An Investigation into Child Pedestrian Behaviour and the Physical Road Environments Around Schools in the Cape Metropolitan Area

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Abstract

Traffic fatalities are a primary cause of premature deaths globally, and pedestrian casualties are a significant component of this problem. This problem is exacerbated by the involvement of children pedestrians who are more vulnerable than adult pedestrians; UNICEF notes that traffic deaths are the leading cause of premature death for children between 5 and 19 years old.

Pedestrian and driver behaviour are two elements that influence crash likelihood but the role of the built environment in shaping that behaviour is increasingly recognised. In considering how the built environment influences road-user behaviour, most available literature focuses on drivers. There is less research on pedestrian behaviour and almost none on child pedestrians.

This paper compares the physical attributes of the road environment around 19 schools in the Cape Town area, and the behaviour of drivers and child pedestrians at each school. The schools were selected based on their proximity to high levels of pedestrian crashes historically; ten are associated with very high pedestrian crash rates and nine with extremely low rates. Significant differences were found in the physical road environments between the two groups, with notable deficiencies in road sign/markings, speed management, and the placement of pedestrian crossings in the high crash areas compared with the low crash areas. The exposure of children to risks was strongly reflected in this division, with children in high-crash areas demonstrating significantly higher levels of risky behaviour like crossing at informal crossings, walking/playing in the road, and needing to take evasive action from vehicles.

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1. Background

Traffic fatalities currently rank as the eighth leading cause of premature death, and their significance is expected to increase in the coming decades. Approximately 1.35 million people lose their lives each year due to road traffic accidents, with pedestrians accounting for about a quarter of these fatalities. While the majority of pedestrian casualties are adults, child pedestrians are disproportionately represented in pedestrian fatalities, reflecting the fact that they are more vulnerable to serious and fatal injury than adults due to their smaller size, but also more likely to be compromised in traffic because of their lower levels of cognitive development. UNICEF reports that traffic injuries are the leading cause of premature mortality for children between 5 and 19 years (UNICEF, n/d, https://www.unicef.org/health/injuries), and the majority of those killed are pedestrians. Child pedestrian injuries have already become a major public health concern in numerous cities, and as motorization rates continue to rise, particularly in developing regions, this problem is likely to become even more pressing.

The factors influencing the likelihood of pedestrian accidents, including those involving children, are complex. Historically, the predominant explanation for pedestrian accidents was behaviour of pedestrians themselves, with pedestrians being held largely responsible for crashes resulting in their injury or death. However, the Safe System approach to road design, promoted by the UN Decades of Action for Road Safety (2011-2020 and 2021-2030), has shifted the focus towards shared responsibility for the safety of all road users, including pedestrians. This new approach obliges planners and road designers to ensure that road designs optimise the safety of all users, including pedestrians. Part of this process requires an examination into which aspects of road design encourage risky behaviour and which elements foster safe walking.

Road designers increasingly acknowledge that road user behaviour is largely shaped by how each user interprets the expectations embedded in the design elements of the road. The more experience a road user has in interpreting road environments, such as the interplay of design features like scale, signage, markings, and traffic characteristics, the faster and more accurately they can understand what is expected, what is potentially hazardous, and how to behave. Most of the knowledge about interpreting complex road environments has been derived from research among drivers, and only limited research exploring the relationship between the built environment and pedestrian behaviour, especially among children. There is a similar gap in our understanding of how children interpret the road environment, and how their behaviour may differ depending on the messages they receive.

We do know that children's ability to assess relationships between objects develops relatively late in childhood. Jean Piaget (1957) specifically noted their inability to calculate the interplay of time, velocity, and distance, meaning that they often cannot predict the path or arrival of a vehicle at a specific point. While children can recognize dangerous objects from a young age, it takes years for them to contextualize the actual risks associated with these objects. For example, it takes time and experience to understand precisely when an approaching vehicle may pose a low risk or a threat to them. The nuances that adults observe and understand in a traffic situation are often overlooked by children, who grasp only the fundamental aspects of a road and are not attuned to the relationships between these elements. Consequently, the elements themselves, rather than the entire traffic environment, serve as crucial cues for children regarding how to behave.

