ORIGINAL ARTICLE

How exposure information can enhance our understanding of child traffic "death leagues"

Nicola Christie, Sally Cairns, Elizabeth Towner, Heather Ward

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See end of article for authors' affiliations

Correspondence to:
Dr N Christie, Postgraduate
Medical School, Daphne
Jackson Road, Manor Park,
University of Surrey,
Guildford GU2 7WG, UK;
n.christie@surrey.ac.uk

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Objectives: To explore whether population-based fatality rates and measures of traffic exposure can be combined to provide a more comprehensive measure of safety. To illustrate how this could be achieved using surveys from a range of Organisation for Economic Cooperation and Development (OECD) countries. To discuss why exposure is important.

Design and setting: Fatality data were obtained from the International Road Traffic and Accident Database and travel data from surveys among government transport administrations in each country.

Methods: Comparable exposure data were obtained for children aged 10–14 years from the UK, the USA, Germany, The Netherlands, Norway, Sweden, Switzerland and New Zealand. Fatality rates for children travelling as pedestrians, cyclists and car occupants were calculated based on (1) per head of population and (2) a combination of rate per head population and per kilometre travelled.

Results: In this study, exposure-based fatality rates suggest a more polarized distribution rather than a graduated league. The USA and the UK were at the lower end of the table for child pedestrian safety; Germany for car-occupant safety, Sweden and New Zealand performed less well. For cycling, the inclusion of exposure data considerably changes positions within the table. Countries with higher cycling levels like The Netherlands perform better than those with low levels like the UK and New Zealand.

Conclusions: Exposure-based fatality rates can help us to understand whether policies reduce exposure or whether they increase safety, given a similar level of exposure. Data need to be harmonized across OECD countries for a better understanding of the risks and links between health and sustainable travel.

International comparisons of unintentional fatality rates per head of population are often presented as "death leagues."¹ They rank countries in order of fatality rate (the lowest first) to compare safety performance. The 2001 Unicef "League Table of Child Deaths by Injury in Rich Nations" showed traffic deaths comprising 41% of all injury deaths in childhood, with those in Korea at the bottom of the league table over five times than those of the top country, Sweden.

At worst, such league tables stigmatize the poorly performing countries by naming and shaming. At best, they can create aspirations by showing what might be achieved by adopting the policies of the best performers.² Population-based fatality rates indicate the burden of traffic injuries compared to other causes of premature death and are a reliable universal measure. The usefulness of such league tables has been brought into question.³ Following the Unicef study, there have been calls for further investigations into the factors affecting the different childhood injury death rates between countries.^{4–5} Many factors such as the quality and quantity of children's exposure to traffic; demographic and socioeconomic factors; and the policy approaches to tackling childhood traffic deaths and injury could explain these differences.⁶ Arguably, only when we understand the differences in how much people walk, cycle or travel by car, and then express the risk of injury per unit of exposure, we can measure how safe these activities are, and the specific policies that contribute to improved safety.

The need for exposure data was identified over 20 years by the Organisation for Economic Cooperation and Development (OECD), but little has been done to coordinate a harmonized dataset across member countries.⁷ Exposure data might be used to understand the fatality league tables better and to monitor progress towards targets—for example, increasing modal shift from car to other forms of transport. Exposure trends can also help us understand whether the rise or fall of injuries occur

because of changes in safety or because of changes in exposure. In the UK, it has been argued that the observed trend in reduced child pedestrian casualties is due to either children walking less over time or because the traffic environment is perceived as increasingly dangerous.⁸ A further illustration of the need to take exposure into account is the 1990 evaluation of the effect of bicycle helmet legislation introduced in Victoria, Australia. This showed an increase in helmet wearing and a 48% reduction in bicyclists killed or hospitalized with a head injury. However, this reduction could have also been attributable to a decrease in the overall level of cycling, which fell by 10% among those aged <12 year and by 44% among teenagers. Research shows that teenagers generally have negative attitudes towards wearing helmets and in Australia, children would have chosen not to cycle rather than wear a helmet.⁹ For policy makers, it is important to know whether casualty reduction over time is a result of exposure reduction policies or through those that increase safety, given a similar level of exposure. As the example shows, policy makers need to consider the relative effects of different policy objectives.

