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TITLE

Reduction of speed limit from 110 km/h to 100 km/h on certain roads in South Australia: a preliminary evaluation

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ABSTRACT

In July 2003, the speed limit on approximately 1,100 km of rural arterial roads in South Australia was reduced from 110 km/h to 100 km/h. The crash experience on these roads in the two years before and the two years following the change has been compared with that on other roads where the 110 km/h limit was not changed.. It appears that the speed limit reduction has had the effect of reducing casualty crashes by 20 per cent. However, the number of crashes on these roads is small and the time since the change is so short that this estimate is uncertain. It is reasonable to think that in the longer term the change might be anywhere between an increase of 4 per cent and a decrease of 44 per cent. There was a decrease in crashes and casualties on the 110 km/h roads where the speed limit did not change and that has been allowed for in the calculations. At six sites, speed measurements before and after the speed limit reduction were available: an average speed reduction of 2 km/h was found.

KEYWORDS

Speed limit, Rural area, Arterial road, Accident rate, Data analysis

Summary

In July 2003, the speed limit on approximately 1,100 km of rural arterial roads (73 road sections) in South Australia was reduced from 110 km/h to 100 km/h.

A limited dataset of measured speeds at six sites indicated a 2 km/h reduction in average travelling speed following the speed limit being lowered.

The crash experience on the changed roads in the two years before and the two years following the lowering of the speed limit was compared with that on other roads where the 110 km/h limit was not changed. The present evidence is that the speed limit reduction has had the effect of reducing casualty crashes on the changed roads by 20 per cent, casualties by 19 per cent, and the annual injury cost to the South Australian community by more than $9 million per year. These reductions are above and beyond a 12 per cent reduction in casualty crashes and a 15 per cent reduction in casualties on the 110 km/h roads where the speed limit was not changed. However, there is a substantial degree of uncertainty in these estimates.

Contents

1 Introduction

In July 2003, the speed limit on certain stretches of road in South Australia was reduced from 110 km/h to 100 km/h. This Report details the crash experience in the two years before and the two years following the change, from July 2003 to July 2005. Comparison is made with roads where the speed limit remained at 110 km/h. A limited dataset on vehicle speeds before and after the speed limit change was available, and is also analysed.

The 73 sections of road where the speed limit was altered are outside the Adelaide metropolitan area, spread across southern South Australia in the areas of the Barossa, Fleurieu Peninsula, Mallee, Mid North, South East, River Murray, Riverland, Yorke Peninsula and Kangaroo Island. The total length of the affected road network is 1,060.3 kilometres. The road sections are rural arterial roads, sealed main traffic routes connecting country towns, with the sections starting and ending outside of the town areas.

2 Method of estimating the effect of the speed limit reduction on casualty crashes

The speed limit was reduced from 110 km/h to 100 km/h on 48 roads in country South Australia. Some of these roads run through towns and have other speed limits assigned in these sections, which splits the altered road network into 73 separate sections of road. A list of the roads where the speed limit was altered was supplied by the South Australian Department for Transport, Energy and Infrastructure (DTEI) with the sections of road identified by running distances. A running distance identifies a location on a road by defining its distance along that road from a specified start point. For example, a road that runs between two intersections will have a running distance set at zero at one intersection and a running distance equal to the total length of that road at the location of the other intersection. In this way all locations along the road can be defined by the distance from the zero point.

The DTEI Traffic Accident Reporting System (TARS) database was the source of all crash and casualty data used in this analysis. The TARS database contains all casualty crashes that are reported to the police in South Australia and is maintained by (DTEI). Currently, reliable data is available for the years 1981 to 2004 and the first half of 2005. The location of a crash is specified in one of three ways: at an intersection between two roads, within a road section between two intersections, or at a running distance along a road.

To identify all of the crashes that occurred within the altered road sections, three lists were compiled, identifying each possible crash location within the road sections by using the three ways of describing locations. The lists were of the intersections, of the road numbers and the beginning and ending running distances, and of the pairs of intersecting roads. This process of identifying the relevant road sections was a complex one; if any minor errors crept in, their effect should at least cancel out, as the same set of location descriptors were used for the data both before and after the speed limit change.

Having identified the relevant roads, the numbers of crashes occurring before and after the change can be compared. It is usually better to have a control group than make a simple before-after comparison in order to remove the effects of any differences or trends unrelated to the change under evaluation. The control group selected was all roads in South Australia where the speed limit was 110 km/h (8,671 km), excluding the roads where the limit was reduced.

