

## **Metrication of the urban speed limit and pedestrian fatalities**

McLean A.J., Anderson R.W.G.

Centre for Automotive Safety Research, University of Adelaide, South Australia 5005

email: jack@casr.adelaide.edu.au

### **Abstract**

In the early 1960s the urban area speed limit was increased from 30 to 35 mph in Victoria and NSW. With the introduction of metrication in 1974 the urban area speed limit of 35 mph (56 km/h) was changed to 60 km/h throughout Australia. The reason why 60 km/h was selected is discussed.

A study of the likely relationship between travelling speeds and the incidence of pedestrian fatalities was conducted by the NHMRC Road Accident Research Unit (now the Centre for Automotive Safety Research) based on the results of detailed investigations of 176 fatal pedestrian crashes in the Adelaide area between 1983 and 1991. A reduction in the urban area speed limit from 60 to 50 km/h was predicted to result in a reduction of 30 percent in the incidence of pedestrian fatalities. The method developed to estimate this reduction is described and compared with the method used in more recent case control studies of travelling speed and the risk of casualty crash involvement. The effect on pedestrian fatalities where the urban area speed limit has been reduced from 60 to 50 km/h is also noted.

Based on the above information, the consequences of the choice of 60 rather than 50 km/h for the urban area speed limit are estimated in terms of the incidence of pedestrian fatalities in Australia since 1974.

### **Keywords**

Pedestrian, Fatality rate, Speed limit

### **Introduction**

In 1937 a speed limit was introduced for built up areas in New South Wales. It was 30 mph and it remained in effect until May 1964 when it was changed to 35 mph for the following reasons:

“Important points in favour of the change were that it would bring NSW in line with other States and with the National Road Traffic Code, and that vehicles, as well as roads, were now far superior in comparison to the standards existing in 1937 when the 30 mph limit was introduced. It was also shown by surveys that the higher limit would not, in reality, bring about any increase in vehicle speeds.” [1].

Victoria, which had also had a 30 mph speed limit for built up, or urban, areas, had increased that limit to 35 mph on January 1, 1963. In South Australia the urban area speed limit, from the time that it was first introduced, was 35 mph.

Consequently, when metrication replaced imperial measure in Australia in 1974 the urban area speed limit in Australia was 35 mph. The choice of a metric equivalent of 35 mph, or 56 km/h, was limited to 50 or 60 km/h, but not 55 km/h, because it was thought by those making the decision that it would be preferable for metric speed limits to end in a zero and advisory speeds to end in a five. Sixty km/h was chosen rather than 50. That is why Australia has had one of the highest urban area speed limits of any OECD country.

The aim of this paper is to estimate the effect of the choice of 60 rather than 50 km/h on the incidence of pedestrian fatalities in Australia since 1974.

## Methods

This investigation into the relationship between pedestrian fatalities and the urban area speed limit makes use of information from three studies.

The effect of a reduction in the speed limit from 60 to 50 km/h on pedestrian fatalities in an urban area was estimated by McLean et al in Adelaide in the mid-1990s [2]. This estimate was based on reconstructions of fatal pedestrian collisions for which there was sufficient information collected at the scene of the crash and elsewhere.

Subsequently a case control study was conducted by Kloeden et al in the same metropolitan area on the relative risk of involvement in a casualty crash involving a passenger car [3,4]. The results of that study indicated that the method used in the earlier study based on fatal pedestrian collisions probably underestimated the sensitivity of the risk of crash involvement to differences in travelling speed.

Finally, the percentage reduction in casualty accidents involving pedestrians following a change in the default urban speed limit from 60 to 50 km/h in South Australia is presented and compared with the estimates obtained previously.

The findings from these three investigations are then applied to information on pedestrian fatalities in Australia to estimate the effect of the choice of 60 rather than 50 km/h for the urban area speed limit in 1974.

### *Vehicle travelling speeds and pedestrian fatalities*

One hundred and fifty three fatal pedestrian collisions that occurred on 60 km/h speed limit roads in metropolitan Adelaide were investigated by the NHMRC Road Accident Research Unit in the ten years from 1983. An additional 23 cases occurred on roads zoned with a higher speed limit. As part of a study of the mechanisms of brain injury, the investigation of each case commenced with attendance at the autopsy of a fatally injured pedestrian and continued with an examination of the vehicle involved and the scene of the collision. In most cases statements were available from the driver and from any witnesses.