This study focuses on the behaviour of primary-school children in different urban environments in Cape Town, South Africa, to identify combinations of physical features associated with risky pedestrian behaviour. Cape Town's diverse urban and road designs offer a unique opportunity to explore how urban form influences children's walking behaviour. The study examines children's understanding of traffic risks, their responses to various threats, and their safe behaviour in different locations and physical environments.

2. Literature review

Child pedestrian injuries are the subject of a wide range of research, mostly emerging from health science literature, and more is now known about what factors of the physical environment are correlated with child pedestrian crash risk. At a very high level these include poverty and population density: the greater the degree of poverty and the higher the population density, the greater the likelihood of child pedestrian fatalities (Cottrill & Vonu, 2010). Multiple research projects have also confirmed the higher vulnerability of pedestrians, and child pedestrians, in lower-income areas of even industrialised countries (Edwards et al., 2006; Lyons et al., 2013)

Research has also identified some of the factors which contribute to this vulnerability, covering both road and child development factors. From an road perspective, high traffic volume, higher density of on-street (kerb) parking and mean speeds greater than 40km/h are indicated as factors influencing child pedestrian risk (Roberts et al., 1995). The complexity of the roadway environment is another factor, with environments of high cognitive load more prone to pedestrian crashes than those with less complexity (Hagai Tapiro, Tal Oron-Gilad, 2020). The number of lanes on a road (influencing both the prevailing travel speeds and the distance needed to cross the road) is a crash risk factor for child pedestrians; as is the absence of safe play areas in the neighbourhood (Roberts et al., 1995; Cottrill and Vonu, 2010); the absence of street lighting (Clifton and Burnier, 2009) and a lack of suitable traffic control measures.

Minimising risk exposure by providing safe pedestrian crossings for children at intersections has long been the responsibility of traffic departments, yet research over many years shows mixed results, with some research suggesting that the majority of crashes involving child pedestrians are found to occur away from intersections, at midblock locations in residential streets, often close to the home of the child (Lightstone et al., 2001; Rivara, F.P. and Barber, M., 1985). Other research shows that marked crossings pose higher risk for pedestrian rashes (including children) where they are used on high volume, multi-lane roads. On a positive note, the use of raised crossings has been found consistently to be associated with lower pedestrian crash rates, on all road types (Zeeger et al., 2002), and there appears to be some degree of improved pedestrian behaviour where crossings are marked, than where they are not (Knoblauch et al., 1988).

A fair amount of research concentrates on yielding behaviour at crossings, specifically under what conditions drivers are more likely to yield to pedestrians on the crossing, with the general finding being that pedestrians are more often required to yield to drivers than vice versa. In their research in Israel, Katz et al. (1975) reported that drivers were more inclined to yield to pedestrians when the pedestrian had clearly not seen the vehicle or when they were crossing in a group. Schroeder and Rouphail (2011)found that drivers would give way more often to assertive pedestrians. Himanen and Kulmala (1988) identified the most important factors influencing the willingness of drivers to yield at crossings to be pedestrians' distance from the kerb (short distances), the size of the city (bigger cities), the number of pedestrians crossing simultaneously (more pedestrians), and vehicle speed (lower speed). Sucha, Dostal and Risser (2017) report that yielding behaviour is intricately associated with the communication between the driver and the crossing pedestrians – almost always the assumption is that both parties have the knowledge and ability to communicate as equals. No research could be found that identified the factors influencing the yielding of drivers to child pedestrians.

From a child-development perspective, crash involvement by children increases with child age. This is probably related to the increased level of mobility they experience with age, though injury severity does not necessarily follow the same trajectory. As with driver competence, hazard recognition and pedestrian competence improve with child age and exposure to the pedestrian environment (Meir and Olon-Gilad, 2015), but the development of these skills is complicated by the cognitive development of children, their tendency towards erratic behaviour (in fact the term "mid-block dart-out" was coined in the 1990s to capture this (Malek, Guyer and Lescohier, 1990) and unsafe behaviours (reflected in the fact that many fatal crashes involved children running, unlike adult pedestrian deaths (Yao, Yang and Otte, 2007).

