A tale of two cities: paradoxical intensity of traffic calming around Auckland schools

Timothy Hopgood, Teuila Percival, Joanna Stewart, Shanthi Ameratunga

Abstract:

Background: The school journey is a common context for child pedestrian injuries in New Zealand, with children from low socioeconomic, Māori or Pacific families being at increased risk. The extent to which evidence-based environmental strategies that can address this problem are equitably implemented is unclear.

Aim: To determine if there is a difference in the distribution of traffic-calming modifications around schools in areas of high and low socioeconomic deprivation in Auckland and Manukau Cities, New Zealand.

Methods: From a list of the most and least socioeconomically deprived schools in Auckland and Manukau Cities, 40 of each were randomly selected. The number of modifications within a 1 km radius of these schools was recorded in December 2009 or January 2010. The association of deprivation and region with the numbers of traffic-calming modifications was examined using a general linear model.

Results: Socioeconomically least deprived schools had more traffic-calming interventions than the most deprived schools (least square mean (LSM): 25 versus 18; p=0.05), and Auckland schools had more interventions than Manukau schools (LSM: 27 versus 16; p=0.001).

Conclusion: Traffic-calming measures were observed more commonly in less deprived areas where the risks of child pedestrian injuries are generally lower. This apparent paradox could result in increasing socioeconomic inequities in the distribution of child pedestrian injuries.

Road traffic injuries account for 22% of all injury deaths among New Zealand children aged less than 15 years old with children of Māori or Pacific ethnicity and those from low income families over-represented in these statistics.1,2 Internationally areas adjacent to schools and recreational centres are recognised high-risk areas for crashes.3 Many New Zealand children are injured on the road within an hour before and after school.4 This risk may lead parents to discouraging children from walking or cycling to school,5,6 reducing their opportunities for physical activity and social interaction.

‘Traffic-calming modifications’ are speed management measures (such as road engineering measures such as speed bumps and limits) with demonstrated effectiveness in reducing injuries among more vulnerable road users, including children, pedestrians and cyclists.7,8

While the study was not specifically focusing on proximity to schools, the implementation of 20 miles per hour zones in London which included traffic-calming interventions resulted in a 41.9% reduction in both fatal and non-fatal casualties of all
ages. The largest reduction was seen in young children aged 0–11 years. A Californian study estimated that the odds of being injured was less than half for children who live within one block of a speed hump.

Previous research in Auckland suggests that newly installed roundabouts have resulted in significant reductions in mean and 85th percentile speeds on roads, resulting in average speeds of less than 30 km/hr in adjacent streets. Concurrently, average speed on urban roads in Auckland varied between 54.4 and 56.3 kilometres per hour (km/hr).

In the period 1982 to 1987, child pedestrian injury rates in the greater Auckland region were higher in the socioeconomically more disadvantaged areas, such as ‘South Auckland’. Paradoxically, walking school buses (involving adult-supervised school journeys) were noted to have been more commonly implemented in higher socioeconomic areas in the Auckland region.

This study was designed to investigate if there were differences in the distribution of traffic-calming modifications adjacent to schools deemed to be most and least socioeconomically deprived in Auckland and Manukau Cities. The 2010 estimated populations of these cities in the central and southern areas of the greater Auckland region were 450,300 and 375,600, respectively.

Methods:

Sampling frame—Sampling frames were formed from Ministry of Education records of all schools within Auckland and Manukau Cities. A total of 101 decile 1 and 2 (i.e. most socioeconomically deprived) schools and 69 decile 9 and 10 (i.e. least socioeconomically deprived) schools were eligible for selection. From these lists, 40 decile 1 or 2 schools (22 from Manukau and 18 from Auckland) and 40 decile 9 or 10 schools (16 from Manukau and 24 from Auckland) were randomly selected for a directly observed survey of traffic calming in the area adjacent to schools.

Areas surveyed—In order to determine an appropriate radius from schools for the proposed survey, we examined Ministry of Transport logged crash data for Auckland and Manukau Cities between 2004 and 2008. Table 1 demonstrates the numbers of day-time crashes involving child pedestrians and cyclists aged from 5 to 18 years occurring within a 0.5 km, 1 km and 2 km radius from schools.

