RESEARCH

Walking, cycling and transport safety: an analysis of child road deaths

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J R Soc Med 2006;**99**:402–405

SUMMARY

Objective To examine trends in road death rates for child pedestrians, cyclists and car occupants.

Design Analysis of road traffic injury death rates per 100 000 children and death rates per 10 million passenger miles travelled.

Setting England and Wales between 1985 and 2003.

Participants Children aged 0–14 years.

Interventions None.

Main outcome measures Death rates per 100 000 children and per 10 million child passenger miles for pedestrians, cyclists and car occupants.

Results Death rates per head of population have declined for child pedestrians, cyclists and car occupants but pedestrian death rates remain higher (0.55 deaths/100 000 children; 95% confidence interval [CI] 0.42 to 0.72 deaths) than those for car occupants (0.34 deaths; 95% CI 0.23 to 0.48 deaths) and cyclists (0.16 deaths; 95% CI 0.09 to 0.27 deaths). Since 1985, the average distance children travelled as a car occupant has increased by 70%; the average distance walked has declined by 19%; and the average distance cycled has declined by 58%. Taking into account distance travelled, there are about 50 times more child cyclist deaths (0.55 deaths/10 million passenger miles; 0.32 to 0.89) and nearly 30 times more child pedestrian deaths (0.27 deaths; 0.20 to 0.35) than there are deaths to child car occupants (0.01 deaths; 0.007 to 0.014). In 2003, children from families without access to a vehicle walked twice the distance walked by children in families with access to two or more vehicles.

Conclusions More needs to be done to reduce the traffic injury death rates for child pedestrians and cyclists. This might encourage more walking and cycling and also has the potential to reduce social class gradients in injury mortality.

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INTRODUCTION

Road traffic crashes account for about 3500 deaths each year in the UK, with ten times as many people seriously injured.[1] Road traffic injuries are the leading cause of death and acquired disability in children.[1] Each year about 170 children are killed and close to 4000 children are seriously injured.[1] Furthermore, road danger is a strong disincentive to active transport (i.e., walking and cycling) and thus contributes to increasing levels of childhood obesity. A survey of parents of primary school children in inner London found that 90% of parents were worried about the safety of their children as pedestrians on the school–home journey.[2] Fear of pedestrian injury can create a vicious circle if an increasingly dangerous pedestrian environment encourages greater car use, leading to higher motorized traffic volumes and greater risks to pedestrians.[3] Because children in families without a car do not have the option of being driven, this vicious circle may also contribute to the social class gradients in injury death rates.[4] Reducing injury risks for child pedestrians and cyclists would be an important part of any strategy to promote walking and cycling, and might also reduce social class gradients in child injury mortality. In this paper we examine trends in injury risks for child pedestrians, cyclists and car occupants.

METHODS

We extracted data on the annual numbers of deaths from road traffic injuries to children aged 0–14 years in England and Wales between 1985 and 2003 from the Office for National Statistics, *Twentieth Century Mortality*[5] for the period 1985–2000, and from the ONS *Mortality Statistics: Injury and Poisoning, Series DH4* for the period 2001–2003. Pedestrians, cyclists and car occupants were identified using the International Classification of Diseases (ICD) external cause codes (Table 1). Death rates/100 000 population were calculated using the child population estimates for each year, rebased according to available census and vital registration data.[5]

Estimates of the average annual number of miles travelled by children aged 0–14 years by mode of transport were obtained from the Department for Transport's National Travel Surveys (a series of household surveys that collect data on personal travel in Britain, based on 7-day

Table 1 **International Classification of Diseases (ICD) codes used for traffic injury fatalities 1985–2003**

	ICD-9 codes (1985–2000)	*ICD-10 codes (2001–03)*
Pedestrians	E810–E819 ending in .7 E822–E825 ending in .7 E826.0	V01–V09
Cyclists	E810–E819 ending in .6 E826.1	V10–V19
Car occupants	E810–E819 ending in .1, .2, .8, .9 E822–E825 ending in .1, .2, .8, .9	V20–V29

personal travel diaries). Travel data were available for the periods 1985–1986, 1989–1991, 1992–1994, 1995–1997, 1998–2000 and 2002–2003. Estimates of annual distances travelled were also provided separately for three indicators of socio-economic status of households: access to vehicles, employment status of head of household, and housing tenure. We used linear interpolation to obtain estimates of the average annual distances travelled by pedestrians, cyclists and car passengers for each year from 1985–2003. These data were then used to estimate death rates/100 000 population and per 10 million passenger miles.

We derived 95% confidence intervals (CI) for the rates using the Poisson distribution. To smooth the fluctuations caused by year-to-year random variation, we calculated 3-year moving averages, except for the start and end of the period, 1985 and 2003, where 2-year averages were calculated. To quantify changes in the mortality rates over time, we calculated the ratio of rates in 2003 to those in 1985. A Poisson regression model was used to derive 95% CI, with year as the independent variable, number of deaths as the dependent variable, and total population or total passenger-miles as the exposure variable. Research ethics approval was not required for this study.

