly and effectively create a safer and more 'crashworthy' travel environment for vulnerable road users. The improvements that appear to provide the most benefit for pedestrians in general, and for children, include: i) measures to reduce travel speeds where pedestrians are present (lower speed zones and traffic-calming measures), and ii) provision of infrastructure that gives higher priority to pedestrians in critical locations (through separation of travel modes, e.g., school crossings, provision of footpaths, signing to warn of children crossing) [19-20].

Pedestrians are only safe when vehicle speeds are low, in the order of 30 to 40 km/h [21-22]. At these speeds, most potential collision situations can be recognised and avoided, and, if a collision does occur, damage and injury should be light to severe, but rarely fatal. Research shows unequivocally that crash incidence and crash severity decline whenever speed limits are reduced and increase when speed limits are raised [23-24]. Most OECD countries have adopted general urban speed limits of 50 km/h and some permit zoning at lower speeds in residential areas and school zones. Reduced speed limits around schools are not common in Malaysia; however, there are increasing numbers of areas introducing 30 km/h speed limits near schools. An analysis of speeding in school zones revealed that there is poor compliance [25] with speed zoning in Malaysia, therefore targeted speed reduction enforcement measures should be a priority in Malaysia. These include lowering of speed limits in high pedestrian activity areas as well as introduction of traffic calming measures. Traffic calming measures aim to reduce the number and speed of vehicles in local streets and in areas where there is high pedestrian activity. They act to make drivers more attentive to their surroundings and drive more slowly or appropriately for the environment. The 'woonerf' concept encourages drivers to drive slowly by physical modifications to the roadway (such as pavement narrowing, refuge islands, alterations to the road surface, speed humps, roundabouts and gateway treatments). These are now common in Europe, with many reports of success, particularly in terms of speed reduction, crash reduction, increased walking activity, and changes in driver behaviour [20].

These measures should be introduced in association with effective enforcement and educational strategies. Given that unsafe pedestrian behaviour often increases their crash risk, educational and training measures that aim to correct or modify these behaviours should be developed and implemented, particularly in rural areas. It is also considered important to educate both pedestrians and drivers/riders about the rights and responsibilities of all road users.

Conclusions

Pedestrian safety is a concern worldwide, and in Malaysia. These concerns are likely to continue to increase unless effective initiatives are implemented. More importantly, the safety of our children as pedestrians is of great concern, given that a sizeable proportion of pedestrians killed and seriously injured involve children and the special value society places on its youth.

The findings from this study confirm previous studies and add some new information on fatal and serious injury collision risk amongst young children in Malaysia. Young children in Malaysia appear to be at highest risk in rural areas, on major roads with a mix of vehicles and relatively high speed limits, and while they are playing or attempting to cross the road without the aid of crossing facilities. The implications for countermeasure development are presented to address these priority issues including improved road design and reduced speeds on rural roads, as well as supporting education and enforcement initiatives.

References

1. World Health Organization, Global status report on road safety: Time for action. 2009: Geneva.
2. Peden, M., Scurfield, R., Sleet, D., Mohan, D., Hyder, A., Jarawan, E., and Mathers, C., World Report on Road Traffic Injury prevention, W.H. Organisation, Editor. 2004: Geneva.
3. Radin Umar, R., Updates of Road Safety Status in Malaysia. IATSS Research, 2005. 29(1): p. 106-108.
4. Bureau of Infrastructure Transport and Regional Economics, Road Deaths Australia: 2010 Statistical Summary. 2011: Canberra.