<table>
<thead>
<tr>
<th>Kilometre radius from schools</th>
<th>Number of crashes</th>
<th>Number of children involved</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5 km</td>
<td>321</td>
<td>321</td>
</tr>
<tr>
<td>1 km</td>
<td>375</td>
<td>378</td>
</tr>
<tr>
<td>2 km</td>
<td>375</td>
<td>378</td>
</tr>
</tbody>
</table>

Based on these data, streets within a 1 km radius of the schools, to the nearest intersection of two roads, were surveyed for traffic-calming modifications. Each street within this area was inspected to determine which, if any, traffic-calming modifications were present.

State Highway Motorways and other roads which cannot be crossed by foot were not included in the analysis. Surveying was done manually by the lead investigator (TH) during December 2009 and January 2010.

Street audit of traffic-calming modifications—Traffic-calming measures were systematically recorded using a standardised recording sheet. Traffic-calming measures defined by Land Transport...
New Zealand were recorded: road humps, raised tables, chicanes, roundabouts, mid-block/median islands, kerb extensions/road narrowing, threshold/perimeter treatments, one and two-lane slow points, intersection priority changes, channelization, speed cushions, driveway links, left-in/left-out islands, pavement bars/tactile surface treatments. The number of each of these modifications observed within a 1 km radius of the index schools was noted. Further, median islands in roads with four or more lanes were not counted. Care was taken to distinguish temporary changes for road maintenance from tactile surface treatments. For median islands to be counted they had to be raised at least one brick in elevation and be away from or extend at least 5m from an intersection.

In instances where multiple modifications were found within 5m of each other, these were prioritized, with respect to the three modifications with strongest evidence of effectiveness. These are speed humps, raised platforms and roundabouts. The category given top priority was counted: roundabouts took precedence over islands; speed bumps and raised platforms took priority over narrowing or tactile surface treatments. No further overlaps were noted.

Analysis—In order to investigate whether the number of calming devices differed in different deciles or region, a general linear model was fitted with the square root of the number of calming devices as the outcome (to remove the correlation of the mean and the variance). The decile of school (high or low), region (Auckland or Manukau) the Ministry of Education classification of the school (state compared to state integrated or private), were included as explanatory variables.

Initially the interaction of region and decile was also included to investigate whether there was a difference in the influence of deprivation on traffic-calming interventions in the different regions. The analysis was repeated with the device count including only speed humps, raised platforms and roundabouts, the three devices considered to be most important in the literature.

The least square means and their 95% confidence intervals (adjusted for imbalance in the other explanatory variables included in the analysis) were back-transformed to provide an estimate of the mean number of traffic-calming modifications.

**Results**

79 schools were surveyed as one decile 1 school was excluded from sampling due to a mapping error. There was a median 23 traffic-calming interventions within a 1 km radius of the schools surveyed (10th to 90th percentile 7 to 54)

Table 2 displays the least square means of the number of traffic-calming devices around a school for different groups. There was no evidence of a differing effect of decile on the number of traffic-calming interventions in the different cities ($p= 0.55$). There was however evidence that least deprived schools (25 interventions) had a higher average of traffic-calming interventions adjacent than most deprived (18 interventions) ($p = 0.05$).

There was also strong evidence of Auckland schools having a higher average number of interventions compared with Manukau schools (27 compared with 16; $p = 0.001$).
Table 2. Means* of number of calming devices and the 95% confidence intervals by city, deprivation and school type

<table>
<thead>
<tr>
<th>Variables</th>
<th>Mean total count</th>
<th>95% confidence interval</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auckland City schools</td>
<td>27</td>
<td>22–33</td>
<td>0.001</td>
</tr>
<tr>
<td>Manukau City schools</td>
<td>16</td>
<td>11–21</td>
<td></td>
</tr>
<tr>
<td>Most deprived schools</td>
<td>18</td>
<td>13–23</td>
<td>0.05</td>
</tr>
<tr>
<td>Least deprived schools</td>
<td>25</td>
<td>19–31</td>
<td></td>
</tr>
<tr>
<td>State-integrated and private schools</td>
<td>17</td>
<td>11–25</td>
<td>0.10</td>
</tr>
<tr>
<td>State schools</td>
<td>25</td>
<td>21–29</td>
<td></td>
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</tbody>
</table>

All means are back transformed from the least squares means of square rooted data.

When the analysis was run using the number of important interventions per school rather than the total of all interventions the effect of region, school type and decile was unchanged.

Table 3 demonstrates that most, but not all, surveyed sites contained at least one roundabout (72%) or speed hump (75%), but less than half contained raised platforms (42%).

