A Follow-up 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. An initial evaluation one year after the change showed that vehicle speeds and crashes had reduced on local roads with the 50 km/h limit and also on arterial roads that were signposted at 60 km/h. This paper reports the results of a follow up evaluation three years after the DUSL was introduced. Vehicles speeds were measured at the same 52 randomly chosen sites across the State. On-road speeds just before the default limit was introduced were compared with speeds measured one and three years later.. Crash data was analysed by examining the crash history of all roads with a 50 km/h or 60 km/h speed limit, three years before and after the new DUSL was introduced. The study found that, on average, mean speeds had fallen by approximately 3.8 km/h on streets where the speed limit was reduced and by 2.1 km/h on arterial roads where 60 km/h speed limit signs were erected. There was a 23% reduction in casualty crashes on 50 km/h roads and a corresponding 16% reduction on 60 km/h arterial roads.

Introduction

On the 1st March 2003, the Default Urban Speed Limit (DUSL) in South Australia was reduced from 60 km/h to 50 km/h. In practice this meant that a large number of local and collector roads had their speed limits lowered. Motorists were advised that the speed limit was 50 km/h unless otherwise signed. Most urban arterial roads maintained their 60 km/h speed limit and the Department of Transport, Energy and Infrastructure (DTEI) erected approximately 4,000 60 km/h signs on these roads. 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, DTEI 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.

IN 2004 the Centre for Automotive Safety Research (CASR) was commissioned by DTEI to conduct an evaluation of the DUSL in terms of changes in travelling speeds and casualty crash numbers. The results of that study were reported in Kloeden, Woolley and McLean (2004)

This paper expands on the previous study with a new set of speed measurements two years on and an additional two years of casualty crash data.

Vehicle Speeds

Methodology

DTEI 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. These measurements were then repeated at the same sites one year later in 2003 and again in 2005. The sites consisted of the following road types:

- 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 60 km/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 in each of the three years . 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 mean speeds were calculated by taking the mean of all speeds measured on roads of the given road type in a given year. 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. The differences between years is shown in Table 1.

Table 1 – Overall relative reductions in mean speed by road type

Road type	Reduction in mean speed (km/h) in 2003 from 2002	Reduction in mean speed (km/h) in 2005 from 2003	Reduction in mean speed (km/h) in 2005 from 2002
Arterial*	0.85	1.21	2.07
Collector	1.92	1.71	3.63
Urban local	3.12	1.15	4.28
Rural local	1.33	1.71	3.04
All roads changed to 50 km/h	2.28	1.47	3.75

* Arterial roads retained a 60 km/h speed limit

Clear reductions in mean speeds are evident on all road types in the year following the introduction of the 50 km/h DUSL. Smaller but continuing reductions are evident two years later. Overall speed reductions comparing 2002 to 2005 are relatively large, especially on roads where the speed limit was reduced to 50 km/h.

Further useful information can be obtained by comparing the speed distributions by road type for each year 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).

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 when compared with the before measurements 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 2002 and 2005. Then, for each distinct speed in the 2002 data, the corresponding percentile speeds in the 2005 data were averaged to obtain a corresponding speed.