Research such as this has contributed to a somewhat improved understanding of why and where child pedestrians are vulnerable, yet in spite of this the solutions to child pedestrian vulnerability remain largely elusive. Research into the behaviour of both pedestrians and motorists on roads, and particularly in the context of high-conflict areas such as crossings and intersections, has yet to produce results that we can extrapolate to all communities.

3. Research questions

In this research, the main goal of the research was to assess the overall impact of the built road environment on child pedestrian behaviour and the associated crash risk. The specific research questions guiding this study were as follows:

- How adequately are schools in high-crash and low-crash areas equipped with safe pedestrian facilities such as sidewalks, crossing points, and waiting areas?
- To what extent is walking to school the predominant mode of transport in each group?
- How effectively do child pedestrians utilize the road design elements?
- What influence does the absence of specific elements have on child pedestrian behaviour and the risks they face as road users?
- Which elements in the traffic environment contribute significantly to the risk for child pedestrians, and how well are these factors addressed in each location?
- Are certain elements more crucial than others in shaping behaviour and ensuring children's safety?

4. Methodology

This study investigated the road environment and the behaviour of child pedestrians traveling to schools in nineteen different areas within the Cape Town metropolitan region. Half of these areas experienced high levels of pedestrian crashes, while the other half did not. The selection of these areas resulted from diverse urban forms and traffic characteristics, largely influenced by historical apartheid planning strategies. These planning decisions have left a lasting impact, leading to evident disparities in wealth, opportunities, and lifestyles among neighbourhoods. Despite South Africa being classified as a middle-class developing country by the World Bank, it exhibits one of the highest and persistent Gini coefficients globally. This is reflected in substantial inequalities at the socio-economic level, including neighbourhood designs.

A database of pedestrian crashes was used to identify and map the highest and lowest concentrations of pedestrian crashes in the Cape Town area over the past 8 years, and publicly-funded primary schools that fell into each of these two extreme groups were identified as being possible candidates for the research project. Invitations to participate were sent to 28 headteachers, of whom 9 schools. The total number of publicly-funded primary schools in the Cape Town area is 180, so the 19 schools are represent only a very sample, which potentially limits the representation of the results to other schools.

Data collection methods encompassed road safety audits based on the AustRoads safety audit around schools, observations of traffic and child pedestrian behaviour along school routes, and surveys targeting the children themselves. A total of 48 hours of observation by a dedicated team of observers contributed to the findings presented in this study.

Table 1: Division of schools into high-crash and low-crash areas

	School No	**School District**	**Street length (km)**	**Ped casualties /km**	**Child casualties/km**
Group A – high pedestrian crash- history	1	Phillipi	1.40	**43.57**	**17.14**
	2	Delft	5.58	**27.78**	**10.04**
	3	Lwandle	1.36	**30.15**	**13.24**
	4	Gugulethu	4.30	**31.16**	**9.77**
	5	Elsies River	2.65	**25.66**	**12.08**
	6	Macassar	1.66	**24.70**	**11.45**
	7	Khayelistha	4.90	**17.96**	**17.96**
	8	Manenburg	5.50	**30.55**	**7.45**
	9	Grabouw	0.59	**23.65**	**27.03**
	10	Dunoon	3.50	**28.00**	**6.57**
Group B – low-pedestrian-crash history	1	Bellville	1.93	**0.52**	**0.00**
	2	Somerset West	3.07	**1.30**	**0.33**
	3	Stellenbosch	0.72	**2.78**	**1.39**
	4	Rondebosch	0.61	**0.00**	**0.00**
	5	Durbanville	1.81	**0.00**	**0.00**
	6	Sun Valley	0.76	**0.00**	**0.00**
	7	Bergvliet	1.32	**0.00**	**0.00**
	8	Bergvliet	2.1	**0.00**	**0.00**
	9	Kuils River	0.51	**0.00**	**0.00**

5. Results

5.1 Physical infrastructure

The physical amenities provided for pedestrians at each school were evaluated through a series of road safety audits. Road safety audits are widely-used, systematic checks of the physical attributes of the multiple factors that together make up the physical road network, largely based on assessing their compliance with accepted geometric design standards. Overall, specific details of the nineteen schools are summarised in Table 2, which presents cumulative results for high-crash schools and low-crash schools separately.

