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The Exposure of Children to Traffic in Melbourne


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**Abstract**

Although pedestrian injury is a major cause of childhood morbidity and mortality, little is known about the determinants of child pedestrian injury rates. In particular we lack reliable measures of children's exposure to traffic. In collaboration with an international group this study aimed to obtain population-based estimates of children's traffic exposure, in particular the numbers of streets crossed per day, by performing a questionnaire-based survey in a random sample of primary schools in Melbourne. The questionnaires sought details of walking activity by children in Years 1 and 4, for the day of the survey. Key results were that children crossed an average of 3.6 streets per day and only 30% of children walked to school. The strongest sociodemographic predictor of exposure was car ownership. Sex differences in exposure do not seem to explain sex differences in injury rates.



**Keywords**

Children, pedestrians, injury rate, exposure to risk, sample survey, modes of transport, sociodemographic factors.


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# The Exposure of Children to Traffic in Melbourne

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# EXECUTIVE SUMMARY

Although pedestrian injury is a major cause of childhood mortality and morbidity, little is known about the underlying determinants of child pedestrian injury rates. In the decade from 1981 to 1991, the pedestrian mortality rate for children aged 5-16 in Australia dropped by 61%, from 3.1 to 1.2 per 100,000 per year. Similar trends occurred in other industrialised nations, although the extent of the decline was much greater in some countries (especially Scandinavia) than in others. The reason for these declines in child pedestrian mortality is unclear but changes in known risk factors, such as traffic volume (which increased dramatically in the same period), do not appear to provide sufficient explanation. A major gap in our understanding of the causes of child pedestrian injury is that we have no reliable measure of the extent to which children are exposed to risk. In particular, little is known of how much children walk, especially in terms of numbers of streets crossed, the measure that might be expected to relate most closely to risk.

Against this background, the International Study of Children's Exposure to Traffic, a collaborative project of researchers in Australia, New Zealand, Canada, U.S.A. and Sweden, sought to survey a random sample of children aged 6 and 9 in a number of cities around the world. In each survey, children at selected schools were asked to take home a short questionnaire, for the parents and child to complete, about the child's walking activities for the day of the survey. Questions were asked about numbers of street crossings for all walking trips made either before school, on the way to school, on the way home from school, and after school. A number of simple background questions were also asked about the child and the family: the child's age and sex, the parents' occupations and education, and the number of cars in the family. This report describes the Melbourne component of the study.

In Melbourne the study was carried out in the second half of 1994 and involved over 3000 children in 72 schools, covering government, Catholic and independent schools. Of all children approached to participate in the study, 82% provided information, and the analysis was finally based on 2846 children aged either 6-7 (Year 1) or 9-10 (Year 2). The results showed that 30% of children walked to school, while 35% walked home. These proportions were only slightly greater in the older group than in the younger, and a sex difference was apparent only in the younger group, where the proportion walking was 5% greater among boys than among girls. Only 3% of children reported riding bicycles to

school and less than 2% used public transport, while the large majority were driven by car (61% going to school, 54% coming from school).

The analysis of street crossings data showed that there was wide variation between schools in the average number of street crossings, with the highest levels in schools in lower-income and inner-city suburbs. Overall, children in the age range studied crossed an average of 3.6 streets a day. The average was less than 1, however, for children who were driven to school. A strong trend in exposure was seen according to the number of cars in the family, with children in families without a car walking about twice as much as children in families with one car (whether measured by average number of street crossings or by the proportion walking to school). There were similar but somewhat weaker relationships between traffic exposure and other socioeconomic indicators.

An important feature of children's walking in Melbourne is that 39% of all children reported using at least one attended school crossing. Questions about total time spent by the child as a pedestrian indicated that 44% of children spend less than 5 minutes of the day walking, and 72% reported less than 15 minutes.

In summary, the study found that young children in Melbourne spend rather little time as pedestrians. Boys were found to walk more than girls, but the sex difference in exposure was much less than the sex difference in pedestrian injury rates, which indicate that in 1994 twice as many boys as girls aged 5-12 were seriously injured as pedestrians in Victoria. Children in families of lower socioeconomic status have higher levels of traffic exposure, especially children of families without a car. As well as their implications for injury risk, the study's results raise questions about children's general level of physical activity and independent mobility; these may be suffering as a result of parents' (justifiable) concerns about pedestrian safety.

## BACKGROUND

Pedestrian injury is a major cause of childhood mortality. In the United States, pedestrian injuries are the most common cause of death from trauma for children aged 5-9 years and are second only to cancer as the greatest overall killers of young school children. Each year in the United States, over one thousand children are killed and approximately 18,000 are hospitalised as a result of injuries sustained in a pedestrian-motor vehicle collision.[1] In Australia in 1994, 40 children aged 5-16 years died from pedestrian injuries, while in 1993 a total of 595 were hospitalised (according to police records, almost certainly an underestimate). Pedestrian injuries are over represented among the most severe injuries presenting to hospitals, and severe head injury is common in these patients with high levels of long term disability[2,3].

With the increasing recognition of the public health importance of child pedestrian injuries, a number of analytical epidemiologic studies have been conducted. These studies have used either case-control or cohort methods in an attempt to identify the factors that place some children at a high risk of pedestrian injury.[4,5,6] However, an effective public health response to the problem of child pedestrian injury requires that a second aetiologic issue be addressed. This concerns the identification of determinants of the incidence rate, and attempting to understand why child pedestrian mortality rates change over time and vary between countries. Answering these questions is likely to be even more important than identifying risk factors, because if the determinants of the incidence rate could be identified at a population level, it might be possible to control them, with considerable gains for the whole child population.[7]

Over the past two decades child pedestrian mortality rates have fallen in many developed countries. A detailed study of rates in Sweden, Denmark, England and Wales, New Zealand, and the USA between 1968 and 1987 showed that, for children aged 0-4 years, there were reductions in the pedestrian mortality rate ranging from 80-90% in Sweden and Denmark, down to only 9% in New Zealand. For children aged 5-14 years, reductions have been less pronounced, ranging from 70-80% in the Scandinavian countries, to about 40% in both England and Wales and the USA, and 24% in New Zealand[8]. Australian data (Federal Office of Road Safety) show that in the decade from 1981 to 1991 the pedestrian mortality rate for children aged 5-16 declined from 3.1 to 1.2 per 100,000, a drop of 61%. The reason for the dramatic decrease in child pedestrian mortality remains unclear, and in more recent years the mortality rate has levelled off in many of these countries and in some, particularly the USA, is rising.

***Possible determinants of the child pedestrian mortality rate.***

**1. Traffic volume.**

A New Zealand study examined the relationship between child pedestrian mortality and traffic volume over the period 1967 to 1987.[9] Although there was a clear relationship between mortality rate and traffic volume, a definite decline in child pedestrian mortality occurred between 1975 and 1981, a period in which there was very little growth in traffic volume as a consequence of the energy crisis. The fall in mortality during this period suggests that there was another process operating over time which tended to lead to a reduction in the pedestrian mortality rate. When a similar analysis was performed for the USA, traffic volume was again shown to exert a powerful effect on the mortality rate, despite similar evidence of an overall downward trend in the child pedestrian mortality rate since 1970.

**2. Reduction in case fatality.**

It is possible that child pedestrian mortality rates have fallen because of a reduction in case fatality. For example, in Britain between 1968 and 1987, the number of police-reported child pedestrian casualties fell by 49% but the number of deaths fell by 61% (J Broughton, Transport Research Laboratory, 1992), suggesting that some of the decline in child pedestrian mortality may be due to a reduction in the case fatality rate. These data must be viewed with caution, however, as child pedestrian injuries are significantly underreported in police accident databases and changes over time in casualty numbers might simply reflect changes in the extent of underreporting.[10] If there has been a reduction in case fatality this may have resulted from better medical care or a decrease in injury severity. With regard to medical care, several case series of injured pedestrians have drawn attention to the severe and multiple nature of the injuries sustained and have argued that improved medical care is unlikely to make a significant impact on pedestrian mortality.[11] Even for urban pedestrian collisions, where access to emergency medical services is optimal, 39.5% of deaths occur at the scene of the collisions or within 1 hour, so that a large proportion of the injured children would not have the opportunity to benefit from improved medical care.[12] Regardless, the 49% decrease in casualty numbers implies that most of the reduction in child pedestrian mortality in Britain is due to a reduction in the occurrence of child pedestrian-motor vehicle collisions.