This analysis explored whether combining fatality and exposure data could provide a more comprehensive measure of safety for each country. The specific research questions were:

- How many countries collect information on children's travel?
- What sorts of information are collected?
- What common data exist between countries?
- How can this be used to provide an index of exposure to risk?
- Does the inclusion of exposure data change the relative ranking of countries in the traffic fatality league table?

Abbreviations: IRTAD, International Road Traffic and Accident Database; OECD, Organisation for Economic Cooperation and Development

Table 1 Details of travel surveys

Country	Sample age group (size)	Data collection method	Newest data available at the time of survey	Other survey details
Germany	10–14 year olds (from a survey of 3200 children and young people)	Interview survey over 27 regions over 4 sampling periods in 12 months	1998–9	Data on kilometres, but not trip numbers
New Zealand	10–14 year olds (from a survey including 3638 children)	Interview survey based on all aspects of travel for 2 days	1997	Distance estimates are not available for walking
The Netherlands	12–14 year olds (from a survey involving 1681 pupils during their first years at various secondary schools)	Travel dairies	1999	
Norway	13–14 year olds (582 children surveyed)	Telephone interviews on one day of travel	2001	Journeys >100 km excluded
Sweden	10–14 year olds (from a survey including approx 1000 children aged 6–14 years)	Telephone interviews on one day of travel (people <15 years are interviewed through parent)	1999	This is the most recent data of suitable quality, although later surveys have been conducted
Switzerland	10–14 year olds (from a survey including 3071 children aged 6–14 years)	Telephone interviews	2000	Some trips are classified as being of unknown mode
UK	10–14 years olds (1527 children surveyed)	Travel diary (1 week)	1999–2001	3-years data are grouped to obtain large enough sample sizes
USA	10–14 year olds (from a survey of 42 033 households)	Interview based household survey	1995	The sample of bicycle trips was too small to give the figures separately

This paper illustrates how the combined data can be used to enhance our understanding of the relative injury risk for different road users in a sample of OECD countries. The quality of the data on exposure is limited, but this paper provides an illustration of what can be achieved when exposure is taken into account.

METHOD

The first stage of the research established which countries collected travel data for children, which variables were measured and how they can be used to make approximate comparisons between countries.

In 2002, a questionnaire survey of policy and practice on children's road traffic safety was conducted among the 30 OECD countries.¹⁰ The aims of the survey were to provide data from OECD countries to identify current patterns of child road safety and best practice in terms of road safety intervention approaches. The survey was conducted among key informants from national government and public road administrations. The survey comprised a series of five questionnaires seeking data on children as pedestrians, bicyclists, vehicle occupants, children's travel and policy on children's traffic safety. The travel questionnaire sought information on:

- Distance travelled by mode
- Travel split by journey purpose
- Number of trips by mode
- Some indication on whether children in different age groups are typically accompanied by adults
- Policy responses to children's growing car use
- Initiatives aimed at influencing children's travel.

Using this information, we were able to assess the effect of exposure on fatality rates. Of the 30 OECD countries, 21 participated in the survey and 14 collected some form of national travel data for children. A number of countries (eg, Denmark) provided travel data, but not in a way that could be used as a denominator for expressing risk (ie, they provided percentage modal share, but not specific distance estimates).

The data used in this analysis were extracted from nationally representative surveys. Although little is known about the precise questions within each national survey, they seem broadly comparable. Most were based on interview surveys;

however, The Netherlands and the UK used travel diaries. The survey did not request exposure data by urban or rural area, but most participants represented highly urbanised populations. Data were often not collected in a standardised form across countries, making international comparisons more difficult. Few countries had travel data for all age groups, but most had information for older children. Given this, a decision was taken to focus on the age group 10–14 years. Eight countries could provide comparable data for these children, although New Zealand could not provide distance estimates for pedestrians and the USA could not provide data on cyclists.

Table 1 shows details of the travel data collected by different countries (before 2000).

Fatality rates were extracted from the International Road Traffic and Accident Database (IRTAD) from at least 3 years between 1996 and 2000 and were averaged to reduce random fluctuation in a given year.

