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Abstract

This report describes and analyses temporal changes in fatalities per population between 1970 and 1990 in Australia.

Annual time trends in fatality rates are examined by road user type (all fatalities, drivers, passengers, pedestrians, motor cyclists and bicyclists), State/Territory, gender, age, time of week and month.

Report CR 115 comprises a summary of this report and of CR 114, which compares the trends in Australia and other countries.

Keywords Fatality rate, crash fatality trends, statistics

Notes:

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- (2) The views expressed are those of the author(s) and do not necessarily represent those of the Commonwealth Government.



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Trends in road crash fatality rates: Australia 1970-1990

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April 1993

Trends in road crash fatality rates: Australia 1970-1990

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Trends in road crash fatality rates: Australia 1970-1990

SUMMARY

This report describes and analyses temporal changes between 1970 and 1990 in road fatality patterns in Australia. Annual time trends are examined by road user type, State/Territory, gender, age, time of week and month. Fatality rates were expressed as deaths per person, deaths per registered vehicle and deaths per kilometre of travel.

<u>The data</u>

The following data were provided by State and Territory authorities: date and time of the crash, State or Territory where the crash occurred, and the gender, age and road user type of the person. In some cases, complete data for the whole period 1970 to 1990 were not available. The available data were collated, assessed for face validity and internal consistency and checked against published data.

In addition, the following data were obtained from the Australian Bureau of Statistics:

- number of persons, classified by State/Territory, gender, age group and year
- number of registered vehicles, classified by State/Territory, vehicle type (motor cycles, other vehicles) and year
- total amount of vehicle travel, classified by State/Territory, vehicle type (motor cycle, other vehicles) and survey year.

Analyses were not always possible for the two Territories because of data unavailability and their small populations.

The analysis approach

Annual fatality rates have been plotted on a logarithmic scale. This enables fatality rates differing by up to several orders of magnitude to be plotted on the same graph. This also means that a constant percentage change over time results in a straight line on the graph. Any departures from a constant percentage change, either in the short term (which frequently occurs) or in the long term can easily be seen in these figures. Wherever reasonable, this report summarises temporal change in rates as an average annual percentage change.

Chapters 2 to 7 analyse trends in fatality rates between 1970 and 1990 for all road users (Chapter 2), drivers (Chapter 3), passengers (Chapter 4), pedestrians (Chapter 5), motor cyclists (Chapter 6) and bicyclists (Chapter 7). Each of these chapters consists of a summary and three sections:

• trends between 1970 and 1990, by type of rate (population, vehicle or distance) and by State/Territory

• trends in population fatality rate, by each of gender, age group, time of week and month

average annual percentage changes for pairs of factors

Chapter 8 summarises the trends for the different road user types analysed individually in Chapters 2 to 7.

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Overall

The average annual % decrease in fatality rate per 100,000 persons for all fatalities was 3.3% between 1970 and 1990.

Of the five road user categories, passengers and pedestrians had the greatest average annual percentage decreases (3.9% and 4.0%, respectively). The average annual percentage decrease in the fatality rate for drivers was just below the average (3.0%), while that for bicyclists was much lower (1.0%).

Unlike the other four road user types, the trend in the population fatality rate for motor cyclists could not be adequately described by an average annual % decrease. This was because there was an irregular pattern of motor cycle use between 1970 and 1990.

Fatality rates can also be expressed as deaths per registered vehicle or as deaths per kilometre of travel. Since both these denominator measures have grown more rapidly than the number of persons between 1970 and 1990, the average annual percentage decreases in fatality rates per vehicle or per kilometre of travel are even greater than for fatalities per person:

Denominator	A 11	Drivers	Passengers	Pedestrians	cyclists	Bicyclists
Persons	3.3	3.0	3.9	4.0	-	1.0
Vehicles	4.8	4.9	6.0	6.3	4.2	3.4
Travel	4.9	5.1	6.1	6.4	-	-

Gender

Overall, the average annual percentage decrease in fatalities per person was greater for males than for females and this was true for each mode:

Gender	A 11	Drivers	Passengers	Pedestrians	Bicyclists
Males	3.6	3.8	4.2	4.2	1.1
Females	2.6	+0.5	3.6	3.8	0.8

(All percentage changes are decreases, except those marked '+'.)

The only large difference was for drivers. Male drivers had an average annual decrease of 3.8% in their fatality rate, while females an increase of 0.5%. Thus, male drivers had a decrease similar in magnitude to passengers and pedestrians. The difference between males and females was much smaller for passengers, bicyclists and pedestrians. It was statistically significant for only passengers.

Age

The decrease in fatality rate per person for drivers between 1970 and 1990 was about 3.0% annually for all age groups.

For young adults (aged 17 to 29 years), the decrease in fatality rates was similar for passengers and drivers, but for older adults, the decrease was greater (about 4.5% annually) for passengers. For children, the average percentage decrease was 3.7% annually.

The percentage decrease for pedestrians was similar to that for passengers for children and older adults. However, for young adults, there was an increase in fatality rates.

This increase in fatality rates for young adults was also seen for bicyclist fatalities. Bicyclist fatality rates for school children (5 to 16 years) decreased by about 2% annually.

Annual percentage decreases in the fatality rate per person for three age groups are:

Age group	A 11	Drivers	Passengers	Pedestrians	Bicyclists	
5-16	3.2	_	3.7	3.4	2.2	
17-29	2.6	3.2	3.1	+1.3	+1.4	
30-69	3.9	3.0	4.5	5.2	0.3	

(All percentage changes are decreases, except those marked '+'.)