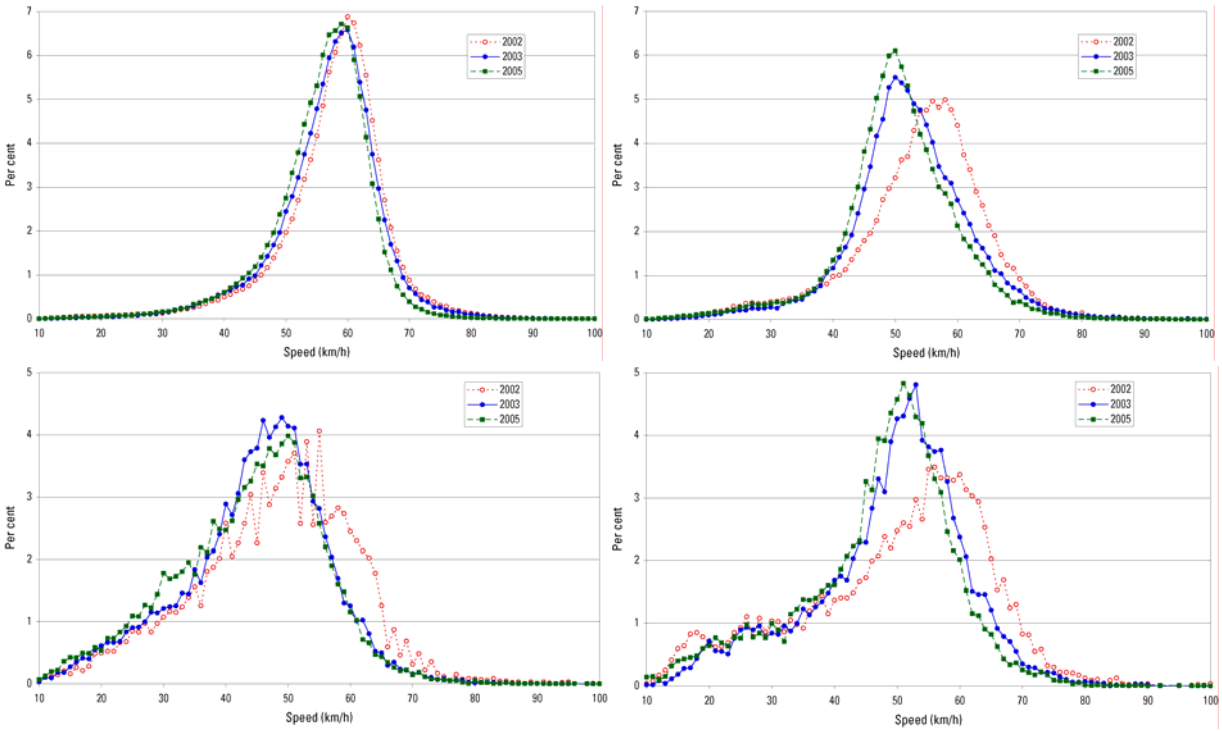

Figure 1 – Speed distributions before and after the change in limit by road type: arterials (top left), collectors (top right), urban local (bottom left), rural local (bottom right)

If we hypothetically assume that the same group of drivers travelled along each section of road in each survey and that they all maintained their rank in travelling speed relative to each other, then Figure 2 gives their change in speed in 2005 based on their speed in 2002.

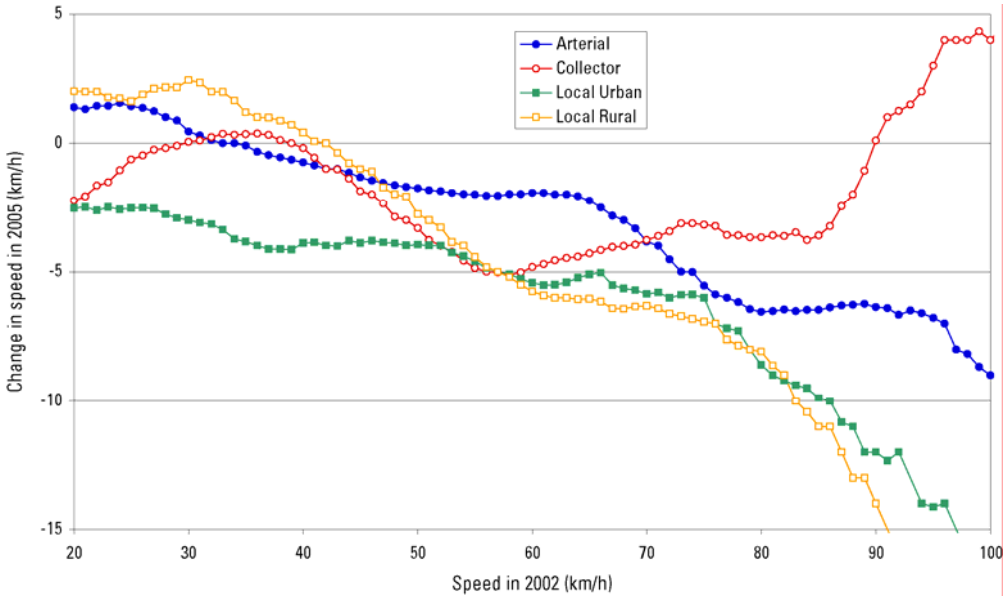

Figure 2 - Change in speed in 2005 by speed in 2002 by road type

This method was used to also compare changes in speeds between the 2002 and 2003, and the 2003 and 2005 speed measurements. The following was found from these comparisons:

- Very fast drivers (80 km/h and above) on all road types (except for collector roads) in 2002 slowed down the most in 2005 (although the small numbers of

vehicles at high speeds means that chance variation can have a large effect on these results).

