Session: Crash and Injury Analysis

Evaluation of the 50km/h Default Urban Speed Limit in South Australia

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Abstract
On the 1st March 2003 the Default Urban Speed Limit (DUSL) in South Australia was lowered from 60 km/h to 50 km/h. Since this date, all urban roads have a speed limit of 50 km/h unless otherwise signed. This paper reports the results of an evaluation of the effectiveness of the reduced DUSL and is based on speed surveys and crash data analysis. Vehicles speeds were measured at 52 randomly chosen sites across the State. Crash data was analysed by examining the crash history of all roads with a 50 km/h or 60 km/h speed limit, a year before and after the new DUSL was introduced. The study found that, on average, mean speeds have fallen by approximately 2.2 km/h on streets where the speed limit was reduced and by 0.7 km/h on arterial roads where 60 km/h speed limit signs were erected. There was a 19.8% reduction in casualty crashes on 50 km/h roads and a corresponding 4.6% reduction on 60 km/h arterial roads when compared with the previous year.

Introduction

From the 1st March 2003, the Default Urban Speed Limit (DUSL) in South Australia became 50 km/h unless otherwise signed. In practice this meant that all major roads outside the city were signposted at 60 km/h. The Department of Transport and Urban Planning (DTUP) erected approximately 4,000 signs on urban arterial roads, for which it is responsible. In addition, Local Government Authorities were able to nominate, with supporting evidence, which of their roads, if any, should remain at 60 km/h. Ultimately, however, DTUP could exercise its authority to determine the speed limit on these roads. The Adelaide City Council decided to adopt 50 km/h throughout most of its central city road network as did some large rural towns.

The change in limit was preceded by State Government mass media advertising on television and radio commencing on the 14 February 2003. The South Australian Police exercised a three month amnesty period for speed enforcement on 50 km/h roads from the 1st March 2003. The speed limit change generated some complaints from the community, particularly with regard to confusion about what the speed limit is on a given road. In response to this, DTUP arranged for 50 km/h reminder signs to be erected on problematic roads. With a few exceptions, DTUP chose not to install 50 km/h speed limit signs and refused requests to indicate the speed limit by means of pavement marking.

This paper reports on the results of an evaluation of the effectiveness of the reduced DUSL. The objectives of the evaluation were to determine the effectiveness of the new limit in terms of measured travelling speeds and changes in the number of crashes after implementation.

Vehicle Speeds

Methodology

DTUP arranged for speeds to be measured at 52 randomly selected sites across the state prior to 1 March 2003, when the 50 km/h default urban speed limit was introduced, and again approximately a year later. The sites consisted of the following:

- 10 main roads (arterials) which retained their 60 km/h speed limit
- 12 major residential roads (collectors) which were changed to the 50 km/h limit
- 18 residential streets (local roads) in the metropolitan area which were changed to the 50 km/h speed limit
- 12 residential streets (local roads) in rural townships which were changed to the 50 km/h speed limit

It was not certain what would happen to speeds on ongoing 60km/h roads and they were therefore included in the measurement exercise. Data were recorded using Metrocount traffic counters using a pair of pneumatic tubes laid across the carriageway. Surveys were conducted so that a minimum of 24 hours of traffic data was obtained during weekdays at each site. Measurement points were at straight mid-block sections located in such a manner to ensure that drivers could adopt their chosen speed without significant influence from the road alignment or junctions. The speeds of all vehicles in both directions of travel at each site for a full 24 hour period were used for analysis.

All Speeds

The speeds of all vehicles at each site were averaged both before and after the introduction of the 50 km/h default limit. The calculated change in mean speed for a clear majority of all sites, overall and within each road type, showed a reduction in the mean speed after the change in the default urban speed limit. Speeds on arterial roads, which retained their 60 km/h limit, were also observed to fall.

The overall reductions were calculated by taking the mean of all speeds measured on roads of the given road type before and after the change in the default urban speed limit (Table 1). The effect of this is to bias the overall mean speeds towards the sites with high traffic volumes. This is desirable for two reasons: it limits the effect of sites with small numbers of measurements which are subject to large random variation, and it is biased towards sites with the highest exposure and hence the highest expected crash numbers. The number of speeds measured in each of the road types where the speed limit was reduced was found to be roughly in proportion to the incidence of crashes on those road types.