Table 2: Summary of environmental elements in school environment

General	High-crash schools (10)	Low-crash schools (9)	Pedestrian Facilities	High-crash schools (10)	Low-crash schools (9)
Speed limit sign present	0	0	Sidewalks all sides	5	9
Speed limit ensured	1	5	Well located crossings	3	8
Sufficient stopping sight distance	8	7	Guaranteed collective use	3	6
Separated traffic speed types	0	1	Further crossing aids required	7	5
Sidewalks present	9	9	Waiting areas present	6	9
Functional road design elements			Crossing refugees sufficient	4	9
Appropriate cross section	10	9	Two-way visual contact observed	4	8
Safe median present	2	2	Physically seperated facilities	5	9
Good long term road grip	7	9	Signposts present & detectable	1	6
Good road/sidewalk surface	5	8	**Intersections, general**		
Sufficient Drainage present	5	9	Perpendicular Intersection	8	9
Road shoulder	3	6	Main direction recognizable	7	9
Formal stops for public transport	4	7	Right of way recognizable	5	9
Clear of sight obstructions	6	9	Guided movements	5	9
Scholar road sign present	4	6	Markings which assist flow	4	4
Road signs and markings clear	2	9	No obstructions to signt at Intersection	3	9
School access			Pedestrian crossings marked	4	8
Crossings at all approaches	0	1	Signals present	2	1
Only crossing near school	3	6	Low kerb crossings	3	8
Reduction of speed required of drivers	2	7	**Lighting**		
Universal access			Lighting along road	5	9
Provision made for access for wheelchairs	0	7	Sufficiently illuminated @ crossing	3	8
Provision made for visually diabled	0	2	**Recreation facility at schools**	6	9

In all cases, the functional road design elements appear to be reasonably well-executed, with appropriate cross sections and geometric design, though significant deficiencies were recorded in the roads' signs and markings, particularly for the high-crash location schools (where only two of the ten schools were signed/marked appropriately). Problems included missing stop or yield signs and missing or weathered markings at crosswalks and intersections. Only four of the ten high-crash schools included marked pedestrian crossings (compared with eight of the nine low-crash schools). Signage specifically indicating the presence of a school or child learners was found at 4 of the high-crash schools and 6 of the low-crash schools. None of the school locations had posted speed limit signs indicating the 60km/h limit, which aligns with typical road engineering practice in South Africa (in urban areas, a 60km/h limit is assumed, and reminder signs are rarely used). However, for critical areas like schools, efforts should arguably be made to remind drivers about their speed and the limit. This could potentially be addressed and improved on.

Although the majority of schools had at least one pedestrian crossing, the focus tended to be on the access in front of the main school entrance rather than addressing potential key crossing points within the wider school zone. This problem was particularly notable in the high-crash schools, with only three of the ten schools having sufficient pedestrian crossings. These schools were also identified as requiring additional assistance to enable learners to cross safely.

Of particular concern is the noticeable shortcomings in roads around the schools located in high-crash areas when compared to those in low-crash areas. In addition to the deficiencies already noted (unclear markings on pedestrian crossings, and the clarity of road signs and markings), the deficiencies include adequate sidewalks and sidewalk width on all approaches (not just in front of the school), road and sidewalk surface quality, drainage, the provision of hard shoulders, sufficient lighting, and formal stopping locations for public transport vehicles.

The management of speed around schools in high-crash areas is also a concern when compared to low-crash schools. Only two out of ten high-crash schools are situated in areas where implemented physical interventions such as road humps to slow down drivers, in contrast to seven out of nine low-crash schools. Regarding universal accessibility, none of the high-crash schools accommodated wheelchair-bound pedestrians or those with visual impairments, whereas seven of the low-crash locations provided dropped kerbs for wheelchairs, and two included bubble paving for individuals with visual limitations.

