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Casualty crash reductions from reducing various levels of speeding

SD Doecke, CN Kloeden, AJ McLean

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TITLE

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ABSTRACT

Casualty crash reductions from reducing various levels of speeding are estimated by applying the relative risk of involvement in a casualty crash to the proportion of vehicles travelling at a given speed. The greatest overall effect on casualty crashes involving vehicles travelling at speeds from 1 to 20 km/h above the speed limit will come from reducing speeds just above that limit in almost all cases. Analysis of where injury and fatal crashes occur indicates that while speed reductions of any type would be expected to reduce injuries and fatalities, the greatest potential gains for reducing injuries appear to be in targeting low level speeding on Adelaide low speed roads. For fatalities this would be extended to include low level speeding on high speed rural roads.

KEYWORDS

Speeding, speed limit, risk, traffic accident, accident countermeasure

Summary

The purpose of this project is to identify which groups of speeding drivers (in terms of their current speed) present the greatest casualty crash reduction potential if their speeds could be lowered.

Casualty crash reduction estimates are derived from the number of vehicles travelling at a given speed (from SA speed surveys) and the relative risk of involvement in a casualty crash (from the CASR case control studies). The resulting estimates provide us with a basis for comparing the casualty crash benefits of a reduction in speed across a number of speed bands.

The results for the relative effects of a 1 km/h speed reduction are summarised for the eight road types considered in the following Table (results were very similar for greater reductions).

The relative percentage effect on casualty crashes of a 1 km/h speed reduction on different road types for different groups of speeding drivers

Road type	Exceeding the speed limit category (km/h)			
	1 - 5	6 - 10	11 - 15	16 - 20
Adelaide 50 km/h	32	28	22	17
Adelaide 60 km/h	56	25	11	8
Adelaide 80 km/h	55	28	12	6
Rural 50 km/h	15	29	35	21
Rural 60 km/h	38	27	19	16
Rural 80 km/h	29	26	23	21
Rural 100 km/h	36	27	21	16
Rural 110 km/h	44	30	15	11

As an example interpretation for Adelaide 50 km/h roads: if the speeds of all vehicles travelling between 51 and 70 km/h were lowered by 1 km/h, there would be a reduction in casualty crashes; 32% of this reduction would be due to those vehicles previously travelling between 51 and 55 km/h; 28% from vehicles between 56 and 60 km/h; 22% from vehicles between 61 and 65 km/h; and 17% from vehicles between 66 and 70 km/h.

With one exception (rural 50 km/h roads), all of the eight speed limit areas listed show that the greatest reduction in casualty crashes is obtained from a reduction in travelling speed in the first 5 km/h above the speed limit with the level of casualty crash reduction decreasing with increasing travelling speed beyond the speed limit.

The extent to which speed reductions in the 1 to 5 km/h range will reduce casualty crashes relative to speed reductions above that range varies between different speed limit areas. The effect is greatest for Adelaide 60 and 80 km/h roads. Greater reductions in casualty crashes will be obtained from reducing speeds in the 1 to 5 km/h range on those roads than from speed reductions in the next three 5 km/h speed ranges combined.

Analysis of where injury and fatal crashes occur indicates that while speed reductions of any type would be expected to reduce injuries and fatalities, the greatest potential gains for reducing injuries appear to be in targeting low level speeding on Adelaide low speed roads. For fatalities this would be extended to include low level speeding on high speed rural roads.

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1 Introduction

The purpose of this project is to identify which groups of speeding drivers (in terms of their current speed) present the greatest casualty crash reduction potential if their speeds could be lowered.

The aim of this project is therefore to show, for speeds above the relevant speed limit, how the proportion of casualty crashes is related to specific speeds on South Australian roads and to estimate the effect on casualty crashes of reducing those speeds by various amounts.

2 Method

2.1 Travelling speeds

A systematic method of measuring and recording vehicle speeds annually in South Australia was introduced in 2007. This has provided information on the distribution of travelling speeds at 127 sites on a range of road types, as shown in Table 2.1. (Kloeden and Woolley, 2010)

Table 2.1
Speed survey site groups

Road type	Number of sites
Adelaide 50 km/h roads	28
Adelaide 60 km/h roads	27
Adelaide 80 km/h roads	6
Rural 50 km/h roads	14
Rural 60 km/h roads	4
Rural 80 km/h roads	4
Rural 100 km/h roads	10
Rural 110 km/h roads	34
Total	127

The distribution of vehicle speeds was obtained for each of these road types from the 127 sites surveyed in 2008.

2.2 Relative risk of casualty crash involvement

Two studies of the relationship between travelling speed and the relative risk of involvement in a casualty crash have been conducted in South Australia by CASR (previously RARU). The first study (Kloeden et al, 2002) was conducted in the Adelaide metropolitan area, in 60 km/h zones; the second in rural areas within about 100 km of Adelaide, mainly on roads having a speed limit of 100 or 110 km/h (Kloeden et al, 2001). Each study involved attending casualty crashes at the scene and calculating the travelling speed of the vehicle of interest. The speeds of non-crash-involved vehicles passing the crash site were subsequently measured with a laser speed gun at the same time of day and day of week as the crash. Comparison of the speed distributions of the two groups of vehicles shows how the risk of being involved in a casualty crash is related to travelling speed.

The actual risk of involvement in a casualty crash for a given travelling speed is not known. However each of these two studies have made it possible to express the crash risk at one speed relative to the crash risk at another speed. Crash risk at a given speed in the metropolitan area is expressed relative to the crash risk of a vehicle travelling at 60 km/h, which is arbitrarily set at a risk of “one”. In rural areas, the crash risk at a given speed is expressed relative to the crash risk of a vehicle travelling at the average speed of traffic at that crash site which, again, is set at “one”.

For the purpose of this project, the risk curve from the metropolitan area study is used for low speed environments (50 and 60 km/h speed limit zones) to determine the relative risk of involvement in a casualty crash at different speeds (Figure 2.1).

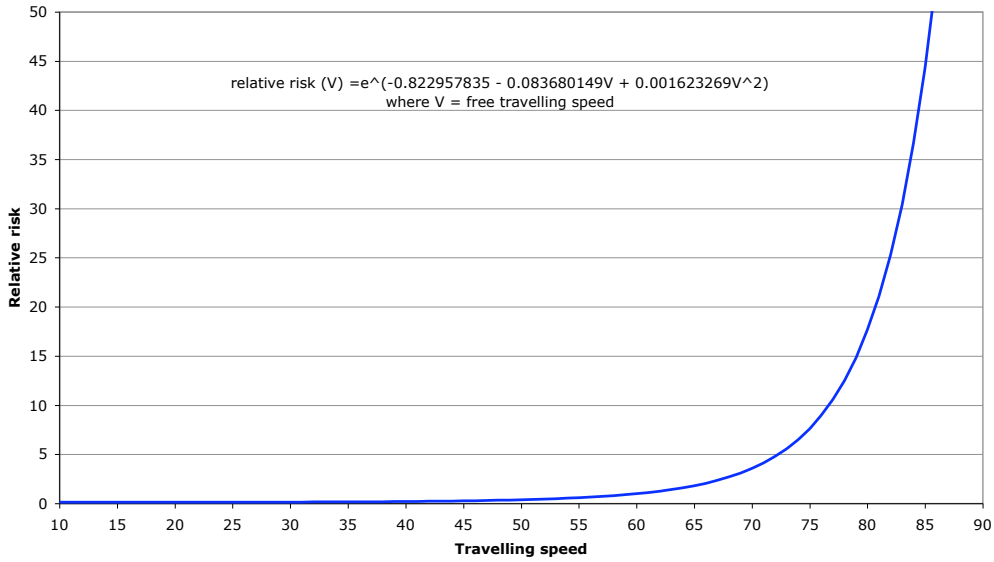

Figure 2.1
The risk curve used for low speed environments

The risk curve from the rural study is used for high speed environments (80, 100 and 110 km/h speed limit zones) and is shown in Figure 2.2.

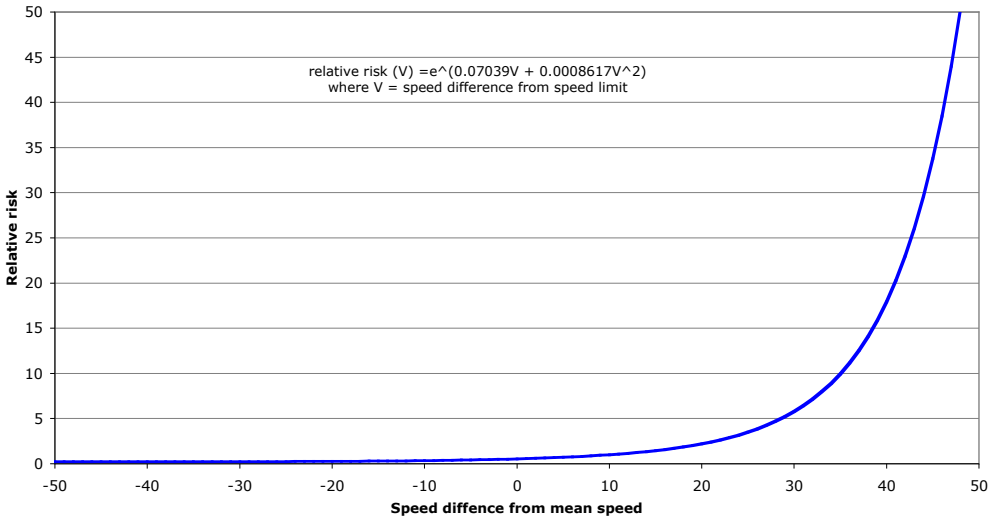

Figure 2.2
The risk curve used for high speed environments

The mathematical formula for each of these polynomial exponential risk curves is given in Figures 2.1 and 2.2.

2.3 Relative frequency of casualty crashes by speed

The aim of this project, as described above, is to show how the proportion of casualty crashes is related to specific speeds above the speed limit and to estimate the effect on casualty crashes of reducing those speeds.

The speed range considered is the 20 km/h band above the speed limit. This is based on the assumption that drivers who choose to exceed the speed limit by more than 20 km/h are unlikely to be influenced by media publicity urging them to slow down. The estimates of the relative risk of involvement in a casualty crash also become less accurate at the higher speeds, being based on a very small number of crashes. As this study is directed at speeding drivers, the proportion of crashes attributable to drivers who comply with the speed limit is not considered, nor is the likely safety benefit to be gained from reducing speed limits.

Figure 2.3 shows the speed distribution (in 1 km/h increments) for all of the surveyed Adelaide 50 km/h roads in 2008 combined and Figure 2.4 shows the speed distribution for the 20 km/h band above the speed limit together with the relative risk curve.

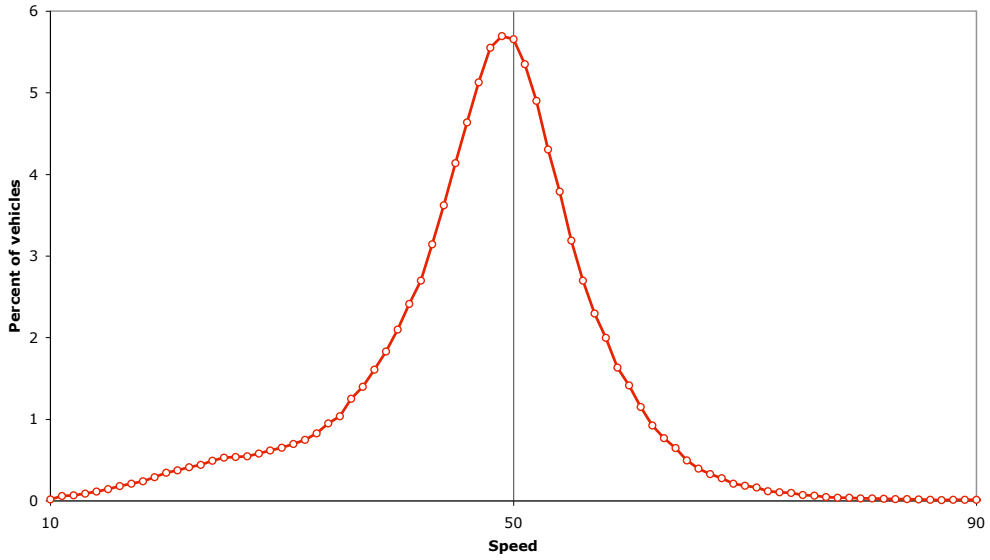

Figure 2.3
Speed distribution of vehicles in Adelaide 50 km/h speed zones

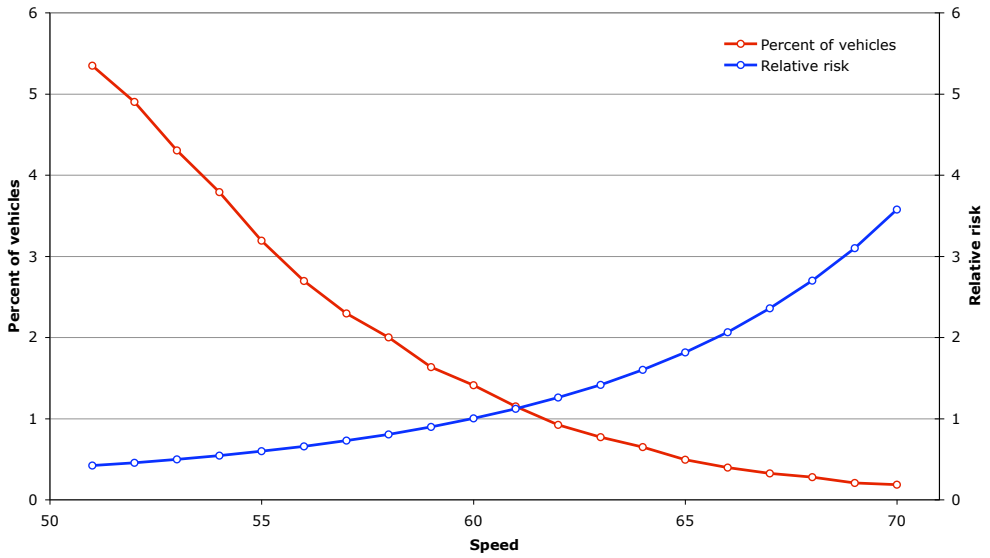

Figure 2.4
Percentages of vehicles in Adelaide 50 km/h zones travelling 1 to 20 km/h above the speed limit and the relative risk of involvement in a casualty crash (both shown in 1 km/h intervals)