**3. Pedestrian Injury Prevention Strategies.**

There is unfortunately little evidence to show that pedestrian injury prevention programmes have contributed to the reduction in child pedestrian mortality. In the USA, Britain and New Zealand, the major thrust of preventive strategy has comprised efforts to improve child pedestrian behaviour through pedestrian skills training programmes. But data from evaluation studies suggest that these programmes are of limited value.[13] Some North American studies have claimed reductions in injury rates following pedestrian education programmes but evaluation was based on before and after comparisons and the reductions are likely to have been confounded by changes in the background rate.[14,15] Studies using more rigorous methods have concluded that even large efforts to improve pedestrian behaviour are rewarded by only small gains.[16]

It is often suggested that international differences in child pedestrian mortality rates reflect the different approaches to prevention that have been adopted in different countries. In this respect the most striking difference between Denmark and Sweden, countries which have made impressive strides in the reduction of pedestrian mortality, and the USA, Britain and New Zealand, where reductions have been less impressive, is the greater emphasis given to environmental approaches to prevention in the former countries, as opposed to educationally based prevention strategies in the latter. In particular, Denmark, which changed its ranking from having the highest mortality rates in 1970 to being second lowest only to Sweden in 1988, made a major commitment to a programme of environmental change that resulted in lower vehicle speeds in urban areas.[17] In Australia, environmentally based prevention strategies such as the Safe Routes to School program have been patchily adopted, and evaluation has been limited. Although the argument is widely accepted and indeed has become part of child injury prevention dogma, the international differences in pedestrian mortality cannot be taken as conclusive evidence for the efficacy of environmental prevention strategies, since there may be other confounding factors that account for them, particularly international differences in children's exposure to traffic. For instance, it is possible that children in Sweden travel by car rather more than children in other countries, because of the nation's relative affluence and more equitable income distribution.[18]

**4. Children's traffic exposure.**

Probably the most plausible explanation for the downward trend in the child pedestrian mortality rate is that it reflects a reduction in children's independent mobility and as a consequence, reduced exposure to traffic. A British study surveyed parents of school children in five English towns and found that whilst in 1971, 80% of English seven and eight year old children were allowed to travel to school unaccompanied, in 1990 the figure was only 9%.[19] The main reason given by parents for their reluctance to allow their children to travel unaccompanied was traffic danger. This reduction in children's independent travel was associated with a corresponding increase in the proportion of children who were either driven to school or accompanied by an older person. This study also alluded to considerable international differences in children's traffic exposure. For example, only 7% of English seven year old children walked to school unaccompanied but the corresponding figure for German seven year olds was approximately 52%. Unfortunately the relationship between changes in children's independent mobility and the child pedestrian mortality rate can only be surmised since no population for which an incidence rate can be calculated was defined. Moreover the survey sample comprised only one school from each of five English towns and therefore would not be representative of children's traffic exposure for the wider child population of England and Wales. A further weakness of this survey is that it provides only a crude measure of traffic exposure. Numbers of roads crossed, by road category, would be required in a more germane measure.

Nevertheless, this study does provide a possible explanation for the observation that child pedestrian mortality rates have fallen over the past two decades, despite increases in traffic volume. Furthermore these findings might explain why the decline in pedestrian mortality has been least for children in the 5-14 age group, since one might expect it to be more difficult for parents to impose restrictions on the mobility of older children. The importance of traffic exposure in the etiology of child pedestrian injuries is also apparent in case centred epidemiologic studies. A North American case control study[4] found that the absence of a play area adjacent to the home was associated with a five fold increased risk of pedestrian injury (OR 5.3, 95% CI 2.6-11.0). The effect of this risk factor is likely to be mediated through the greater traffic exposure of children who have fewer alternatives to playing in the street.

In summary, over the past two decades, child pedestrian mortality rates have fallen, despite increases in traffic volume. It cannot be inferred that this represents improvements in pedestrian safety since an appropriate denominator of the incidence rate, a measure of children's traffic exposure, has not been available. Child pedestrian deaths have not received nearly the attention that road safety authorities have given to motor vehicle occupant injuries, at least in part because it is perceived that the problem is being controlled. It is possible, however, that pedestrian travel is in fact becoming increasingly dangerous and in response to this danger, children's independent travel is being increasingly curtailed. Similarly, international differences in pedestrian mortality may reflect international differences in children's traffic exposure rather than being a manifestation of the different public health responses. The aim of this study was to assess international differences (and, eventually, trends over time) in children's traffic exposure and independent mobility so that valid cross sectional and longitudinal comparisons of child pedestrian injury rates can be made. A further aim was to examine the strength of association between exposure measures and sociodemographic variables, many of which have been shown to be associated with injury risk.

The international study aimed to determine traffic exposure at ages 6 and 9 years. (In the Victorian education system this corresponded to Year Levels 1 and 4.) These ages were chosen for several reasons. First, the child pedestrian injury rate is highest at ages five and six years. These early school years represent a "window of vulnerability" where children become increasingly exposed to the traffic environment although their developmental capabilities in traffic are still rudimentary. Differences in traffic exposure are therefore likely to be most important at this age. The age of six years was chosen because children in some countries do not start school until that age. Second, for children under five years, non-traffic pedestrian injuries, usually occurring when children are reversed over in the driveway, comprise a significant proportion of all pedestrian injuries. However, nearly half of all non-traffic pedestrian injuries are misclassified as traffic pedestrian injuries.[20,21] Traffic exposure would not be relevant for non-traffic injuries and therefore comparison of traffic pedestrian injury data with traffic exposure data would be confused by this misclassification. Finally, differences in traffic exposure within and between populations are likely to be greatest for this age group. Below six years, few children are exposed, above ten years most children are exposed.[22]

### *SUMMARY OF OBJECTIVES and INTERNATIONAL CONTEXT*

The aim of the study was to obtain valid and precise estimates of children's exposure to traffic as pedestrians, measured primarily in terms of numbers of streets crossed per day, in the metropolitan area of Melbourne and simultaneously in several other cities in advanced industrialised countries. We also aimed to examine the extent to which variations in exposure could be related to age, sex and socioeconomic differences in the population. The Melbourne study described in this report is part of an international collaboration initiated by Dr Ian Roberts of the University of Auckland (now at the Institute of Child Health, London). Similar surveys have now been conducted or are under way in Auckland, Perth, Montreal (Canada), Baltimore (U.S.A.) and Umea (Sweden).

## DESIGN AND METHODS

To obtain population-based estimates of children's traffic exposure (measured as the number of roads crossed in different categories), we required an appropriately designed sample of children, and a questionnaire for parents to complete.

### *SAMPLE DESIGN*

The primary sampling frame was a list of all primary schools (including independent schools) in the Melbourne metropolitan area, which we limited to local government areas with a population density of at least 500 per square km, according to the 1990 census (a detailed list of areas included is available from the authors; the areas excluded comprised Melbourne's outer suburban fringe). The sampling frame was further limited to schools having at least 100 enrolled students, a limitation which excluded less than 2% of all children in the age groups of interest. From this list a stratified random sample of 72 schools was selected with a sampling probability in proportion to the number of children on the school roll, stratified by government, Catholic and independent schools. Each stratum was sampled in proportion to its relative size in the population. The number of schools was chosen to ensure that at least 1500 children would be obtained in each of the age-groups to be studied, Years 1 and 4. By sampling two intact classes (at Year 1 and at Year 4) within each school we aimed to obtain a cluster sample giving each child in the defined population approximately equal probability of being selected. To ease administrative difficulties, single mixed-grade classes were used where necessary, rather than composing "pure" groups of Year 1 or Year 4 students out of several classes. Of the 72 schools, 48 were government schools, 20 Catholic and 4 independent schools. A geographically neighbouring "reserve" school was identified for each school selected in the sample, to be used in case the initially chosen school refused or was unable to participate. We obtained permission from the Directorate of School Education and the Catholic Education Office to approach schools under their respective jurisdictions to participate in the study.