Thus we can find the difference between the before-after change on the relevant roads and on the control roads, expressed in terms of crashes. The difference in casualties can similarly be obtained. Finally, the annual reduction in the number of casualties can be expressed in dollar terms.

3 An estimate of the effect of the speed limit reduction on casualty crashes

The method of estimation of the effect of the speed limit reduction is, in principle, straightforward. But along with the estimate, the likely random variability should be kept in mind. Looking ahead, in Section 3.2 a reduction of casualty crashes of about 20 per cent will be found. However, random variability means that this is give or take about 24 per cent. That is, it seems likely that there really was a reduction, but there is not enough data to be fully confident. See Section 5 for more on this.

3.1 Choices made in the analysis

In analysing this dataset of crashes, a number of choices need to be made, including the time period for analysis, what is the control group to be, what severity of crashes to include and what to compare (crashes or casualties or dollars) in order to evaluate the effect of the reduced speed limit.

Time period. The change in speed limit was made at the end of June 2003. At the time of analysis, reliable casualty crash data was available in TARS from 1981 to midway through 2005. The time period of July 2001 until the end of June 2005 was chosen, allowing comparisons to be made between crash occurrences in the 2 years before the change and the 2 years that followed.

Control group of roads. A suitable control group consists of all roads in South Australia where the speed limit remained at 110 km/h. Using a control group removes any underlying trends in crash numbers from the comparison. There was indeed a downward trend in casualty crash numbers for the control group of roads. The percentage reduction in casualty crashes, presumed here to be attributable to the reduced speed limit, for the roads with the speed limit reductions the difference between the percentage reduction for those roads and the percentage reduction for the control roads.

Crash severity. The severity of a casualty crash is defined here as the highest level of severity of any of the casualties in terms of the treatment required or the outcome, if fatal. Crashes are thus categorised as: treated by private doctor, treated at hospital, admitted to hospital, or fatal. Crashes which resulted in property damage only were not included.

Sections 3.2, 3.3, 3.4 give the results in terms of casualty crashes, casualties, and financial cost (dollars), respectively.

3.2 Results in terms of crashes

Casualty crash data was extracted for the time period of July 2001 until June 2005, for the severity range described in Section 3.1. Table 3.1 shows the number of casualty crashes for each severity of casualty that occurred in each six month time period for the roads where the speed limit was altered. Table 3.2 shows the same casualty crash information for the control group.

Table 3.1
Casualty crash numbers for roads where the speed limit was altered from 110 km/h to 100 km/h (altered road network)

Severity	Before	After	% Change
Doctor	8	5	-37.5
Treated	58	47	-19.0
Admitted	61	35	-42.6
Fatal	14	9	-35.7
Total	141	96	-31.9

Table 3.2
Casualty crash numbers for roads where the speed limit remained at 110 km/h (control group)

Severity	Before	After	% Change
Doctor	71	59	-16.9
Treated	449	397	-11.6
Admitted	374	344	-8.0
Fatal	79	54	-31.6
Total	973	854	-12.2

The percentage changes from Tables 3.1 and 3.2 are compared in Table 3.3. The difference between the altered network and the control group percentage changes indicates the overall benefit of the speed limit reduction.

Table 3.3
Results of the comparison between crash numbers two years before and two years after the change, for the altered road network and the control group

Severity	Control roads	Altered roads	Difference
Doctor	-16.9	-37.5	-20.6
Treated	-11.6	-19.0	-7.4
Admitted	-8.0	-42.6	-34.6
Fatal	-31.6	-35.7	-4.1
Total	-12.2	-31.9	-19.7

Table 3.3 shows that there was a 31.9% reduction in total casualty crashes on the roads where the speed limit was altered from 110 km/h to 100 km/h and a 12.2% reduction on roads that were not altered, the control roads. By comparing these values a reduction of 19.7% is attributed to the change in speed limit.

3.3 Results in terms of casualties

Casualty numbers were also extracted from the TARS database for the same time period and casualty severity categories (Tables 3.4 and 3.5). Using the same methods as described above in Section 3.2, an estimate of the reduction in casualties is calculated below in Table 3.6.