By multiplying the proportion of vehicles by the relative risk for each speed in Figure 2.4, the expected relative frequency of casualty crashes in the 51 to 70 km/h speed range can be determined for each 1 km/h increment in travelling speed. Table 2.2 presents an example of this procedure for two travelling speeds and the results over the 51 to 70 km/h speed range are shown in Figure 2.5

Table 2.2
The expected relative frequency of casualty crashes at 55 and 65 km/h in Adelaide 50 km/h speed zones

Travelling speed (km/h)	55	65
% vehicles	3.19	0.49
Relative risk	0.60	1.82
Expected relative frequency of crashes	1.91	0.89

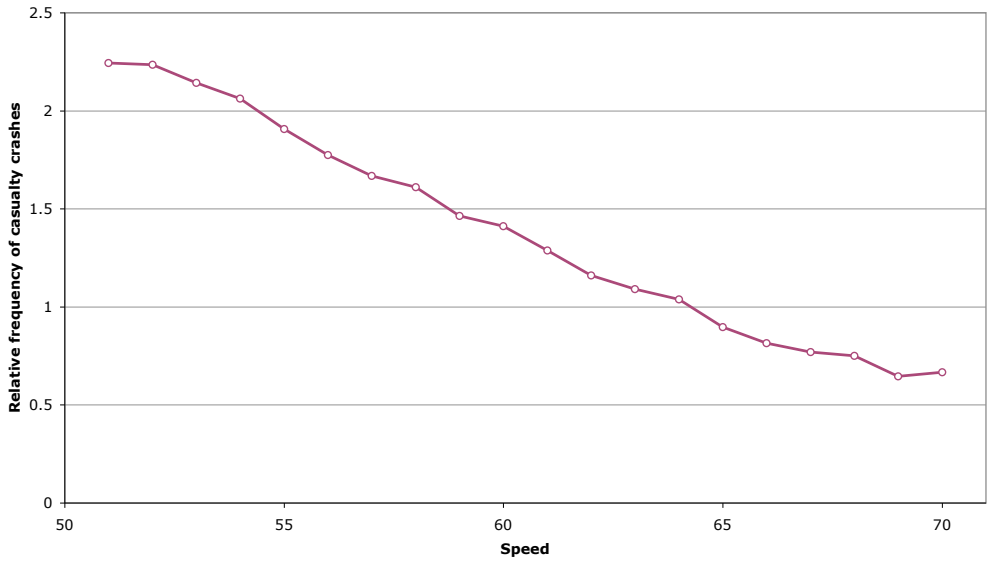

Figure 2.5
Expected relative frequency of casualty crashes by speed for vehicles travelling at 51 to 70 km/h in Adelaide 50 km/h zones

2.4 Casualty crash reductions from specific speed reductions

The expected reduction in casualty crashes due to reducing the speeds of vehicles can be calculated by multiplying the original proportion of vehicles travelling at a given speed by the relative risk of involvement in a casualty crash at the new lower speed. The result of a 1 km/h speed reduction is shown in Figure 2.6 for Adelaide 50 km/h zones, together with the original curve from Figure 2.5.

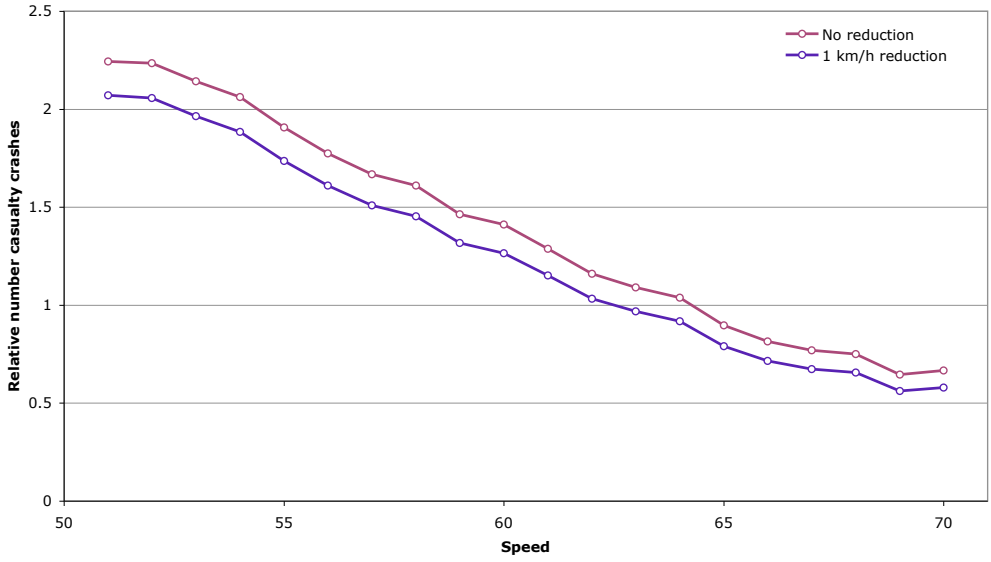

Figure 2.6
Expected effect of a 1 km/h speed reduction on the relative frequency of casualty crashes for vehicles travelling at 51 to 70 km/h in Adelaide 50 km/h zones

The expected reduction in the relative frequency of casualty crashes is indicated by the difference between the two curves in Figure 2.6. It is shown by travelling speed in Figure 2.7. The reduction in

the frequency of casualty crashes from a 1 km/h reduction in travelling speed is almost twice as great for vehicles initially travelling at 51 to 55 km/h compared with vehicles travelling at 65 to 70 km/h.

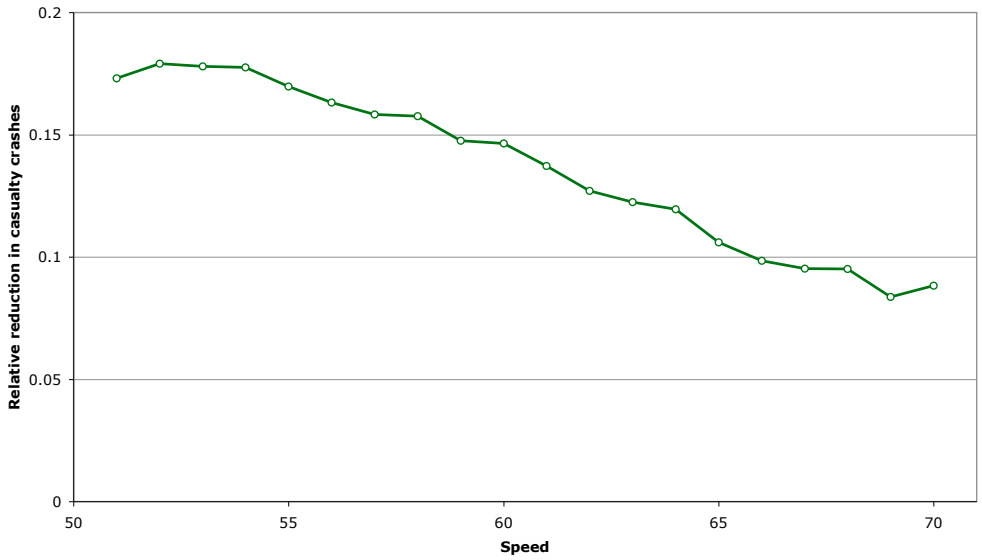

Figure 2.7

Expected effect of a 1 km/h speed reduction on the relative frequency of casualty crashes by speed for vehicles travelling at 51 to 70 km/h in Adelaide 50 km/h zones

The effects of reducing the speeds of vehicles by 2 km/h, 5 km/h and 10 km/h were also examined. The estimated reductions in casualty crashes for these speed reductions are shown in Figure 2.8. The greater the speed reduction the greater the reduction in casualty crashes, as would be expected.

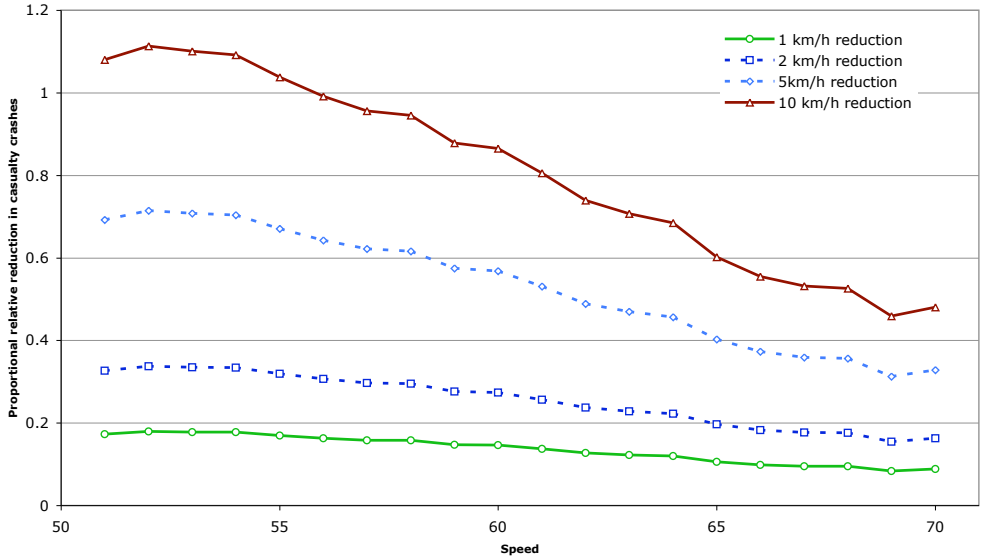

Figure 2.8

Reduction in the relative frequency of casualty crashes for each specified reduction in travelling speed in the 51 to 70 km/h speed range: Adelaide 50 km/h zones

However, the aim of this project is to show, for speeds above the relevant speed limit, how the proportion of casualty crashes is related to specific speeds on South Australian roads and to estimate the effect on casualty crashes of reducing those speeds. Therefore the crash reductions shown in Figure 2.8 have been normalised in Figure 2.9 for each of the specified speed reductions to facilitate comparisons of how they vary with travelling speed over that speed range. The results are expressed as a proportion of the sum of the reductions in the relative frequencies of casualty crashes over the 51 to 70 km/h range in each case. It can be seen that the level of speed reduction has little effect on the relationship between travelling speed and the relative reduction in the frequency of casualty crashes.

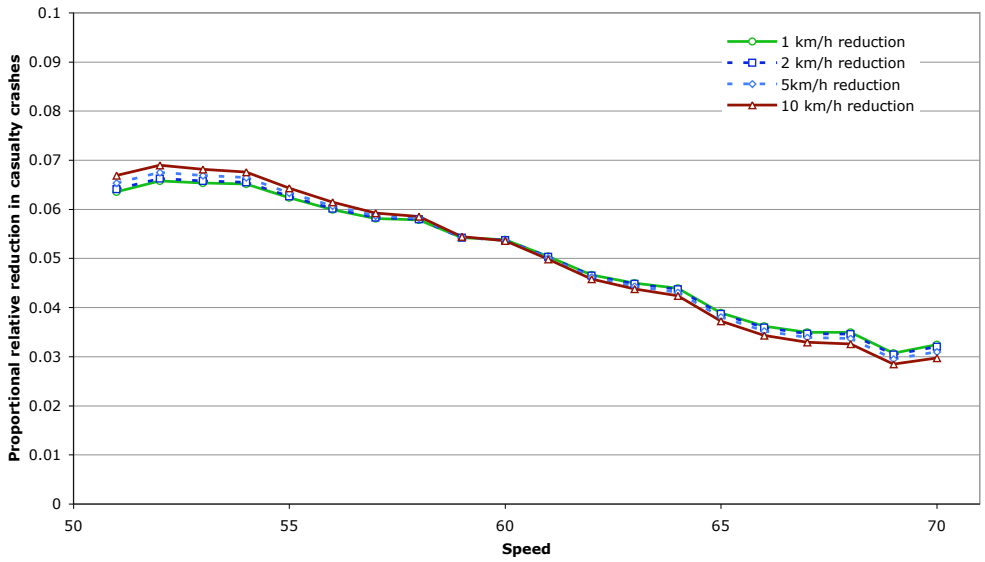

Figure 2.9
Reduction in the relative frequency of casualty crashes expressed as a proportion of the total reduction in casualty crashes for each specified reduction in travelling speed in the 51 to 70 km/h speed range: Adelaide 50 km/h zones

The 1 km/h speed brackets were then collapsed into 5 km/h groups and the relative casualty crash number savings of each group of the various speed reductions were calculated and normalised to 100 with the results shown in Table 2.3.

Table 2.3
Relative reductions in casualty crashes
from various speed reductions: Adelaide 50 km/h speed zones

Speed reduction	Exceeding the speed limit category (km/h)			
	1 - 5	6 - 10	11 - 15	16 - 20
1 km/h	32	28	22	17
2 km/h	32	28	22	17
5 km/h	33	29	22	16
10 km/h	34	29	22	16

As an example interpretation: if the speeds of all vehicles travelling between 51 and 70 km/h were lowered by 1 km/h, there would be a reduction in casualty crashes; 32% of this reduction would be due to those vehicles previously travelling between 51 and 55 km/h; 28% from vehicles between 56 and 60 km/h; 22% from vehicles between 61 and 65 km/h; and 17% from vehicles between 66 and 70 km/h.

This same procedure was applied to all of the speed zones and the results are presented in the following section but with just the key results being shown.

3 Results

The following sections assess the effect of speed reductions on each road type individually. For completeness, the calculations for Adelaide 50 km/h roads which have been presented in the Methods section are repeated in this section.

3.1 Adelaide 50 km/h roads

Figure 3.1 shows the speed distribution (1 km/h increments) for all of the Adelaide 50 km/h roads surveyed in 2008 combined.