5. Mohamed, N., Voon, W.S., Hashim, H.H., and Othman, I., An Overview of Road Traffic Injuries Among Children in Malaysia and Its Implication on Road Traffic Injury and Prevention Strategy. 2011, Malaysian Institue of Road Safety Research: Kuala Lumpur, Malaysia.
6. Manan, M.M.b.A. and Hoong, A.P.W., Traffic Calming Scheme Around the Vicinity of School: A Survey in the Klang Valley, Malaysia. 2009, Malaysian Institute of Road Safety Research: Kuala Lumpus, Malaysia.
7. Zeedyk, S., Wallace, M., and Spry, L., Stop, look, listen and think? Accident Analysis and Prevention, 2002. 34: p. 43-50.
8. Sarkar, S., Kaschade, C., and de Faria, F., How well can child pedestrians estimate potential traffic hazards? Transportation Research Record, 2003. 1828: p. 38-46.
9. Oxley, J., Congiu, M., D'Elia, A., and Charlton, J., The impacts of functional performance, behaviour and traffic exposure on road-crossing judgements of young children. Proceedings of 51st AAAM Annual Conference, 2007.
10. Demetre, J. and Gaffin, S., The salience of occludnig vehicles to child pedestrians. British Journal of Educational Psychology, 1994. 64: p. 243-251.
11. Leadbetter, C. Road smart children. in Proceedings of the Conference on Pedestrian Safety. 1998. Melbourne, Australia.
12. Thompson, J., Tolmie, A., and Mamoon, T., Road accident involvement of childrne from ethnic minorities: A literature review., R.S.R.R. 19, Editor. 2001: Department for the Environment, Transport and Regions, London, UK.
13. Hewson, P., Deprived children or deprived neighbourhoods? A public health approach to the investigation of links between deprivation and injury risk with specific reference to child road safty in Devon County UK. BMC Public Health, 2004. 4: p. 15.
14. Hasselberg, M. and Laflamme, L., Children at risk in traffic: improvement potentials in the Swedish context. Acta Paediatrics, 2004. 93(1): p. 113-9.
15. Preusser, D.F., Wells, J., Williams, A.F., and Weinstein, H., Pedestrian crashes in Washinton, DC and Baltimore. Accident Analysis and Prevention, 2002. 34: p. 703-710.
16. Oxley, J., Lenné, M.G., and Corben, B., The effect of alcohol impairment on road-crossing behaviour. Tranportation Research Part F: Traffic Psychology and Behaviour, 2006. 9(4): p. 258-268.
17. Agran, P.F., Castillo, D.N., and Winn, D.G., Limitations of data compiled from police reports on pediatric pedestrian and bicycle motor vehicle events. Accident Analysis and Prevention, 1990. 22(4): p. 361-370.
18. Rosman, D.L., The Western Australian Road Injury Database (1987-1996): ten years of linked police, hospital and death records of road crashes and injuries. Accident Analysis and Prevention, 2001. 33(1): p. 81-88.
19. Devlin, A., Hoareau, E., Logan, D.B., Corben, B., and Oxley, J., Towards Zero Pedestrian Trauma: Preliminary Analyses, in Proceedings Road Safety Research, Policing and Education Conference. 2010: Canberra, Australia.
20. European Transport Safety Commission, Safety of pedestrians and cyclists in urban areas. 1999: Brussels, Belgium.
21. Wramborg, P. The new approach to traffic planning and street design. in Proceedings of Velo City. 2004. Paris, France.
22. Yeates, M., 60, 50, 40km/h - which is safest? Australian Cyclist, 2001 (March).
23. Anderson, R.W.G., McLean, A.J., Farmer, M.J.B., Lee, B.H., and Brooks, C.G., Vehicle travel speeds and the incidence of fatal pedestrian crashes. Accident Analysis & Prevention, 1997. 29(5): p. 667-674.
24. Haworth, N., Ungers, B., Vulcan, P., and Corben, B., Evaluation of a 50km/h default urban speed limit for Australia. 2001, National Road Transport Commission: Melbourne, Australia.
25. Hanan, S.A., King, M.J., and Lewis, I.M., Understanding speeding in school zones in Malaysia and Australia using an extended Theory of Planned Behaviour: The potential role of mindfulness. Journal of the Australasian College of Road Safety, 2011. 22(2): p. 56-62.

Child occupant protection in Australia

by Julie Brown[1, 2] and Lynne E Bilston[1, 3]

[1]Neuroscience Research Australia
[2]School of Medical Sciences
[3]Prince of Wales Clinical School, University of New South Wales

Abstract

Child occupants require special consideration in the motor vehicle, where the environment is largely engineered for adults. This paper reviews the issues that place child occupants in a special category and how these have been dealt with in Australia, as well as the history of legislation covering children in cars and its effectiveness in enhancing crash protection. Recent research highlighting current problem areas for Australian child occupants is also reviewed.

This review illustrates that the general principles of occupant protection can be applied to children but that this application also requires knowledge of the developmental stages of children. Legislation has been effective in getting children into restraints when travelling in cars, and recent changes to Australian law mandating the types of restraint used appears to have improved restraint choice in the short term. The history of legislation effectiveness suggests that it is likely that ongoing educational and enforcement activities will be required to sustain and maximise the effect of the new laws.

Ensuring that restraints are used correctly is as important as getting children into the right type of restraint. Increasing correct use among child occupants requires additional strategies. To date, the only strategies shown to be associated with increased levels of correct restraint use are hands-on demonstration and the use of services like the New South Wales Authorised Restraint Fitting Station network. There is a need for continued focus on reducing the complexity of child restraint systems to enable correct use. Other issues of current importance for child occupants include the need to ensure