Trends in road crash fatality rates in Australia 1970-1990

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<u>State</u>

There were differences between States in the average annual percentage decrease in fatality rate per person for different modes of travel:

State	A 11	Drivers	Passengers	Pedestrians	Bicyclists	
New South Wales	2.8	2.7	3.4	3.6	0.7	
South Australia	3.3	3.6	4.0	3.4	1.2	
Victoria	3.5	2.5	4.5	4.5	0.3	
Tasmania	4.0	2.2	4.2	2.9	5.4	
Queensland	4.7	4.5	4.7	5.0	1.7	
Western Australia	4.8	5.2	3.4	6.3	2.7	
Australia	3.3	3.0	3.9	4.0	1.0	

The pattern was similar for annual percentage changes in fatality rates per vehicle and after taking account of the different gender and age distributions in each State.

Time of week

The average annual percentage decrease in fatality rate varied with time of week. The pattern of decreases was similar for each mode of travel:

Time of week	A 11	Drivers	Passengers	Pedestrians	Bicyclists
Week day					
Day	1.1	0.6	1.8	1.5	+1.2
Evening	4.0	3.6	4.4	5.4	2.2
Night	2.2	2.4	2.0	2.2	-
Waskand					
Dav	2.4	2.2	3.0	3.0	1.7
Evening	5.7	5.5	6.2	6.7	5.4
Night	3.3	3.5	4.4	0.3	-

(All percentage changes are decreases, except those marked '+'.)

The largest average annual percentage decreases were mostly for evenings (4pm to midnight), particularly during the weekend. There were lesser decreases during the night (midnight to 6am), and the least decreases during the day (6am to 4pm).

Month

Although the average annual percentage change in fatality rate varied statistically significantly with month for all fatalities, it did not do so for drivers, passengers and pedestrians separately. There was no obvious seasonal pattern. August had a particularly high average annual percentage decrease for drivers, passengers and pedestrians, and April had a particularly high decrease for bicyclists.

Related reports

A companion report (CR114) compares the average annual percentage decrease in Australian road fatalities with those in other countries. Report CR115 summaries both reports.

1. Introduction

1.1 Background

This report describes and analyses temporal changes between 1970 and 1990 in road fatality patterns in Australia. Annual time trends are examined by road user type, jurisdiction, gender, age or shorter time scale (month, day of week and time of day).

1.2 Australian data sources

Numerator data

Road crash data are collected by States and Territory authorities. Details of road crashes were sought for the period 1970 to 1990, although not all States and Territories could supply data for the whole period. For each fatality in Australia between 1970 and 1990, the requested data were date and time of the crash, State or Territory where the crash occurred, and the gender, age and road user type of the person. These data were collated, assessed for face validity and internal consistency and checked against published data.

For each jurisdiction, the years for which this level of detail had been recorded were:

New South Wales	1970 - 1990
Victoria	1970 - 1990; drivers, motor cyclists and cyclists
	missing in 1970, 1971 & 1973
Queensland	1975 - 1990
South Australia	1970 - 1989; missing 1977, 1987 & 1988
Western Australia	1976 - 1990
Tasmania	1970 - 1990; time of week missing in 1970 - 1975
Northern Territory	1979 - 1990
Australian Capital Territory	1985 - 1989

Because only five years of data were available for the ACT, trends over the period 1970 to 1990 could not be assessed. This was also not always possible for the Northern Territory, partly because data for the first nine years were unavailable, and partly because the low population base results in relatively few road fatalities.

Denominator data

Population data, classified by State/Territory, gender, age group and year, was obtained from the Australian Bureau of Statistics. The number of registered vehicles, classified by State/Territory, vehicle type (motor cycles, other vehicles) and year, were also obtained from the Australian Bureau of Statistics.

Annual estimates of the total amount of vehicle travel were linearly interpolated from data collected by the Australian Bureau of Statistics in its survey of motor vehicle usage. These data were classified by State/Territory, vehicle type (motor cycle, other vehicles) and survey year (1971 (preliminary data), 1976, 1979, 1982, 1985 and 1988 (preliminary data)). While it is possible that the data from the 1971 survey may be less reliable than those from the later years, the estimates of fatality rates using this denominator appeared to be consistent with the pattern observed for later years.

1.3 Statistical methods

Data conformation

The numbers of fatalities were tabulated for each road user type, classified by jurisdiction, year, gender, age group and month. The age groups were chosen to reflect important age groups for road safety policy purposes, and so were not necessarily the same for all road user types. For example, there were less age groups for motor cyclists and bicyclists than for the other modes.

Another set of tables was also produced, substituting time of week for month. Time of week reflected day of the week (classified as weekday or weekend) and five time periods during the day. The five times of the day were chosen because they correspond to different patterns of road use:

Time period	<u>24 hour clock</u>	<u>Term used in text</u>
midnight to 6 am	0000-0600	night
6am to 10am	0600-1000	morning
10am to 4pm	1000-1600	day
4pm to 8pm	1600-2000	early evening
8pm to midnight	2000-2400	late evening

(The 24 hour clock is used to annotate the figures, while the terms used in the text are easier to read than the exact time periods.) The weekend period begins on Friday late evening and ends on Sunday early evening, while the weekday period begins on Sunday late evening and ends on Friday early evening.