The striking vehicle had a free travelling speed in 133 of these 153 collisions with a pedestrian. The other 20 cases involved vehicles that were turning, accelerating from a standstill, or had run off the carriageway, and some cases where it was clear that the pedestrian had intended to commit suicide or the driver had collapsed at the wheel. In 15 of the 133 free travelling speed cases there was not sufficient information available to estimate that speed reliably and so the calculations of the effects of changes to travelling speeds were based on 118 fatal pedestrian collisions. The estimated effects on the incidence of fatal pedestrian collisions of hypothetical changes to the travelling speeds of these 118 cases, including reducing the speed limit from 60 to 50 km/h, were then related back to the full sample of 153 cases to give an estimate of the overall effect in 60 km/h zones. This was done to allow for those pedestrian collisions which would not be expected to be affected by a change in the travelling speed of the vehicle.

The driver stated that no evasive action was attempted prior to the collision in 45 percent of the 118 cases that could be analysed. This was usually because the pedestrian was not seen at all or the driver did not realise there was danger of a collision. The impact speed in these cases was equal to the travelling speed of the vehicle.

In the other 55 per cent of the analysed cases, some evasive action was taken. As the evasive action was typically emergency braking, the travelling speed of the vehicle could usually be estimated from braking skid marks. A description of the crash reconstruction techniques used is given in the full report on this study [2] where it is also shown that if a car travelling at 50 km/h can be braked to a stop just before striking a pedestrian a car travelling at 60 km/h will still be travelling at 44 km/h at that point.

The likely effect of the reduced travelling speeds on the number of fatalities was based on an estimate of the probability of the pedestrian being fatally injured at a given impact speed. This estimate was based on the best available data from a number of sources [2]. At an impact speed of 40 km/h the probability of the

pedestrian being fatally injured was estimated to be 25 per cent. This probability increased rapidly with increasing impact speed; by 50 km/h it was estimated to be to 85 per cent.

Based on this approach, a reduction in the urban area speed limit from 60 to 50 km/h, with the same level of compliance as at present, would be expected to reduce fatal pedestrian collisions by 30 per cent, including preventing the collision altogether in 14 per cent of the cases.

#### *Travelling speed and the relative risk of crash involvement*

In the mid-1990s Kloeden et al [3] conducted a case control study to quantify the relationship between free travelling speed and the risk of involvement in a casualty crash for passenger cars in 60 km/h speed limit zones. Investigators from the Unit attended the scene of 952 crashes to which an ambulance was called in the Adelaide metropolitan area. From these 952 crashes, 247 met the criteria for inclusion in the study: a passenger car which had a free travelling speed before being involved in a crash in which at least one person was injured seriously enough to be transported by ambulance to hospital. The reasons for the exclusion of the other cases are listed in the main report on the study [3]. In 99 of the 247 crashes we were not able to estimate the travelling speed of the case vehicle and so the study was based on 148 crashes and 151 case vehicles. The methods of analysis and the case data are presented in Volume 2 of Reference 3. The 604 control vehicles (four per case) were passenger cars matched to the cases by location of the crash, direction of travel, time of day, and day of week. Their speeds were measured with a laser speed meter.

The risk of casualty crash involvement was expressed as a risk relative to that experienced by a driver travelling at 60 km/h. This relative risk of crash involvement was found to approximately double for each increase of 5 km/h in travelling speed above the 60 km/h speed limit [3, 4].

Unlike in the pedestrian study, we did not attempt to estimate the percentage of those crashes which would still have occurred but at such a low speed as to no longer result in injury (in a fatality in the pedestrian study).

The estimated effect of a reduction in the speed limit from 60 to 50 km/h on the number of casualty crashes in the Adelaide metropolitan area was calculated in two basically different ways. The first was similar to that used in the study based on fatal pedestrian collisions. Each case was analysed separately to estimate whether or not that crash would have still occurred had the speed limit been reduced, assuming the same level of compliance with the limit as previously. Taken together, we concluded from these cases that the speed limit reduction would result in a reduction of 32.7 percent in the number of free speed casualty crashes. Allowing for the 44 percent of the casualty crashes investigated that were excluded from the study because they did not meet the criteria for a "free travelling speed" crash, and for other reasons, we then concluded that this change in the speed limit would reduce the number of all casualty crashes by 18.3 percent.

The second method of analysis involved working back from the relative risk estimates to predict the effect of a 10 km/h reduction in the 60 km/h speed limit [4]. From this we concluded that 67.8 percent of all free speed casualty crashes would be prevented and 38.0 percent of all casualty crashes in 60 km/h zones. However, if one assumes that drivers who were exceeding the 60 km/h limit by a wide margin are unlikely to slow down simply because the speed limit, which they have been ignoring, has been lowered then these percentage reductions become 37.7 percent and 21.1 percent respectively. Details of these two sets of assumptions are presented in Table 3.7 of Reference 4. (The observed reduction in casualty crashes was 23 percent [6].)