Exposure-based fatality rates

The analysis assessed whether the fatality rate per unit of exposure changed the assessment of those countries showing good and less good performance. Exposure-based fatality rates were calculated by taking the fatality rate per 100 000 population for the appropriate age group (in this case, 10–14 year olds) when travelling by a particular mode (eg, as a pedestrian), and then dividing that fatality rate by the average kilometres travelled by children of that age group each year.

For example, the fatality rate that took exposure into account for 10–14-year old-pedestrians, according to the distance they travelled, was calculated as:

Pedestrian deaths per 100 000 10–14 year olds per year (1996–2000 average)

Number of kilometres travelled on foot per 10–14 year olds per year.

This gave an indicator of the deaths per 100 000 km travelled by mode and age group.

RESULTS

Data are presented for fatality rates per 100 000 children and fatality rates per 100 000 km travelled by children. For child

Figure 1 (A) Pedestrians aged 10–14 years: population-based fatality rates for a sample of Organisation for Economic Cooperation and Development (OECD) countries. (B) Pedestrians aged 10–14 years: population-based fatality rates expressed per unit of exposure for a sample of OECD countries.

pedestrians (fig 1), fatality rates expressed per 100 000 children show a graduated league with Norway having the lowest fatality rate and the UK the highest. When exposure is taken into account, a different picture emerges. The USA, where children undertake relatively little travel as pedestrians, emerges as the most dangerous. In Norway and Switzerland, 10–14-year-old children walk relatively long distances and these countries perform relatively well.

For child car occupants (fig 2), fatality rates expressed per 100 000 children show the lowest rate for The Netherlands and the highest rate for New Zealand. When exposure is taken into account, New Zealand and Germany appear at the bottom of the league and Switzerland, the UK, The Netherlands and Norway emerge as the safest.

For child cyclists (fig 3), fatality rates expressed per 100 000 children show the lowest rate for Sweden and the highest rate for The Netherlands. For cycling, inclusion of exposure data entirely alters classification of countries as good and less good. Particularly, countries with low levels of cycling are generally relatively unsafe for bicyclists.

DISCUSSION

This study combined a range of existing and new data sources: mortality data from IRTAD and exposure data from questionnaire surveys. Key informants from 21 countries participated in the survey representing a response rate of 70% among OECD countries. The absence of the contribution from nine countries could have influenced the comparison of countries.

However, those who were participating provided a range of performers (in terms of deaths per 100 000 children). The survey was simpler to accomplish in smaller unitary countries than in larger federal ones. Particularly, in the USA, the enormous variations between different states made data collection very difficult for the key informant. The strength of this study is its systematic attempt to account for international differences in child traffic accidents. Some of the data sources used were readily available, but were newly analysed for specific types of traffic injury: pedestrian, bicycle and car occupants, and for a particular age group of children.

The study also showed the difficulty of incorporating exposure data. Although many countries collect children's travel data, it is often not produced in a standardized format that facilitates international comparisons. For example, information was not available for distance estimates for all modes of transport, and age groups did not always match exactly.

The original objective had been to combine population and exposure data for children aged 0–14 years. Few countries had travel data for all age groups, but most countries had information for older children and therefore a decision was made to focus on the age group 10–14 years. The exposure patterns of older children might be quite different from that of younger children and conclusions drawn are limited and cannot be generalised to younger children.

In addition, the exposure measures used here were based only on the distance travelled. Research shows that it is important to know the characteristics of the road environment

Figure 2 (A) Car occupants aged 10–14 years: population-based fatality rates for a sample of Organisation for Economic Cooperation and Development (OECD) countries. (B) Car occupants aged 10–14 years: population-based fatality rates expressed per unit of exposure for a sample of OECD countries.