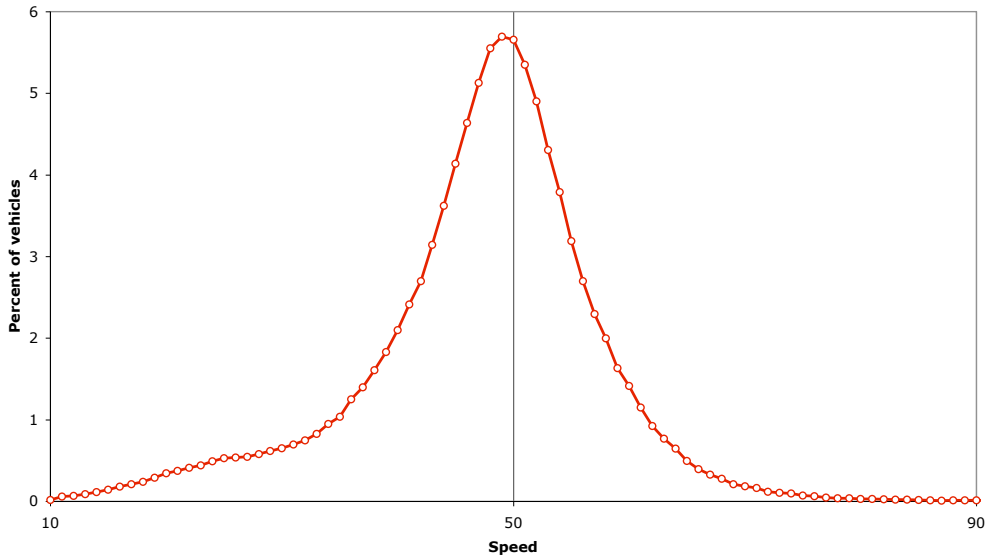

Figure 3.1
Speed distribution of vehicles in Adelaide 50km/h speed zones

The percentages of vehicles travelling from 1 to 20 km/h above the speed limit are plotted in 1 km/h increments in Figure 3.2 along with the relevant section of the relative risk curve from Figure 2.1.

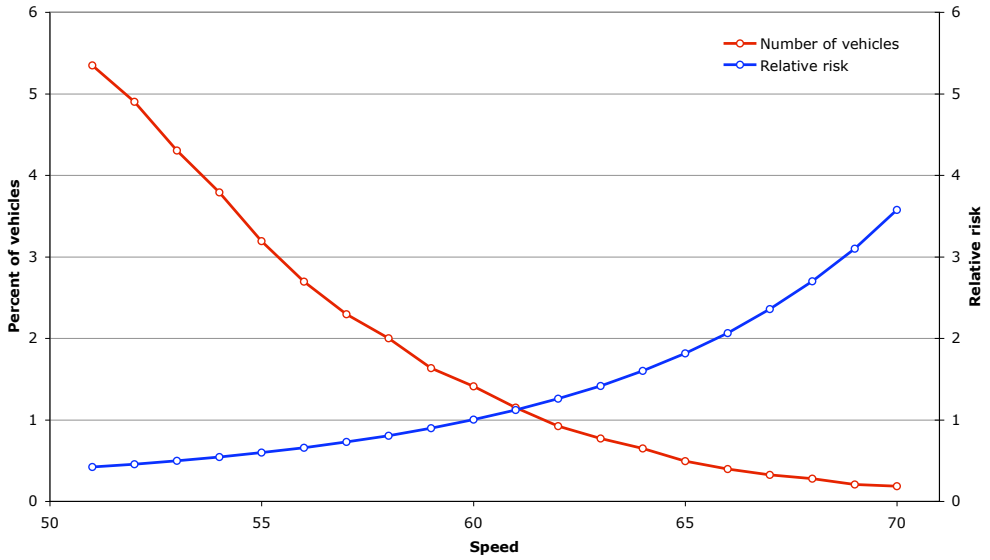

Figure 3.2
Percentages of vehicles in Adelaide 50 km/h zones travelling 1 to 20 km/hr above the speed limit and the relative risk of involvement in a casualty crash (both shown in 1 km/h intervals)

The expected relative frequency of casualty crashes is shown for each speed in Figure 3.3.

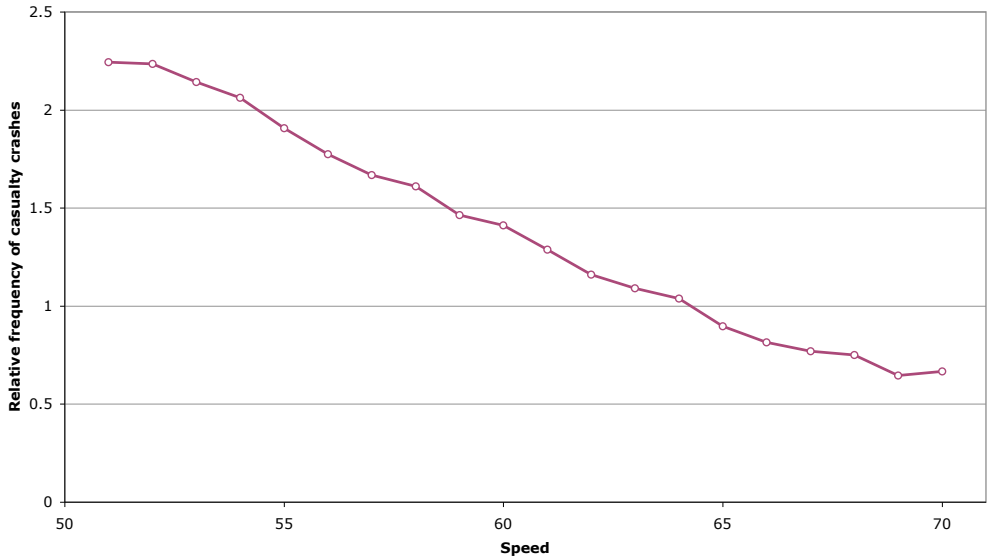

Figure 3.3
Expected relative frequency of casualty crashes by speed for vehicles travelling from 1 to 20 km/h above the speed limit in Adelaide 50 km/h zones

The effects of reducing the speeds of vehicles by 1 km/h, 2 km/h, 5 km/h and 10 km/h, expressed as a proportion of the sum of the reductions in the relative frequencies of casualty crashes over the 51 to 70 km/h range in each case, are shown in Figure 3.4.

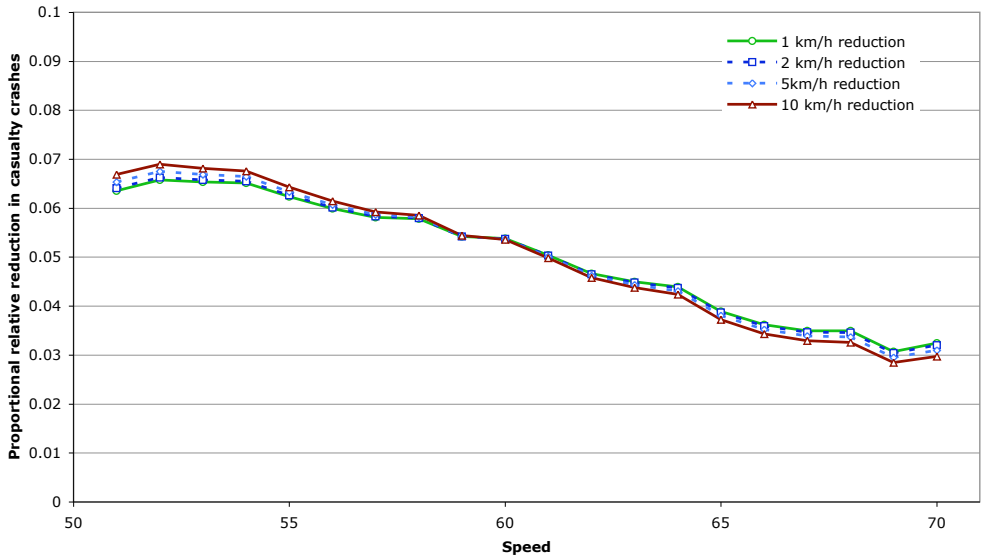

Figure 3.4
Reduction in the relative frequency of casualty crashes expressed as a proportion of the total reduction in casualty crashes for each specified reduction in travelling speed in the 51 to 70 km/h speed range: Adelaide 50 km/h zones

The 1 km/h speed brackets were then collapsed into 5 km/h groups and the relative casualty crash number savings of each group of the various speed reductions were calculated with the results shown in Table 3.1. As noted previously, all of these speed reductions result in casualty crash reductions that are almost twice as great for vehicles initially travelling at 51 to 55 km/h (up to 5 km/h above the speed limit) compared with 65 to 70 km/h (16 to 20 km/h above the limit).

Table 3.1
Relative reductions in casualty crashes
from various speed reductions: Adelaide 50 km/h speed zones

Speed reduction	Exceeding the speed limit category (km/h)			
	1 - 5	6 - 10	11 - 15	16 - 20
1 km/h	32	28	22	17
2 km/h	32	28	22	17
5 km/h	33	29	22	16
10 km/h	34	29	22	16

3.2 Adelaide 60 km/h roads

Figure 3.5 shows the speed distribution (1 km/h increments) for all of the Adelaide 60 km/h roads surveyed in 2008 combined.

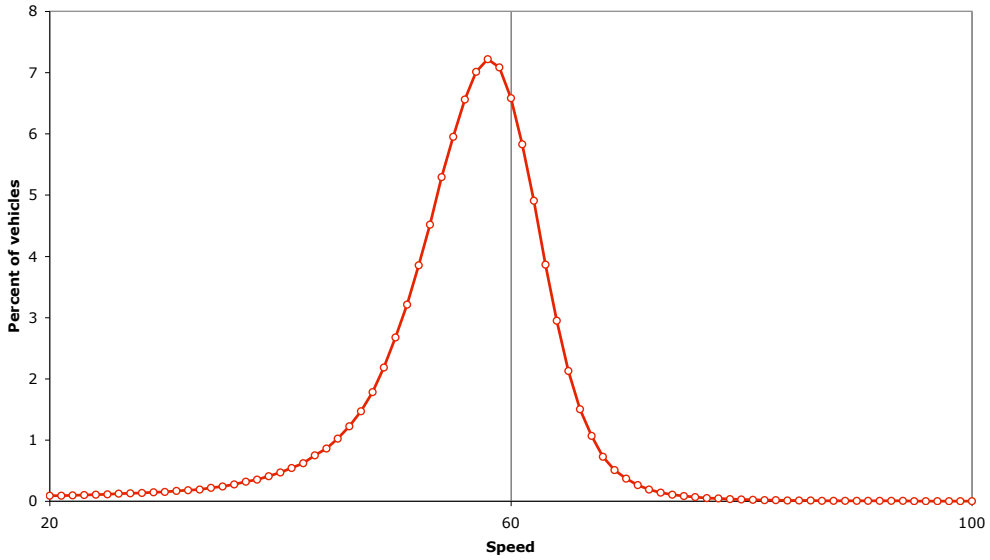

Figure 3.5
Speed distribution of vehicles in Adelaide 60 km/h speed zones

The percentages of vehicles travelling from 1 to 20 km/h above the speed limit are plotted in 1 km/h increments in Figure 3.6 along with the relevant section of the relative risk curve from Figure 2.1.

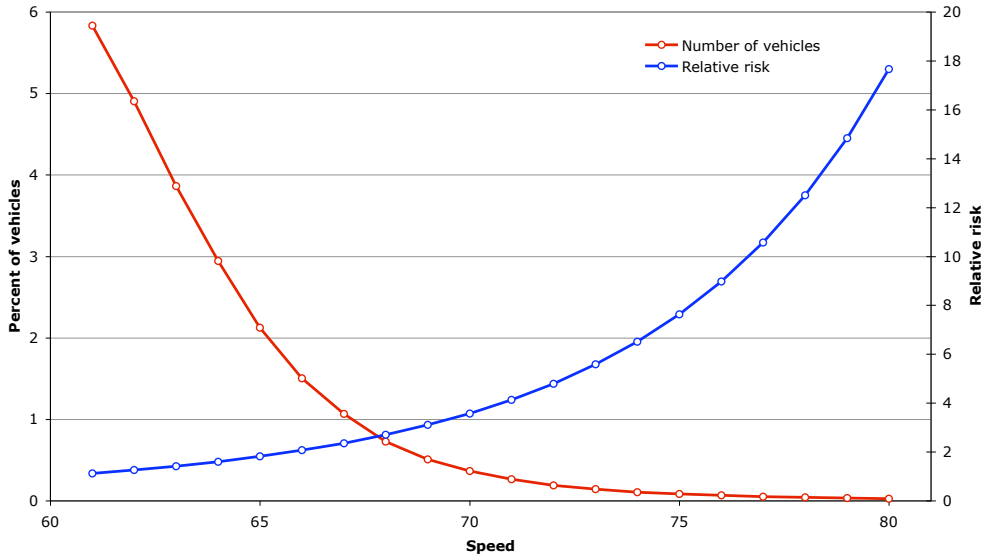

Figure 3.6
Percentages of vehicles in Adelaide 60 km/h zones travelling 1 to 20 km/hr above the speed limit and the relative risk of involvement in a casualty crash (both shown in 1 km/h intervals)

The expected relative frequency of casualty crashes is shown for each speed in Figure 3.7.

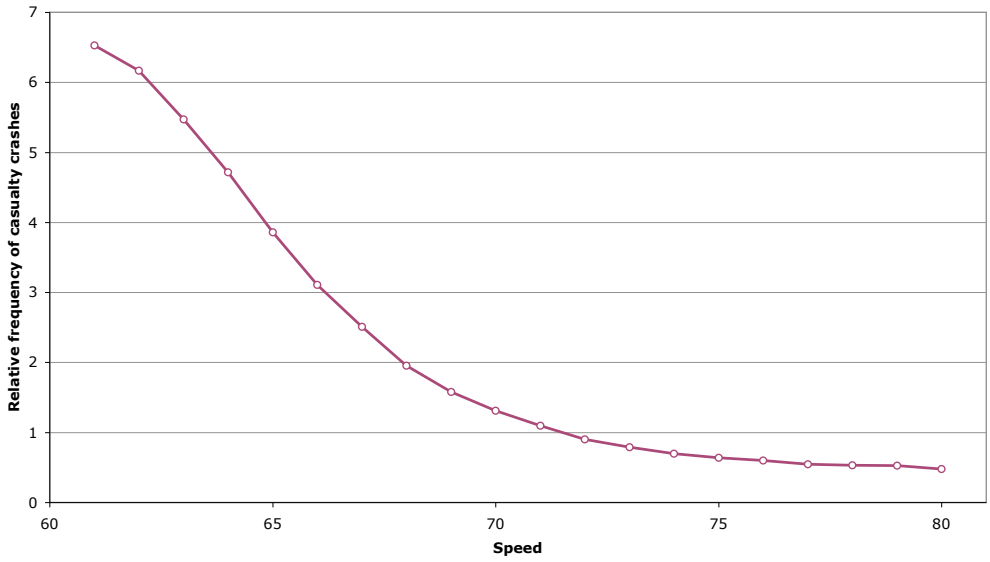

Figure 3.7
Expected relative frequency of casualty crashes by speed for vehicles travelling from 1 to 20 km/h above the speed limit in Adelaide 60 km/h zones

The effects of reducing the speeds of vehicles by 1 km/h, 2 km/h, 5 km/h and 10 km/h, expressed as a proportion of the sum of the reductions in the relative frequencies of casualty crashes over the 61 to 80 km/h range in each case, are shown in Figure 3.8.