Similar tabulations of the number of people in the Australian population, the number of registered vehicle and the total distance travelled were also formed. These tabulations give 'at-risk' information, and enable fatality rates to be calculated from the numbers of fatalities.

Annual fatality rates have been plotted in the figures at the beginning of the chapters for each road user type. The fatality rates are plotted on a logarithmic scale because these rates may differ by up to several orders of magnitude between different groups. Another advantage of the logarithmic scale is that constant percentage changes result in straight lines when plotted using this scale.

Poisson regression models

Tables of the number of fatalities can be analysed using Poisson regression models. For these models, the number of fatalities is assumed to have a Poisson distribution. This is a standard assumption for data that are counts of statistically independent events. For any given cell of the table, the mean of the Poisson distribution can be expressed as the number at risk multiplied by the fatality rate.

The fatality rate may differ between cells, that is (for example) with factors such as gender, age group, year, time of week and road user type. In Poisson regression, the fatality rate is typically modelled as consisting of several multiplicative parameters, each depending on one or more of these factors. Such models are described as log-linear models, because the logarithm of the fatality rate can be expressed as a linear model, that is, as the sum of one or more regression terms.

As with other statistical models, Poisson regression models also allow:

- assessment of how much different variables are related to fatality rates
- assessment of the separate associations of each factor with the fatality rate
- assessment of interactions between factors
- calculation of confidence intervals for the regression parameters

It is also possible to take account of extra-Poisson variation, by assuming that the variation in the number of fatalities is proportional to Poisson variation.

Average annual percentage change as a summary of the trend over time

The primary aim of this report is to describe trends in road fatality rates between 1970 and 1990. The simplest trend is where the percentage change in the fatality rate is the same for each year between 1970 and 1990. This relationship corresponds to a linear regression term for year in a log-linear model, and to a straight line when the logarithm of the fatality rate is plotted against the year. Most figures showing the logarithm of the fatality rate with year include a straight line corresponding to a constant annual percentage change in the fatality rate. Any departures from this trend, either in the short term (which frequently occurs) and in the long term can easily be seen in these figures.

A constant annual percentage change can be characterised by a single number, which provides a succinct summary. For each road user type, the later figures and tables display this summary statistic for pairs of explanatory variables. Because almost all trends are for a deceasing fatality rate, these tables show the average annual percentage decrease as an unsigned number. In the few instances where the trend is for an increasing rate of fatalities, the change is shown with an explicit '+' sign.

The Poisson regression models were fitted using GLIM 3.77 (NAG, 1987). There were several technical difficulties. The data tables are extremely large, and could not be directly analysed without further summary.

A first approach is to summarise the tables over all dimensions but year and one other. The resulting fatality rates can be plotted (as described above), and the average annual percentage change calculated for each level of the other variable. This is the approach adopted for the univariate analyses in the first two sections of each road user chapter. This approach ignores any interaction or confounding between the variables, and so could overstate or miss factors associated with trends in fatality rates.

A second strategy is to summarise the data for the year dimension only, by calculating the average percentage change. These average annual percentage changes, weighted inversely by their standard errors, were then analysed using ordinary regression. The third section of each road user chapter follows this approach. This section shows how the average percentage change in road fatality rates varies with pairs of explanatory variables.

To ensure consistency between the sections within each chapter and that the most appropriate estimates and test statistics are reported, estimates and test statistics quoted in the first two sections have been calculated using this second strategy. All univariate estimates appear as marginal totals in the tables in the third section.

A third approach, not reported in detail in this publication, is to reduce the number of levels for some explanatory variables and to omit unimportant variables. Unfortunately, given the size of the data set and the computational effort required to fit each model, this is time consuming. Furthermore, deciding how best to reduce the data set is not straightforward. Where these models could be checked against corresponding models fitted as part of the second strategy, the estimates appeared to show broad agreement.

1.4 Report outline

Chapters 2 to 7 analyse trends in fatality rates between 1970 and 1990 for all road users (Chapter 2), drivers (Chapter 3), passengers (Chapter 4), pedestrians (Chapter 5), motor cyclists (Chapter 6) and bicyclists (Chapter 7). Each of these chapters consists of a summary and three sections.

The first section shows univariate trends between 1970 and 1990, and shows graphs of the fatality rate with year. It also considers differences depending on the type of rate (population, vehicle or distance), as well as differences between States and Territories.

The second section also reports univariate analyses. It shows graphs of the fatality rate with year and each of gender, age group, time of week and month.

The third section considers the average annual percentage change. It consists primarily of bivariate analyses.

Chapter 8 summarises the trends for the different road user types analysed individually in Chapters 2 to 7.

This report is summarised in CR115 (Adena, Anderson and Montesin, 1993). CR115 also summarises a companion report (CR114; Anderson, Adena and Montesin, 1993) which compares the changes seen in Australia between 1970 and 1990 with those seen in other countries.

2. All road users

- Fatality rates, per 100,000 persons, for all road users have fallen by an average of 3.3% each year between 1970 and 1990.
- Of the six States, Queensland and Western Australia have the largest average annual % decreases and New South Wales has the smallest.
- The decrease for males (an average of 3.6% each year) was larger than that for females (an average of 2.6% each year).
- The average annual percentage decrease varied with age. Older adults aged 50 to 69 years
 had the largest decreases and young adults aged 20 to 39 had the smallest.
 - the difference between males and females was most marked for persons aged 17 to 24 years, and those aged 40 years and older.