RESULTS

Between 1985 and 2003, injury death rates/100 000 children declined for the three modes of travel (Table 2). Pedestrian death rates remained higher (0.55 deaths/100 000; 95% confidence interval 0.42 to 0.72 deaths) than those for car occupants (0.34 deaths; 95% CI 0.23 to 0.48 deaths) and cyclists (0.16 deaths; 95% CI 0.09 to 0.27 deaths).

Figure 1 shows trends in the modes of transport used by children since 1985. By 2003 the average mileage travelled as a car occupant had increased by 70%, the average mileage walked had declined by 19%, and the average mileage cycled had declined by 58%, compared with 1985. Death rates/10 million passenger miles travelled declined over the study period for all modes of transport, although cycling showed the smallest reduction (Table 3). By 2003, for every 10 million miles travelled, there were 0.55 child cyclist deaths (95% CI 0.31 to 0.89 deaths), 0.27 child pedestrian deaths (95% CI 0.20 to 0.35 deaths) and 0.01 child car occupant deaths (95% CI 0.007 to 0.014 deaths). The child pedestrian death rate was 27 times (95% CI 17 to 42) higher than the child car occupant death rate, and the child cyclist death rate was 55 times (95% CI 30 to 100) higher.

Figure 2 shows the average distances walked annually by children for three indicators of socio-economic status of household. Children from households without access to vehicles, or where the head of household is not working, or where households are rented, all walked further each year than did their counterparts. By 2003, children without access to a vehicle were walking twice the distance walked by children in families with access to two or more vehicles.

Table 2 **Death rates (95% confidence intervals [CI]) per 100 000 children aged 0–14 by mode of transport in 1985 and 2003**

	1985	*2003*	
	Death rate (CI) per 100 000 children	*Death rate (CI) per 100 000 children*	*% decline*
Car occupants	0.84 (0.66 to 1.04)	0.34 (0.23 to 0.48)	59% (39% to 73%)
Pedestrians	2.73 (2.41 to 3.09)	0.55 (0.42 to 0.72)	80% (73% to 85%)
Cyclists	0.60 (0.46 to 0.78)	0.16 (0.09 to 0.27)	73% (53% to 84%)

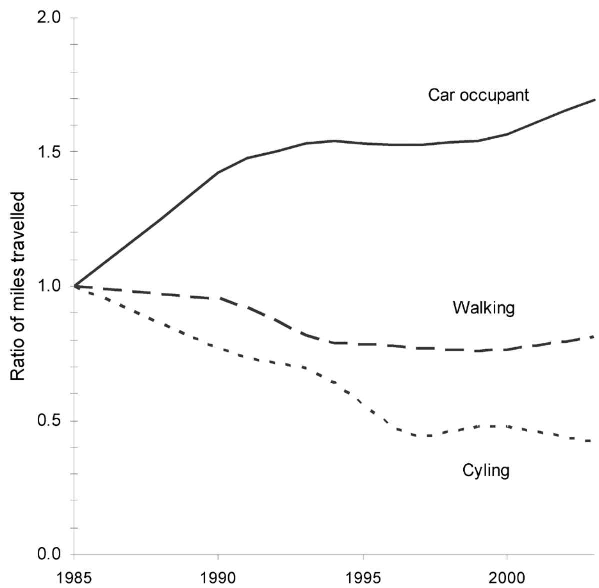

Figure 1 **Trends in mode of transport used by children aged 0–14 years since 1985.**

DISCUSSION

Principal findings

For each mile travelled in England and Wales there are about 50 times more child cyclist deaths and nearly 30 times more child pedestrian deaths than there are deaths to child car occupants. Although there have been declines in death rates for all modes of travel, pedestrians and cyclists remain at greatest risk. Because children from households without access to vehicles walk much more than their counterparts in car-owning families, the differences in risk by mode of travel are likely to contribute to the steep social class gradients in road traffic injury death rates. Although walking and cycling provide important benefits in terms of physical activity and have none of the adverse climate impacts of motorized travel, they appear to be the poor relations in terms of transport safety.

Strengths and weaknesses of this study

It is important to bear in mind that this paper reports an ecologic analysis. Our inferences about the relative safety of different modes of travel are based on aggregate data and we cannot assess individual risks from average distances travelled. There are also acknowledged limitations in both mortality data and travel survey data for addressing questions of risk exposure. Using mortality data to estimate injury risks for different modes of travel avoids the problems of incomplete reporting that can occur with less severe injury and which may be differential according to mode of travel. However, there are two problems. First, mortality depends on case fatality and substantial reductions in injury case fatality have been documented.[6] Although this would explain some of the overall decline in injury mortality rates, it is unlikely to account for the large differences in risk according to mode of travel. Second, the observed injury mortality differentials by mode of travel may not represent the situation for non-fatal injuries. However, comparisons of risks for those killed and seriously injured and for all casualties for the whole population suggest the relative risks for the three modes considered here are similar.[7]

For each mode, we calculated death rates per mile travelled, using estimated average annual distances travelled. It is possible that injury risks vary with length of journey. In particular, longer journeys typically taken by car are unlikely to be taken by children as pedestrians or cyclists. However, we were unable to calculate death rates per mile travelled adjusted for journey length, because information about the journey on which deaths occurred is not recorded. An alternative risk exposure indicator is injury rate by hour of journey time. In other studies, comparisons of fatalities per hour and for distance suggest that walking and cycling still have higher risks than car transport, but that the differential is not so great.[7]