Regardless of which of these two assumptions are followed, estimates of casualty crash reductions based solely on the risk curve are greater than those based on a case by case reconstruction. Several possible reasons why this is so are discussed in Section 5.1.1 of Reference 3. One of these relates to driver expectancies:

"It is likely that a driver of a vehicle that is travelling unusually fast may create dangerous situations. This can happen when another driver assumes that the approaching speeding car is travelling at about the same speed as other traffic on that road.

Some evidence that such a phenomenon exists was provided by the in-depth study of a representative sample of accidents conducted in Adelaide 20 years ago (McLean, Offler and Sandow, 1979). In 35 collisions at Stop sign controlled intersections it was concluded that only two resulted from a driver failing to observe the Stop sign. In the remaining cases a driver stopped at the sign and then moved off into the path of an approaching car on the through road.

The drivers involved in all of the crashes in that study were routinely asked about any prior convictions for speeding in the previous five years.”

“Drivers on the through roads were four times more likely to have reported a prior conviction for speeding than the drivers who were, in almost every case, moving off from a Stop sign.” [3]

It seems likely that a pedestrian attempting to cross a road might also be deceived by the approach of a car which is travelling unusually fast. Consequently, it is reasonable to assume that the case by case method of analysis used in the study of fatal pedestrian collisions, outlined above, has probably underestimated the importance of the role of travelling speed.

#### *Reductions in pedestrian casualties following a change in the speed limit from 60 to 50 km/h*

The default urban area speed limit was lowered from 60 to 50 km/h in South Australia on March 1, 2003 except on roads which were signed otherwise. In practice this meant virtually all urban arterial roads remained at 60 km/h, except in the central business district (CBD) of the City of Adelaide where the 50 km/h limit was introduced on all of the roads, with a few exceptions.

Anderson [5] estimated the reductions in pedestrian casualties attributable to the speed limit change in the three years before, and the three years after, it was introduced. Serious pedestrian casualties (those admitted to hospital or fatally injured) on the affected roads decreased by 36 percent Statewide, 31 percent in the Adelaide metropolitan area, and 39 percent in the CBD.

#### *Summarising the relationship between the urban area speed limit and the incidence of fatal pedestrian collisions based on these three studies*

It appears that the initial prediction [2] of a 30 percent reduction in fatal pedestrian collisions following a change in the urban area speed limit from 60 to 50 km/h is probably conservative. The individual case reconstruction method used in that study was shown to produce estimates of reductions in all casualty crashes that were less than those obtained from the relative risk curve in the case control study. The estimated reductions in serious pedestrian casualties on roads on which the speed limit became 50 km/h in South Australia were also greater than 30 percent. Nevertheless, it is assumed here that fatalities in pedestrian collisions will be 30 percent less if the urban area speed limit is 50 km/h rather than 60 km/h for the purpose of this study, for reasons which are discussed later in the paper.

## **Results**

The annual number of pedestrian fatalities in Australia increased rapidly through the 1950s to a peak of 873 in 1964. Since then it has decreased, more or less steadily, to 202 in 2007 (Figure 1).

From the year following metrication of the urban area speed limit, 1975, to 2007, inclusive, there were 14,417 pedestrians fatally injured in collisions with vehicles on Australian roads [7,8,9].

As the purpose of this study is to estimate what effect a different urban area speed limit to the 60 km/h that was chosen in 1974 would have had on pedestrian fatalities the first step is to document the number of fatalities which have occurred on 60 km/h roads. Figure 2 shows that information for Australia from 1989 to 2007, that being the time period for which data are available in the Australian Road Fatality Statistics maintained by the Australian Transport Safety Bureau.