Table 1 – Overall reductions in mean speed by road type

Road type	Reduction in mean speed (km/h)
Arterial (retained 60km/h speed limit)	0.85
Collector	1.92
Urban local	3.13
Rural local	1.40
All roads that changed to 50 km/h	2.29

Further useful information can be obtained by comparing the speed distributions by road type before and after the speed limit change as shown in Figure 1. In theory, a change to a lower speed limit should see the speed distribution shift towards lower speeds (ie to the left). Earlier studies in Adelaide also suggest that the distribution becomes narrower as the higher speed drivers slow down (Woolley, Dyson, Taylor, Zito and Stazic, 2002).

There is an obvious shift to the left for all of the speed distributions indicating an overall reduction in vehicle speeds. Furthermore, the distributions have narrowed slightly suggesting a small reduction in the range of speeds adopted by the majority of vehicles.

These figures do not reveal what is happening at the individual speed level. That is, did drivers who were travelling at, say, 60 km/h before the introduction of the 50 km/h speed limit reduce their travelling speed by the same amount as drivers who had travelled at 55 km/h? The following method was adopted for exploring this further. For a given road type, the observed speeds were rounded to the nearest integer and ranked separately for both 2002 and 2003. Then, for each distinct speed in the 2002 data, the corresponding percentile speeds in the 2003 data were averaged to obtain a corresponding speed. The results of this are shown in Figure 2.

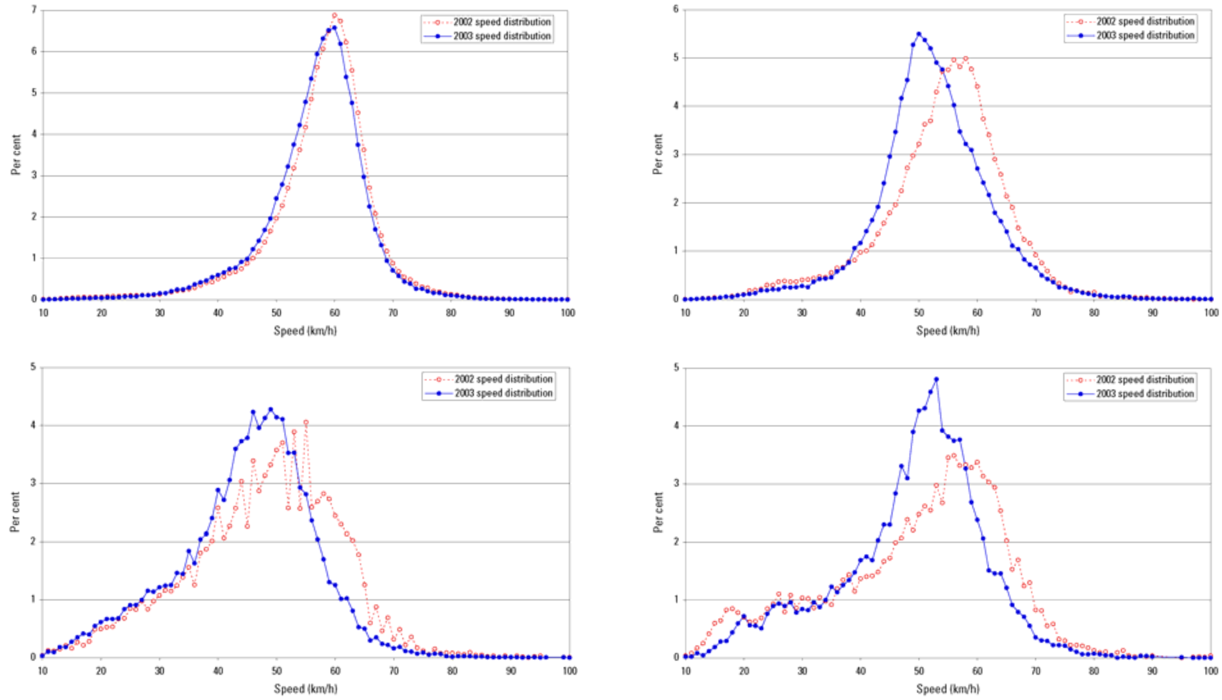

Figure 1 – Speed distributions before and after the change in limit by road type: arterials (top left), collectors (top right), urban local (bottom left), rural local (bottom right)

If we hypothetically assume that the same group of drivers travelled along each section of road in 2002 and 2003 and that they all maintained their rank in travelling speed relative to each other, then Figure 3 gives their change in speed in 2003 based on their speed in 2002.