### *Sample size and power considerations*

Sample size estimates were based primarily on data collected for a study of pedestrian injuries in Auckland in 1992. The principal outcome measure used for these estimates was the number of streets crossed while travelling to and from school. In the Auckland study among 186 children aged between 5 and 10, the distribution of number of streets crossed was approximately exponential with a mean of 2.0 streets per day and a standard deviation of 2.3. Based on these values, under simple random sampling, comparisons between samples of 460 children each would have 90% power at a (two-sided) significance level of 0.05 to detect a difference in the mean number of streets crossed of 0.5 or more per day. Alternative analyses might be based on the proportion of children who walk on the road at all (have any street crossings); in the Auckland sample this was about 60%. Under simple random sampling with the same significance level and power, samples of size 538 would be required to detect differences of 10 percentage points or more in this proportion. Because of the proposed study's cluster sample design, it was advisable to adjust these sample sizes for expected design effects. In particular, if equal-sized clusters of size $k$ are used and the intraclass correlation (within clusters or schools) is $r$, the design effect is $1+(k-1)r$, and the necessary sample size is obtained by multiplying the sample size under simple random sampling by this factor. The value of $r$ was investigated in the Auckland data and in some similar data from a case-control study of pedestrian injuries in Perth. Although reliable estimates were not possible from these limited data, a value of 0.05 appeared reasonable as a working basis for planning the present study. Based on an average cluster size of 35 children per school (in a given grade or one-year age group), the design effect was therefore 2.70. Adjusting the two sample size values given above by this factor led to the figures of 1242 and 1453, respectively. This led to the proposal that a minimum of 1250 children should be recruited in each of the two age groups, with a preferred target of 1500. In retrospect, the cluster size used in this calculation was too large; on the other hand we may have underestimated the intraclass correlation for some outcome measures.

## *QUESTIONNAIRE*

Exposure data were collected using a survey questionnaire that was distributed to children in the classroom setting, completed at home with the help of their parents, and then collected by the class teacher the following day This method of data collection was the same as that used in two recent successful studies of childhood asthma in Melbourne. It had several advantages. First, it was considerably less costly than a study based on interviewer administered questionnaires, which would be prohibitively expensive because interviews would have to be conducted during the evenings when both parents and children are home. Routledge found that parental reports underestimated children's traffic exposure, usually because children take routes other than the most obvious one.[23] Second, it has been demonstrated that respondents, both parents and children, underreport trips when a long recall period is used.[24] With the method used here, children completed the survey with their parents in the evening, documenting their travel for that day. Recall was therefore likely to be optimal.

As well as exposure information, the questionnaire sought data on age, sex, socioeconomic status and ethnic group. Ethnicity classification was based on the reported language spoken at home. Socioeconomic status was measured by occupation, coded according to the Daniel scale of occupational status[25], and by the education level of both parents. Information was also collected on local weather conditions for the nominated pedestrian exposure day. The data was collected over as short a time period as possible, between September and November 1994, in order to obtain a period of mild and reasonably consistent weather conditions.

Beginning in July 1994, several drafts of the questionnaire were prepared and subjected to extensive pretesting and discussion in the study team and with international collaborators. In late August one primary school was selected for piloting the final draft questionnaire and also for trialling our procedures for approaching the schools for distribution of the questionnaire. A copy of the final questionnaire is appended to this report (Appendix 1). Translations were prepared in four of the major languages other than English: Arabic, Greek, Turkish and Vietnamese.

It was clear that specific strategies would be needed to ensure satisfactory response rates from parents. To this end, the protocol specified that the Research Assistant ensure wherever possible that explicit records were kept in each school of which students had been issued with questionnaires and which had replied. Where less than 90% of a class returned the questionnaire, a replacement was issued to all nonresponders. As incentives for encouraging active class participation in the survey process, we instituted the following strategies:

1. We arranged delivery of the road safety kit "Out and About", produced by the Federal Office of Road Safety, to all schools wishing to obtain it.
2. We developed a poster with accompanying stickers that was to be used to raise and maintain awareness in the classroom by allowing the children in the class to chart the class response by placing a sticker on a central "pathway" in the poster for every questionnaire that was returned, with the aim of bringing class return rate up to at least 90%.
3. All schools that achieved 90% return rate of questionnaires were entered in a raffle where the participating classes at one school would be selected to receive an expenses-paid excursion to the ScienceWorks Museum.

The survey sought details of all street crossings made by the child on the day the questionnaire was distributed. The parent was questioned separately about four periods of the day: "Before school", "Going to school", "Coming from school" and "After school". Within each period of the day, a question asked whether the child walked anywhere during that time and if so whether the child was accompanied by either another child, an older child (up to 18 years of age) or an adult. For the journeys to and from school, the parent was asked to identify all the modes of transport used, ranging from walking alone through walking with various levels of accompaniment to being taken by car or using public transport. If the parent indicated any walking by the child during that period of the day, they were then asked to indicate how many streets were crossed, where these were subdivided into 4 categories designed to reflect increasing levels of traffic volume and density: "Quiet local", "Busy local", "Main road", "Main road crossed at lights". An additional information sheet was provided with the questionnaire, giving a map of the local area (school-specific) and some local examples of streets fitting the intended categorisation. Another question asked whether the child used attended street crossings either going to or coming from school (and if so, how many crossings were made in this way). Finally there was a question asking the parent to estimate the total time spent by the child as a pedestrian in the traffic environment.

Various summaries were derived for each child from the detailed street crossings information. In particular, we derived the total numbers of street crossings in each of the four periods of the day, and also a total number that was adjusted for street crossings accompanied by an adult, whether a school crossing attendant or an accompanying adult. A unique classification of mode of travel to and from school into one of five categories (Walk, Walk+Car, Car, Bicycle, Public Transport) was also obtained by assigning children with multiple classifications to the mode assumed to be dominant. Details of the derivation of these variables are given in Appendix 2.

Analysis was performed using the statistical package Stata[26]. Population mean values were estimated by weighted means of the mean values obtained within each category of interest (e.g. age by sex) within each school, weighted proportionally to the sample number and inverse-proportionally to the cluster (school or class) size. For overall means this is equivalent to taking the means of the cluster means (appropriate because of the sample design and the varying response rates between clusters), but for subcategory means the weighting accounts more appropriately for the varying numbers in the subcategories.

## RESULTS

### *DATA COLLECTION, COMPUTER ENTRY AND DATA CLEANING*

Data collection took place over two weeks in mid-September and then 9 weeks of the final school term beginning in the second week of October. The weather during this period remained generally mild, with some warmer days occurring near the end of data collection. Letters inviting participation were sent to school principals and these were followed by telephone calls by the Research Assistant, who arranged to visit the school with the questionnaires. All questionnaires were pre-numbered and were distributed with similarly numbered envelopes, to assist in tracking non-responders, with the envelope provided to ensure confidentiality of responses if the parents were concerned about this. After about a week, the Research Assistant returned to schools and, where necessary, reissued questionnaires to non-responding families.

Of the originally selected schools, 7 declined participation, 2 on the basis of practical difficulties (school being relocated in one case, and renovations in the other) and 5 refused. Six of these schools were substituted by their nominated reserve school, and one additional Catholic school was included when it was anticipated that an originally selected school would withdraw; the final sample included 47 government schools, 21 Catholic and 4 independent. Thus, despite slight deviations from the original random sample, we ultimately surveyed 72 schools that provided wide geographic coverage of the Melbourne area.

Data collection was completed by the second week of December. A total of 3,963 questionnaires were distributed initially, and there were 701 reissues. The final rate of return was 87.9%, ranging from 54.2% to 100% among the 72 schools. Some questionnaires were returned blank or with an indication that the parent declined to participate; after adjustment for these, the removal of 9 questionnaires on which the information provided turned out not to be useable, and the omission of 2 duplicate grade 4 classes (where grade 1 classes should have been included), the final overall response rate was estimated to be 82.0%. This was a conservative estimate because it was not always possible to adjust the denominator appropriately for class absentees who failed to receive questionnaires.

Data were entered to a computer file, after manual coding of occupation according to the Daniel scale[25]. A number of anomalies and inconsistencies were corrected; in particular there were a substantial number of children reporting the use of attended street crossings and some of these reported no other street crossings in the main part of the questionnaire. This appeared to be generally due to children who were taken to school by car failing to indicate street crossings apart from the attended crossings that are often used outside the school. The main assumptions used in data cleaning are detailed in Appendix 2.