Table 3.4
Casualty numbers for each casualty severity for the altered road network

Severity	Before	After	% Change
Doctor	9	5	-44.4
Treated	108	91	-15.7
Admitted	104	51	-51.0
Fatal	16	10	-37.5
Total	237	157	-33.8

Table 3.5
Casualty numbers for each casualty severity for the control group

Severity	Before	After	% Change
Doctor	94	75	-20.2
Treated	768	658	-14.3
Admitted	541	473	-12.6
Fatal	93	69	-25.8
Total	1496	1275	-14.8

Table 3.6
Results of the comparison between casualty numbers two years before and two years after the change, for the altered road network and the control group

Severity	Control roads	Altered roads	Difference
Doctor	-20.2	-44.4	-24.2
Treated	-14.3	-15.7	-1.4
Admitted	-12.6	-51.0	-38.4
Fatal	-25.8	-37.5	-11.7
Total	-14.8	-33.8	-19.0

This method of calculation gives a 19.0% reduction in the total number of casualties attributed to the change in speed limit.

3.4 Results in terms of dollars

What do the percentage reductions in the specified levels of casualtiesattributed to the reduced speed limit in Table 3.6 translate to in terms of economic benefit, using conventional dollar figures for casualties? Table 3.7 shows the answer is about 9.5 million dollars per year (all monetary figures are in Australian dollars). In this Table the column marked "2004$/casualty" shows the costs for each level of casualty severity based upon a 2000 Bureau of Transport Economics report, plus an allowance for inflation (Australian Bureau of Statistics, 2004; Bureau of Transport Economics, 2000). The pre-change average casualty numbers are for the altered roads using the July 2001 to June 2003 casualty data, averaged over the two years to give the average number of casualties for each category for one year.

For the reasons noted in the previous section, this best estimate of 9.5 million dollars is of low precision. Over time it may be that the effect of the speed limit reduction will be found to be much greater, or even of negative value (plus or minus about 11 million dollars).

Table 3.7
Cost reduction attributable to the reduced speed limit on the altered roads for one year

Severity	2004$/casualty	Pre-change average casualty numbers (1 year)	% difference attributable to speed limit reduction	Change in casualty numbers	Resulting difference in cost for 1 year
Doctor	$14,434	4.5	24.2	1.1	$15,739
Treated	$14,434	54	1.4	0.8	$11,051
Admitted	$390,922	52	38.4	20.0	$7,804,349
Fatal	$1,804,257	8	11.7	0.9	$1,687,853
Total					$9,518,993

4 Changes in vehicle speeds

No speed measurements were taken on the roads where the speed limit was reduced specifically for this study. However, by examining the routine speed data collection conducted by DTEI, a small number of sites were identified where speed measurements were taken over one week both before and after the reduction of the speed limit (on 1 July 2003). These sites are listed in Table 4.1.

Table 4.1
Sites where the speed limit was reduced and speed measurements were taken before and after the change

Site	Date of before sample	Date of after sample
Port Clinton	29/01/2003	29/10/2003
Urania	03/04/2003	23/10/2003
Yorketown - Edithburgh	17/01/2002	17/06/2004
Corny Point - Yorketown	09/08/2002	06/08/2004
Warooka - Marion Bay	24/06/2003	03/07/2003
Murray Bridge - Jervois	04/12/2002	10/09/2003

Data on average speeds is given below. However, there may be variations in speed associated with traffic conditions and weather (notice that the before and after measurements were not necessarily at the same time of year), and variations across sites in the effect on average speed of the speed limit change, that are not captured in such a limited dataset.

4.1 All vehicle speeds

Table 4.2 shows that mean speeds went down by about 2 km/h after the speed limit change.

Table 4.2
Change in average speed at sites where the speed limit was reduced and speed measurements were taken before and after the change

Site	Before speed limit change		After speed limit change		Change in average speed
	Number of vehicles	Average speed	Number of vehicles	Average speed	
Port Clinton	12730	100.4	12459	98.9	-1.5
Urania	3076	102.6	3058	99.5	-3.2
Yorketown - Edithburgh	4123	99.6	3428	96.6	-3.1
Corny Point - Yorketown	3040	101.1	3269	95.2	-5.9
Warooka - Marion Bay	1158	100.7	1381	99.7	-1.1
Murray Bridge - Jervois	8797	96.2	7882	95.8	-0.4
All sites combined	32924	99.4	31477	97.5	-1.9

4.2 Vehicle free speeds

There is often specific interest in vehicles travelling at a "free" speed, rather than those which are travelling in a platoon of traffic or closely following another vehicle. We here regard vehicles travelling with a headway of 4 seconds or greater from the previous vehicle as having a free speed. In fact, on these roads most vehicles are travelling at a free speed. Thus the speed reduction of 2 km/h is almost unchanged when only free speed vehicles are considered (Table 4.2).