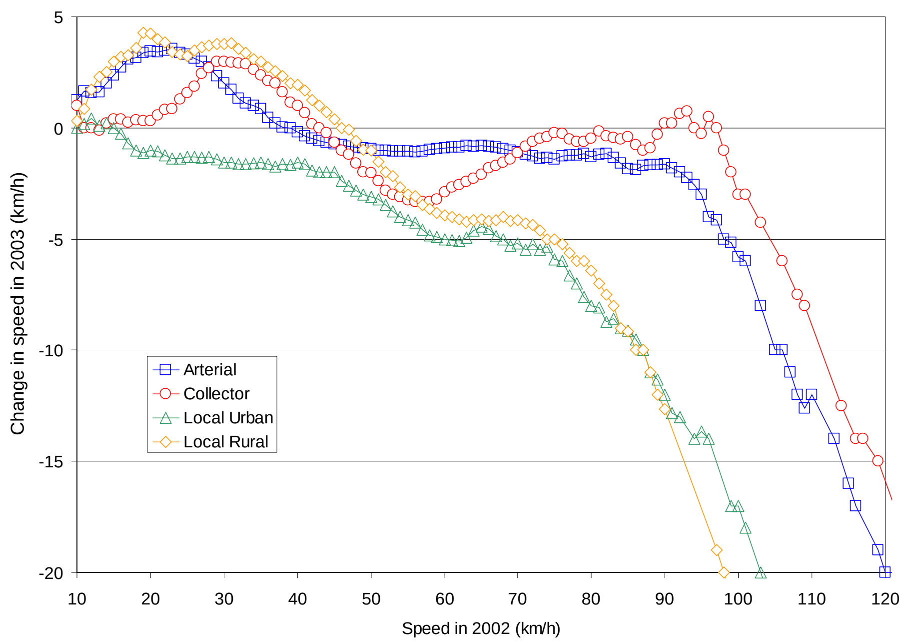

Figure 2 - Change in speed in 2003 by speed in 2002 by road type

The following is then apparent from Figure 2:

- Drivers on arterial roads travelling between 50 km/h and 70 km/h in 2002, slowed down by about 1 km/h in 2003.

- On collector roads, apart from the very high speeders, drivers travelling just below 60 km/h in 2002 slowed down the most in 2003
- On local streets both in urban and rural areas, the higher the speed in 2002, the greater the reduction in speed in 2003.
- Very slow drivers on most road types in 2002 tended to speed up in 2003. This effect was also observed when an area of Adelaide adopted a 40km/h speed limit (Woolley *et al*, 2002). However, the small numbers of vehicles at low speeds means that chance variation can have a large effect on the results.
- Very fast drivers on all road types in 2002 slowed down the most in 2003. Once again the small numbers of vehicles at high speeds means that chance variation can have a large effect on these results.

Free Speeds

While the speeds of all vehicles are the most relevant to crash causation in general, they do not capture the influence on drivers' freely chosen speeds under different conditions. This is because drivers in the middle of a platoon of traffic are limited to the speed of the vehicle in front of them and thus do not really have a free choice of their travelling speed.

In order to assess drivers' choice of speed it is preferable to restrict the analysis to free travelling speeds. A commonly adopted and accepted way to determine free travelling speeds is to select vehicles that are travelling at least four seconds behind the vehicle in front of them. Applying this filtering eliminates approximately 50 per cent of vehicles on arterial roads, 15 per cent on collector roads and 7 per cent on local roads. This reflects the higher degree of congestion and platooned vehicles due to traffic signals on the busier arterial and collector roads. On all road types, the percentage of vehicles with a free travelling speed dropped slightly in from 2002 to 2003.

The free travelling speeds were averaged at each site both before and after the introduction of the 50 km/h default limit. An overall change in mean free travelling speed was then calculated for each road type (Table 2).