- Drivers on arterial roads at speeds above 65 km/h, slowed down more in 2005 compared to 2003, and more than in 2003 compared to 2002.
- On collector roads, 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 travelling speed in 2002, the greater the reduction in speed in 2003 although this was somewhat reversed in 2005 compared to 2003.
- Very slow drivers (below about 45 km/h) on most road types in 2002 tended to speed up in 2003 and slow down in 2005 (although, once again, the small numbers of vehicles at low speeds means that chance variation can have a large effect on the 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 increased slightly from 2002 to 2005.

The free travelling speeds of all vehicles were averaged at each site for each of the three years and the 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) in 2003 from 2002	Reduction in mean free travelling speed (km/h) in 2005 from 2003	Reduction in mean free travelling speed (km/h) in 2005 from 2002
Arterial*	0.72	1.57	2.29
Collector	1.77	1.76	3.53
Urban local	3.07	1.09	4.16
Rural local	1.17	1.57	2.74
All roads changed to 50 km/h	2.19	1.43	3.62

* Arterial roads retained a 60 km/h speed limit

Out of the 52 sites: 11 (21%) had higher mean free travelling speeds in 2003 compared to 2002; 11 (21%) had higher mean free travelling speeds in 2005 compared to 2003; 5 (10%) had higher mean free travelling speeds in 2005 compared to 2002. Overall and within each road type, the mean free travelling speed of vehicles is clearly trending down over time.

The distributions of free travelling speeds from the 2002, 2003 and 2005 surveys are shown in Figure 3. There is an obvious shift to the left for all of the free travelling speed distributions indicating an overall reduction in free travelling speeds.

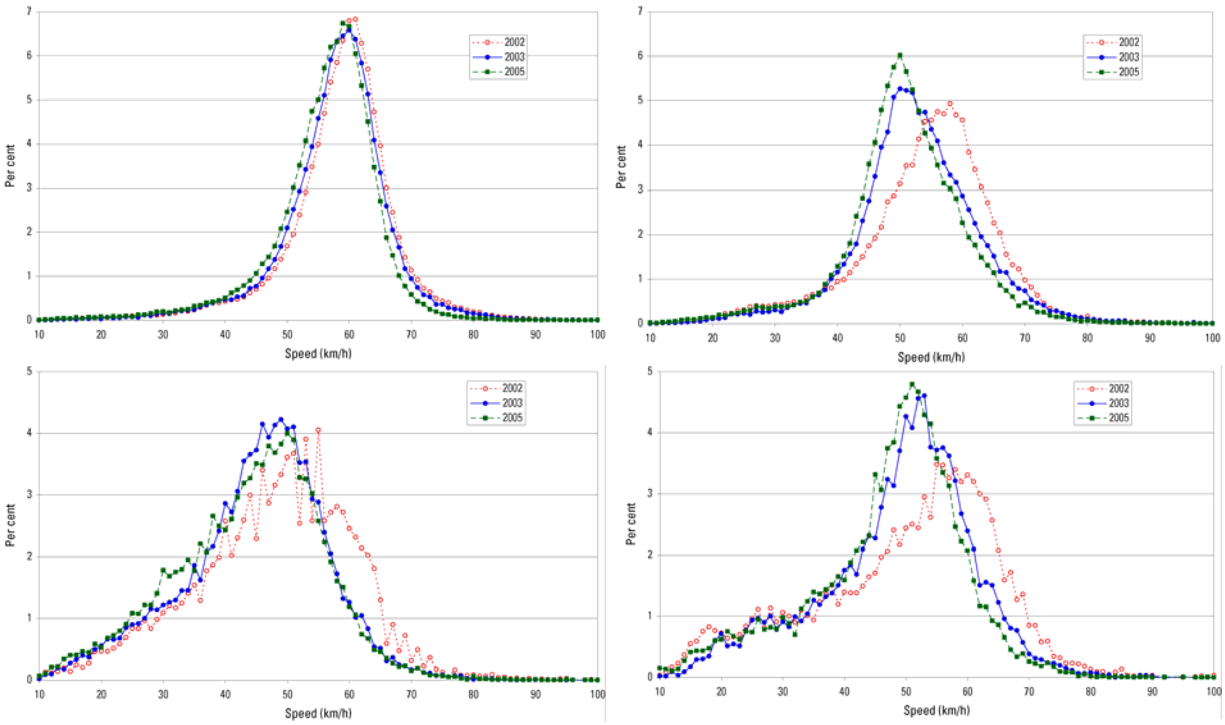

Figure 3 – Free speed distributions before (2002) and after (2003 and 2005) the change in limit by road type: arterials (top left), collectors (top right), urban local (bottom left), rural local (bottom right)

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 for speeds up to 80 km/h and the same general observations apply.