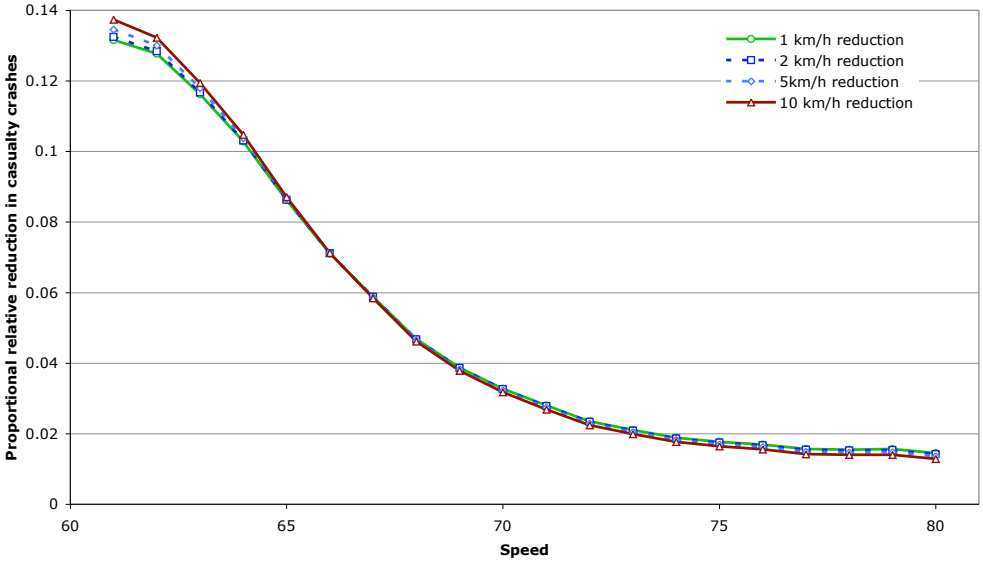

Figure 3.8
Reduction in the relative frequency of casualty crashes expressed as a proportion of the total reduction in casualty crashes for each specified reduction in travelling speed in the 61 to 80 km/h speed range: Adelaide 60 km/h zones

The 1 km/h speed brackets were then collapsed into 5 km/h groups and the relative casualty crash number savings of each group of the various speed reductions were calculated with the results shown in Table 3.2. By far the greatest benefit from reducing the speed of vehicles travelling over the speed limit would come from those travelling 1 to 5 km/h over the speed limit.

Table 3.2
The relative effect of various speed reductions in Adelaide 60 km/h speed zones

Speed reduction	Exceeding the speed limit category (km/h)			
	1 - 5	6 - 10	11 - 15	16 - 20
1 km/h	56	25	11	8
2 km/h	57	25	11	8
5 km/h	57	25	11	7
10 km/h	58	25	10	7

3.3 Adelaide 80 km/h roads

Figure 3.9 shows the speed distribution (1 km/h increments) for all of the Adelaide 80 km/h roads surveyed in 2008 combined.

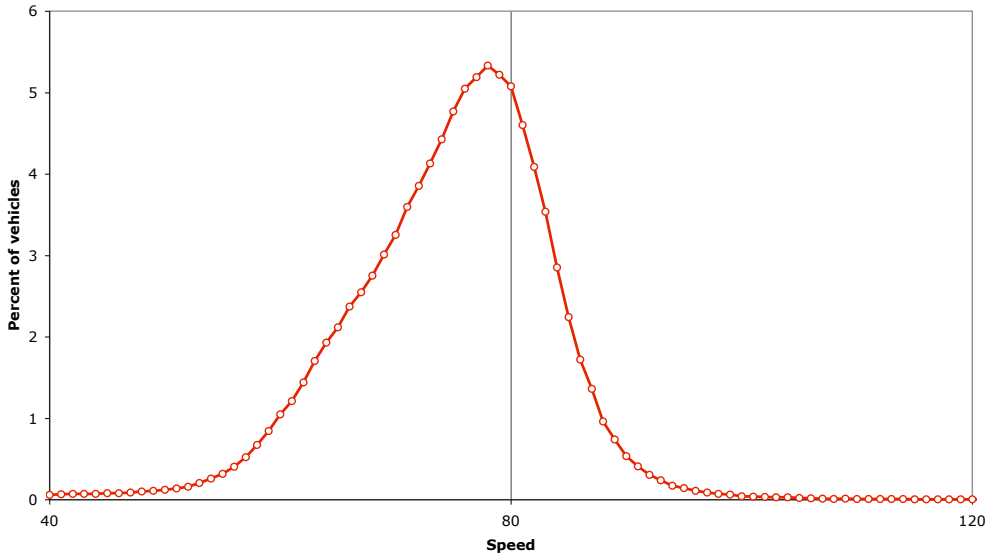

Figure 3.9
Speed distribution of vehicles in Adelaide 80km/h speed zones

The percentages of vehicles travelling from 1 to 20 km/h above the speed limit are plotted in 1 km/h increments in Figure 3.10 along with the relevant section of the relative risk curve from Figure 2.2.

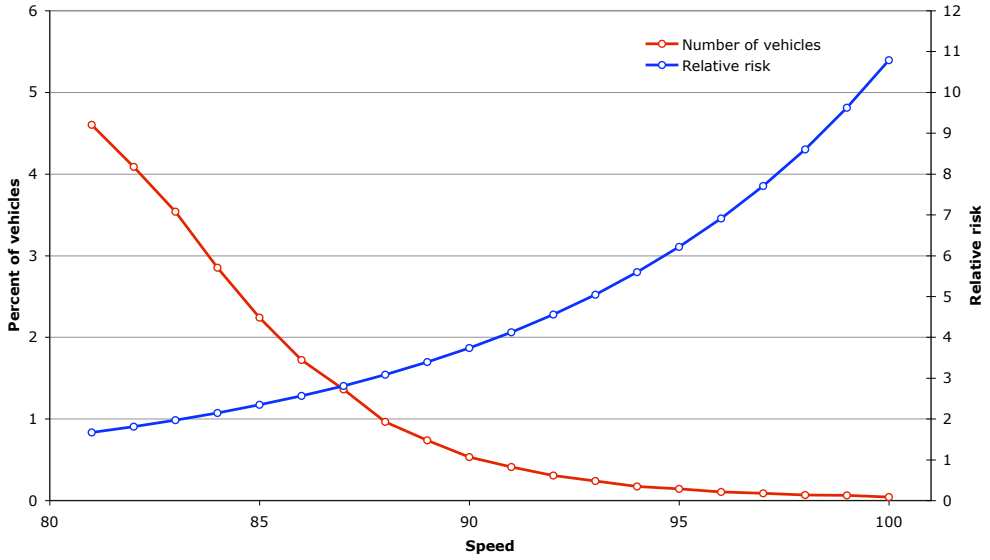

Figure 3.10
Percentages of all vehicles in Adelaide 80 km/h zones travelling 1 to 20 km/hr above the speed limit and the relative risk of involvement in a casualty crash (both shown in 1 km/h intervals)

The expected relative frequency of casualty crashes is shown for each speed in Figure 3.11.

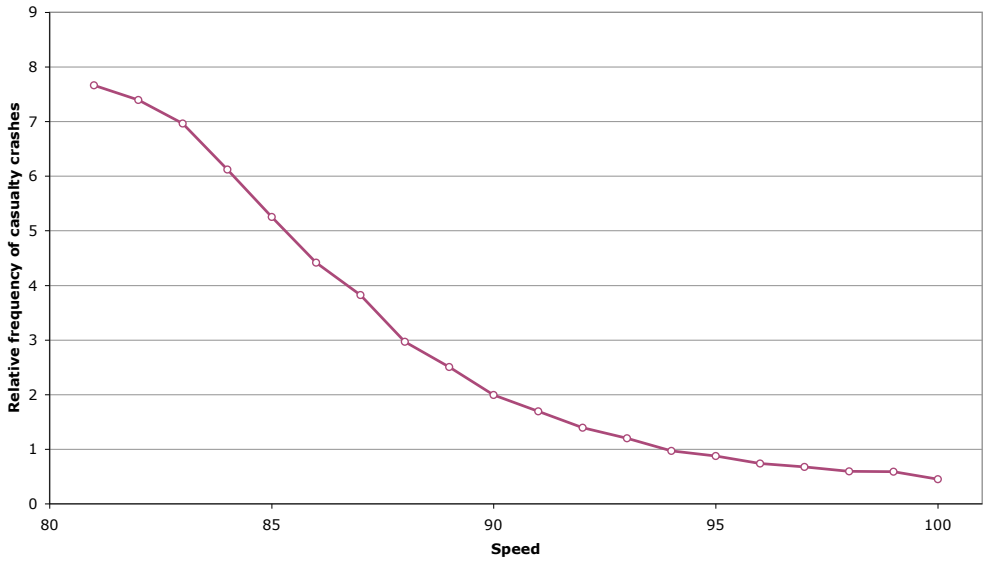

Figure 3.11
Expected relative frequency of casualty crashes by speed for vehicles travelling from 1 to 20 km/h above the speed limit in Adelaide 80 km/h zones

The effects of reducing the speeds of vehicles by 1 km/h, 2 km/h, 5 km/h and 10 km/h, expressed as a proportion of the sum of the reductions in the relative frequencies of casualty crashes over the 81 to 100 km/h range in each case, are shown in Figure 3.12.

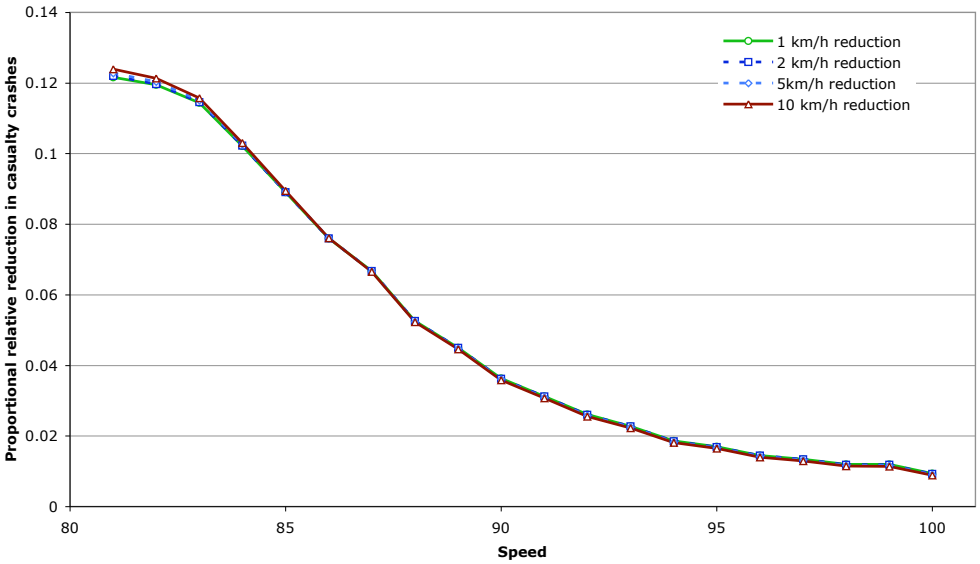

Figure 3.12
Reduction in the relative frequency of casualty crashes expressed as a proportion of the total reduction in casualty crashes for each specified reduction in travelling speed in the 81 to 100 km/h speed range: Adelaide 80 km/h zones

The 1 km/h speed brackets were then collapsed into 5 km/h groups and the relative casualty crash number savings of each group of the various speed reductions were calculated with the results shown in Table 3.3. As for Adelaide 60 km/h roads, the greatest benefit from reducing the speed of vehicles travelling over the speed limit would come from those travelling 1 to 5 km/h over the speed limit.

Table 3.3
The relative effect of various speed reductions in Adelaide 80 km/h speed zones

Speed reduction	Exceeding the speed limit category (km/h)			
	1 -5	6 - 10	11 - 15	16 - 20
1 km/h	55	28	12	6
2 km/h	55	28	12	6
5 km/h	55	28	11	6
10 km/h	55	28	11	6

3.4 Rural 50 km/h roads

Figure 3.13 shows the speed distribution (1 km/h increments) for all of the rural 50 km/h roads surveyed in 2008 combined. The high proportion of vehicles exceeding the speed limit should be noted.

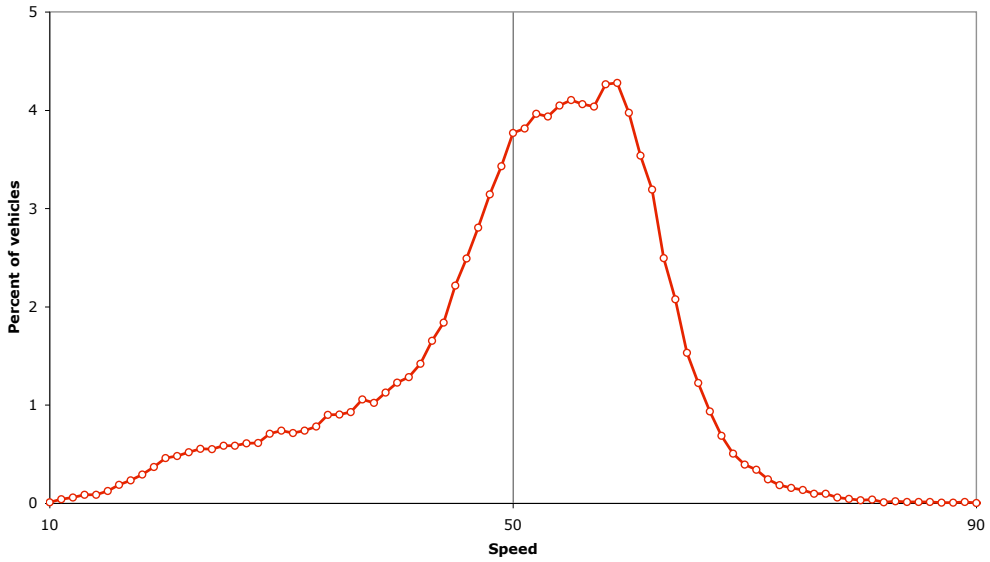

Figure 3.13
Speed distribution of vehicles in rural 50 km/h speed zones

The percentages of vehicles travelling from 1 to 20 km/h above the speed limit are plotted in 1 km/h increments in Figure 3.14 along with the relevant section of the relative risk curve from Figure 2.1.

