ESTIMATED CASUALTY CRASH REDUCTIONS FROM REDUCED TRAVELLING SPEEDS

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ABSTRACT :

A method was developed for estimating the overall reduction in casualty crashes on metropolitan Adelaide roads given a reduction in free travelling speeds. For example, it was found that a 5 km/h "free speed" reduction for all vehicles would be expected to lower the number of metropolitan Adelaide casualty crashes by more than 15 per cent. The method also allows the effects of speed changes on casualty crashes to be assessed independently for local, collector, undivided arterial or divided arterial roads.

BODY :

1. INTRODUCTION

A report has been prepared in response to a brief from Transport SA to further develop the findings from the report by Kloeden et al (1997), "Travelling Speed and the Risk of Crash Involvement", in order to provide support for the development of policy in the speed management area. The report develops estimates for casualty crash reductions in the Adelaide metropolitan area from reductions in travelling speeds on various categories of roads. This paper is a summary of that report.

Not all of the information needed for the calculation of the estimates of crash reductions was available; some surrogate measures were used. Consequently, although we believe that the estimates presented here are reasonable deductions from the available information, they are dependent in part on certain assumptions, as noted in the text.

2. RELATIVE CRASH RISK

In the report "Travelling Speed and the Risk of Crash Involvement" (Kloeden et al 1997), the free travelling speeds of cars involved in casualty crashes were compared with the speeds of cars not involved in crashes but travelling in the same direction, at the same location, time of day, day of week and time of year. This study was restricted to the Adelaide metropolitan area, on roads with a 60 km/h speed limit. Table 4.3 in Kloeden et al (1997) presents estimates of the risk of involvement in a casualty crash at a given travelling speed relative to travelling at 60 km/h in a 60 km/h speed limit zone. These relative risks form the basis of the estimation of crash reductions in this paper. However, some adjustments have been made to the relative risks. They have been set at 1 for speed groups from 35 to 60 km/h since the observed relative risks for speed groups below 60 km/h ranged from 0.62 to 1.41, with none of them being statistically significantly different from 1. (The relative risk for speeds grouped around 35 km/h is certainly not zero, despite the lack of any crashes in that speed range in the study by Kloeden et al 1997.) The relative risk for speeds above the 85 km/h group has been set at 100 by extrapolation from Figure 4.3 in Kloeden et al (1997). Table 1 presents these figures.

Table 1
Travelling Speed and the Relative Risk of Involvement in a Casualty Crash in a 60 km/h Speed Limit Area
(adapted from Table 4.3, Kloeden et al, 1977)

Nominal Speed (km/h)	Speed Range	No. Cases	No. Controls	Relative Risk	Modified Relative Risk
35	33-37	0	4	0.00[1]	1.00
40	38-42	1	5	1.41	1.00
45	43-47	4	30	0.94	1.00
50	48-52	5	57	0.62	1.00
55	53-57	19	133	1.01	1.00
60	58-62	29	205	1.00	1.00
65	63-67	36	127	2.00	2.00
70	68-72	20	34	4.16	4.16
75	73-77	9	6	10.60	10.60
80	78-82	9	2	31.81	31.81
85	83-87	8	1	56.55	56.55
85+	88+	11	0	Infinite[2]	100.00
Total		**151**	**604**		

Notes: [1] Listed as zero because no crashes observed in this speed range.
[2] Infinite because no control vehicles in this speed range.

3. REDUCTIONS IN "FREE TRAVELLING SPEED" CASUALTY CRASHES ON 60 KM/H ROADS IN METROPOLITAN ADELAIDE

Table 2 shows the estimated result of a uniform 5 km/h reduction in free travelling speeds, based on the assumptions described above. The term "Exposure Index" is a measure of the number of vehicles travelling at a given speed. It consists of the number of crashes at a given speed, say 65 km/h, divided by the product of the actual crash risk at 60 km/h and the relative risk at 65 km/h. We do not know the actual risk at 60 km/h but we do have our estimate of the relative risk and the number of crashes at that speed. However, because we are making comparative estimates of the effect of an across the board reduction in travelling speed we do not need to know the actual crash risk at 60 km/h. If we are estimating the likely effect of a uniform 5 km/h reduction in travelling speeds, we simply have to assume that the same number of vehicles that were travelling at 65 km/h would then be travelling at 60 km/h. In other words, the Exposure Index that applied to 65 km/h would be assumed to apply to the 60 km/h speed group.

The application of the above method for a 5 km/h reduction in travelling speeds is a 31.9% reduction in "free travelling speed" casualty crashes as shown in Table 2.