### *ANALYSIS*

A summary of the schools that participated in the survey is given in Table 1, which also gives the mean numbers of streets crossed by children at each school. The schools have been ordered in the table by the average number of cars per household reported by parents at each school (within strata of type of school), since this was strongly predictive of pedestrian traffic exposure among children (see Tables 4 and 5 below).

TABLE 1. Summary of school characteristics, response rates and principal results. See text for further details on definition of variables.

| School id[1] | Measure of school size[2] | Percentage responding (of all approached) | Number responding (ages 6-7 & 9-10)[3] | Sex (% female) | Age (% 9-10 cf. 6-7) | Mean no. cars per household | Mean no. streets crossed | Mean no. streets crossed unaccompanied |
|---|---|---|---|---|---|---|---|---|
| ***Government schools*** | | | | | | | | |
| 30 | 78 | 90.6 | 41 | 35 | 49 | 1.05 | 4.93 | 3.07 |
| 38 | 73 | 70.6 | 29 | 45 | 55 | 1.12 | 9.76 | 4.24 |
| 31 | 42 | 65.7 | 36 | 58 | 56 | 1.15 | 5.25 | 3.92 |
| 32 | 82 | 65.4 | 21 | 29 | 38 | 1.21 | 6.90 | 1.57 |
| 40 | 44 | 85.4 | 21 | 62 | 52 | 1.24 | 4.57 | 1.67 |
| 16 | 42 | 65.3 | 24 | 43 | 46 | 1.26 | 3.83 | 1.71 |
| 18 | 105 | 63.8 | 34 | 64 | 47 | 1.27 | 4.71 | 1.26 |
| 45 | 85 | 67.9 | 26 | 46 | 42 | 1.27 | 3.62 | 1.77 |
| 11 | 67 | 88.7 | 18 | 47 | 100[4] | 1.33 | 4.94 | 2.83 |
| 36 | 88 | 87.0 | 32 | 53 | 62 | 1.34 | 6.16 | 3.81 |
| 37 | 88 | 74.1 | 37 | 59 | 59 | 1.35 | 4.43 | 2.30 |
| 39 | 48 | 81.1 | 33 | 48 | 55 | 1.36 | 3.94 | 2.52 |
| 48 | 92 | 90.7 | 47 | 48 | 51 | 1.36 | 6.96 | 4.64 |
| 2 | 110 | 74.0 | 36 | 44 | 61 | 1.39 | 3.36 | 1.25 |
| 9 | 35 | 90.9 | 44 | 45 | 48 | 1.42 | 4.36 | 2.91 |
| 27 | 52 | 83.0 | 26 | 54 | 38 | 1.44 | 3.19 | 1.15 |
| 22 | 111 | 72.1 | 42 | 50 | 43 | 1.48 | 3.43 | 1.98 |
| 3 | 68 | 95.7 | 43 | 40 | 58 | 1.49 | 2.98 | 1.79 |
| 15 | 95 | 91.8 | 56 | 53 | 48 | 1.49 | 3.29 | 1.71 |
| 7 | 108 | 56.7 | 19 | 37 | 53 | 1.53 | 2.32 | 1.42 |
| 13 | 94 | 92.6 | 44 | 64 | 45 | 1.53 | 2.64 | 0.91 |
| 33 | 144 | 90.6 | 48 | 47 | 56 | 1.56 | 2.92 | 1.42 |
| 4 | 149 | 88.9 | 54 | 58 | 54 | 1.57 | 4.24 | 2.24 |
| 20 | 66 | 90.9 | 26 | 42 | 54 | 1.57 | 5.73 | 4.23 |
| 12 | 91 | 90.6 | 43 | 51 | 58 | 1.58 | 4.70 | 2.35 |
| 5 | 75 | 98.2 | 43 | 55 | 58 | 1.63 | 3.58 | 1.79 |
| 46 | 81 | 75.9 | 43 | 44 | 67 | 1.63 | 3.14 | 1.79 |
| 17 | 66 | 66.1 | 41 | 40 | 32 | 1.65 | 2.85 | 1.66 |
| 23 | 109 | 87.7 | 49 | 57 | 53 | 1.65 | 2.02 | 1.51 |
| 26 | 113 | 98.1 | 46 | 49 | 57 | 1.67 | 3.83 | 1.50 |
| 24 | 203 | 86.7 | 48 | 54 | 48 | 1.68 | 2.42 | 1.17 |
| 28 | 174 | 93.5 | 57 | 54 | 51 | 1.70 | 2.86 | 1.37 |
| 1 | 125 | 75.9 | 15 | 33 | 100[4] | 1.71 | 3.47 | 2.40 |
| 41 | 259 | 88.5 | 39 | 59 | 51 | 1.74 | 3.36 | 1.77 |
| 10 | 128 | 92.6 | 50 | 47 | 54 | 1.76 | 2.68 | 1.38 |
| 19 | 96 | 98.3 | 55 | 44 | 51 | 1.76 | 2.51 | 1.53 |
| 35 | 43 | 92.9 | 33 | 33 | 58 | 1.76 | 5.55 | 3.70 |
| 44 | 88 | 77.4 | 33 | 52 | 42 | 1.76 | 3.15 | 0.94 |
| 21 | 141 | 82.5 | 50 | 47 | 56 | 1.78 | 2.00 | 1.22 |
| 6 | 47 | 75.5 | 25 | 44 | 56 | 1.80 | 3.32 | 1.88 |



table continued...

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 43 | 100 | 93.0 | 51 | 55 | 47 | 1.80 | 2.65 | 1.53 |
| 42 | 171 | 90.7 | 48 | 49 | 54 | 1.81 | 2.67 | 1.10 |
| 14 | 57 | 54.2 | 19 | 47 | 68 | 1.83 | 2.05 | 0.89 |
| 29 | 99 | 98.0 | 47 | 51 | 60 | 1.84 | 2.96 | 2.28 |
| 34 | 82 | 43.3 | 32 | 58 | 44 | 1.84 | 2.75 | 0.91 |
| 8 | 187 | 96.5 | 55 | 51 | 51 | 1.89 | 2.80 | 1.51 |
| 25 | 127 | 73.8 | 44 | 59 | 34 | 1.91 | 1.75 | 0.75 |
| ***Catholic schools*** | | | | | | | | |
| 62 | 100 | 66.7 | 35 | 49 | 69 | 1.03 | 12.26 | 5.91 |
| 59 | 53 | 83.3 | 25 | 52 | 28 | 1.21 | 3.84 | 2.12 |
| 73 | 90 | 93.2 | 30 | 45 | 53 | 1.43 | 4.43 | 2.07 |
| 67 | 45 | 79.5 | 34 | 48 | 56 | 1.44 | 3.53 | 2.85 |
| 66 | 80 | 69.0 | 39 | 53 | 46 | 1.46 | 4.62 | 1.49 |
| 53 | 86 | 78.0 | 46 | 44 | 41 | 1.49 | 3.43 | 1.46 |
| 50 | 163 | 98.3 | 46 | 52 | 46 | 1.57 | 4.63 | 2.67 |
| 55 | 51 | 82.5 | 35 | 57 | 57 | 1.57 | 4.60 | 2.94 |
| 51 | 56 | 62.7 | 30 | 53 | 70 | 1.60 | 3.80 | 1.90 |
| 56 | 156 | 83.1 | 48 | 46 | 48 | 1.60 | 2.83 | 1.21 |
| 61 | 68 | 88.7 | 47 | 48 | 38 | 1.62 | 2.34 | 0.77 |
| 63 | 130 | 86.2 | 54 | 57 | 52 | 1.64 | 3.22 | 0.91 |
| 57 | 53 | 84.6 | 44 | 49 | 48 | 1.66 | 3.16 | 2.07 |
| 68 | 111 | 89.7 | 49 | 58 | 51 | 1.69 | 3.27 | 1.31 |
| 64 | 166 | 84.9 | 45 | 53 | 51 | 1.70 | 2.89 | 1.47 |
| 60 | 169 | 90.3 | 56 | 54 | 55 | 1.75 | 2.30 | 1.05 |
| 52 | 177 | 82.0 | 47 | 41 | 60 | 1.82 | 2.40 | 0.85 |
| 54 | 124 | 86.5 | 35 | 54 | 57 | 1.88 | 2.20 | 1.80 |
| 65 | 129 | 84.5 | 48 | 41 | 50 | 1.90 | 3.40 | 2.48 |
| 49 | 105 | 89.1 | 47 | 57 | 40 | 1.91 | 1.68 | 0.77 |
| 58 | 92 | 74.6 | 42 | 60 | 45 | 2.02 | 0.31 | 0.17 |
| ***Independent schools*** | | | | | | | | |
| 69 | 56 | 82.1 | 45 | 100 | 56 | 1.96 | 1.53 | 0.69 |
| 72 | 46 | 93.8 | 44 | 100 | 39 | 2.00 | 2.30 | 1.11 |
| 70 | 117 | 95.7 | 44 | 35 | 45 | 2.16 | 0.70 | 0.52 |
| 71 | 92 | 60.4 | 28 | 4 | 71 | 2.25 | 2.61 | 1.32 |
| ***MEAN of school means*** | | | | | | | | |
| | 99 | 82.3 | 39.5 | 50 | 53 | 1.60 | 3.61 | 1.88 |
| ***MEAN of all individuals*** | | | | | | | | |
| | 105 | 82.0 | - | 51 | 52 | 1.63 | 3.46 | 1.81 |