5.2 Traffic risk identification

The risk identification component of the study involved morning observations of children and motorized vehicles in the vicinity of nineteen schools during peak school hours. To assess the relative traffic-related risks, the following factors were examined:

- The proportion of children walking to school.
- The extent to which vehicles stopped for children at both formal and midblock crossings.
- Whether parked vehicles hindered access and visibility for drivers and pedestrians.
- The observed speeds of passing vehicles.
- The presence and behaviour of minibus taxis.
- The level of concentration exhibited by children while crossing the road.
- The level of crowding on sidewalks.
- Instances where children had to take evasive action to avoid collisions.

Table 3: Summary of traffic risk elements by school

School district	% Children by foot	Observed cars stopping	Parked vehicles	Observed speed	Taxi behaviour	Child distraction (%)	Pavement crowding	Need for evasive action
Delft	90	Partial	No	Major	Minor	20	No	Yes
Elsies River	60	Partial	No	Major	Major	57	No	Yes
Manenburg	70	No crossing	Major	Minor	Major	46	Major	Yes
Grabouw	85	Partial	No	Major	Minor	11	No	No
Lwandle	94	Partial	No	Major	Minor	25	Minor	Yes
Phillipi	82	Partial	Minor	Major	Major	6	No	Yes
Khayelitsha	92	Partial	Major	Major	Major	23	No	No
Macassar	70	Partial	Major	Minor	Minor	48	Major	Yes
Gugulethu	90	No stopping	No	Minor	Minor	100	No	Yes
Dunoon	80	No stopping	Minor	Major	Minor	58	Major	Yes
Bervliet	8	All	No	Minor	No	0	No	No
Somerset West	43	All	Minor	No	No	12	No	No
Stellenbosch	11	All	Minor	No	No	17	No	No
Durbanville	12	All	No	No	No	22	No	No
Rondebosch	8	All	Major	Minor	No	26	No	No
Kuils River	10	All	No	No	No	42	No	No
Sun Valley	7	All	Minor	No	No	10	No	No
Bergvliet	10	All	No	Minor	No	0	No	No
Bellville North	32	All	No	No	No	0	No	No

There was a noticeable contrast between schools with high rates of crashes and those with low crash rates regarding the mode of transportation chosen by students. In high-crash schools, the majority of students walked to school, with the lowest percentage being 70%. In these schools, the remaining 30% mostly arrived by mini-bus taxi.

In contrast, most students in low-crash schools were dropped off by private vehicles. Only one low-crash school had a significant number of students walking to school, accounting for 43% of the total student population.

An initial analysis of the possible relationship between the mode of transport (children arriving by foot versus other modes) and the historic pedestrian crash risk showed a distinct though possibly unsurprising relationship (see Table 4). Children arriving at school as pedestrians were strongly linked to the high pedestrian crash rate demonstrated by their neighbourhood; this same relationship was demonstrated by the number of children observed on the sidewalks (which is itself a proxy for pedestrian dominance). There was an inverse relationship between pedestrian crash history and children arriving at school by private vehicle.

Table 4: Correlation between mode of transport to school and neighbourhood pedestrian crash history

Children arrive at school by walking	0.8170* (0.0002)
Children arrive at school by private car	-0.8509* (0.0001)
Children arrive at school by bus or taxi	0.5350* (0.0399)
Number of children on sidewalk	0.6833* (0.0035)

Traffic behaviour varied significantly between high-crash and low-crash areas. High traffic speeds were a concern in all high-crash schools during site observations, whereas this issue was non-existent in low-crash schools. Additionally, there was a marked difference in the number of vehicles stopping for children crossing the road between the two types of schools. In low-crash schools, all vehicles were observed stopping for pedestrians. In contrast, three high-crash schools showed no evidence of vehicles stopping for students, and the other seven schools displayed only partial instances of vehicles stopping. This disparity likely explains the observed evasive actions taken by students; a problem noted in eight high-crash locations but not in any low-crash schools. Taxi behaviour raised concerns in all high-crash schools but was not an issue in low-crash schools.