Table 3. The percentage of schools which had at least one of these interventions located in the area adjacent to them

<table>
<thead>
<tr>
<th>Traffic-calming intervention</th>
<th>Percentage</th>
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</thead>
<tbody>
<tr>
<td>Roadhump</td>
<td>74.68</td>
</tr>
<tr>
<td>Raised platform/table</td>
<td>41.77</td>
</tr>
<tr>
<td>Roundabout</td>
<td>72.15</td>
</tr>
<tr>
<td>Chicane</td>
<td>17.72</td>
</tr>
<tr>
<td>Mid-block/median islands</td>
<td>92.41</td>
</tr>
<tr>
<td>Kerb extensions</td>
<td>50.63</td>
</tr>
<tr>
<td>Left-in/left-out islands</td>
<td>20.25</td>
</tr>
<tr>
<td>Pavement bars</td>
<td>53.16</td>
</tr>
<tr>
<td>Intersection priority changes</td>
<td>21.52</td>
</tr>
</tbody>
</table>

Discussion

Main findings—Our data suggests that the intensity of traffic calming (represented by the mean number of interventions) was significantly greater around socioeconomically least deprived schools than schools that were most deprived. Similarly, traffic calming appeared more intense around schools in Auckland City compared with those in Manukau City.

These findings are disappointing given the socioeconomic patterns and geographical distributions of child pedestrian injuries in the region.

Strengths—The random selection of schools from the study base produced a large representative sample of about half the eligible schools in Auckland and Manukau City, the country’s most populous region.
Further, the study operationalised a research design replicating key aspects of a study recently undertaken in the United Kingdom, informed by updated evidence on effective traffic-calming devices.22 We used a standardised approach to observation and data collection in a school zone radius that related to the risk of road injuries in school aged children in the study base.

No assumptions were made regarding students’ exposure to, or behaviour when, walking to school. In order to ensure comparability of the types of schools of concern, the study focused on mainstream schools (public and private), with specialised education facilities that are distributed in selected sites of the region (such as teen parent units, special needs schools) replaced during the sampling process.

Limitations—In the absence of digital or geographical information system approaches to identifying road and traffic-calming measures which could have provided a more easily reproducible database, we collected data manually.

The direct observations permitted the assessment of structures that were current and operational. Possible observer bias was reduced through the use of a standardised data recording sheet, and the cross-check of findings with available council records, where such data were available.

A study of two UK cities using a manual audit of traffic-calming measures found that both cities had a greater concentration of traffic calming in socioeconomically more deprived areas.22, 23 Importantly, the city where this concentration was greater also had a significantly greater narrowing of the socio-economic gradient in childhood pedestrian injuries.

As in the UK study,22 we quantified the presence of evidence based measures with the assumption that a greater density of such measures in the zone adjacent to schools is likely to enhance effectiveness of traffic calming in terms of reduced vehicle speed in the area.

Identifying the association between the numbers or specific configurations of calming devices and injury rates in this study region was outside the scope of this investigation. It is also conceivable that specific local conditions, such as geographical features or other structural modifications (such as fencing) which are not examined in this survey could influence risks of injury in this region.

Meaning of study findings—Our findings are in contrast to two studies from the United Kingdom which have demonstrated greater levels of implementation of traffic-calming devices in more deprived areas compared with more affluent areas.22, 23

While these studies did not attribute a reduction of socioeconomic inequalities in child pedestrian injury rates to these policies, the opportunities to have such an impact are clear.

Compared with Auckland, the population of Manukau City has, on average, a median income that is $2,000 lower,24 and a greater representation of Māori and Pacific populations both numerically and proportionally.25

Given children in these groups are known to be at increased risk of child pedestrian injury, the lower intensity of road traffic-calming measures in Manukau City (compared with Auckland City) is discouraging.
Nine years ago, Land Transport New Zealand reported that 91% of territorial authorities used requests from public or concerns from council members or police to identify need for traffic-calming measures, while two thirds had no formal policies for implementation of traffic-calming measures.\textsuperscript{26}

Relying on community advocacy alone to address these disparities appears misguided given families of lower socioeconomic status and of Māori or Pacific ethnicity are less likely to complete petitions for such interventions.\textsuperscript{27} The observed disparities make the case for more explicit use of risk prediction when implementing road safety strategies, an approach recommended by regional authorities in 2004. \textsuperscript{26}

**Competing interests:** Nil.

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**References:**