[1] Identifying number used for internal purposes only.
[2] Officially recorded total enrolment in Grades 1 and 4, used to draw the sample of schools.
[3] Analysis omitted 352 children aged 5, 8 and 11, in order to focus on the main groups of interest (ages 6-7 and 9-10).
[4] Grade 1 group was omitted in these schools due to administrative problems.

It is apparent from the Table that there was substantial variability between the schools, both for numbers of participants and response rates as well as for the outcome measures of car ownership and streets crossed. Because of this variation it is important in the analysis to base estimates of means on schools rather than on individuals.

In Table 2 we show the modes of transport used for the journey to and from school. In summary, 30% of children reported walking to school, 3% rode bicycles and less than 2% used public transport, while the majority were driven by car. These proportions varied only slightly by age and sex, although at the younger age boys were more likely to walk. The proportion walking home from school was 5% greater than that walking to school.

TABLE 2. Details of mode of travel used for journey to and from school, with summaries of total numbers of street crossings made. Means are appropriately weighted means of the means obtained for each school (n=72; average number of students per school = 39.5).

| | By age and sex | | | | |
|---|---|---|---|---|---|
| | 6/7 years | | 9/10 years | | Combined |
| | Boys % | Girls % | Boys % | Girls % | % |
| JOURNEY TO SCHOOL | | | | | |
| Walked | 30.1 | 25.3 | 32.1 | 33.6 | 30.4 |
| Walked + Car | 4.8 | 4.2 | 3.9 | 3.7 | 4.1 |
| Car | 62.9 | 68.2 | 55.6 | 57.1 | 60.7 |
| Public Transport | 1.3 | 1.4 | 1.4 | 2.6 | 1.7 |
| Bicycle | 0.9 | 0.9 | 7.0 | 3.0 | 3.0 |
| | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| JOURNEY FROM SCHOOL | | | | | |
| Walked | 35.1 | 29.3 | 37.3 | 39.6 | 35.5 |
| Walked + Car | 4.9 | 5.5 | 5.4 | 3.8 | 4.9 |
| Car | 57.3 | 62.5 | 48.0 | 51.1 | 54.4 |
| Public Transport | 1.8 | 1.6 | 2.3 | 2.6 | 2.1 |
| Bicycle | 0.8 | 1.0 | 7.0 | 2.9 | 3.1 |
| | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

As shown in Table 3, the mean number of streets crossed before and on the way to school (and after school) differed between those who walked and those who were driven, with children reporting other modes of transport (including a combination of walking and car) having mean numbers of crossings similar to those that reported walking. About half of all street crossings were reported to be accompanied by adults, and of the accompanied crossings one half again were at attended school crossings, which were used by 39% of all children.

TABLE 3. Mean numbers of street crossings by mode of travel. The averages shown include any street crossings before the journey to school with "JOURNEY TO SCHOOL" and crossings after school along with "JOURNEY FROM SCHOOL". In fact 78% of crossings were associated with the school-home journey rather than periods before and after school.

| | By age and sex | | | | Combined | |
|---|---|---|---|---|---|---|
| | 6/7 years | | 9/10 years | | | |
| | Boys | Girls | Boys | Girls | | |
| | Mean number of streets crossed | | | | | Mean no. without adult |
| JOURNEY TO SCHOOL | | | | | | |
| Walked | 2.96 | 2.64 | 3.40 | 3.39 | 3.15 | 1.46 |
| Walked + Car | 2.78 | 1.53 | 2.98 | 2.62 | 2.56 | 1.24 |
| Car | 0.55 | 0.50 | 0.56 | 0.48 | 0.52 | 0.31 |
| Public Transport | 2.77 | 3.90 | 1.76 | 3.03 | 2.90 | 1.40 |
| Bicycle | 3.28 | 3.34 | 3.05 | 3.88 | 3.30 | 2.64 |
| | 1.43 | 1.16 | 1.78 | 1.70 | 1.54 | 0.79 |
| JOURNEY FROM SCHOOL | | | | | | |
| Walked | 3.52 | 3.16 | 3.83 | 3.58 | 3.56 | 1.71 |
| Walked + Car | 3.13 | 2.74 | 3.66 | 3.19 | 3.26 | 1.77 |
| Car | 0.99 | 0.71 | 0.80 | 0.89 | 0.84 | 0.48 |
| Public Transport | 2.76 | 3.10 | 3.04 | 2.68 | 2.88 | 1.92 |
| Bicycle | 3.51 | 3.40 | 4.20 | 4.14 | 4.06 | 2.85 |
| | 2.04 | 1.62 | 2.38 | 2.18 | 2.07 | 1.09 |

TABLE 4. Mean number of street crossings by demographic and socioeconomic variables. Means were obtained in the same way as for Tables 2 and 3.

| | | Streets crossed (mean no.) | Streets crossed without adult (mean no.) |
|---|---|---|---|
| AGE | | | |
| | 6-7 | 3.17 | 1.30 |
| | 9-10 | 4.00 | 2.40 |
| SEX | | | |
| | Boy | 3.82 | 2.10 |
| | Girl | 3.37 | 1.67 |
| NUMBER OF CARS | | | |
| | 0 | 9.07 | 3.38 |
| | 1 | 4.30 | 2.26 |
| | ≥2 | 2.82 | 1.51 |
| HOME OWNERSHIP | | | |
| | yes | 3.26 | 1.73 |
| | no | 4.76 | 2.40 |
| MOTHER'S EDUCATION | | | |
| | Primary | 4.01 | 2.28 |
| | Secondary | 3.48 | 1.57 |
| | Tertiary | 3.31 | 1.72 |
| OCCUPATIONAL STATUS | | | |
| | 1st tertile | 3.15 | 1.62 |
| | 2nd tertile | 2.99 | 1.52 |
| | 3rd tertile | 4.29 | 2.19 |

In Tables 4 and 5 we show comparisons by the major demographic and socioeconomic variables. Table 4 shows mean numbers of street crossings while Table 5 summarises indicators of walking activity on two major dimensions, whether or not the child walked to and from school, and also the proportions of children reported to spend less than 5 or 15 minutes as pedestrians. In Table 4 we see a marked age difference in numbers of street crossings, and also strong trends with most indicators of socioeconomic status (SES), especially the number of cars in the family and home ownership.

Similarly, Table 5 shows trends toward less walking with higher SES, although these trends are stronger for the walking to/from school outcomes than for the total time estimates. Overall, 44% of children were reported to spend less than 5 minutes of the day walking and 72% reported less than 15 minutes.