Figure 3 (A) Bicyclists aged 10–14 years: population-based fatality rates for a sample of Organisation for Economic Cooperation and Development (OECD) countries. (B) Bicyclists aged 10–14 years: population-based fatality rates expressed per unit of exposure for a sample of OECD countries.

in which the travel takes place, especially for vulnerable road users. In the UK, studies have shown that the risk is greatest when children travel on road networks associated with housing estates built before 1914, busy main roads and on roads where there is a mix of both residential homes, shops or businesses.^{11–14}

Following on from the work undertaken in this study, we recommend that an international standard be developed, which allows travel information to be collected more consistently. Various specific recommendations emerged about ways to approach data collection and common areas of questioning. Ideally, travel surveys should be carried out at least every 5 years covering adult and child travel habits, and using household travel diaries. For comparison with IRTAD, it is useful to record information about 15–18 year olds separately from data about the other age groups because of risks associated with independent travel and car, moped and motorcycle use. Distinguishing between travel to school (or educational establishments) and travel for other purposes is the easiest distinction to make in terms of trip purpose. In terms of modal breakdown, the simplest distinctions for information collection about children's travel are between car, cycle, walk, public transport and other although different countries may have special types of transport that they might choose to focus on (eg, school bus). In terms of travel units, kilometres are currently the most popular measure, and therefore most likely to facilitate international comparisons. However, a strong case can be made that countries should also measure trip numbers and travel times, especially when some of the distances travelled are so short. Ideally, an international standard should be developed for recording travel information—for example, what counts as a journey. Sample sizes used by different countries for measuring travel by 0–14 year olds are typically between 1500 and 4500 children. Larger numbers may be needed to provide reliable information about less well-used travel modes.

Finally, consideration could be given to describing the contexts of exposure in terms of the road environment. Useful examples exist from UK studies.

CONCLUSIONS

The need for information on exposure was identified over 20 years ago by the OECD report, *Traffic Safety of Children*.⁷ Information on the amount of walking, cycling and travelling in cars by children of different age groups is essential before we can properly understand whether countries can be classified as relatively safe or unsafe. This is particularly important in relation to cycling, where there is a great range in activity between different countries. When including exposure, countries that can be classified as relatively safe or unsafe are

different from those that emerge from population-based league tables. Particularly, countries with low levels of cycling emerge as relatively unsafe for cyclists.

To undertake more sophisticated comparisons, there needs to be a move towards harmonization of travel information across OECD countries. This is particularly important, given its relevance for understanding fatality rates, and for meeting targets for health and sustainability agendas. Only when standardized exposure data are collected across OECD countries, more accurate traffic fatality league tables can be developed taking the effect of exposure into account.

IMPLICATIONS FOR PREVENTION

Across countries, the burden of road traffic deaths among children is often compared in league tables based on road traffic fatality rates per head population. By comparing countries in this way we might make assumptions about the policies and practices giving rise to the low-fatality rates, and then advocate these to less well performing countries. However, without knowing how much people walk, cycle or travel in cars in each country, we cannot truly understand the safety of these activities. The addition of exposure-based data provides a different, more polarized picture of children's traffic safety in this sample of OECD countries.

Key points

- Traffic fatality league tables are a common way of indicating road safety performance of Organisation for Economic Cooperation and Development (OECD) countries.
- Leagues based on fatality rates per head of population do not take exposure into account.
- A minority of countries can provide exposure data for children, we examined the data for those aged 10–14 years.
- Population-based fatality rates and exposure data were combined to create fatality rates per unit of exposure.
- Fatality rates per unit of exposure polarise the data into good and less good performers for child pedestrians and car occupants, and alter the child cyclists' league.
- Harmonized exposure data across OECD countries would enhance understanding of traffic fatality league tables and inform health and sustainability agendas.

Less well performing countries for child pedestrian safety included the USA and the UK; those doing less well for car-occupant safety included Germany, Sweden and New Zealand. For cycling, inclusion of exposure data entirely alters classification of countries as good and less good. Countries with low levels of cycling are generally unsafe for bicyclists. The UK and New Zealand emerged as relatively less good performers, whereas the countries with higher levels of cycling like The Netherlands perform better. Also, there are important implications for monitoring the impact on injury rates of policies aimed at increasing walking and cycling. If such policies are successful, fatality rates will need to be adjusted to take into account these changes, thereby enabling more accurate judgements of safety performance.

Authors' affiliations

Nicola Christie, Postgraduate Medical School, University of Surrey, Guildford, UK

Sally Cairns, Transport Studies, University College London, London, UK

Elizabeth Towner, University of the West of England, Centre for Child and Adolescent Health, Bristol, UK

Heather Ward, Centre for Transport Studies, University College London, London, UK

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