The average annual percentage decrease was greater for the weekend than for during the week. Evenings (4pm to midnight) had a larger decrease than other times of day.

- The average annual percentage decrease varied with month. It was greatest for April and August, and least for January and September.
- All the above results are for fatality rates calculated as the number of fatalities per person. The average annual decrease was greater when the fatality rates are calculated as the number of fatalities per registered vehicle or per kilometre of travel. The overall average percentage decreases in the latter rates were 4.8% and 4.9%, respectively, for each year between 1970 and 1990.



Figure 2.1.1 Fatality rates of all road users between 1970 and 1990 a. per 10⁵ persons with fitted linear and quadratic trends

b. per 10⁵ persons, per 10⁴ registered vehicles and per 10⁸ vehicle kilometres



2.1 Fatality rates between 1970 and 1990

Overall

Fatality rates in Australia have fallen from 28.8 deaths/100,000 persons in 1970 to 13.5 deaths/100,000 persons in 1990 (Figure 2.1.1a; the actual yearly fatality rates with their 95% confidence intervals are shown by the unbroken line with the short perpendiculars). The average % decrease in the rate was 3.3% each year, giving an estimated decrease over twenty years of 49%. A 95% confidence interval for the average annual % change is 3.1 to 3.5%.

The average % change is a summary of the trend over the twenty year period. On the logarithmic scale, a constant percentage change results in a straight line (the dashed line in Figure 2.1.1a). For 1970 to 1990 overall, the description of the total fatality rate as decreasing by an average of 3.3% annually can be seen to provide an acceptable fit to the data.

This did not necessarily apply for shorter time periods. For example, there was little change between 1983 and 1989. Modelling the annual % change as a smoothly varying curve gave a closer fit, but not markedly so (see the estimated quadratic curve in Figure 2.1.1a). Compared with both the linear and quadratic curves, 1990 had an unexpectedly low fatality rate.

The fatality rates in Figure 2.1.1a are deaths/100,000 person-years. Figure 2.1.1b shows this fatality rate, together with fatality rates expressed as deaths/10,000 registered vehicles and deaths/100 million vehicle kilometres of travel. The average annual & decrease is similar (4.8% and 4.9% respectively) for these last two rates, and is greater than for the population based rate (3.3%). This means that even though the number and use of vehicles grew between 1970 and 1990, the total fatality rate decreased over this period. Table 2.1.1 also gives the number of deaths included in the analysis for each year. This is always less than the actual number of fatalities for the year because some fatality records had missing information. Further, for some States data were not available for all years (see Section 1.2).

	Fata	Deaths			
Year	Persons	Vehicles	Kilometres	Analysed	Total
1970	28.8	6.62	4.10	2816	3798
1971	25.9	5.78	3.59	2575	3590
1972	23.9	6.10	3.81	2403	3422
1973	25.1	5.22	3.29	2553	3679
1974	24.9	5.82	3.72	2563	3572
1975	26.3	5.88	3.84	3278	3694
1976	25.3	5.42	3.53	3394	3583
1977	25.2	5.32	3,44	3116	3578
1978	25.6	5.17	3.39	3595	3705
979	24.3	4.81	3.14	3479	3508
1980	22.3	4.34	2.80	3234	3274
1981	22.3	4.22	2.74	3276	3321
1982	21.5	3.91	2.58	3215	3252
1983	17.9	3.22	2.11	2714	2755
1984	18.1	3.20	2.09	2778	2621
1985	18.6	3,23	2.10	2936	2941
1986	18.0	3.11	1.98	2884	2688
1987	16.9	2.95	1.81	2511	2772
1988	17.5	3.06	1.85	2655	2888
1989	16.6	2.86	1.73	2793	2802
1990	13.5	2.30	1.36	2072	2328

Table 2.1.1 Total fatality rates between 1970 and 1990, classified by type of rate (/10⁵ persons, /10⁴ registered vehicles and /10⁸ vehicle kilometres).

Years of data: All road deaths in New South Wales (1970-90), Victoria (1970-1990), Queensland (1975-1990), South Australia (1970-1989 except 1977, 1987 and 1988), Western Australia (1976-1990), Tasmania (1970-90), Northern Territory (1989-1990) and the Australian Capital Territory (1985-1989).

At-risk information is from sources described in Section 1.2.

The population rate does not take into account the amount of travel undertaken. For example, the fatality rate per 10⁵ persons could be decreasing because the average distance travelled by each person is decreasing, resulting in a lower average risk of being killed in a road accident. In fact, both the number of vehicles and the distance travelled have more than doubled between 1970 and 1990. The estimated average distance travelled per vehicle has increased slightly from 16,200 km to 17,100 km.

Since there has not been a large change in average vehicle kilometrage, the trends in the fatality rate should be similar whether it is expressed as a vehicle or a distance rate. In the same period, the population of Australia has increased by a third from 12.8 million to 17.1 million. Vehicle travel per person has thus increased and this appears to be mostly due to an increase in vehicle ownership from 36% in 1970 to 57% in 1990. This means that the estimated decline in population based fatality rates is less than that for the other two rates.