TABLE 5. Proportions walking to and from school, and proportions spending 5 minutes or less and 15 minutes or less as pedestrians, by demographic and socioeconomic variables. Means were obtained in the same way as for Table 2.

| | Walked to school | Walked from school | Spent ≤ 5 mins walking | Spent ≤ 15 mins walking |
|---|---|---|---|---|
| AGE | | | | |
| 6-7 | 28.0 | 32.4 | 47.5 | 75.3 |
| 9-10 | 33.0 | 38.6 | 39.8 | 68.8 |
| SEX | | | | |
| Boy | 31.2 | 36.3 | 42.3 | 69.9 |
| Girl | 29.8 | 34.8 | 44.8 | 74.0 |
| NUMBER OF CARS | | | | |
| 0 | 82.5 | 84.6 | 8.6 | 32.8 |
| 1 | 36.8 | 41.5 | 38.6 | 67.7 |
| ≥2 | 23.1 | 28.6 | 48.8 | 77.2 |
| HOME OWNERSHIP | | | | |
| yes | 28.1 | 33.1 | 44.8 | 74.3 |
| no | 38.9 | 43.7 | 38.5 | 63.6 |
| MOTHER'S EDUCATION | | | | |
| Primary | 35.5 | 41.2 | 41.6 | 70.4 |
| Secondary | 30.9 | 36.4 | 44.7 | 71.5 |
| Tertiary | 24.2 | 27.6 | 45.3 | 74.3 |
| OCCUPATIONAL STATUS | | | | |
| 1st tertile | 23.6 | 28.7 | 44.7 | 74.9 |
| 2nd tertile | 27.9 | 32.4 | 47.6 | 74.5 |
| 3rd tertile | 36.4 | 41.8 | 41.0 | 69.4 |

## DISCUSSION

The survey results indicate that young children in a major Australian city spend remarkably little time as pedestrians, and even less time walking unaccompanied. In 60% of cases children are driven to school by car. Ironically, the fact that cars are used so predominantly for transporting children may lead to increased risk of pedestrian injury for those children whose parents are unable or less willing to drive their children.

Another finding of interest is that the number of children using bicycles to travel to school is extremely low. This may indicate that the prevailing emphasis in much school-based traffic safety programs on bicycle safety, especially in relation to bicycling as a means of commuting for children, is misplaced. (The use of bicycles for play rather than transportation should be considered separately: see Carlin et al[27].)

Further aspects of the results that are particularly interesting were:

1. It is clear that few children in this age group use public transport for getting to school.
2. Exposure as reported does not seem to explain sex differences in injury rates. Data from VicRoads (personal communication) indicate that twice as many boys as girls aged 5-12 were seriously injured as pedestrians in Victoria in 1994. We found however that the difference in apparent exposure, measured as average number of street crossings was small.
3. Socioeconomic status, car ownership and injury rates. By far the strongest predictor of walking pattern was the number of cars owned by the family. Weaker although still consistent trends were seen to greater exposure in groups of lower SES, by measures of parental education and occupational status.
4. More children walk home from school than walk to school.

More sophisticated statistical analysis of the data generated by this study is warranted and will be pursued by the authors.

As well as implications for injury risk, the results of the study raise questions about children's general level of physical activity[28,29], and their degree of personal independence and mobility[19]. It may be that a pattern of "being driven everywhere" contributes to (a) lower levels of physical activity and hence lower fitness levels, (b) development of habits counter to longterm healthy lifestyles (ie. longer term effects if not immediate ones), and (c) curtailment of children's sense of independence and mobility, with implications for self-esteem and confidence.

### *SOURCES OF BIAS*

For the valid estimation of children's traffic exposure it was essential that a high response rate was obtained from a random sample of parents. A low response rate would raise concern that more cautious or more restrictive parents had preferentially responded, threatening the validity of the results. In fact our response rates were as good as could be expected for this sort of study, and it appears unlikely that a major nonresponse bias could have entered our findings. The use of a sampling frame of all schools in the study region ensured that all children had an approximately equal probability of selection.

The validity of interview-reported pedestrian activity was examined in a study by Routledge et al who observed a child pedestrian's activity one day and interviewed the same child the following day, for a number of children.[30] Observers recorded all road crossings and road entries. The results revealed that road exposure was slightly underreported: 86% of the number of roads observed to be crossed were reported. Underreporting in this situation is likely to be due to children forgetting road crossings and is likely to be similar for children across all the study regions and for different groups within regions, so we do not regard it as a serious threat to study validity.

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# APPENDIX 1.

## QUESTIONNAIRE

# INTERNATIONAL STUDY OF THE EXPOSURE OF CHILDREN TO TRAFFIC

Royal Children's Hospital

## *CONFIDENTIAL QUESTIONNAIRE*

Dear Parent,

We are asking you to help us by answering a few simple questions about your child's walking activities. Your child's school has agreed to take part in this survey, which is based at the Royal Children's Hospital. The information you give us will be very valuable in our research into why some children have accidents on the roads and ultimately it should help in the development of policies that will make the roads safer for all children.

*Background*
The aim of our study is to find out how much traffic young children are exposed to in the Melbourne area. A number of children are injured each year as pedestrians and sometimes these injuries are very serious or even fatal. It seems clear that the risk of injury is related to the amount of walking children do and the number and types of streets that they cross. *This has never been measured before and so we do not* know how close the relationship is. Our survey is part of an international study, so the results will be important not only to Melbourne families but also to those in many other cities.

Please fill in the details below, then open the questionnaire and answer the questions about your child's walking activity today (or yesterday, if you are filling this out in the morning) and finally please complete a few background questions on the back page. If you have more than one child, please answer in relation to the child who was given the questionnaire. The whole form should take no more than about 10 minutes to complete. ***Please return the form to school, using the envelope provided if you wish.***

For this study we require from you only the information asked for in this questionnaire. Whether or not you decide to participate in the survey, please be assured that your decision would not in any way affect treatment that might be provided to your children for any reason at the Royal Children's Hospital. All replies will be treated with complete confidentiality and will only be used for the purposes of this study. Only summary information which does not identify individuals will be provided to your school .

If you have any questions about the survey, please contact Dr John Carlin or Dr Terry Nolan, Clinical Epidemiology and Biostatistics Unit, Royal Children's Hospital, Parkville 3052; telephone 345 6368 (9-5pm).

Thank you very much for your help.

John Carlin — Terry Nolan

Dr John Carlin — Assoc. Prof. Terry Nolan

*WE WOULD LIKE TO KNOW ABOUT THE STREETS YOUR CHILD CROSSED* ***ON FOOT*** *TODAY. PLEASE FILL IN THIS QUESTIONNAIRE WITH YOUR CHILD AT THE END OF THE DAY*

**I am willing to take part in this survey** YES NO *If no, please return the blank form anyway*
*(please circle)*

**1** **I am the child's** *(please tick)* **MOTHER** ☐ **FATHER** ☐ **OTHER** ________ *(please specify)*

**2** **Is your child a** boy girl **?** *(please circle)*

**3** **How old is your child?** *(at last birthday)* ______ *years*

*Office Use*
*Sch* ☐☐
*Ind* ☐☐

**PLEASE USE THE MAP** THAT IS PROVIDED WHEN COUNTING STREETS CROSSED- IT MIGHT BE USEFUL TO MARK YOUR HOUSE ON THE MAP.

**4** **This information refers to:** *(Please circle)*

**MON TUES WED THUR FRI**

**DATE:** ☐ *(day)* ☐ *(month)* ☐ *(year)*

**The weather today was** *(please tick one)* **Fine** (no rain) ☐ **Showers or light rain** ☐ **Heavy or persistent rain** ☐

# BEFORE LEAVING FOR SCHOOL

**5 Did he/she walk anywhere** (eg. to shop) **BEFORE leaving for school?**

*(Tick ONE box)*

| | | |
|---|---|---|
| **NO** | ☐ | ▶ ***Go to question 7*** |
| **YES, alone** | ☐ | ▶ ***Go to question 6*** |
| **YES, with other children, 12 or under** | ☐ | |
| **YES, with teenager(s) under 18** | ☐ | |
| **YES, with adult(s), 18 years or over** | ☐ | |

**6 How many times did he/she cross streets of the following types ON FOOT before going to school?**

*(Please write* ***number*** *of each type.*
*NO TICKS PLEASE.)*

| | **Number** |
|---|---|
| **Quiet local street** (almost never need to wait to cross) | ☐ |
| **Busy local street** (often wait to cross) | ☐ |
| **Main road, not at traffic lights** (nearly always need to wait to cross) | ☐ |
| **Main road, at traffic lights** | ☐ |