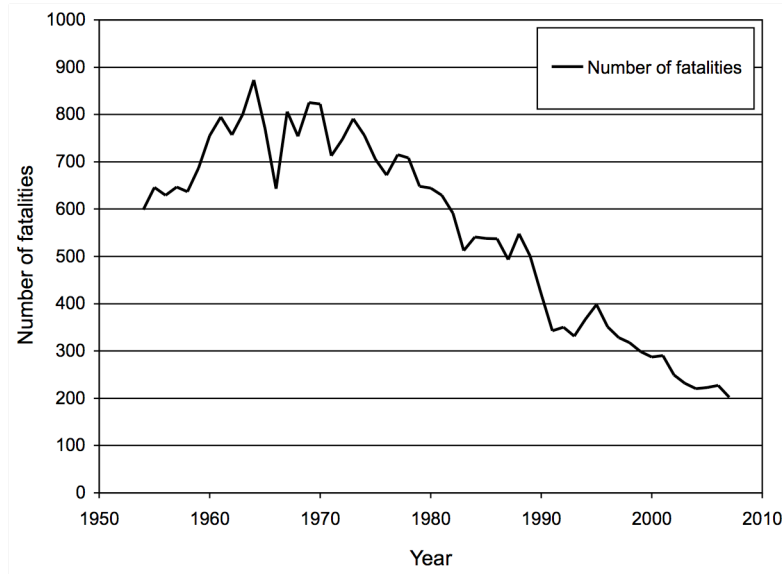


Figure 1: Annual pedestrian fatalities in Australia 1954 to 2007

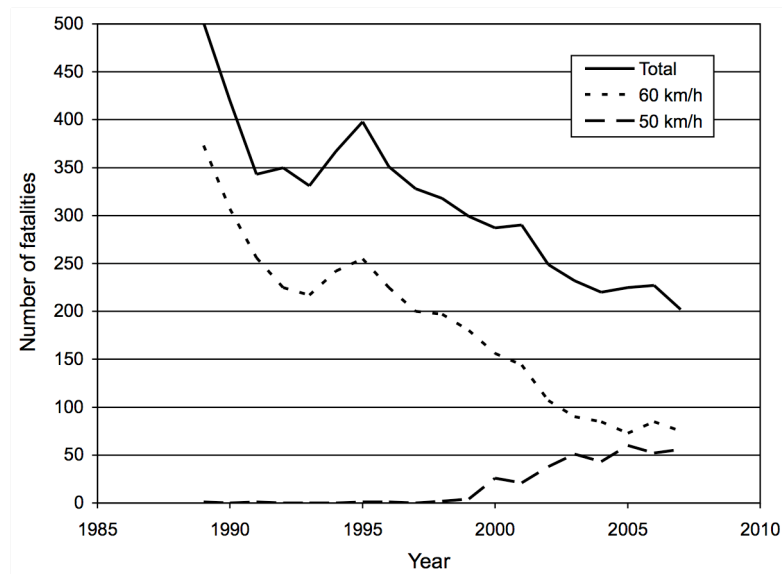


Figure 2: Pedestrian fatalities: Annual total and on 50 and 60 km/h roads in Australia 1989 to 2007

Figure 3 shows the percentage of pedestrian fatalities in Australia that occurred on 60 km/h speed limit roads from 1989 to 2007. It is notable that it decreased markedly during this time period. The decline from 2000 onwards is understandable because of the substantial increase in the number of fatalities on 50 km/h roads, presumably mainly as a consequence of an increase in the proportion of urban roads zoned with that speed limit. Other likely reasons for the decrease in the percentage of pedestrian fatalities on 60 km/h roads are a subject for another study.

Some information on the likely percentage of pedestrian fatalities on 60 km/h roads in the 1970s was found for South Australia, based simply on a metropolitan/rural criterion (which probably underestimates the percentage of interest because some fatalities in rural areas would have been in rural towns). In 1971 the percentage in the metropolitan area was 70; and in 1974, 80. Data from the South Australian Traffic Accident Reporting System, derived from Police reports, showed that from 1981 to 1999 the average was 82 percent and from 2000 to 2007, 69 percent (based on small numbers of cases). Australia-wide the average percentage was 67 for the years from 1989 to 1999, and 42 for 2000 to 2007.



**Figure 3:** Pedestrian fatalities: Annual percentage on 60 km/h roads in Australia 1989 to 2007

Based on this incomplete information, the assumption is made here that 75 percent of pedestrian fatalities in Australia occurred on 60 km/h roads from 1975 to 1988. For the remainder of the period of interest there is accurate information, as shown in Figure 3. These two sources of information yield an estimate of 9,194 pedestrians fatally injured on 60 km/h roads in Australia from 1975 to 2007, inclusive. Taking the figure of a 30 percent reduction in pedestrian fatalities had the chosen limit been 50 km/h, the choice of 60 km/h for the urban area speed limit has resulted in the deaths of 2,758 pedestrians in Australia since 1974.