Table 2
Estimated Reduction in Free Travelling Speed Casualty Crashes on 60 km/h Roads Given a Uniform 5 km/h Speed Reduction

Speed (km/h)	Modified Relative Risk [A]	Observed Crashes [B]	Exposure Index [B/A]	Exposure Index (-5 km/h) [C]	Estimate Crashes (-5 km/h) [A x C]
20	1.00	0	0.00	0.00	0.00
25	1.00	0	0.00	0.00	0.00
30	1.00	0	0.00	0.00	0.00
35	1.00	0	0.00	1.00	1.00
40	1.00	1	1.00	4.00	4.00
45	1.00	4	4.00	5.00	5.00
50	1.00	5	5.00	19.00	19.00
55	1.00	19	19.00	29.00	29.00
60	1.00	29	29.00	18.00	18.00
65	2.00	36	18.00	4.81	9.62
70	4.16	20	4.81	0.85	3.53
75	10.60	9	0.85	0.28	3.00
80	31.81	9	0.28	0.14	4.50
85	56.55	8	0.14	0.11	6.22
90+	100.00	11	0.11	0.00	0.00
Total		**151**			**102.87**
Reduction					**31.9%**

The calculations were repeated for 10, 15 and 20 km/h speed reductions, producing estimated casualty crash reductions on 60 km/h roads of 41.3%, 44.4% and 45.2% respectively.

4. INCONSISTENT SPEED REDUCTIONS

The method described here has been applied on the assumption that there will be a constant reduction in speed regardless of the initial travelling speed. This assumption may not be valid for the lower or higher speed ranges. Recalculating the figures assuming no change for low speed (<= 35 km/h) drivers makes no difference to the percentage crash reductions (since the relative crash risk is 1 at these speeds) but re-calculations for high speeds (>= 90 km/h) remaining constant, produces crash reductions of 28.8%, 36.3%, 37.9% and 38.3%, for 5,10,15 and 20 km/h speed reductions respectively.

The remainder of this paper assumes a consistent speed reduction across all speeds.

5. REDUCTION IN ALL CASUALTY CRASHES IN THE ADELAIDE METROPOLITAN AREA

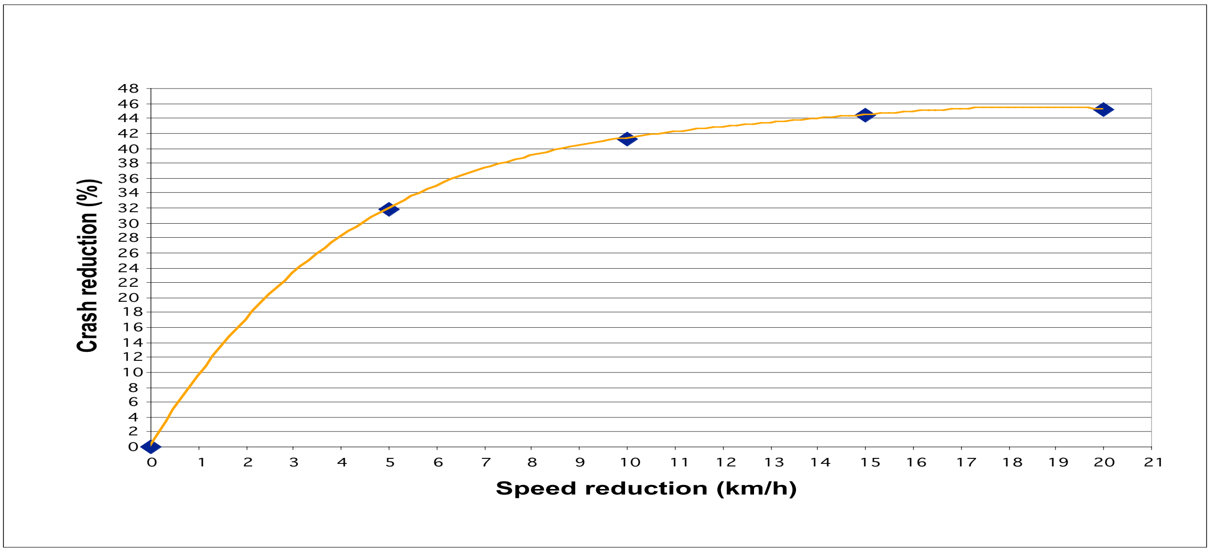
The relative crash risk refers to "free travelling speed" casualty crashes on 60 km/h speed limit roads in the Adelaide metropolitan area. In order to estimate reductions in all casualty crashes for the whole metropolitan area, the proportion of casualty crashes which involve vehicles with a free travelling speed and the proportion of all casualty crashes on roads zoned at 60 km/h (84.3% for 1998 data) must be taken into account.

"Free travelling speed" crashes are defined here as those involving at least one vehicle moving freely along a mid-block section of road, or with right of way through an intersection, and not slowing to join, or accelerating away from a traffic stream. The study by Kloeden et al (1997), was not designed to estimate the proportion of casualty crashes that involved at least one car which had a free travelling speed before the crash, however, in the absence of other information, the figure of 56%, taken from the crashes investigated in that study, is used here as the best estimate of the proportion.