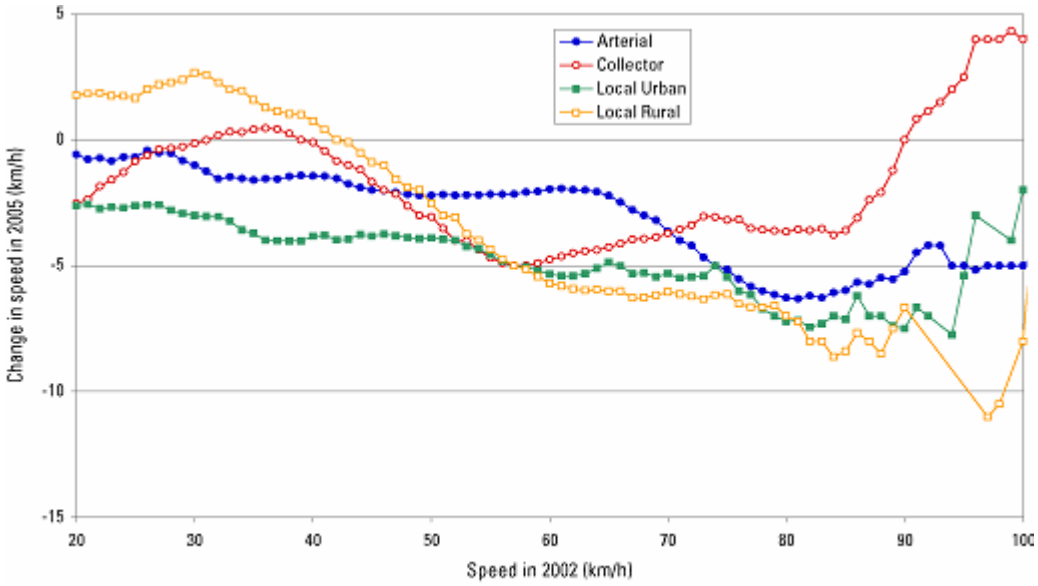

Figure 4 - Change in free speed in 2005 by free speed in 2002 by road type

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 DTEI into the Traffic Accident Reporting System database (TARS). The database current as of November 2006 for the period March 1994 to February 2006 was used for the analysis.

An analysis of casualty crashes was performed comparing the three years immediately before and the three years immediately 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 from March in a given year to February in the following year inclusive were compared for given years ranging from 1994 to 2005. A slight upward trend is apparent until 2002 when there was a marked reduction, which continued through 2005.