The mortality data used in this study were extracted from ONS data files. During the study period the way that injuries were classified changed as a result of the move from ICD-9 to ICD-10. Although this may have caused discontinuities in the trends that were not due to real changes over time, the results from a comparability study conducted by the World Health Organization suggest that the change to ICD-10 would have had no noticeable effect.[8]

Non-response in the National Travel Surveys can be as high as 40% and this presents a threat to the validity of the

Table 3 **Death rates (95% confidence intervals [CI]) per 10 million passenger miles by mode of transport in 1985 and 2003**

	1985	*2003*	
	Death rate (CI) per 10 million miles	***Death rate (CI) per 10 million miles***	***% decline***
Car occupants	0.04 (0.03 to 0.05)	0.01 (0.007 to 0.014)	76% (64% to 84%)
Pedestrians	1.08 (0.95 to 1.22)	0.27 (0.20 to 0.35)	75% (66% to 81%)
Cyclists	0.84 (0.64 to 1.09)	0.55 (0.31 to 0.89)	35% (−14% to 62%)

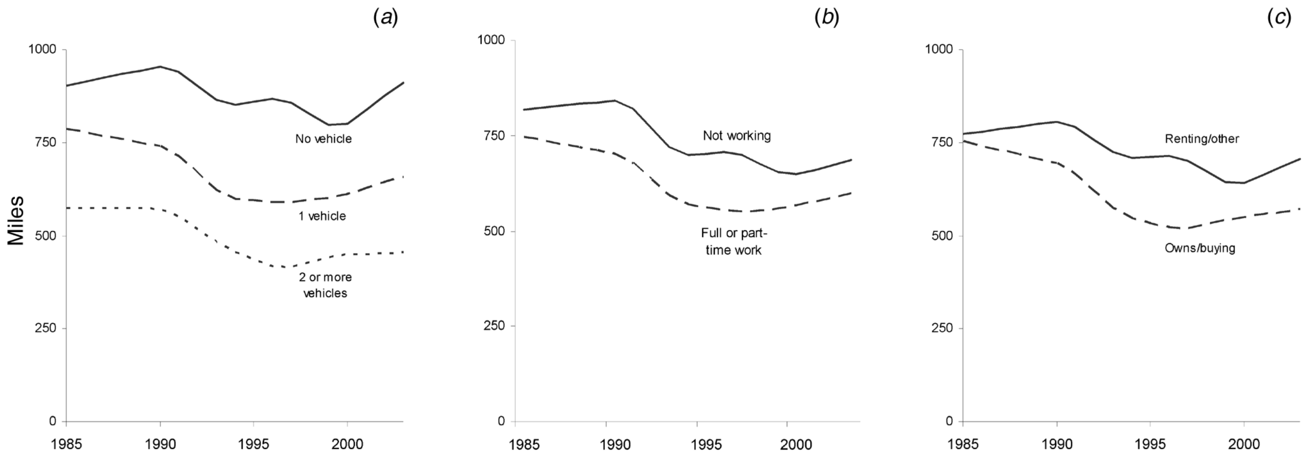

Figure 2 **Average distances walked annually by children aged 0–14, by three indicators of socio-economic status of household.** (*a*) No access to vehicle; (*b*) head of household not working; (*c*) home is rented

travel estimates. The Department for Transport is currently conducting analyses to assess the impact of non-response on the travel survey estimates but these results are currently unavailable.

We used injury deaths for England and Wales but the National Travel Surveys also include Scotland. There is some evidence that Scottish residents walk and cycle further than the English and Welsh, and so their inclusion may have led to an overestimate in walking mileage.[9] However, the effect of overestimating walking mileage would have been to understate the risks per mile walked for pedestrians.

Policy implications

Road danger is a disincentive to active transport. Reducing the traffic injury risks for child pedestrians and cyclists must be an important part of any strategy to encourage walking and cycling. Our results suggest that more needs to be done in this respect. At present, the conditions are set for a vicious circle of rising road danger leading to more children being driven which increases traffic volumes adding further to road danger. International evidence suggests that the number of people walking and cycling is inversely related to the number of collisions between motor vehicles and pedestrians or cyclists.[3] Thus a virtuous circle is possible, in which addressing the higher risks of active transport could encourage more cycling and walking, and thus potentially further reduce road danger.

Reducing the risks of active transport to encourage more children to walk and cycle has added public health benefits. First, the increased physical activity may help to stem the rising levels of childhood obesity. Second, reductions in the use of motorized vehicles would reduce transport related carbon dioxide emissions which is a major contributor to climate change. Third, because poor children walk more than more affluent children, efforts to improve the safety of walking has the potential to reduce the steep social class gradients in child injury death rates.

Competing interests None declared.

Funding This work was undertaken by the London School of Hygiene & Tropical Medicine who received funding from the Department of Health. The views expressed in the publication are those of the authors and not necessarily those of the Department of Health.

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