# GOING TO SCHOOL

**7 How did he/she get to school?**

*(Please tick all that apply, for example child may walk, then take bus)*

| | |
|---|---|
| **Walked, alone** | ☐ |
| **Walked, with other children, 12 or under** | ☐ |
| **Walked, with teenager(s) under 18** | ☐ |
| **Walked, with adult(s), 18 years or over** | ☐ |
| **Bike, skateboard, in-line skates** | ☐ |
| **Car** | ☐ |
| **Public transport** | ☐ |

**8 How many times did he/she cross streets of the following types ON FOOT on the way to school?**

*(Please write* ***number*** *of each type.*
*NO TICKS PLEASE.)*

| | **Number** |
|---|---|
| **Quiet local street** (almost never need to wait to cross) | ☐ |
| **Busy local street** (often wait to cross) | ☐ |
| **Main road, not at traffic lights** (nearly always need to wait to cross) | ☐ |
| **Main road, at traffic lights** | ☐ |

**9** **Please estimate the total time your child spent as a pedestrian (walking, standing or running on street, footpath or nature strip)** ***before and on the way to school*****.** ☐ *mins*

# COMING HOME FROM SCHOOL

**10 How did he/she get home from school?**

*(Please tick all that apply and include going to & from after-school care, if applicable.)*

- **Walked, alone** ☐
- **Walked, with other children, 12 or under** ☐
- **Walked, with teenager(s) under 18** ☐
- **Walked, with adult(s), 18 years or over** ☐
- **Bike, skateboard, in-line skates** ☐
- **Car** ☐
- **Public transport** ☐

**11 How many times did he/she cross streets of the following types ON FOOT on the way home from school?**

*(Please write **number** of each type NO TICKS PLEASE.)*

| | Number |
|---|---|
| **Quiet local street** (almost never need to wait to cross) | |
| **Busy local street** (often wait to cross) | |
| **Main road, not at traffic lights** (nearly always need to wait to cross) | |
| **Main road, at traffic lights** | |

# AFTER SCHOOL

**12 Did he/she walk anywhere** *(eg. to shop)* **AFTER coming home from school?**

*(Tick ONE box)*

- **NO** ☐ → ***Go to question 14***
- **YES, alone** ☐
- **YES, with other children, 12 or under** ☐
- **YES, with teenager(s) under 18** ☐
- **YES, with adult(s), 18 years or over** ☐

→ ***Go to question 13***

**13 How many times did he/she cross streets of the following types ON FOOT after coming home from school?**

*(Please write **number** of each type. NO TICKS PLEASE.)*

| | Number |
|---|---|
| **Quiet local street** (almost never need to wait to cross) | |
| **Busy local street** (often wait to cross) | |
| **Main road, not at traffic lights** (nearly always need to wait to cross) | |
| **Main road, at traffic lights** | |

**14 Please estimate the total time your child spent as a pedestrian (walking, standing or running on street, footpath or nature strip) *coming home from and after school*.** ____ *mins*

**15 How many times did your child use a street crossing with an attendant ("lollipop person") out of the totals reported above?**

**Going to school?** ____ *number* **Coming from school?** ____ *number*

*PLEASE TURN PAGE TO COMPLETE QUESTIONNAIRE*

# BACKGROUND INFORMATION

**16 What is your child's date of birth?** ____ / ____ / ____
*(day/month/year)*

**17 Mother's usual occupation** ____________
*(write N/A if mother does not live with child)*

**18 Mother's education**

| | | |
|---|---|---|
| How many years of high school did she complete? | ____ *years* | |
| Did she complete a high school or technical certificate? | YES | NO |
| Did she complete a university or college degree or diploma? | YES | NO |

**19 Father's usual occupation** ____________
*(write N/A if father does not live with child)*

**20 Father's education**

| | | |
|---|---|---|
| How many years of high school did he complete? | ____ *years* | |
| Did he complete a high school or technical certificate? | YES | NO |
| Did he complete a university or college degree or diploma? | YES | NO |

**21 What language is usually spoken in your home?** ____________
*(if other than English)*

**22 What is the name of the street in which you live?** ____________

**23 Would you describe your street between 8 and 9 a.m. as a** *(Please tick one box)*

*(Note:*
*This question is to help standardise the interpretation of the street categories.)*

- **Quiet local street** (almost never need to wait to cross) ☐
- **Busy local street** (often wait to cross) ☐
- or **Main road** (nearly always need to wait to cross) ☐ **?**

**24 What is your postcode?** ☐☐☐☐

**25 Does your family own the home you live in?** *(please circle)* YES NO
(whether with or without mortgage)

**26 How many cars does your family own?** ____

*THANK YOU FOR PARTICIPATING IN THIS STUDY*

# APPENDIX 2.

## Definition of variables for Melbourne INSECT analysis

John Carlin 25/7/95

### I. Preliminary: handling of missing data on street crossings (questions 6, 8, 11, 13):

A. Blank was assumed to be the same as 0, as long as there was other information provided consistent with this assumption, in particular either a non-walking mode of transport was indicated in the preceding question, OR a non-blank street count was entered in at least one of the other boxes in the same question.

B. Where a box was ticked (no number entered) this was entered as "1", unless the pattern of responses on the entire form was such as to indicate an invalid response (e.g. ticks in all boxes). If all street crossings data were missing/invalid, the subject was deleted from the analysis (did not contribute to the calculated response rate).

### II. Adjustment of street crossing totals for adult accompaniment.

A. (Preliminary:) If the number of attended crossings before (after) school exceeded *total* street crossings reported before and on the way to (coming home from and after) school and the latter were no more than 0 or 1, then the number of attended crossings was added to the number of *busy local* crossings on the way to (coming home from) school. (129 changes going to school, 95 coming from.) For 6 additional cases where the number of attended crossings exceeded the corresponding total number of crossings (but the latter were greater than 1), the attended crossings were reduced to one (each way) on the assumption that the parent had incorrectly interpreted the question.

B. (Adjusting for attended crossings, i.e. "lollipop" attendants.) Variables were defined to represent the numbers of street crossings minus the total number of attended crossings reported, where attended crossings before school were allocated first to the "going to school" total, and then if any remained (n=13) to the "before school" total, and similarly for after school (n=31 allocated to "after school"). [Produced variables named *bsctota, gsctota, csctota, asctota.*]

C. (Adjusting for reported adult accompaniment.) The variables in (b) were further adjusted to estimate total numbers of street crossings in the 4 time categories, adjusted *both* for attended crossings and for adult accompaniment, as follows:

1. *Before school*: total from (b) reduced to zero if q.5 answered with box 5 ("YES with adult").

2. *Going to school*: total from (b) reduced to zero if q.7 answered YES to box 4 ("walked with adult") and did *not* answer YES to any of the first 3 boxes.

3. *Coming from school*: similarly to (ii).

4. *After school*: similarly to (i).
   [Produced variables named *bsctota2, gsctota2, csctota2, asctota2*; the subjectwise total of these variables is labelled *stotaa*, the total number of street crossings without adult accompaniment (cf. the total of *all* streets crossed, labelled *stot*).]

## III. Definition of mode of travel classification.

The questions on mode of travel to and from school (q.'s 7 and 10) allowed multiple responses. A tabulation of these showed that apart from the combined category of "walked" and "went by car," the numbers in each multiple classification were very small. The following method was used to assign all subjects to a mutually exclusive classification, aiming to assign each case to the major mode of transport used (applying the following rules in sequence):

A. Car assigned if box 6 was ticked and no walking box (1-4).

B. Car+Walk assigned if box 6 ticked and any walking box (1-4) ticked.

C. Public Transport assigned if box 7 ticked, whether walked or not (1-4).

D. Bicycle assigned if box 5 ticked, whether walked or not (1-4).

E. Walked assigned if any of boxes 1-4 ticked and not already assigned.

[Produced categorical variables labelled *modetos, modefrs.*] (Note that the order of assignment has the effect that Public Transport overrides Car, if both were reported, and Bicycle overrides Car or PT if a combination was reported.)