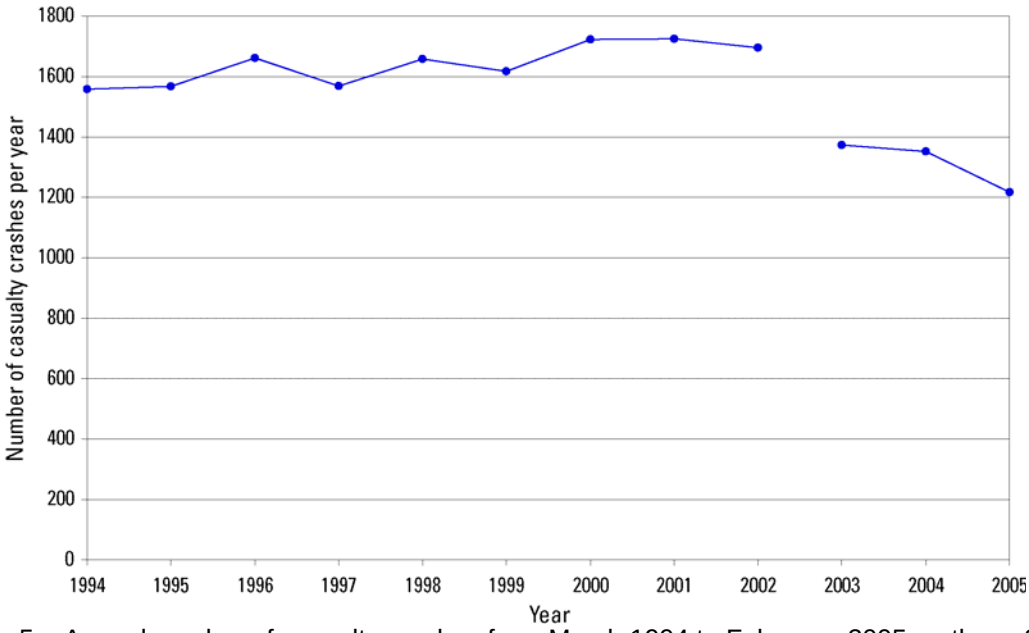

Figure 5 – Annual number of casualty crashes from March 1994 to February 2005 on those South Australian roads where the speed limit was reduced from 60 km/h to 50 km/h on 1 March 2003

Table 3 breaks down the casualty crashes by the severity of the most severely injured person involved in the crash in terms of the outcome, or treatment required, and compares the three years after the DUSL was reduced to the three years before. The number of cases in all levels of injury severity fell by statistically significant amounts ranging from 20 to 40 per cent after the speed limit was reduced.

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

Crash injury severity	Mar 2000 - Feb 2003 60 km/h limit	Mar 2003 - Feb 2006 50 km/h limit	Per cent reduction	95% confidence limits of % reduction
Private doctor	1686	1255	25.6	19.3, 31.9
Hospital treated	2659	2053	22.8	17.7, 27.9
Hospital admitted	759	610	19.6	10.1, 29.2
Fatal	40	24	40.0	0.8, 79.2
Total casualty crashes	5144	3942	23.4	19.7, 27.0

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 2000 - Feb 2003 60 km/h limit	Mar 2003 - Feb 2006 50 km/h limit	Per cent reduction	95% confidence limits of % reduction
Private doctor	2012	1441	28.4	22.7, 34.1
Hospital treated	3485	2612	25.1	20.7, 29.4
Hospital admitted	891	683	23.3	14.6, 32.1
Fatal	41	26	36.6	-2.5, 75.7
Total casualties	6429	4762	25.9	22.7, 29.2

The average reductions in casualty crashes and casualties per year comparing the three year period after the default limit was introduced to the three year period 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	Average reduction per year
Total number of casualty crashes	401
Number of private doctor crashes	144
Number of hospital treatment crashes	202
Number of hospital admission crashes	50
Number of fatal crashes	5
Total number of casualties	556
Number of private doctor casualties	190
Number of hospital treated casualties	291
Number of hospital admissions	69
Number of fatalities	5

Table 6 shows the crash types and compares the three years after the default limit was reduced to the three years before. All crash types except “other” showed reductions with several of them being statistically significant in their own right. It is interesting to note that the three crash types with the largest reductions all involve the detection of other vehicles and judgements about their speeds.

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

Crash type	Mar 2000 - Feb 2003 60 km/h limit	Mar 2003 - Feb 2006 50 km/h limit	Per cent reduction	Statistical significance*
Right turn	322	180	44.1	significant
Right angle	1346	926	31.2	significant
Rear end	928	647	30.3	significant
Left road - out of control	31	23	25.8	-
Hit parked vehicle	272	205	24.6	significant
Hit object on road	14	11	21.4	-
Hit pedestrian	573	455	20.6	significant
Side swipe	349	291	16.6	significant
Head on	155	135	12.9	-
Hit animal	8	7	12.5	-
Roll over	141	126	10.6	-
Hit fixed object	921	852	7.5	-
Other	84	84	0.0	-
Total	5144	3942	23.4	significant

* $p < 0.05$

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 from March in a given year to February in the following year inclusive were compared for given years ranging from 1994 to 2005. An upward trend is apparent from 1997 to 2001 with a continuing reduction evident from 2002 onwards.