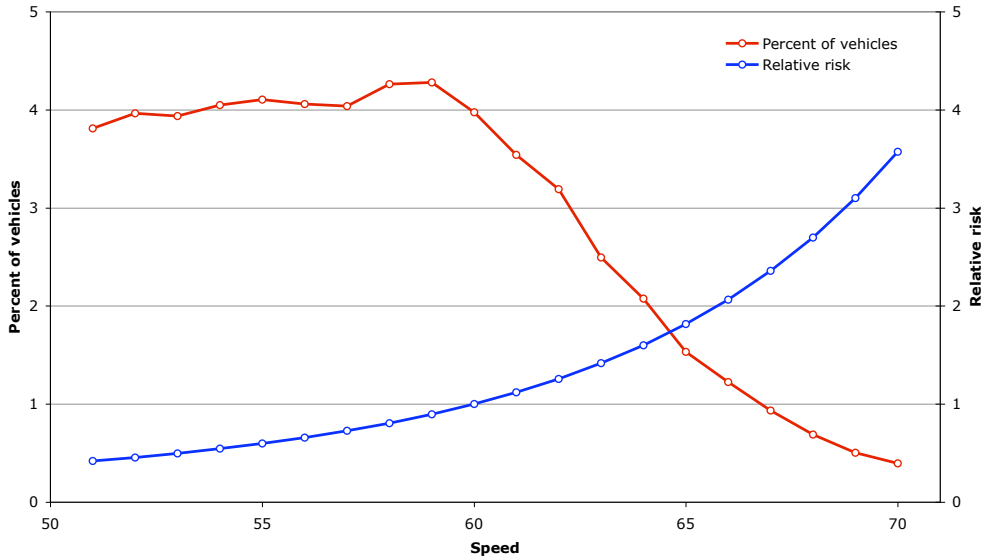

Figure 3.14
Percentages of vehicles in rural 50 km/h zones travelling 1 to 20 km/hr above the speed limit and the relative risk of involvement in a casualty crash (both shown in 1 km/h intervals)

The expected relative frequency of casualty crashes is shown for each speed in Figure 3.15.

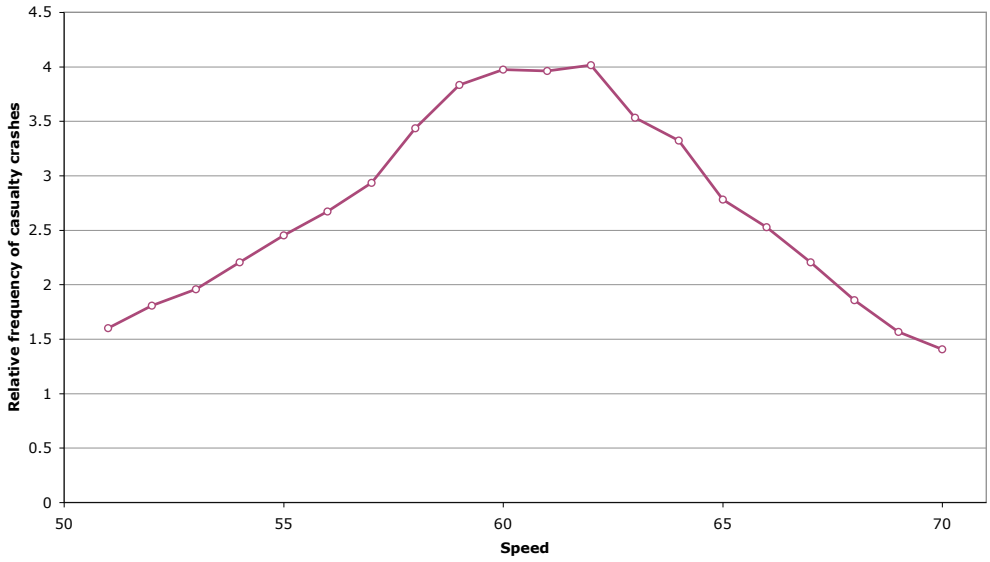

Figure 3.15
Expected relative frequency of casualty crashes by speed for vehicles travelling from 1 to 20 km/h above the speed limit in rural 50 km/h zones

The effects of reducing the speeds of vehicles by 1 km/h, 2 km/h, 5 km/h and 10 km/h, expressed as a proportion of the sum of the reductions in the relative frequencies of casualty crashes over the 51 to 70 km/h range in each case, are shown in Figure 3.16.

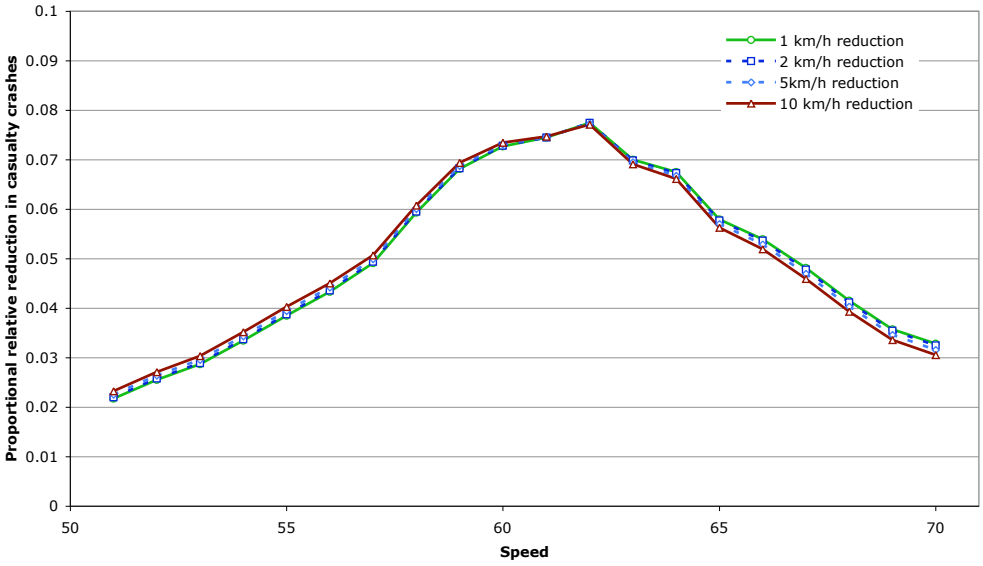

Figure 3.16
Reduction in the relative frequency of casualty crashes expressed as a proportion of the total reduction in casualty crashes for each specified reduction in travelling speed in the 51 to 70 km/h speed range: rural 50 km/h zones

The 1 km/h speed brackets were then collapsed into 5 km/h groups and the relative casualty crash number savings of each group of the various speed reductions were calculated with the results shown in Table 3.4. It can be seen that reducing travelling speeds by various amounts produces very similar

relative results regardless of the level of speed reduction. The greatest benefit of reducing the speed of vehicles travelling over the speed limit would come from those travelling 11 to 15 km/h above the speed limit. This is a result of the high level of vehicles exceeding the speed limit in rural 50 km/h zones.

Table 3.4
The relative effect of various speed reductions in rural 50 km/h speed zones

Speed reduction	Exceeding the speed limit category (km/h)			
	1 - 5	6 - 10	11 - 15	16 - 20
1 km/h	15	29	35	21
2 km/h	15	29	35	21
5 km/h	15	30	35	21
10 km/h	16	30	34	20

3.5 Rural 60 km/h zones

Figure 3.17 shows the speed distribution (1 km/h increments) for all of the rural 60 km/h roads surveyed in 2008 combined.

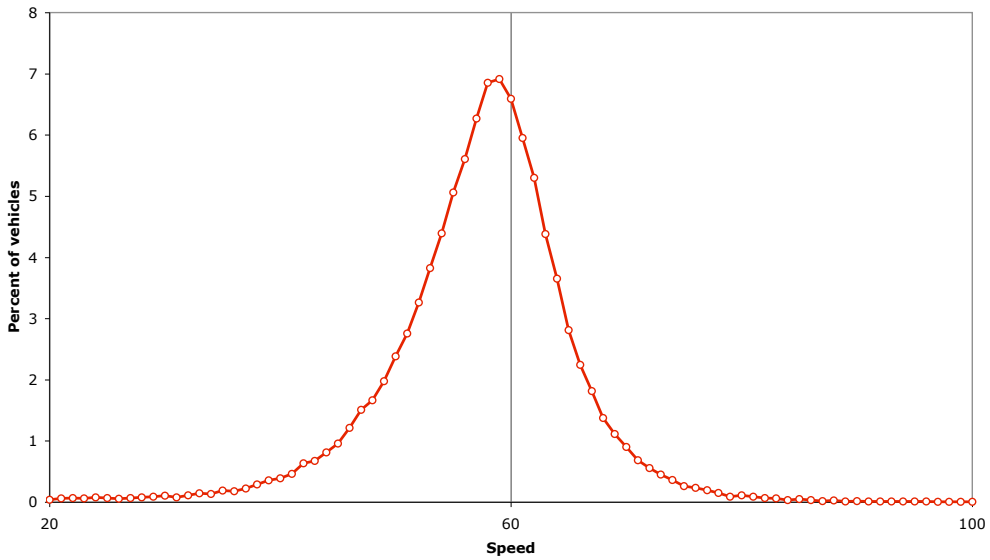

Figure 3.17
Speed distribution of vehicles in rural 60 km/h speed zones

The vehicles measured as travelling from 1 to 20 km/h above the speed limit are plotted in 1 km/h increments in Figure 3.18 along with the relevant section of the relative risk curve from Figure 2.1.

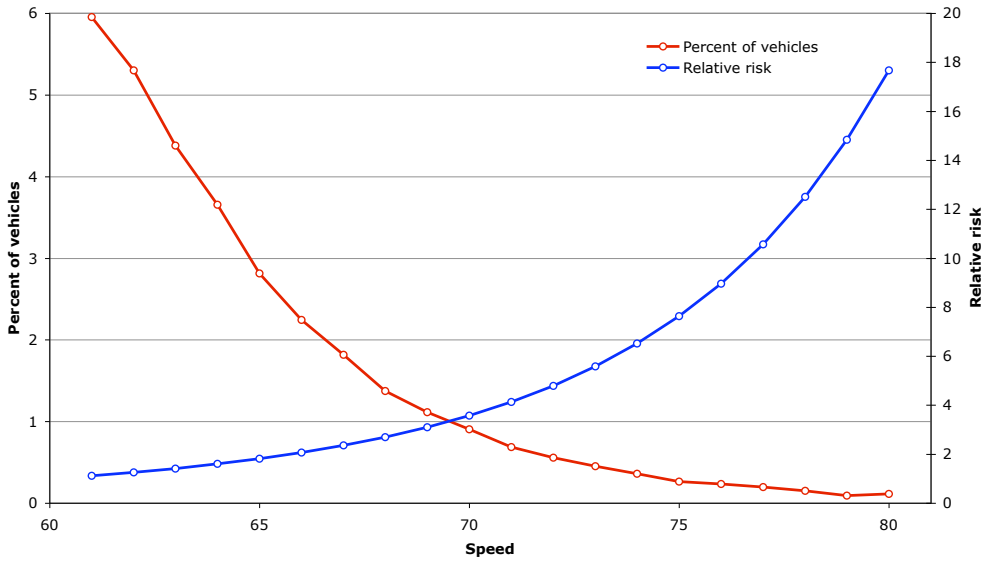

Figure 3.18
The relative proportion of vehicles measured at speeds between 1 and 20 km/h over the speed limit in rural 60 km/h zones and the relative risk curve that was used for 60 km/h zones

The expected relative frequency of casualty crashes is shown for each speed in Figure 3.19.

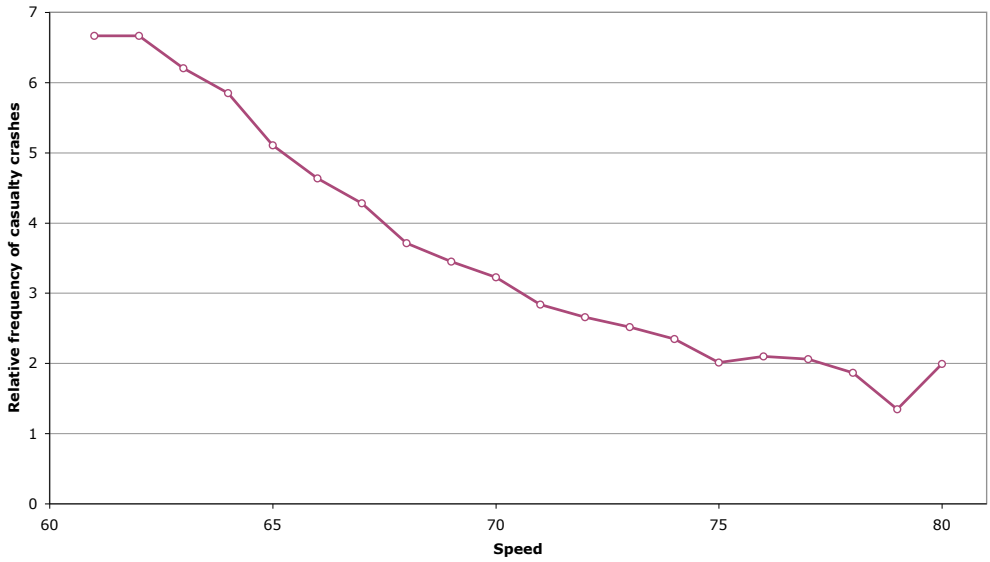

Figure 3.19
Expected relative frequency of casualty crashes by speed for vehicles travelling from 1 to 20 km/h above the speed limit in rural 60 km/h zones

The effects of reducing the speeds of vehicles by 1 km/h, 2 km/h, 5 km/h and 10 km/h, expressed as a proportion of the sum of the reductions in the relative frequencies of casualty crashes over the 61 to 80 km/h range in each case, are shown in Figure 3.20.