6. REDUCTIONS IN CASUALTY CRASHES PER 1 KM/H REDUCTIONS IN TRAVELLING SPEEDS

To obtain estimates of casualty crash reductions per 1 km/h speed reductions, the calculated points were linked by a "line of best fit" (Figure 1).

Figure 1
Estimated Reduction in Casualty Crashes
for Given Speed Reductions



From the equation of the "line of best fit", and with an assumption of a uniform reduction in travelling speed and also assuming that 56% of casualty crashes involve at least one vehicle having a "free travelling speed", and that 84.3% of metropolitan crashes occur on 60 km/h roads, an estimate was made of the likely reduction in casualty crashes in the Adelaide metropolitan area for each 1 km/h reduction in free travelling speeds on all 60 km/h roads (Table 3). This metropolitan wide calculation assumes that there is no impact on “non free travelling speed crashes” from reduced “free travelling speed”. It is likely that there will be some reduction in “non free travelling speeds” also, however the size of this reduction or the size of the consequential crash reduction cannot be calculated. The overall reduction as shown in Table 3 is thus likely to be the minimum expected reduction (given the other assumptions made).

Table 3
Estimated Reduction in Casualty Crashes
for Unit Speed Reductions

Uniform Speed Reduction (km/h)	**Reduction in “Free Speed” 60 km/h Metro Casualty Crashes** (%)	**Overall Reduction in All Metro Casualty Crashes** (%)
1	9.4	4.4
2	17.0	8.0
3	23.2	10.9
4	28.1	13.2
5	31.9	15.1
6	34.9	16.5
7	37.2	17.6
8	39.0	18.4
9	40.4	19.0
10	41.4	19.6
11	42.3	20.0
12	43.1	20.3
13	43.8	20.7
14	44.4	21.0
15	45.1	21.3
16	45.7	21.6
17	46.3	21.9
18	46.8	22.1
19	47.2	22.3
20	47.3	22.3

7. ROAD HIERARCHY

One aim of this study was to determine the likely reductions in casualty crashes should the speed limit be reduced on different categories of roads - local streets, collector roads, undivided arterial roads and divided arterial roads. A random sample of casualty crashes was selected and the roads on which these crashes occurred were classified. The percentage of casualty crashes on each category of road were found to be 15%,11%, 28% and 46% respectively.

These percentages were combined with the estimates presented in Table 3 to provide estimates of the metropolitan-wide reductions in casualty crashes that would be likely to result from the specified speed reductions on the listed categories of roads, as shown in Table 4.

Table 4
Estimated Reduction in Casualty Crashes for the Whole Metropolitan Area, for Unit Speed Reductions, by Class of Road

Speed Reduction (km/h)	Local Roads (%)	Collector Roads (%)	Undivided Arterials (%)	Divided Arterials (%)	All Roads (%)
1	0.7	0.5	1.2	2.0	4.4
2	1.2	0.9	2.2	3.7	8.0
3	1.6	1.2	3.1	5.0	10.9
4	2.0	1.5	3.7	6.1	13.2
5	2.3	1.7	4.2	6.9	15.1
6	2.5	1.8	4.6	7.6	16.5
7	2.6	1.9	4.9	8.1	17.6
8	2.8	2.0	5.2	8.5	18.4
9	2.9	2.1	5.3	8.8	19.0
10	2.9	2.2	5.5	9.0	19.6
11	3.0	2.2	5.6	9.2	20.0
12	3.0	2.2	5.7	9.4	20.3
13	3.1	2.3	5.8	9.5	20.7
14	3.1	2.3	5.9	9.6	21.0
15	3.2	2.3	6.0	9.8	21.3
16	3.2	2.4	6.0	9.9	21.6
17	3.3	2.4	6.1	10.1	21.9
18	3.3	2.4	6.2	10.2	22.1
19	3.3	2.4	6.2	10.2	22.3
20	3.4	2.5	6.3	10.3	22.3

The table can be used to estimate crash reductions following speed limit changes. It is additive by road classification. If a speed limit is introduced on local roads, and a 1 km/h reduction in speeds is experienced on these roads, then a 0.7% reduction in casualty crashes is expected for the whole metropolitan area. If a speed limit reduction is introduced on all roads, resulting in, say, a 1 km/h actual reduction in travelling speeds on local roads and a 5 km/h reduction on other roads, a 13.5% (0.7% + 1.7% + 4.2% + 6.9%) reduction in casualty crashes is expected for the whole metropolitan area.

REFERENCES :

Kloeden CN, McLean AJ, Moore VM, Ponte G. (1997) Travelling Speed and Risk of Crash Involvement, Federal Office of Road Safety CR172, Canberra Australia.