For each year, there are estimates available of the number of vehicles and the number of kilometres travelled, but this information is classified by State only. Therefore, further analysis can use only the population rate. Examination of the vehicle and distance rates for Australia and for each State can be useful in comparing the linearity of trends at this level. It is still not possible, however, to determine the extent that changes for fatality rates for other groupings of the population (for example, by sex and age) are being affected by changes in travel patterns. Further, there are no estimates over the twenty years for bicycle and pedestrian travel.

States and Territories

Population rates for total road deaths are higher in the Northern Territory than elsewhere, and may be lower than elsewhere in the ACT (Figure 2.1.2a). Of the States (Figure 2.1.2b), Queensland had high rates, while Victoria had low rates.

There was statistically significant variation between States in the average annual & change $(F_{5,1114} = 9.7, p < 0.001)$. The largest & decreases were for Queensland and Western Australia (4.7% and 4.8% respectively), and the least was New South Wales (2.8%). The other States were similar and intermediate in the size of the decrease in their fatality rates.

These patterns are broadly similar when the rates are expressed as deaths per 10,000 registered vehicles (Figures 2.1.3a and 2.1.3b). The relative ordering of rates between the States is almost the same, although the amount of variation between them is reduced. The percentage decreases for Queensland and Western Australia are closer to those of most of the other States. The percentage decrease for Victoria is much lower, mainly due to some comparatively low rates in the early 1970's.

Figure 2.1.2 Population fatality rates of all road users between 1970 and 1990 a. for each State and Territory



b. for each State (with fitted trends)



18.

Figure 2.1.3 Vehicle fatality rates of all road users between 1970 and 1990 a. for each State and Territory



b. for each State (with fitted trends)



2.2 Variation in fatality rates

Gender

Over the twenty year period, male fatality rates were nearly three times those for females.

The annual % decrease was 3.6% for males and 2.6% for females. While these decreases are similar, the male % change was statistically significantly greater ($F_{1,1118} = 23$, p < 0.001; estimated difference of 1.0% with a 95% confidence interval of 0.6% to 1.5%). The description of the changes for males and for females as an average constant % change between 1970 and 1990 provides an acceptable fit to the data (Figure 2.2.1).

Age group

Fatality rates are highest for 17 to 19 year olds. The age-specific rates for adults are lower for each age group between age groups 17-19 and 40-49 and are then successively higher for each older age group. The rates for persons aged 70 or older are similar to those for persons in their twenties. The rates for children aged 16 or younger are lowest of all. Except for the relative position of the 30 to 39 age group these patterns held throughout the period from 1970 to 1990 (Figures 2.2.2a and 2.2.2b; the 30 to 39 year age group is on both graphs to facilitate comparison).

Persons in their 50's and 60's had the greatest average annual % decreases (4.5%), whereas persons in their 20's and 30's had the lowest average annual % decreases (2.3% for the three groups combined). All other age groups had average annual decreases between 3% and 4%. Fatality rates for the four age groups between 30 and 69 years have become more similar over the twenty year period. Of these four groups, the 30-39 age group has the highest estimated fatality rates in recent years although it had the lowest rates at the beginning of the period. This is due to the relatively low average % annual decrease for this group. The variation in % changes between all age groups was statistically significant (F_{9,1110} = 89, p < 0.001).

Figure 2.2.1 Population fatality rates of all road users between 1970 and 1990 for males and females







b. for persons aged 30 years and older (in 5 age groups)



Trends in road crash fatality rates in Australia 1970-1990: All road users

Figure 2.2.3 Population fatality rates of all road users between 1970 and 1990 a. during the week



b. during the weekend



Time of week

For each time of day except 6am to 10am, fatality rates are lower during the week (Figure 2.2.3a) than at the weekend (Figure 2.2.3b). However, the average annual decreases were greater at the weekend than during the week.

During the week, greater % decreases occurred for the evening (4pm to midnight; 4.0%) than at the other times (midnight to 4pm; 1.3%). This means that the degree of variation between all periods, except midnight to 6am, has lessened considerably over the twenty years. The fatality rate in the day (10am to 4pm) has changed from being about half the late evening (8pm to midnight) rate in 1970 to having a greater rate than this period by 1990.

During the weekend, fatality rates are lowest in the morning (6am to 10am). In 1970, rates in the evening (4pm to midnight) were higher than those for the night (midnight to 6am) and day (10am to 4pm), but by 1990 these rates were similar. The greatest annual % decrease was for the evening (4pm to midnight), and this change (5.7%) was greater than that for the same period during the week (4.0%). The % decrease for the other times during the weekend (midnight to 4pm; 2.9%) was also greater than for the same period during the week (1.3%).

The variation between times of the week in % decreases was statistically significant ($F_{9,1110} = 42$, p < 0.001).

Month

the third fatality rates for males and for females show considerable variation about the longtrend (Figure 2.2.4). There is statistically significant variation in the average annual & decrease in road fatality rates with month (Figures 2.3.4a and 2.3.4b; between months $F_{1,1366} = 3.1$, 0.001 F_{2,1368} = 3.6, 0.01 The highest decreases are for April and August (4.2%) and the lowest are for January and September (2.6% and 2.8% respectively) with the other months clustered around the average of 3.3%.