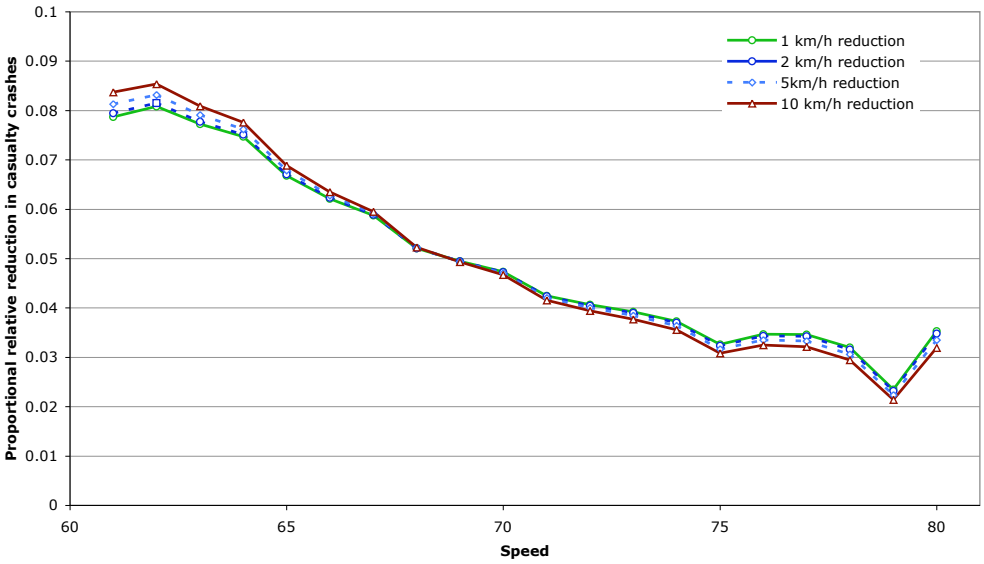

Figure 3.20
Reduction in the relative frequency of casualty crashes expressed as a proportion of the total reduction in casualty crashes for each specified reduction in travelling speed in the 61 to 80 km/h speed range: rural 60 km/h zones

The 1 km/h speed brackets were then collapsed into 5 km/h groups and the relative casualty crash number savings of each group of the various speed reductions were calculated with the results shown in Table 3.5. It can be seen that reducing the speed by various amounts produces very similar relative results regardless of the level of speed reduction. The greatest benefit of reducing the speed of vehicles travelling over the speed limit would come from those travelling 1 to 5 km/h over the speed limit.

Table 3.5
The relative effect of various speed reductions in rural 60 km/h speed zones

Speed reduction	Exceeding the speed limit category (km/h)			
	1 - 5	6 - 10	11 - 15	16 - 20
1 km/h	38	27	19	16
2 km/h	38	27	19	16
5 km/h	39	27	19	15
10 km/h	40	27	19	15

3.6 Rural 80 km/h zones

Figure 3.21 shows the speed distribution (1 km/h increments) for all of the rural 80 km/h roads surveyed in 2008 combined.

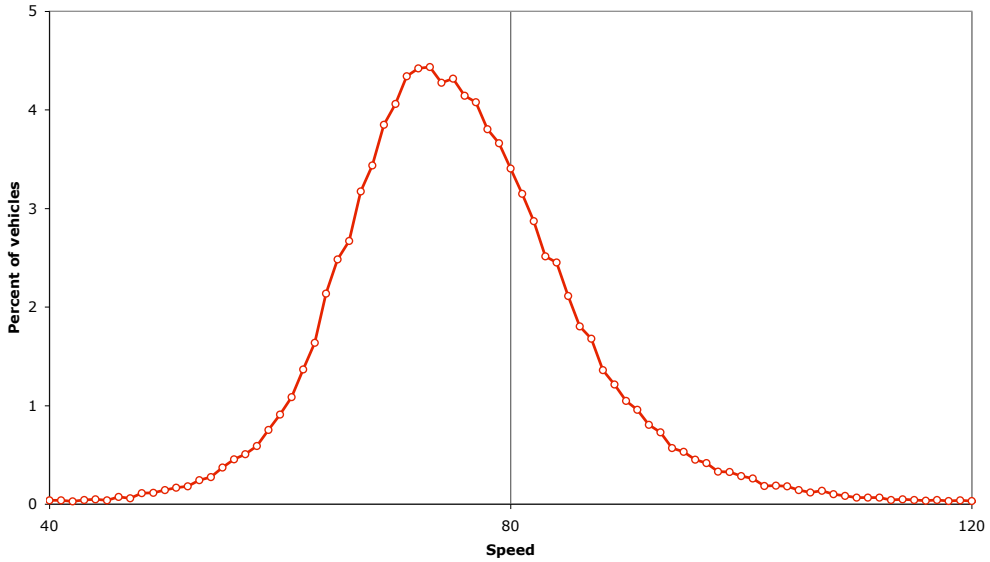

Figure 3.21
Speed distribution of vehicles in rural 80 km/h speed zones

The vehicles measured as travelling from 1 to 20 km/h above the speed limit are plotted in 1 km/h increments in Figure 3.22 along with the relevant section of the relative risk curve from Figure 2.2.

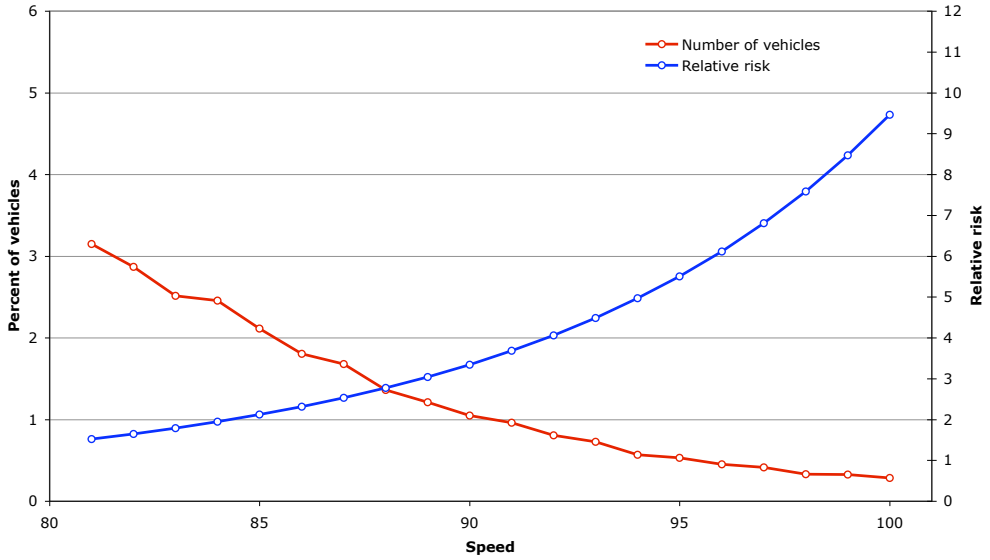

Figure 3.22
The relative proportion of vehicles measured at speeds between 1 and 20 km/h over the speed limit in rural 80 km/h zones and the relative risk curve that was used for 80 km/h zones

The expected relative frequency of casualty crashes is shown for each speed in Figure 3.23.

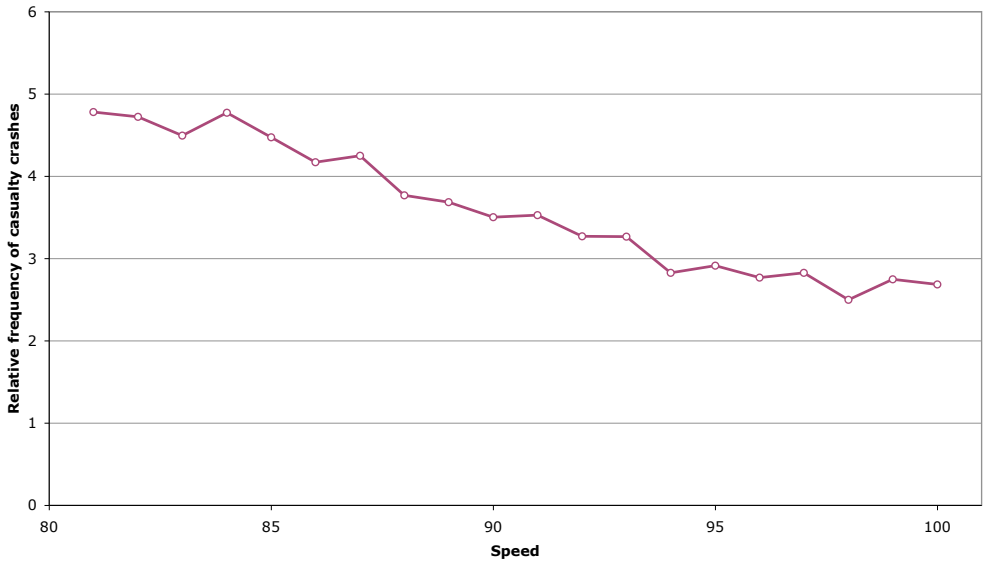

Figure 3.23
Expected relative frequency of casualty crashes by speed for vehicles travelling from 1 to 20 km/h above the speed limit in rural 80 km/h zones

The effects of reducing the speeds of vehicles by 1 km/h, 2 km/h, 5 km/h and 10 km/h, expressed as a proportion of the sum of the reductions in the relative frequencies of casualty crashes over the 81 to 100 km/h range in each case, are shown in Figure 3.24.

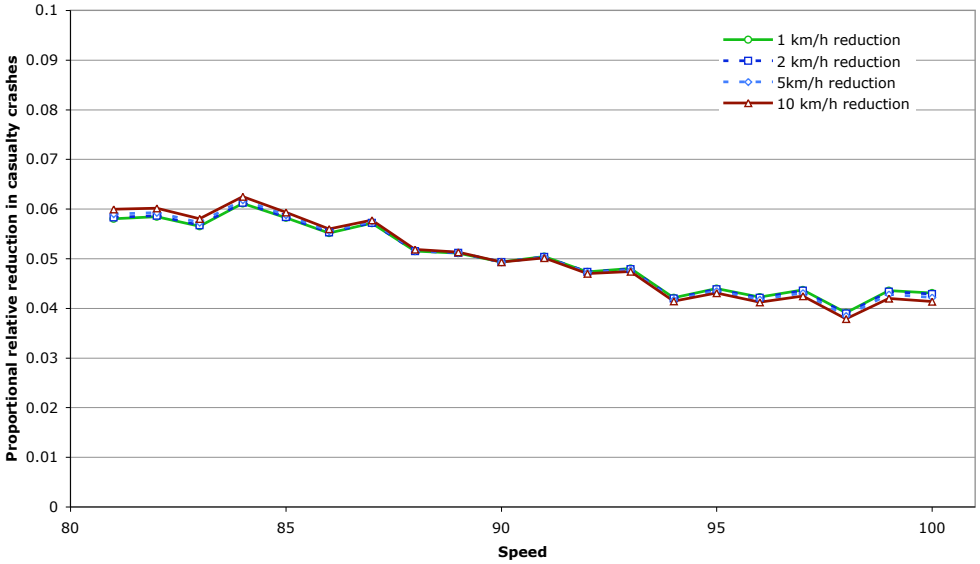

Figure 3.24
Reduction in the relative frequency of casualty crashes expressed as a proportion of the total reduction in casualty crashes for each specified reduction in travelling speed in the 81 to 100 km/h speed range: rural 80 km/h zones

The 1 km/h speed brackets were then collapsed into 5 km/h groups and the relative casualty crash number savings of each group of the various speed reductions were calculated with the results shown in Table 3.6. It can be seen that reducing the speed by various amounts produces very similar relative results regardless of the level of speed reduction. The greatest benefit of reducing the speed of vehicles travelling over the speed limit would come from those travelling 1 to 5 km/h over the speed limit but there is little difference in crash reduction over the 20 km/h speed range.

Table 3.6
The relative effect of various speed reductions in rural 80 km/h speed zones

Speed reduction	Exceeding the speed limit category (km/h)			
	1 - 5	6 - 10	11 - 15	16 - 20
1 km/h	29	26	23	21
2 km/h	29	26	23	21
5 km/h	30	27	23	21
10 km/h	30	27	23	20

3.7 Rural 100 km/h zones

Figure 3.25 shows the speed distribution (1 km/h increments) for all of the rural 100 km/h roads surveyed in 2008 combined.

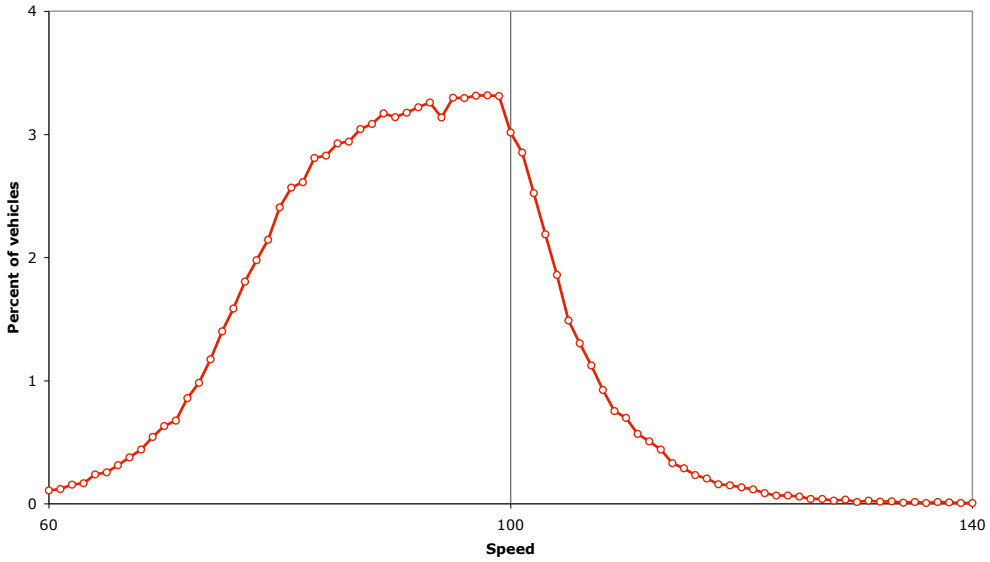

Figure 3.25
Speed distribution of vehicles in rural 100 km/h speed zones

The percentages of vehicles travelling from 1 to 20 km/h above the speed limit are plotted in 1 km/h increments in Figure 3.26 along with the relevant section of the relative risk curve from Figure 2.2.