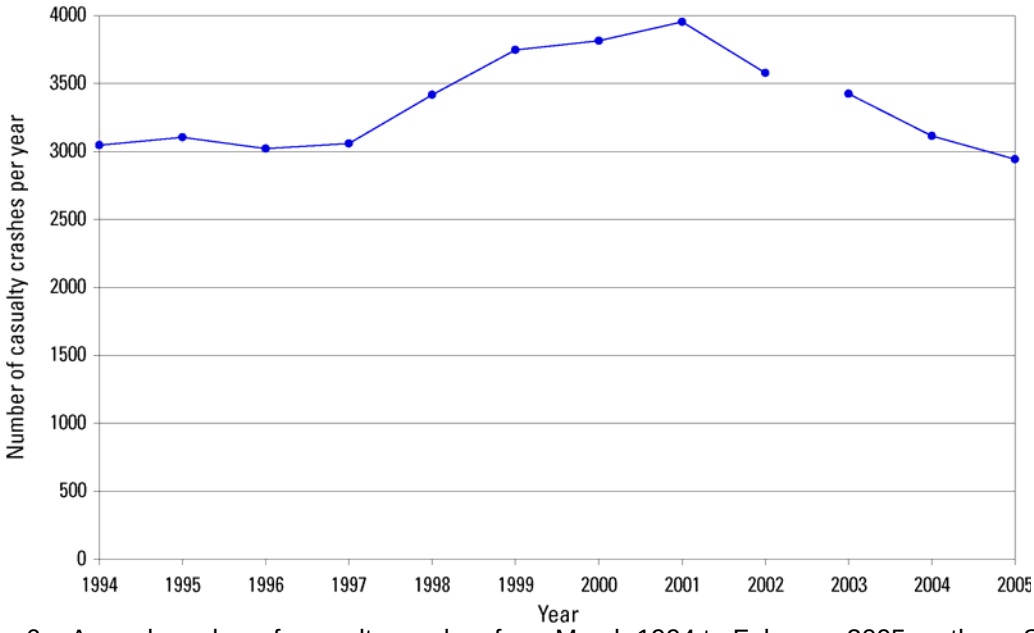

Figure 6 – Annual number of casualty crashes from March 1994 to February 2005 on those South Australian roads where the speed limit was reduced from 60 km/h to 50 km/h on 1 March 2003

Table 7 breaks down the casualty crashes by the severity of the most severely injured person involved in the crash and compares the three years after the default limit was reduced to the three years before. There was an overall reduction of 16 per cent in all casualty crashes and the number of cases in all levels of injury severity, except fatals, fell by a statistically significant amount after the speed limit was reduced.

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

Crash injury severity	Mar 2000 - Feb 2003	Mar 2003 - Feb 2006	Per cent reduction	95% confidence limits of % reduction
Private doctor	4885	3959	19.0	15.2, 22.7
Hospital treated	5158	4471	13.3	9.6, 17.0
Hospital admitted	1199	962	19.8	12.2, 27.4
Fatal	110	93	15.5	-9.9, 40.8
Total casualty crashes	11352	9485	16.4	14.0, 18.9

An examination of individual casualty numbers by the severity of the injury three years before and three years after the DUSL was introduced was made (Table 8). The number of cases in all levels of injury severity fell after the speed limit was reduced and all groups, apart from fatals, showed statistically significant reductions. The percentage reduction in the overall number of casualties (18.3%) was greater than for the corresponding percentage reduction in the overall number of casualty crashes indicating that, on average, fewer people were as severely injured per crash following the introduction of the default 50 limit.

Table 8 – Casualties in crashes on roads that remained at 60 km/h by crash injury severity

Casualty severity	Mar 2000 - Feb 2003	Mar 2003 - Feb 2006	Per cent reduction	95% confidence limits of % reduction
Private doctor	5937	4733	20.3	16.9, 23.7
Hospital treated	7138	6009	15.8	12.7, 19.0
Hospital admitted	1486	1157	22.1	15.4, 28.9
Fatal	120	97	19.2	-4.9, 43.2
Total casualties	14681	11996	18.3	16.1, 20.5

Discussion

Average travelling speeds continued to fall over the three observation surveys for roads that reduced their speed limit from 60 km/h to 50 km/h and also roads that maintained their 60 km/h speed limit. The latter observation is still unexplained however similar observations have been made in other jurisdictions when the 50 km/h DUSL was introduced (Kidd and Radalj, 2003; and Green, Gunatillake and Styles, 2003). 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, we cannot conclude to what extent reduced travelling speeds have contributed to the overall crash reductions during 2002 on arterial roads. However, it is reasonable to assume that reduced speeds played a meaningful role, for the reasons outlined in the next paragraph.

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 is reasonable to conclude 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.

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 2.3 km/h in the first year and an additional 1.5 km/h by the third year and 3.8 km/h overall. Mean speeds on major roads that retained their 60 km/h limit dropped by 0.7 km/h in the first year and an additional 1.2 km/h by the third year and 2.1 km/h overall. Casualty crashes fell by 23% (401 fewer casualty crashes per year) on roads which changed to 50 km/h and 16% (622 fewer casualty crashes per year) 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 where the speed limit was changed from 60 to 50 km/h.

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