Figure 2.2.4 Population fatality rates of all road users between 1970 and 1990 by month



Trends in road crash fatality rates in Australia 1970-1990: All road users

Figure 2.3.1 Average annual % change in population fatality rate of all road users a. for males and females by age group







Time of week

Note: Shaded areas denote night (6pm to 6am) Trends in road crash fatality rates in Australia 1970-1990: All road users

2.3 Average annual % decrease in fatality rates

The average annual % decrease in fatality rates differed for males and females (Figure 2.2.1) and by age group (Figures 2.2.2a and 2.2.2b). However, it appears that the gender difference varies with age group (Figure 2.3.1a; Table 2.3.1; interaction $F_{9,1005} = 3.2$, 0.001 < p < 0.01).

Males aged 17 to 24 showed a much greater annual % decrease (3.6%) than similarly aged females (0.8%). For 0 to 16 year olds and 25 to 39 year olds, the average annual % decrease was similar for males and females, while males again showed a larger decrease than females in the older age groups.

Male-female differences in the pattern of average annual & decrease in fatality rates with time of week were not statistically significant ($F_{9,1005} = 1.3$, p > 0.05; Figure 2.3.1b; Table 2.3.1). Figure 2.3.1b plots the decreases for each time of the week. The definition of times of week (see Section 1.3) means that Monday, Tuesday, Wednesday and Thursday have the same weekday estimates. The figure shows Thursday to Monday for ease of comparison. The shaded area for each day is from 6pm to 6am.

Table 2.3.1 Average annual % decrease in road fatality rates (deaths per person) between 1970 and 1990, classified by gender, by gender and age group, by gender and time of week, and by gender and State.

	Gender							
Group	Males	Females	Persons					
Total	3.6	2.5	3.3					
Age group	• •							
	3.4	3.9	3.6					
J-10 17_19	3.4	2.8	3.2					
20-24	4.3	1.7	3.8					
25-29	2.7	1.2	2.4					
20-30	1.0 7 C	1.2	1.5					
40-49	2.0	2.0	2.0					
40-49 50_50	4.1	3.1	3.8					
69-69	4./ 5.5	3.1	4.2					
70+	3.7	2.9	3.4					
Time of week								
Weekday								
0000-0600	2.7	+0.3	2.2					
0600-1000	1.3	0.1	1.0					
1000-1600	1.4	0.7	1.1					
1600-2000	3.9	3.3	3.7					
2000-2400	4.6	3.5	4.4					
Weekend								
0000-0600	3.3	3.4	3.3					
0600-1000	2.1	1.4	1.9					
1000-1600	2.9	2.6	2.8					
1600-2000	5.4	5.4	5.4					
2000-2400	6.4	5.3	6.1					
State								
Western Australia	4.9	4.3	4.8					
Queensland	5.3	3.1	4.7					
Tasmania	4.3	2.9	4.0					
Victoria	3.9	2.5	3.5					
South Australia	3.3	3.4	3.3					
New South Wales	3.0	2.2	2.8					

Notes: All changes are decreases, except those marked '+' See Appendix 1 for data details

Figure 2.3.2 Average annual % change in population fatality rate of all road users a. for males and females by State



b. for each State by age group



Male-female differences in the pattern of variation with State were nominally statistically significant ($F_{5,991} = 2.4$, 0.01 F_{45,951} = 1.6, 0.01 < p < 0.05; Figure 2.3.2b; Table 2.3.2).

Table 2.3.2 Average annual % decrease in road fatality rates (deaths per person) between 1970 and 1990, classified by age group, by age group and State, and by age group and time of week.

					Ag	e group	l .				
Group	0-4	5-16	17-19	20-24	25-29	30-39	40-49	50-59	60-69	70+	A11
Total	3.6	3.2	3.8	2.4	1.5	2.6	3.8	4.2	4 .B	3.4	3.3
State							. .				
Western Australia	4.5	4.5	4.3	3.4	1.3	5.9	5.4	7.1	7.4	6.1	4.8
Queensland	5.2	5.1	5.9	4.4	3.2	3.3	6.5	5.4	5.4	2.7	4./
Tasmania	+1.4	3.6	6.9	3.9	0.4	0.0	4.4	3.6	7.1	3.5	4.0
Victoria	4.5	3.7	4.0	2.8	1.2	2.8	4.1	4.0	4.8	2.9	3.5
South Australia	2.8	2.5	4.1	1.3	+0.1	1.3	5.7	4.3	7.6	4.2	3.3
New South Wales	2.9	2.5	3.0	1.8	1.6	2.3	2.7	3.8	4.2	3.6	2.8
Time of week											
Weekday											
0000-0600	+3.4	2.4	3.3	2.2	1.8	1.0	1.9	1.9	4.6	1.1	2.2
0600-1000	2.8	1.1	0.7	0.0	+0.7	1.6	1.2	1.0	2.2	0.6	1.0
1000-1600	1.7	0.5	1.0	0.9	0.0	1.0	1.0	1.2	2.1	1.2	1.1
1600-2000	3.7	3.3	3.1	2.1	1.4	2.B	5.0	4.4	6.3	4.1	3.7
2000-2400	4.6	3.3	4.9	3.1	1.2	3.2	5.0	7.0	6.7	7.6	4.4
Week end											
0000-0600	7.6	4.0	3.3	2.3	2.0	3.0	5.0	7.5	4.1	9.3	3.3
0600-1000	4.8	1.8	1.5	0.9	1.8	3.1	2.4	1.6	1.9	1.9	1.9
1000-1600	3.1	4.2	2.8	0.3	1.5	2.1	3.1	З.В	3.8	2.6	2.8
1600-2000	7.8	4.6	5.9	4.1	2.6	3.3	5.7	7.6	8.5	6.4	5.4
2000-2400	5.1	6.6	6.5	4.9	3.4	5.0	6.7	7.3	9.0	9.0	6.1

Notes: All changes are decreases, except those marked '+' See Appendix 1 for data details

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Figure 2.3.3 Average annual % change in population fatality rate of all road users a. for selected times of the week by age group

b. for selected age groups by time of week



Note: Shaded areas denote night (6pm to 6am) Trends in road crash fatality rates in Australia 1970-1990: All road users

28.