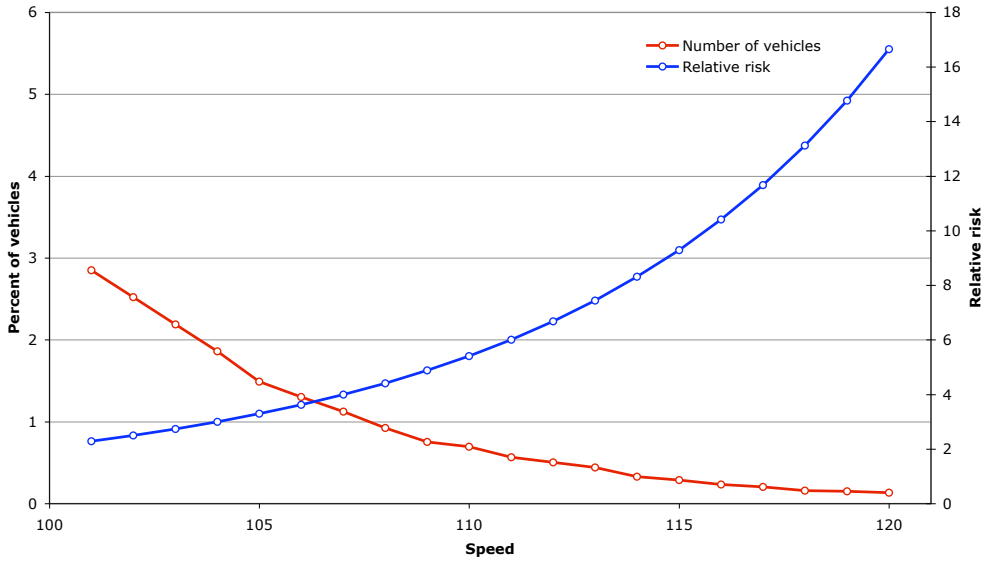

Figure 3.26
The relative proportion of vehicles measured at speeds between 1 and 20 km/h over the speed limit in rural 100 km/h zones and the relative risk curve that was used for 100 km/h zones

The expected relative frequency of casualty crashes is shown for each speed in Figure 3.27.

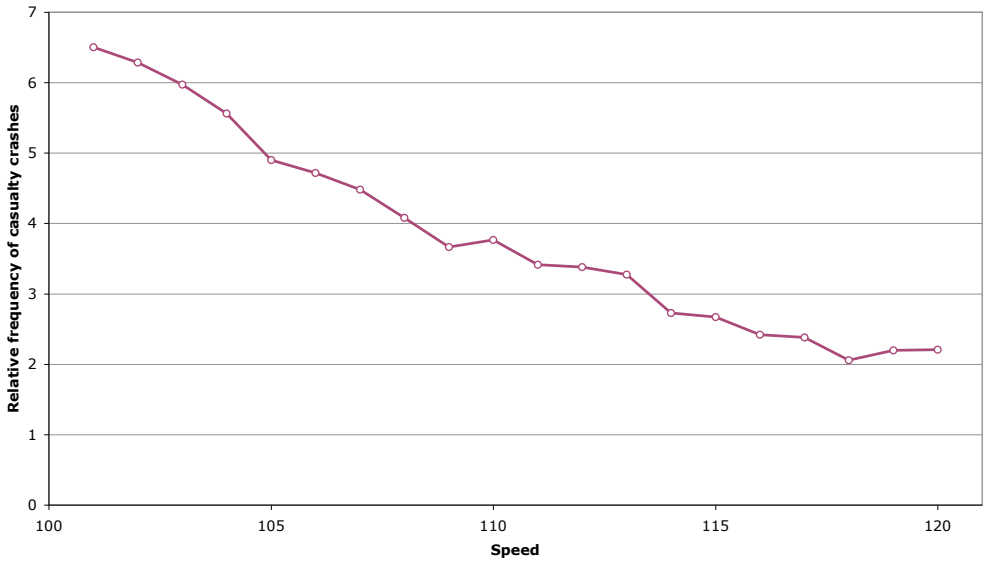

Figure 3.27
Expected relative number of casualty crashes in rural 100 km/h zones

The effects of reducing the speed of the vehicles in the range being considered by 1 km/h, 2 km/h, 5 km/h and 10 km/h were examined. The results, expressed as a fraction of the sum of the relative crash number savings over the 20 km/h range, are shown in Figure 3.28. As seen previously, reducing the speed by various amounts produces very similar relative results regardless of the level of speed reduction. The greatest benefit of reducing the speed of vehicles travelling over the speed limit would come from those travelling at the lower speeds in the 20 km/h range.

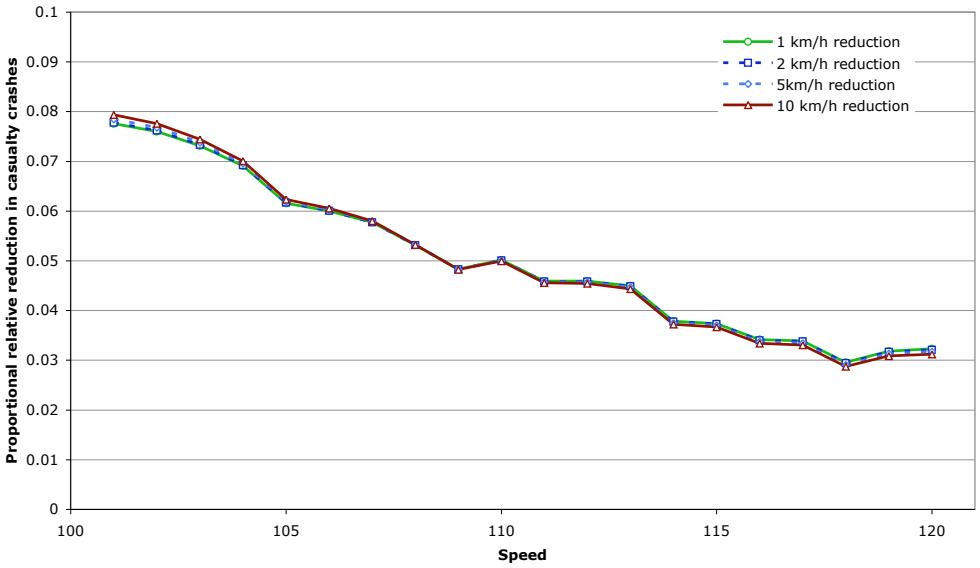

Figure 3.28
Reduction in the relative frequency of casualty crashes expressed as a proportion of the total reduction in casualty crashes for each specified reduction in travelling speed in the 101 to 120 km/h speed range: rural 100 km/h zones

The 1 km/h speed brackets were then collapsed into 5 km/h groups and the relative crash number savings of each group of the various speed reductions were calculated with the results shown in Table 3.7.

Table 3.7
The relative effect of various speed reductions in rural 100 km/h speed zones

Speed reduction	Exceeding the speed limit category (km/h)			
	1 - 5	6 - 10	11 - 15	16 - 20
1 km/h	36	27	21	16
2 km/h	36	27	21	16
5 km/h	36	27	21	16
10 km/h	36	27	21	16

3.8 Rural 110 km/h zones

Figure 3.29 shows the speed distribution (1 km/h increments) for all of the rural 110 km/h roads surveyed in 2008 combined.

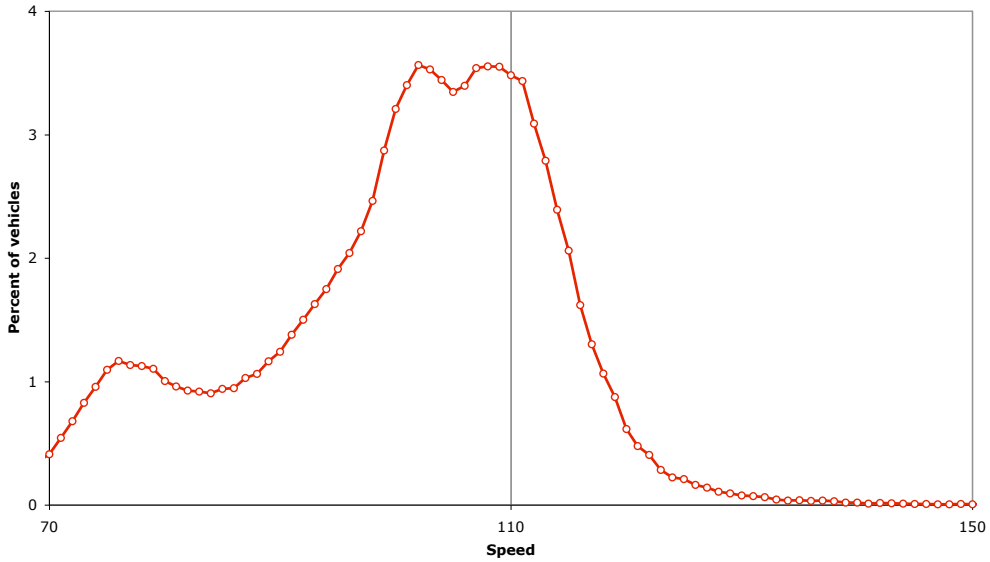

Figure 3.29
Speed distribution of vehicles in rural 110 km/h speed zones

The percentages of vehicles travelling from 1 to 20 km/h above the speed limit are plotted in 1 km/h increments in Figure 3.30 along with the relevant section of the relative risk curve from Figure 2.2.

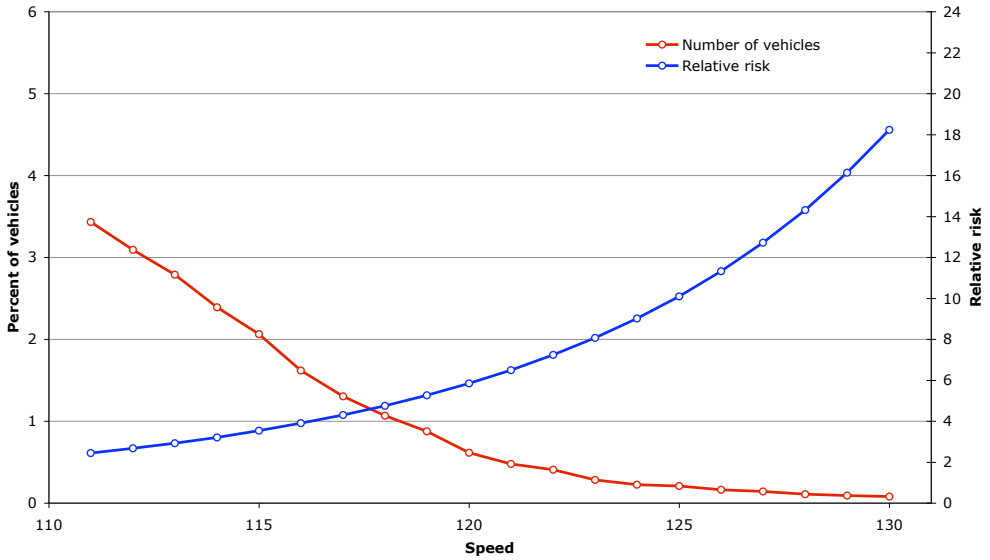

Figure 3.30
The relative proportion of vehicles measured at speeds between 1 and 20 km/h over the speed limit in rural 110 km/h zones and the relative risk curve that was used for 110 km/h zones

The expected relative frequency of casualty crashes is shown for each speed in Figure 3.31.

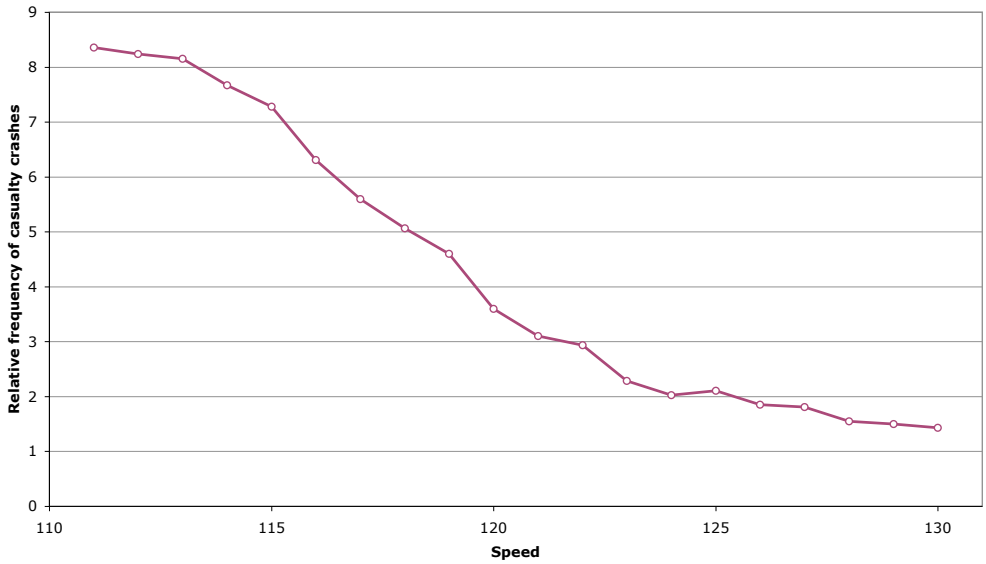

Figure 3.31
Expected relative frequency of casualty crashes by speed for vehicles travelling from 1 to 20 km/h above the speed limit in rural 110 km/h zones

The effects of reducing the speed of the vehicles in the range being considered by 1 km/h, 2 km/h, 5 km/h and 10 km/h were examined. The results, expressed as a fraction of the sum of the relative crash number savings over the 20 km/h range, are shown in Figure 3.32. As before, reducing the speed by various amounts produces very similar relative results regardless of the level of speed reduction. The greatest benefit of reducing the speed of vehicles travelling over the speed limit would come from those travelling just above the speed limit.