Table 4.2
Change in average free speed at sites where the speed limit was reduced and speed measurements were taken before and after the change

Site	Before speed limit change		After speed limit change		Change in average free speed
	Number of vehicles	Average free speed	Number of vehicles	Average free speed	
Port Clinton	10787	101.1	10682	99.3	-1.7
Urania	2904	103.0	2904	99.7	-3.3
Yorketown - Edithburgh	3901	99.7	3317	96.7	-3.0
Corny Point - Yorketown	2918	101.2	3141	95.3	-6.0
Warooka - Marion Bay	1123	100.9	1327	99.7	-1.2
Murray Bridge - Jervois	7943	96.8	7154	96.2	-0.6
All sites combined	29576	99.9	28525	97.9	-2.1

5 Discussion

Examining Table 3.3, we see the numbers of crashes on the altered roads were much smaller than on the control roads. The random variability in crash numbers will therefore be (proportionately) much greater on the altered roads. On the altered roads, the numbers of crashes were (in two years) 141 before the change and 96 after. The change is thus approximately a 32 per cent reduction. The variance of crash numbers will be approximately 141 before the change and 96 after. (This assumes the number of crashes follows the Poisson distribution.) The difference in annual crash numbers will have a variance of approximately 237. (This is because the variance of the difference between two independent random variables is the sum of the variances.) The standard deviation of the difference in crash numbers is thus approximately 15. (The standard deviation is the square root of the variance.) This is approximately 11 per cent of 141, the number before the speed limit change.

The reduction attributable to the speed limit change was estimated to be 20 per cent. We have just worked out that the standard error associated with this is rather greater than 11 per cent. It is rather greater because random variability of the number of crashes on the control roads has been neglected; when this is included, the standard error is found to be about 12 per cent. It is common to regard two standard errors as being the "give or take" value associated with an estimate, so the conclusion is that the percentage reduction attributable to the speed limit change is 20, plus or minus 24. Thus it seems likely that there really was a reduction, but the quantity of data is not sufficient to be sure.

Research of this type has some well-known limitations, which we should briefly mention.

- The sections of road that were treated (by reduction of the speed limit) were selected on the basis of the condition of the road, not on the basis of crash history. This reduces but does not necessarily eliminate the possibility that the observed reduction in crashes may have been due to regression to the mean.
- The effect of the speed limit reduction may not be confined to the sections of road that were treated. A lower speed limit on one section of road may lead to lower speeds, and fewer crashes, on adjoining untreated sections of road also.
- The selection of the control roads is an important issue and it is difficult to know whether the most appropriate decision has been made. We are not aware of any factors affecting the crash rates over time on the control roads that did not apply to the treated roads.
- Routine crash data often has errors in it. Specifically, the location of the crash site may have been reported by the driver or other person involved. If they remember seeing a (relatively unusual) 100 km/h sign, they may report the location as inside the treated section, even if they had later left it and crashed where the speed limit was 110 km/h.

In short, it is easy to imagine reasons why the effect of the speed limit change may be understated or overstated. Nevertheless, being able to imagine reasons for errors in our estimate does not mean they in fact occurred. Our confidence in the reality of the reduction is increased because its mechanism is very obvious: lower speed limits lead to lower travelling speeds, lower travelling speeds make loss of control less likely, give drivers longer to react, and reduce the accelerations sustained if there is an impact, and thus crashes will be fewer and less severe.

6 Conclusions

On the road sections where the speed limit was reduced from 110 km/h to 100 km/h, casualty crashes were observed to drop by 32 per cent. On all the 110 km/h roads that were not changed, casualty crashes were observed to drop by 12 per cent.

If there were no other factors (and we are not aware of any), a 20 per cent reduction can be assumed to be the best estimate of the effect on crashes of the lowering of the speed limit.

However, the small number of crashes on the affected roads means that this estimate is somewhat uncertain. So while the best estimate of the effect is a 20 per cent reduction, it is possible that the true effect might have been anywhere between an increase of 4 per cent and a reduction of 44 per cent.

There was a decrease in crashes and casualties on the 110 km/h roads where the speed limit did not change. This has been allowed for in the above calculations. It could mean that there is something else that is affecting crashes, and possibly that there has been a drop in travelling speed everywhere. It might conceivably be due to an increased awareness of speed, in part because of the speed limit reduction on the roads of interest.

A very limited dataset on speeds has also been examined. Comparing average speeds before and after the speed limit change at six sites, an average 2 km/h reduction was found.

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