Table 2 – Overall reductions in mean free travelling speed by road type

Road type	Reduction in mean free travelling speed (km/h)
Arterial (retained 60km/h speed limit)	0.72
Collector	1.77
Urban local	3.07
Rural local	1.17
All roads that changed to 50 km/h	2.19

As with all speeds, a clear majority of all sites, overall and within each road type, showed a reduction in the mean free travelling speed after the change in the DUSL. The distributions of free travelling speeds from the 2002 survey are compared with the 2003 survey in Figure 3.

There was an obvious shift to the left for all of the free travelling speed distributions indicating an overall reduction in free travelling speeds. Figure 4 reveals what is happening with individual free travelling speeds before and after the speed limit change. The figure is essentially similar to Figure 2 with the exception that higher speeds are expressed by the extremely faster drivers due to unconstrained traffic conditions (ie the effect of platooning has been filtered out).

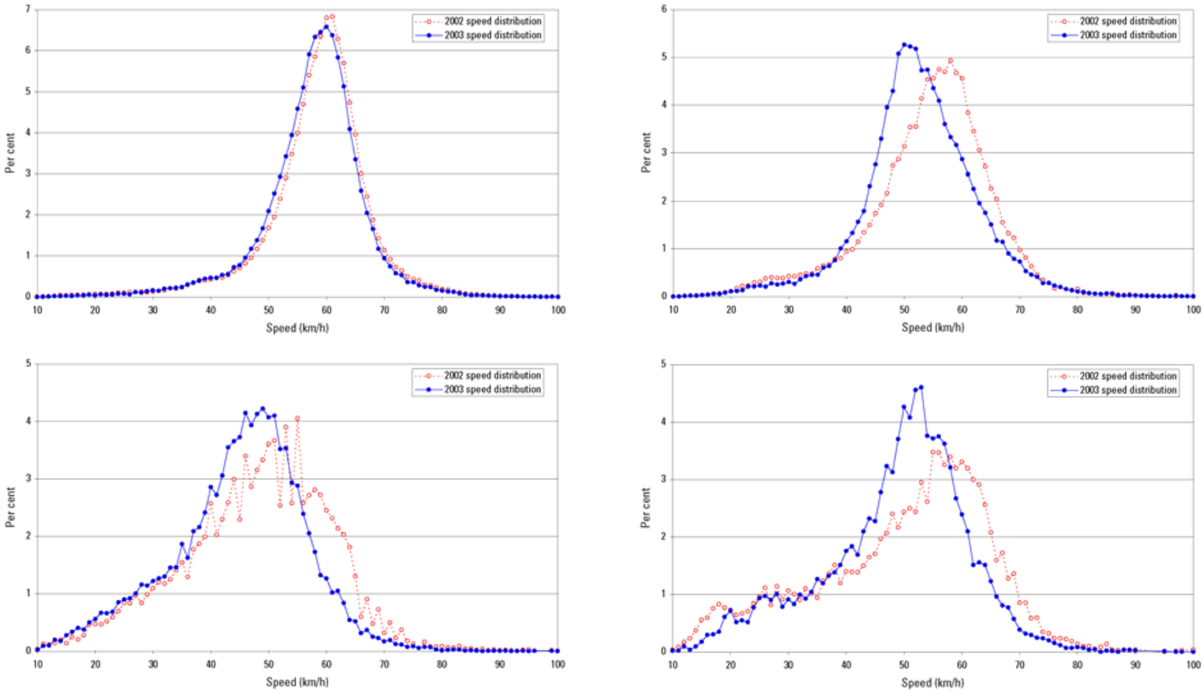

Figure 3 – Free speed distributions before and after the change in limit by road type: arterials (top left), collectors (top right), urban local (bottom left), rural local (bottom right)