The age-related variation appears to differ according to the time of week ($F_{5,996} = 1.4$, 0.001 < p < 0.01; Figures 2.3.3a and 2.3.3b; Table 2.3.2). Figures 2.3.3a and 2.3.3b show the patterns for some combinations of time of week and age group. For adults, it appears that the decrease in nighttime fatality rates is least for the 25 to 29 age group but then is greater for each older age group and greatest for persons aged 50 years and older. By contrast, the daytime fatality rates showed less variation in their average percentage decreases.

This interaction between age and time of day occurred during both the week and the weekend. It also appears that the 5 to 16 year olds have a larger difference between the decrease for the weekend than the other age groups.

Figure 2.3.4 Average annual % change in population fatality rate of all road users a. for males and females by month



b. for selected age groups by month



Note: January to March are repeated

There is no statistically significant difference with month in the gender or age-related variation in the average annual % change in road fatality rates (sex x month interaction $F_{11,1234} = 1.6$, p > 0.05; age x month interaction $F_{99,1234} = 1.0$, p > 0.05; Table 2.3.3; Figures 2.3.4a and 2.3.4b).

Table 2.3.3 Average annual % decrease in road fatality rates (deaths per person) between 1970 and 1990, classified by month, by month and gender, and by month and age group.

	Month												
Group	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	A11
Total	2.6	3.0	3.2	4.2	3.5	3.2	3.3	4.2	2.8	3.1	3.4	3.1	3.3
Gender													
Males	2.8	3.0	3.5	4.5	3.6	3.6	3.9	4.5	2.8	3.5	3.5	3.7	3.6
Females	2.2	3.0	2.2	3.2	3.1	1.9	1.9	3.4	2.7	2.1	3.1	1.6	2.5
Age group													
0- 4	3.3	2.9	5.8	5.4	2.2	4.2	2.6	1.6	0.5	3.4	6.8	4.3	3.6
5-16	1.4	3.4	2.7	4.7	4.1	3.3	3.0	3.9	2.9	3.8	3.3	2.7	3.2
17-19	3.4	3.4	4.8	3.9	3.9	2.6	3.7	4.6	2.5	3.3	4.1	4.5	3.7
20-24	2.6	1.6	2.3	2.7	2.4	2.7	1.7	3.0	1.0	1.3	3.5	3.0	2.3
25-29	0.2	1.3	+0.2	3.4	2.5	2.4	0.9	3.3	1.8	1.7	1.1	1.3	1.6
30-39	2.1	3.4	1.6	3.5	1.6	3.2	2.4	3.4	2.4	3.3	2.5	2.2	2.6
40-49	3.5	3.4	4.0	4.5	3.4	3.5	5.3	4.3	2.8	3.3	4.4	3.1	Э.В
50-59	4.6	2.6	4.3	4.6	4.1	3.4	4.6	5.6	4.9	5.0	3.6	3.3	4.2
60-69	3.6	4.7	4.3	6.8	6.6	4.6	5.5	6.2	4.9	2.8	3.6	4.0	4.8
70+	1.9	3.4	2.7	4.3	3.8	2.8	3.0	5.0	3.8	4.1	2.6	2.3	3.4

Notes: All changes are decreases, except those marked '+' See Appendix 1 for data details

3. Drivers

- Fatality rates, per 100,000 persons, for drivers have fallen by an average of 3.0% each year between 1970 and 1990.
- Of the six States, Western Australia and Queensland had the greatest average annual % decreases and New South Wales, Victoria and Tasmania had the least.
- The fatality rate for males decreased by an average of 3.8% each year, while that for females **increased** by an average of 0.5% each year.
- Overall, the average percentage decrease did not vary greatly with age.
 - the difference between males and females was generally less at older age groups (except for 70 years and over).
- The average percentage decrease was greater for the weekend than for during the week.
- For weekdays, evening (4pm to midnight) had the larger decrease, followed by nighttime (midnight to 6am), with daytime (6am to 4pm) having the smallest decrease.
- For weekends, evening and night (4pm to 6am) had the largest decrease, followed by morning (6am to 10am), with the rest of the day (10am to 4pm) having the smallest decrease.
- The average percentage decrease did not vary statistically significantly with month or season.
- The above results are for fatality rates calculated as the number of driver fatalities per person. The average annual decrease was greater when the fatality rates are calculated as the number of driver fatalities per registered vehicle or per kilometre of travel. The overall average percentage decreases in the latter rates were 4.9% and 5.1%, respectively, for each year between 1970 and 1990.









3.1 Fatality rates between 1970 and 1990

Overall

Driver fatality rates have fallen from 11.9 deaths/100,000 persons in 1970 to 5.9 deaths/100,000 persons in 1990 (Table 3.1.1; Figure 3.1.1a). The average % decrease in the rate was 3.0% each year, giving an estimated decrease over twenty years of 46%. A 95% confidence interval for the annual % decrease is 2.8 to 3.3%.