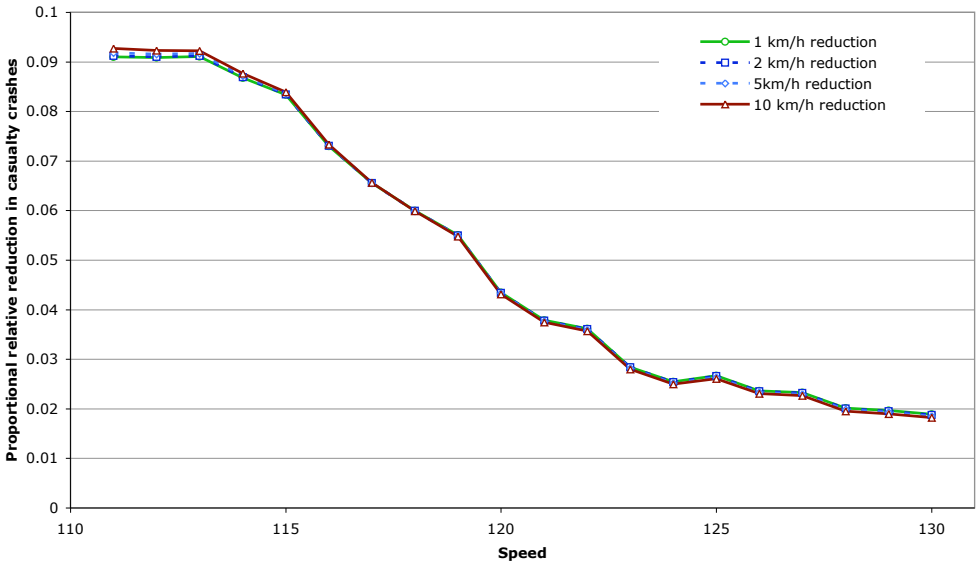

Figure 3.32
Reduction in the relative frequency of casualty crashes expressed as a proportion of the total reduction in casualty crashes for each specified reduction in travelling speed in the 111 to 130 km/h speed range: rural 110 km/h zones

The 1 km/h speed brackets were then collapsed into 5 km/h groups and the relative casualty crash number savings of each group of the various speed reductions were calculated with the results shown in Table 3.8.

Table 3.8
The relative effect of various speed reductions in rural 110 km/h speed zones

Speed reduction	Exceeding the speed limit category (km/h)			
	1 - 5	6 - 10	11 - 15	16 - 20
1 km/h	44	30	15	11
2 km/h	44	30	15	11
5 km/h	45	30	15	10
10 km/h	45	30	15	10

4 Discussion

4.1 Potential benefits of reducing speeds within road types

The primary purpose of this project was to identify which groups of speeding drivers (in terms of their current speed) present the greatest casualty crash reduction potential if their speeds could be lowered for different road types.

We have based the study on speeding drivers in the 20 km/h band above the speed limit. This assumes that drivers who choose to exceed the speed limit by more than 20 km/h are unlikely to be influenced by media publicity urging them to slow down. For reference, an examination of the travel speeds of vehicles in casualty crash used in Kloeden, Ponte and McLean (2001) and Kloeden, McLean and Glonek (2002) revealed that 14% of the 146 casualty crashes in Adelaide and 10% of the 83 casualty crashes in rural South Australia involved a vehicle travelling more than 20 km/h above the speed limit. If only the crashes where the vehicle was speeding are considered this increases to about 21% in both areas.

The method we have used has been made possible by the availability of State-wide speed surveys and information on the relationship between travelling speed and the relative risk of involvement in a casualty crash in both urban and rural areas of the State. The representativeness of the speed survey data is not known but the survey sites have been selected with that characteristic in mind. The risk estimates are based on studies conducted in South Australia. These estimates have been found to accurately predict the effect of changes in travelling speed on casualty crash rates.

The casualty crash estimates are derived from the product of the number of vehicles travelling at a given speed, from the speed surveys, and the relative risk of involvement in a casualty crash at that speed. The resulting number provides us with a basis for comparing the benefits in terms of casualty crash reduction between, say, a 1 km/h reduction in travelling speed and a 5 km/h reduction. These are relative benefits in terms of casualty crashes prevented.

The results on the relative effects of various speed reductions that were presented in the previous Section for eight categories of road and speed limit are summarised in Table 4.1. The numbers in the cells of the Table can be compared by row (where the add up to 100) for each of the eight categories, but not by column because they are from normalised data (eg: from Figure 2.9 not Figure 2.8). As mentioned in the previous paragraph, they indicate the relative levels of casualty crash reductions. The rows may not always sum to exactly 100 due to rounding.

With one exception, all of the eight speed limit areas listed in Table 4.1 show that the greatest reduction in casualty crashes is obtained from a reduction in travelling speed in the first 5 km/h above the speed limit. The level of casualty crash reduction from a given reduction in speed decreases with increases in travelling speed beyond the speed limit. This is because there are more, usually many more, vehicles in the 1 to 5 km/h speed range above the speed limit and this has a much greater effect than the lower relative risk of casualty crash involvement for that lower speed range.

The exception to the above generalisation is rural roads with a 50 km/h speed limit. On these roads the greatest benefit is obtained from speed reductions in the speed range 11 to 15 km/h above the speed limit, followed by 6 to 10 km/h. This is because the distribution of vehicle numbers by speed for rural 50 km/h roads is unusual for the speed limit areas presented here in that there are more vehicles exceeding than complying with the speed limit (Figure 3.13).

The extent to which speed reductions in the 1 to 5 km/h range will reduce casualty crashes relative to speed reductions above that range varies between different speed limit areas. The effect is greatest for Adelaide 60 and 80 km/h roads. Greater reductions in casualty crashes will be obtained from reducing speeds in the 1 to 5 km/h range on those roads than from speed reductions in the next three 5 km/h speed ranges combined (Table 4.1).

In summary, any reductions in travelling speeds will reduce casualty crashes. The greatest overall effect on casualty crashes involving vehicles travelling at illegal speeds will come from reducing speeds just above the speed limit in almost all cases.

Table 4.1
The relative percentage effect on casualty crashes of various speed reductions on different road types for different groups of speeding drivers

Speed limit area	Speed reduction	Exceeding the speed limit category (km/h)			
		1 - 5	6 - 10	11 - 15	16 - 20
Adelaide 50 km/h	1 km/h	32	28	22	17
	2 km/h	32	28	22	17
	5 km/h	33	29	22	16
	10 km/h	34	29	22	16
Adelaide 60 km/h	1 km/h	56	25	11	8
	2 km/h	57	25	11	8
	5 km/h	57	25	11	7
	10 km/h	58	25	10	7
Adelaide 80 km/h	1 km/h	55	28	12	6
	2 km/h	55	28	12	6
	5 km/h	55	28	11	6
	10 km/h	55	28	11	6
Rural 50 km/h	1 km/h	15	29	35	21
	2 km/h	15	29	35	21
	5 km/h	15	30	35	21
	10 km/h	16	30	34	20
Rural 60 km/h	1 km/h	38	27	19	16
	2 km/h	38	27	19	16
	5 km/h	39	27	19	15
	10 km/h	40	27	19	15
Rural 80 km/h	1 km/h	29	26	23	21
	2 km/h	29	26	23	21
	5 km/h	30	27	23	21
	10 km/h	30	27	23	20
Rural 100 km/h	1 km/h	36	27	21	16
	2 km/h	36	27	21	16
	5 km/h	36	27	21	16
	10 km/h	36	27	21	16
Rural 110 km/h	1 km/h	44	30	15	11
	2 km/h	44	30	15	11
	5 km/h	45	30	15	10
	10 km/h	45	30	15	10

4.2 Potential benefits of reducing speeds between road types

While the above analysis indicates which speed bands have the greatest potential safety benefits for speed reductions within each road type, the absolute safety benefits cannot be directly compared between sites.

Table 4.1 presents the number of people injured and the number of people fatally injured in South Australia between 2005 and 2009 by road type (location and speed limit). Nearly half of all the injuries occurred on Adelaide 60 km/h roads while more than half of the fatalities occurred on high speed (100 km/h or greater) rural roads.

Table 4.1
Number of people injured and fatally injured in South Australia by road type (2005-2009)

Road type	Injured	Fatal
Adelaide 50 km/h	7207	30
Adelaide 60 km/h	17678	114
Adelaide 80 km/h	2547	48
Rural 50 km/h	1586	20
Rural 60 km/h	1139	16
Rural 80 km/h	1198	34
Rural 100 km/h	3030	154
Rural 110 km/h	3011	138

Cameron and Elvik (2010) developed estimates for expected reductions in casualties and fatalities due to changes in the mean speeds of vehicles for different road environments using refined power estimates for the model originally developed by Nilsson (1981, 2004). The power estimates from Table 5 in Cameron and Elvik (2010) were used to calculate reductions that would be expected from a 1 km/h reduction in mean speeds for each road type. Since Cameron and Elvik (2010) did not analyse the specific road types analysed in this report: the value for urban arterial roads was used for all 50 km/h and 60 km/h roads and for urban 80 km/h roads; and the value for rural highways was used for rural 80 km/h roads and all 100 km/h and 110 km/h roads.

Table 4.2 shows the percentage reductions in the number of people injured that would be expected from a 1 km/h reduction in mean travelling speeds on each road type. The numbers from Table 4.1 were then used predict actual numbers of injuries saved each year. As an example: on 50 km/h Adelaide roads the ratio of mean speeds was 0.979 ((48.2-1)/48.2); raising this to the power of 1.746 gives 0.964; this represents a 3.6 per cent expected reduction in persons injured due to the lower mean speed of vehicles; multiplying this by 7207 (the number of injured people in 5 years) and dividing by 5 (to get a yearly figure) gives an expected saving of 51.8 injured people per year.

The largest potential for reducing injuries by lowering mean speeds by 1 km/h is clearly in Adelaide 60 km/h speed zones followed distantly by Adelaide 50 km/h speed zones. The combined effect of lowering mean speeds by 1 km/h on these two road types is expected to be 160 fewer injured persons each year.

It should be noted that the resulting estimates using Cameron and Elvik's work appear conservative compared to actual changes in mean speed and injured persons observed in South Australia (Kloeden, Woolley and McLean, 2007; Long, Kloeden, Hutchinson and McLean, 2006) which suggest the actual savings may be up to twice as much as those estimated here.

Table 4.2
Estimated annual reductions in people injured from a 1 km/h reduction in mean speed by road type

Road type	Mean speed	Power coefficient	% reduction	Number saved per year
Adelaide 50 km/h	48.2	1.746	3.6	51.8
Adelaide 60 km/h	56.5	1.746	3.1	108.5
Adelaide 80 km/h	74.8	1.746	2.3	11.8
Rural 50 km/h	51.9	1.746	3.3	10.6
Rural 60 km/h	57.6	1.746	3.0	6.9
Rural 80 km/h	76.6	2.495	3.2	7.7
Rural 100 km/h	92.1	2.495	2.7	16.3
Rural 110 km/h	103.3	2.495	2.4	14.4

The same method was also used to calculated fatality reductions with the results shown in Table 4.3. While the largest potential for reducing fatalities by lowering mean speeds by 1 km/h was in Adelaide 60 km/h speed zones, both 100 and 110 km/h rural roads showed similar potential reductions.

Table 4.3
Estimated annual reductions in people fatally injured from a 1 km/h reduction in mean speed by road type

Road type	Mean speed	Power coefficient	% reduction	Number saved per year
Adelaide 50 km/h	48.2	4.251	8.5	0.5
Adelaide 60 km/h	56.5	4.251	7.3	1.7
Adelaide 80 km/h	74.8	4.251	5.6	0.5
Rural 50 km/h	51.9	4.251	7.9	0.3
Rural 60 km/h	57.6	4.251	7.2	0.2
Rural 80 km/h	76.6	4.711	6.0	0.4
Rural 100 km/h	92.1	4.711	5.0	1.5
Rural 110 km/h	103.3	4.711	4.5	1.2

4.3 Conclusion

While speed reductions of any type would be expected to reduce injuries and fatalities, the greatest potential gains for reducing injuries appear to be in targeting low level speeding on Adelaide low speed roads. For fatalities this would be extended to include low level speeding on high speed rural roads.

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References

Cameron MH, Elvik R (2010) 'Nilsson's Power Model connecting speed and road trauma: Does it apply on urban roads', 2010 Australasian Road Safety Research, Policing, Education Conference, Canberra, 1-3 September 2010.

Kloeden CN, McLean AJ, Glonek G (2002) Reanalysis of travelling speed and the risk of crash involvement in Adelaide South Australia (CR207), Australian Transport Safety Bureau, Canberra.

Kloeden CN, Ponte G, McLean AJ (2001) Travelling speed and the risk of crash involvement on rural roads (CR204), Australian Transport Safety Bureau, Canberra.

Kloeden CN, Woolley JE (2010) Vehicle speeds in South Australia 2008 (CASR066), Centre for Automotive Safety Research, Adelaide.

Kloeden CN, Woolley JE, McLean AJ (2007) 'A follow-up evaluation of the 50km/h default urban speed limit in South Australia', 2007 Road Safety Research, Education and Policing Conference, Melbourne, Australia, 17-19 October 2007.

Long AD, Kloeden CN, Hutchinson TP, McLean AJ (2006) 'Reduction of speed limit from 110km/h to 100km/h on certain roads in South Australia: A preliminary evaluation', 2006 Australasian Road Safety Research, Policing and Education Conference, Gold Coast, Australia, 25-27 October 2006.

Nilsson G (1981) 'The effects of speed limits on traffic accidents in Sweden'. Proceedings, International Symposium, Dublin. OECD.

Nilsson G (2004) 'Traffic safety dimensions and the Power Model to describe the effect of speed on safety'. Bulletin 221, Lund Institute of Technology, Department of Technology and Society, Traffic Engineering, Lund, Sweden.