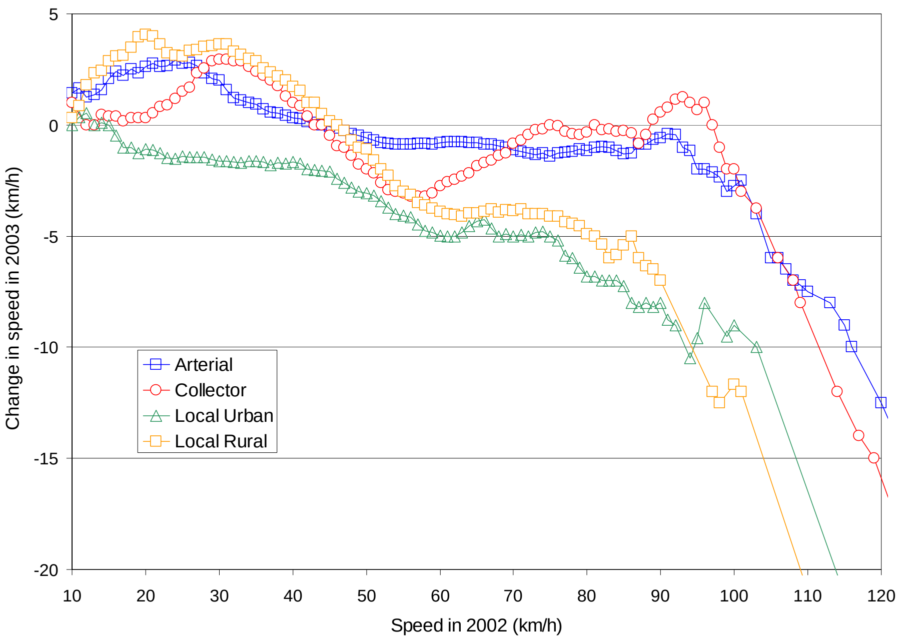

Figure 4 - Change in free speed in 2003 by free speed in 2002 by road type

Changes in casualty crash numbers

Crashes in South Australia are recorded by the police on a per report basis in their vehicle collision computer database system. This data is then further processed by DTUP into the Traffic Accident Reporting System database (TARS). The database current as of August 2004 for the years 1994-2004 was used for the analysis.

Property damage only crashes were not investigated due to the unavailability of the bulk of this data at the time of analysis.

An analysis of casualty crashes was performed comparing the year immediately before and after the introduction of the 50 km/h DUSL. The method reported here tests for statistical significance at the five per cent level based on a comparison of the crash data assuming a Poisson distribution. Other tests incorporating annual trend data were also performed and are mentioned in the discussion.

Casualty crashes on roads going from 60 km/h to 50 km/h

Since the 50 km/h default limit was introduced on 1 March 2003 casualty crash numbers for March 2003 - February 2004 were compared with the corresponding March - February casualty crash numbers for previous years as shown in Figure 5. A slight upward trend is apparent up until 2002 with a big reduction after the change of speed limit.

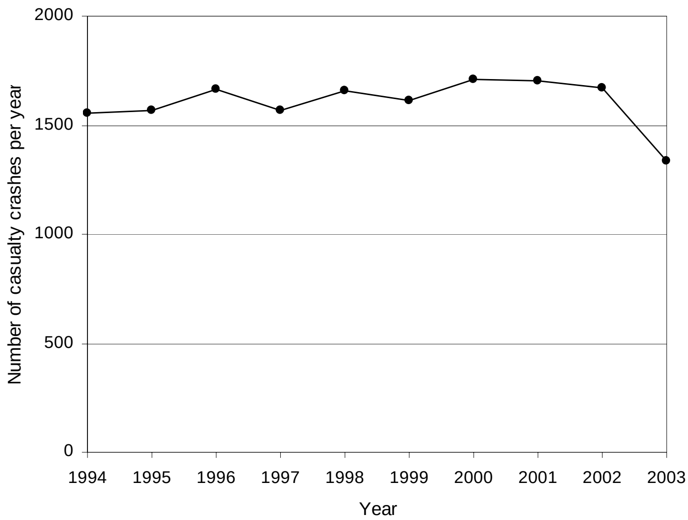

Figure 5 – Annual number of casualty crashes from March 1994 to February 2004 on those South Australian roads where the speed limit was reduced from 60 km/h to 50 km/h on 1 March 2003

Table 3 breaks down the casualty crashes by the severity of the most severely injured person involved in the crash and compares the year after the DUSL was reduced to the year before. The number of cases in all levels of injury severity fell after the speed limit was reduced and the two groups with the largest numbers showed statistically significant drops along with total casualty crashes.