The level of distraction among pedestrians varied, with lower distraction levels recorded in low-crash schools, except for one exception. Distraction was assessed based on the extent to which crossing students were focused on traffic, observed through their head and eye movements, as well as whether they displayed obvious signs of distraction, such as using a cell phone or engaging in deep conversations with others.

5.3 Child pedestrian behaviour

This element of the analysis focused on identifying the typical behaviour of children pedestrians as they were approaching the schools. In this case, we looked at the percentage of children using sidewalks compared with those walking on the road; the percentage of children crossing at formal crossings vs crossing midblock; whether children were observed running on the road or when crossing the road; and whether children were observed using the roadway for playing.

Table 5: Summary of behaviour (observed) by school

	School district	% Children using sidewalk	% Children using crossings	% Children running on/across road	% Children playing on road
High-crash schools	Delft	81	15	20	20
	Elsies River	100	37	28	0
	Manenburg	69	60	9	2
	Grabouw	75	77	5	0
	Lwandle	75	40	5	5
	Phillipi	92	10	19	3
	Khayelitsha	66	0	61	12
	Macassar	84	0	29	8
	Gugulethu	23	0	14	0
	Dunoon	13	n/a	5	2
Low-crash schools	Bergvliet	100	100	0	0
	Somerset West	100	100	0	0
	Stellenbosch	100	55	0	0
	Durbanville	94	89	0	0
	Rondebosch	100	67	4	0
	Kuils River	64	79	5	0
	Sun Valley	100	60	0	0
	Bergvliet	100	100	0	0
	Bellville	95	95	3	0

Table 5 shows very different patterns of child pedestrian behaviour between the two groups of schools. Encouragingly, the majority of children in both groups did use sidewalks, which reinforces the importance of these basic roadway features. However, there were marked differences in the percentage of children using formal crossings, which is likely a function of the suitability and number of crossings provided. It may possibly be linked to education campaigns, which needs more investigation. More children in the high-crash schools were observed running on or across the road, and playing in the roadway.

5.4 Relationships between behaviours and road environment features

The differences in road environment features between the two categories of schools, and the marked differences in behaviour between them made it difficult to conduct a single correlation analysis for all schools in the sample. The schools were thus examined by category, to identify whether there were correlations between some of the physical features and the behaviour of child pedestrians in each category. A selection of these results is presented in Tables 6 and 7.

Table 6: Correlations between traffic environment and child behaviour at low-crash schools

	Children on sidewalk	Children walking in street	Children using formal crossing	Children stop at kerb first	Relying on adults
Pedestrian crossings marked			0.7538* (0.0308)	-0.7410* (0.0354)	
Traffic signals recognisable	-1.0000* (0.0001)				
Markings which assist flow		.			-0.7227* (0.0428)

(Note: standard errors are given in brackets and statistical significance is at the 5% level.)

For the low-crash/higher-income schools, there was a clear relationship between children using the formal crossing appropriately (i.e., including their stopping at the kerb) where the crossings were clearly marked. This was possibly the most significant finding, but it is also important to bear in mind that the number of children observed crossing on any form of crossing was lower at these schools, given the fact that the primary mode of transport was private vehicle. A second interesting finding, however, was the relationship between road markings which assist the traffic to flow conflict-free, and the independence of the children crossers – the better the markings the more confident children appeared to be to cross without the assistance of adults.

Table 7: Correlations between traffic environment and child behaviour at high-crash schools

	Children on sidewalk	Children using formal crossing	Playing distraction	Other distraction	Children playing in road	Children evasive action	Vehicles evasive action
Speed limit ensured	-0.5855* (0.2221)					-0.6667* (0.0353)	-0.7454* (0.0338)
Main direction recognisable				-0.7157* (0.0199)			
Intersection sight obstructed			0.8134* (0.0042)	0.7157* (0.0199)	0.9221* (0.0001)		
Clear road markings		0.3490* (0.323)				-0.7748* (0.0408)	
Lighting		0.8182* (0.0038)			0.6761* (0.0318)		

There were more child pedestrians to observe at the high crash locations and a wider range of behaviours. Beginning with the presence of clear pedestrian crossings, the analysis for the high-crash schools showed weaker correlations with the use of crossings, which is in contrast to the finding in the low-crash schools but is possibly the consequence of a general absence of such crossings and habituated behaviour as a result. The same is true for the impact of clear road markings on the crossing behaviour of children, however, the correlation between clear road markings and observed vehicles stopping was significant.