# INTERNATIONAL STUDY OF THE EXPOSURE OF CHILDREN TO TRAFFIC

Royal Children's Hospital

## *CONFIDENTIAL QUESTIONNAIRE*

Dear Parent,

We are asking you to help us by answering a few simple questions about your child's walking activities. Your child's school has agreed to take part in this survey, which is based at the Royal Children's Hospital. The information you give us will be very valuable in our research into why some children have accidents on the roads and ultimately it should help in the development of policies that will make the roads safer for all children.

*Background*
The aim of our study is to find out how much traffic young children are exposed to in the Melbourne area. A number of children are injured each year as pedestrians and sometimes these injuries are very serious or even fatal. It seems clear that the risk of injury is related to the amount of walking children do and the number and types of streets that they cross. This has never been measured before and so we do not know how close the relationship is. Our survey is part of an international study, so the results will be important not only to Melbourne families but also to those in many other cities.

Please fill in the details below, then open the questionnaire and answer the questions about your child's walking activity today (or yesterday, if you are filling this out in the morning) and finally please complete a few background questions on the back page. If you have more than one child, please answer in relation to the child who was given the questionnaire. The whole form should take no more than about 10 minutes to complete. ***Please return the form to school, using the envelope provided if you wish.***

For this study we require from you only the information asked for in this questionnaire. Whether or not you decide to participate in the survey, please be assured that your decision would not in any way affect treatment that might be provided to your children for any reason at the Royal Children's Hospital. All replies will be treated with complete confidentiality and will only be used for the purposes of this study. Only summary information which does not identify individuals will be provided to your school .

If you have any questions about the survey, please contact Dr John Carlin or Dr Terry Nolan, Clinical Epidemiology and Biostatistics Unit, Royal Children's Hospital, Parkville 3052; telephone 345 6368 (9-5pm).

Thank you very much for your help.

Dr John Carlin    Assoc. Prof. Terry Nolan

***WE WOULD LIKE TO KNOW ABOUT THE STREETS YOUR CHILD CROSSED* ON FOOT *TODAY. PLEASE FILL IN THIS QUESTIONNAIRE WITH YOUR CHILD AT THE END OF THE DAY***

**I am willing to take part in this survey** YES NO *(please circle)* ***If no, please return the blank form anyway***

**1** **I am the child's** *(please tick)*
- **MOTHER** ☐
- **FATHER** ☐
- **OTHER** ______ *(please specify)*

**2** **Is your child a** boy girl **?** *(please circle)*

**3** **How old is your child?** *(at last birthday)* ______ *years*

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**PLEASE USE THE MAP** THAT IS PROVIDED WHEN COUNTING STREETS CROSSED- IT MIGHT BE USEFUL TO MARK YOUR HOUSE ON THE MAP.

**4** **This information refers to:** *(Please circle)*

**MON TUES WED THUR FRI**

**DATE:** ☐ *(day)* ☐ *(month)* ☐ *(year)*

**The weather today was** *(please tick one)* **Fine** (no rain) ☐ **Showers or light rain** ☐ **Heavy or persistent rain** ☐

## BEFORE LEAVING FOR SCHOOL

**5** **Did he/she walk anywhere** (eg. to shop) **BEFORE leaving for school?**

*(Tick ONE box)*

- **NO** ☐ → ***Go to question 7***
- **YES, alone** ☐
- **YES, with other children, 12 or under** ☐
- **YES, with teenager(s) under 18** ☐
- **YES, with adult(s), 18 years or over** ☐

→ ***Go to question 6*** (for any YES)

**6** **How many times did he/she cross streets of the following types ON FOOT before going to school?**

*(Please write **number** of each type. NO TICKS PLEASE.)*

| | Number |
|---|---|
| **Quiet local street** (almost never need to wait to cross) | |
| **Busy local street** (often wait to cross) | |
| **Main road, not at traffic lights** (nearly always need to wait to cross) | |
| **Main road, at traffic lights** | |

## GOING TO SCHOOL

**7** **How did he/she get to school?**

*(Please tick all that apply, for example child may walk, then take bus)*

- **Walked, alone** ☐
- **Walked, with other children, 12 or under** ☐
- **Walked, with teenager(s) under 18** ☐
- **Walked, with adult(s), 18 years or over** ☐
- **Bike, skateboard, in-line skates** ☐
- **Car** ☐
- **Public transport** ☐

**8** **How many times did he/she cross streets of the following types ON FOOT on the way to school?**

*(Please write **number** of each type. NO TICKS PLEASE.)*

| | Number |
|---|---|
| **Quiet local street** (almost never need to wait to cross) | |
| **Busy local street** (often wait to cross) | |
| **Main road, not at traffic lights** (nearly always need to wait to cross) | |
| **Main road, at traffic lights** | |

**9** **Please estimate the total time your child spent as a pedestrian (walking, standing or running on street, footpath or nature strip) *before and on the way to school*.** ☐ *mins*

# COMING HOME FROM SCHOOL

**10 How did he/she get home from school?**

*(Please tick all that apply and include going to & from after-school care, if applicable.)*

- Walked, alone ☐
- Walked, with other children, 12 or under ☐
- Walked, with teenager(s) under 18 ☐
- Walked, with adult(s), 18 years or over ☐
- Bike, skateboard, in-line skates ☐
- Car ☐
- Public transport ☐

**11 How many times did he/she cross streets of the following types ON FOOT on the way home from school?**

*(Please write **number** of each type NO TICKS PLEASE.)*

| | Number |
|---|---|
| **Quiet local street** (almost never need to wait to cross) | |
| **Busy local street** (often wait to cross) | |
| **Main road, not at traffic lights** (nearly always need to wait to cross) | |
| **Main road, at traffic lights** | |

# AFTER SCHOOL

**12 Did he/she walk anywhere** *(eg. to shop)* **AFTER coming home from school?** *(Tick ONE box)*

- NO ☐ ▶ *Go to question 14*
- YES, alone ☐
- YES, with other children, 12 or under ☐
- YES, with teenager(s) under 18 ☐
- YES, with adult(s), 18 years or over ☐

▶ *Go to question 13*

**13 How many times did he/she cross streets of the following types ON FOOT after coming home from school?**

*(Please write **number** of each type. NO TICKS PLEASE.)*

| | Number |
|---|---|
| **Quiet local street** (almost never need to wait to cross) | |
| **Busy local street** (often wait to cross) | |
| **Main road, not at traffic lights** (nearly always need to wait to cross) | |
| **Main road, at traffic lights** | |

**14 Please estimate the total time your child spent as a pedestrian (walking, standing or running on street, footpath or nature strip) *coming home from and after school*.** ______ *mins*

**15 How many times did your child use a street crossing with an attendant ("lollipop person") out of the totals reported above?**

**Going to school?** ______ *number* **Coming from school?** ______ *number*

*PLEASE TURN PAGE TO COMPLETE QUESTIONNAIRE*

# BACKGROUND INFORMATION

**16 What is your child's date of birth?** / / *(day/month/year)*

**17 Mother's usual occupation**
*(write N/A if mother does not live with child)*

**18 Mother's education**

How many years of high school did she complete? ____ *years*

Did she complete a high school or technical certificate? YES NO

Did she complete a university or college degree or diploma? YES NO

**19 Father's usual occupation**
*(write N/A if father does not live with child)*

**20 Father's education**

How many years of high school did he complete? ____ *years*

Did he complete a high school or technical certificate? YES NO

Did he complete a university or college degree or diploma? YES NO

**21 What language is usually spoken in your home?**
*(if other than English)*

**22 What is the name of the street in which you live?**

**23 Would you describe your street between 8 and 9 a.m. as a**

*(Please tick one box)*

*(Note:*
*This question is to help standardise the interpretation of the street categories.)*

**Quiet local street** ☐
(almost never need to wait to cross)

**Busy local street** ☐
(often wait to cross)

or **Main road** ☐ ?
(nearly always need to wait to cross)

**24 What is your postcode?**

☐ ☐ ☐ ☐

**25 Does your family own the home you live in?** *(please circle)* YES NO
(whether with or without mortgage)

**26 How many cars does your family own?** ☐

*THANK YOU FOR PARTICIPATING IN THIS STUDY*