Table 3 – Crashes on roads that changed from 60 to 50 km/h by crash injury severity

Crash injury severity	Mar 2002 - Feb 2003 60 km/h limit	Mar 2003 - Feb 2004 50 km/h limit	Per cent change	Statistical significance ($p < 0.05$)
Private doctor	527	452	-14.2	significant
Hospital treated	895	676	-24.5	significant
Hospital admitted	233	202	-13.3	ns
Fatal	13	8	-38.5	ns
Total casualty crashes	1668	1338	-19.8	significant

Table 4 examines individual casualty numbers by the severity of the injury to the casualty and compares the year after the default limit was reduced to the year before. The number of cases in all levels of injury severity fell after the speed limit was reduced and the two groups with the largest numbers showed statistically significant drops along with total casualties. The reductions in the number of casualties was greater than for the corresponding reduction in the number of casualty crashes indicating that, on average, fewer people were as severely injured per crash following the speed limit reduction.

Table 4 – Casualties in crashes on roads that changed from 60 to 50 km/h by casualty severity

Casualty severity	Mar 2002 - Feb 2003 60 km/h limit	Mar 2003 - Feb 2004 50 km/h limit	Per cent change	Statistical significance ($p < 0.05$)
Private doctor	627	524	-16.4	significant
Hospital treated	1198	846	-29.4	significant
Hospital admitted	262	228	-13.0	ns
Fatal	14	8	-42.9	ns
Total casualties	2101	1606	-23.6	significant

The reductions in casualty crash and casualty numbers in the first year after the default limit was introduced compared to the year before are presented in Table 5.

Table 5 – First year reductions in casualty crashes and crash casualties on roads that changed from 60 to 50km/h

Measure	First year reduction
Total number of casualty crashes	330
Number of private doctor crashes	75
Number of hospital treatment crashes	219
Number of hospital admission crashes	31
Number of fatal crashes	5
Total number of casualties	495
Number of private doctor casualties	103
Number of hospital treated casualties	352
Number of hospital admissions	34
Number of fatalities	6

Table 6 shows the crash types and compares the year after the default limit was reduced to the year before. All crash types except “head on”, “left road out of control” and “hit animal” showed reductions with “right angle”, “rear end”, “side swipe” and “right turn” being statistically significant in their own right.

Table 6 – Casualty crashes on roads that went from 60 to 50 km/h by crash type

Crash type	Mar 2002 - Feb 2003 60 km/h limit	Mar 2003 - Feb 2004 50 km/h limit	Per cent change	Statistical significance ($p < 0.05$)
Right angle	434	300	-30.9	significant
Hit fixed object	317	286	-9.8	ns
Rear end	311	246	-20.9	significant
Hit pedestrian	167	154	-7.8	ns
Side swipe	116	87	-25.0	significant
Right turn	96	66	-31.3	significant
Hit parked vehicle	82	69	-15.9	ns
Roll over	54	42	-22.2	ns
Head on	41	44	7.3	ns
Other	33	27	-18.2	ns
Left road - out of control	8	8	0.0	ns
Hit object on road	7	6	-14.3	Ns
Hit animal	2	3	50.0	Ns
Total	1668	1338	-19.8	significant

Casualty crashes on roads remaining at 60 km/h

Since the 50 km/h default limit was introduced on 1 March 2003 casualty crash numbers for March 2003 - February 2004 were compared with the corresponding March - February casualty crash numbers for previous years as shown in Figure 6. It is not clear why there is a reduction in 2002 preceding the introduction of the 50 km/h DUSL.

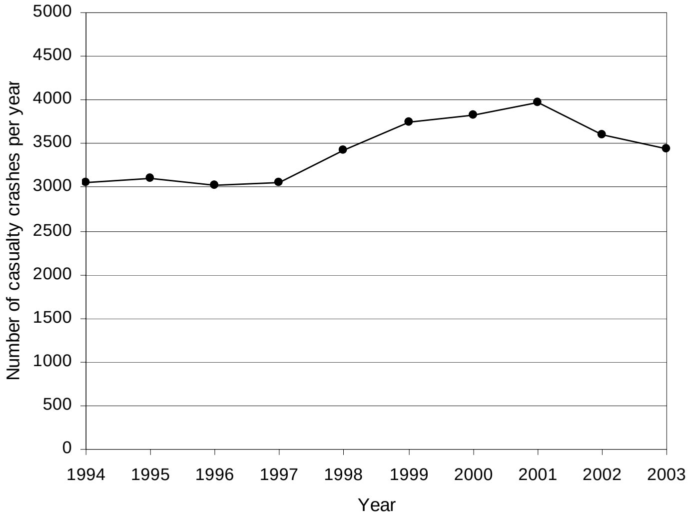

Figure 6 – Annual number of casualty crashes from March 1994 to February 2004 on those South Australian roads where the speed limit was reduced from 60 km/h to 50 km/h on 1 March 2003