The correlation analysis identified relationships between the degree to which the speeds of the vehicles were managed around the schools and the amount of evasive action there was on the part of both children and vehicles – the less control, the more evasive action was observed. Interestingly, children were likely to pay less attention to the traffic when the traffic flow was not dominant in one direction, i.e., where the roads around the school carried equal numbers or traffic in multiple directions. This seems counterintuitive, because with more complexity of traffic flow there should arguably be more attention paid to traffic flow, but the lack of dominance of one direction may give children a false sense that there was not one particular threat to have to deal with.

Where the intersection sight distance was obstructed, once again there was more evidence of children not paying attention. Indeed, observations showed children to be playing in the road at such locations, possibly because they were unaware of the potential risks as they were not immediately visible to them.

Table 8 shows the correlation between the traffic environment and vehicle stopping for all schools. The correlation analysis suggests that if speed limits are better managed, pedestrian crossings are well-located, and road markings are clear, cars are more likely to stop for children at crossings.

Table 8 : Correlations between traffic environment and vehicle stopping for the full sample

	Cars stop at crossing for children	**Cars not stop at crossing for children**	**Cars not stop at midblock for children**
Managed speed limit		-0.6625* (0.0052)	-0.5487* (0.0226)
Crossings at all approaches	0.4941* (0.0371)		
Well located crossings	0.6073* (0.0212)		
Right of way recognisable		-0.5823* (0.0112)	-0.5395* (0.0171)
Pedestrian crossings marked			-0.5047* (0.0275)
Clear road markings	0.5732* (0.0129)	-0.7907* (0.0001)	-0.4990* (0.0296)

6. **Discussion and concluding comments**

International literature has concentrated primarily on understanding pedestrian risks from the perspective of adults, with very little attention being paid to understanding how children cross roads, and what aspects of the physical environment have the strongest influences on their safety as pedestrians. Child pedestrians are not simply smaller versions of adults; their understanding of what is expected of them on the roadways is far less well-developed than that of adults, and their ability to negotiate safe passage with vehicle drivers, while admittedly under-researched, is most likely non-existent. In locations of high child pedestrians, it is critically important to ensure that children are able to cross without the need to give way to vehicles; that the road design not only separates them as far as possible from vehicles but that they are never exposed to a conflict with a vehicle where their passage is negotiable.

In the two types of school environments that were explored in this study, there were significant and startling differences in the quality of the roadways around the schools. In the low-crash/upper-income environments, the schools were significantly better provided with crossings, road markings, and means of reducing and managing vehicle speeds than those in the high-crash/lower-income areas. To some extent, this is ironic as the higher-income areas had the smallest number of children using the roads as pedestrians, as most arrived at schools by private transport. Children attending schools in the high-crash areas are predominantly pedestrians having little choice of school they attend, and no transport alternatives.

Among the most notable deficiencies were the absence of sufficient and well-marked pedestrian crossings; the absence of road signs and markings; physical interventions designed to manage down vehicle speeds, safe and distinct parking areas for minibus taxis, and obstructions at intersections. The behaviour of children both crossing and using roads in these areas demonstrated significantly higher degrees of risk than in the schools where road facilities were of a higher quality and standard.

In starting this research, we wondered whether the higher crash rates involving pedestrians in the areas would have resulted in child pedestrians en route to schools being more safety savvy and aware of road risks. The behaviour that was observed in the research did not support this in any way.

The neglect of schools and roadways in Cape Town's poorest neighbourhoods presents very real challenges to the learners of the schools. Whatever the long-term social and psychological effects may be of growing up in neighbourhoods where even basic safety infrastructure is conspicuously absent, those absences have very real and persistent consequences for children's health and safety today.

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