## Discussion

### *Speed limit change and the effect on travelling speed*

The reasons given for the choice of 60 km/h for the metric speed limit in NSW included that:

“It was also shown by surveys that the higher limit would not, in reality, bring about any increase in vehicle speeds.” [1]

Presumably the surveys referred to had been conducted following the increase in the urban area speed limit from 30 to 35 mph.

There is now evidence that a speed limit change from 60 to 50 km/h is followed by a reduction in mean travelling speeds, albeit less than the reduction in the speed limit. Three years after the introduction of the default urban area speed limit of 50 km/h in South Australia in 2003 the mean free travelling speed had decreased by 3.6 km/h on affected roads [6]. As noted above, this reduction in mean free travelling speed was accompanied by a reduction of 23 percent in casualty crashes [6].

However, speed enforcement has changed markedly since 1974 in both methods and efficiency, notably with the introduction of speed cameras, and casual observation of travelling speeds indicates that there is an increasing awareness of compliance with speed limits. The extent to which this may be due to recognition of an increased risk of apprehension if speeding or to an increasing awareness of the association between travelling speed and the risk of crash involvement is not clear.

In any event, it is likely that compliance with the urban area speed limit was less in the 1970s than it is today. That could be taken to mean that a 10 km/h lower speed limit would have had less effect at that time on travelling speeds than it would today and so the estimate of a 30 percent reduction in pedestrian fatalities used in this paper may have been too high for that time period. On the other hand, the higher the mean free travelling speed is, the greater the reduction in crash risk from a given reduction in that mean

speed. That is because the risk of crash involvement increases rapidly with increasing travelling speed [3,4].

### Conclusion

The selection of a metric equivalent for the Australian urban area speed limit of 35 mph was made at a time when there was less knowledge and awareness than there is today of the close relationship between travelling speed and the risk of involvement in a casualty crash. Nevertheless, decisions on matters such as this are critically important. As noted above, the choice of 60 km/h rather than 50 km/h for the urban area speed limit has resulted in the deaths of about 2,700 pedestrians in Australia since 1974. On the arterial roads in our urban areas where the speed limit remains at 60 km/h, we are still counting.

### Acknowledgements

The study of the effect of travelling speed on pedestrian fatalities was funded by the Federal Office of Road Safety and was based on data collected with the support provided by the National Health and Medical Research Council. The speed case control study was funded by the Federal Office of Road Safety and Transport SA, with additional support from a Research Unit grant from the National Health and Medical Research Council. The study of the effect of the introduction of the default urban speed limit of 50 km/h in South Australia was funded by the South Australian Department of Transport, Energy and Infrastructure, and the study of pedestrian collisions in South Australia was funded by the South Australian Motor Accident Commission.

The Centre for Automotive Safety Research receives core funding from both the Motor Accident Commission and the Department of Transport, Energy and Infrastructure.

The views expressed in this paper are those of the authors and do not necessarily represent those of the University of Adelaide or the sponsoring organizations.

### References

1. NRMA. 1988. Road safety milestones. National Roads and Motorists' Association (NRMA) Sydney, 72 p.
2. McLean AJ, Anderson RWG, Farmer MJB, Lee BH and Brooks CG. 1994. Vehicle travel speeds and the incidence of fatal pedestrian collisions. Canberra: Federal Office of Road Safety: Report CR 146. 82 p.
3. Kloeden CN, McLean AJ, Moore VM, Ponte G. 1997. Travelling speed and the risk of crash involvement. Canberra: Federal Office of Road Safety. Report CR 172, 72 p.
4. Kloeden CN, McLean AJ, Glonek G. 2002. Reanalysis of travelling speed and the risk of crash involvement in Adelaide, South Australia. Canberra: Australian Transport Safety Bureau, Report CR 207, 32 p.
5. Anderson RWG. 2008. Pedestrian collisions in South Australia (CASR039). Adelaide: Centre for Automotive Safety Research, 52 p.
6. Kloeden CN, Woolley JE, McLean AJ. 2006. Further evaluation of the South Australian default 50 km/h speed limit (CASR034). Adelaide: Centre for Automotive Safety Research, 32 p.
7. Federal Office of Road Safety. 1984. Road traffic accident data and rates: Australia, States and Territories: 1925 to 1981. Canberra: Federal office of Road Safety. Report OR 7, 35 p.
8. Australian Transport Safety Bureau. 2005. Road deaths Australia: 2005 Statistical summary. Canberra, Australian Transport Safety Bureau, 48 p.
9. Australian Transport Safety Bureau. 2008. Australian Road Fatality Statistics. (web based) Canberra, Australian Transport Safety Bureau.