Table 7 breaks down the casualty crashes by the severity of the most severely injured person involved in the crash and compares the year after the default limit was reduced to the year before. The number of cases in all levels of injury severity, except treatment by private doctor, fell after the speed limit was reduced although only hospital treated crashes and total casualty crashes showed statistically significant changes.

Table 7 – Crashes on roads that remained at 60 km/h by crash injury severity

Crash injury severity	Mar 2002 - Feb 2003 60 km/h limit	Mar 2003 - Feb 2004 50 km/h limit	Per cent change	Statistical significance ($P < 0.05$)
Private doctor	1505	1506	0.1	ns
Hospital treated	1686	1545	-8.4	significant
Hospital admitted	385	367	-4.7	ns
Fatal	31	24	-22.6	ns
Total casualty crashes	3607	3442	-4.6	significant

An examination of individual casualty numbers by the severity of the injury a year before and after the DUSL was introduced was made. The number of cases in all levels of injury severity fell after the speed limit was reduced although only “hospital treated casualties” and “total casualties” showed statistically significant reductions. The reductions in the number of casualties were all greater than for the corresponding reductions in the number of casualty crashes indicating that, on average, fewer people were as severely injured per crash following the speed limit reduction.

Discussion

The introduction of the 50 km/h DUSL on 1st March 2003 has coincided with a reduction of vehicle speeds and casualty crashes. Correlation alone does not, of course, demonstrate causation. However, many things would suggest that the lower DUSL played a major part in these reductions:

- Other states have experienced similar speed and crash reductions when a 50 km/h DUSL was introduced
- There is a growing body of research literature which points to lower casualty crashes and injuries from lower vehicle speeds (such as Kloeden, McLean, Moore and Ponte, 1997; Kloeden, McLean and Glonek, 2002; Taylor, Baruya and Kennedy, 2001; and Nilsson 1993).
- There are sound physical and epidemiological reasons why casualties would decrease with the lowering of vehicle speeds

In other words, it makes sense that speeds and crashes should reduce as a result of a lower DUSL, and it is more than likely that the observed reductions on 50 km/h roads are largely due to the lower DUSL. Statistically, the overall reduction in casualty crashes was significant and unlikely to be due to chance variation. Space does not permit a discussion of other tests performed taking into account annual crash data back to 1994. However these tests have indicated even greater statistical significance for the reduction in casualty crashes on 50 km/h roads.

Still unexplained, however, are the reduction of casualty crashes and the reduction in speeds on 60 km/h arterial roads. The latter phenomenon has also been observed in other jurisdictions in Australia such as Western Australia and the ACT when a 50km/h DUSL was introduced (Kidd and Radalj, 2003; and Green, Gunatillake and Styles, 2003). An untested hypothesis is the possibility that publicity and awareness generated on speed limits amongst the community prior to 1st March 2003 may have led to reduced travelling speeds on major roads. Linked to this is the fact that numerous 60 km/h signs were erected where they did not previously exist and there was confusion by many in relation to what the speed limit was on many roads.

Figure 6 shows a downwards trend in casualty crashes preceding the introduction of the 50 km/h DUSL. Given that we do not have any speed measurements for the years before 2002, it is impossible to conclude to what extent reduced travelling speeds have contributed to the overall crash reductions during 2002.

Conclusions

This paper presented an analysis of speeds and casualty crashes before and after the introduction of a 50 km/h DUSL in South Australia. The analysis showed that overall mean speeds on roads that changed from 60 to 50 km/h dropped by 2.2 km/h and mean speeds on major roads that retained their 60km/h limit dropped by 0.7 km/h. Coincident with the lower DUSL, casualty crashes fell by 19.8% on roads which changed to 50 km/h and 4.6% on major roads which remained at 60 km/h. Whilst we cannot prove causation, there are good reasons for believing that the DUSL was the single greatest contributor to these reductions on roads that changed their speed from 60 to 50 km/h.

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