For 1970 to 1990 overall, the description of the driver fatality rate as decreasing by an average of 3.0% annually is reasonable. This did not necessarily apply for shorter time periods. For example, there was little change between 1983 and 1989. However, modelling the annual % change as a smoothly varying curve did not give a markedly better description of the data (see the estimated quadratic curve in Figure 3.1.1a).

The fatality rates in Figure 3.1.1a are deaths/100,000 person-years. Figure 3.1.1b shows this fatality rate, together with fatality rates expressed as deaths/10,000 registered vehicles and deaths/100 million vehicle kilometres of travel. The average annual θ decrease is similar (4.9 θ and 5.1 θ respectively) for these last two rates, and is greater than for the population based rate (3.0 θ). That is, even though the number and use of vehicles grew between 1970 and 1990, the driver fatality rate decreased over this period. Except for analyses by State, later analyses are of the population based rate only (see Sections 1.2 and 2.1).

Table 3.1.1	Driver fatality rates between 1970 and 1990, classified by type of rate (/10 ⁵
	persons, $/10^4$ registered vehicles and $/10^8$ vehicle kilometres).

Fatality rate denominator							
Year	Persons	Vehicles	Kilometres	Deaths			
1970	11.9	3.04	1.87	673			
1971	10.8	2.68	1.65	623			
1972	9.2	2.19	1.34	838			
1973	10.1	2.33	1.46	595			
1974	10.0	2.20	1.37	933			
1975	10.8	2.29	1.45	1221			
1976	10.4	2.13	1.35	1270			
1977	10.6	2.12	1.34	1187			
1978	10.8	2.08	1.33	1391			
1979	10.2	1.93	1.23	1346			
1980	9.2	1.71	1.08	1228			
1981	9.3	1.70	1.07	1268			
1982	8.9	1.56	1.00	1224			
1983	7.3	1.27	.81	1023			
1984	7.2	1.24	.78	1027			
1985	7.B	1.31	.83	1140			
1986	7.6	1.27	.79	1131			
1987	7.3	1.21	.73	997			
1968	7.5	1.25	.74	1053			
1989	7.2	1,18	.70	1123			
1990	5.9	.95	.55	B35			

Years of data: Driver deaths in New South Wales (1970-90), Victoria (1972, 1974-1990), Queensland (1975-1990), South Australia (1970-1989 except 1977, 1987 and 1988), Western Australia (1976-1990), Tasmania (1970-1990), Northern Territory (1989-1990) and the Australian Capital Territory (1985-1989).

At-risk information is from sources described in Section 1.2.

States and Territories

Population rates for driver deaths are higher in the Northern Territory than elsewhere, and may be lower than elsewhere in the ACT (Figure 3.1.2a). Of the States (Figure 3.1.2b), in 1990 Tasmania had the highest rate and Western Australia the lowest.

There was statistically significant variation between States in the average annual change (F_{5.912} = 6.4, p < 0.001). The largest decreases were for Queensland and Western Australia (4.5% and 5.2% respectively). These two States had the highest fatality rates in the 1970's but declined to be among the lowest rates in the 1980's. The least decreases were for Tasmania (2.2%), Victoria (2.5%) and New South Wales (2.7%).

These patterns are similar when the rates are expressed as deaths per 10,000 registered vehicles (Figures 3.1.3a and 3.1.3b). The relative ordering of rates between the States is the same, although the differences between States are not as large.

Figure 3.1.2 Population fatality rates of drivers between 1970 and 1990 a. for each State and Territory



b. for each State (with fitted trends)







b. for each State (with fitted trends)



Figure 3.2.1 Population fatality rates of drivers between 1970 and 1990 for males and females



Figure 3.2.2 Population fatality rates of drivers between 1970 and 1990 for persons aged 17 years and older



3.2 Variation in fatality rates

Gender

The average annual decrease for male drivers was 3.8. By contrast, fatality rates for female drivers are estimated to have **increased** over the 20 years by +0.5 per year (Figure 3.2.1). This has meant that the ratio of the male fatality rate to the female fatality rate has declined from about 7 to 1 in 1970 to about 3 to 1 in 1990. This difference in change was statistically significant (F_{1.916} = 174, p < 0.001; estimated difference of 4.3 with a 95 confidence interval of 3.6 to 4.9). The description of the changes for males and for females as an average constant change between 1970 and 1990 provides an acceptable fit to the data (Figure 3.2.1). It is possible that some of the variation from an average constant males and females and females.

Age group

Driver fatality rates are highest for 17 to 19 year olds. The age-specific rates for adults are lower for each successive age group, except for the 70+ age group.

Ignoring the oldest age group this pattern held throughout the period from 1970 to 1990 as the other eight age groups all had similar average annual % decrease close to the overall average of 3% (Figure 3.2.2). One exception is that 60-69 year olds had a slightly higher decrease (3.6%) which resulted in their rates declining from being similar to the 40 year olds in 1970 to below the 50 year olds in 1990.

The 70+ age group had a smaller average annual & decrease (1.4%) and changed from having the lowest fatality rate to one higher than the 40 to 69 year olds. However, the variation in % changes between age groups was not statistically significant ($F_{8,909} = 1.5$, p > 0.05).

Figure 3.2.3 Population fatality rates of drivers between 1970 and 1990 a. during the week



b. during the weekend



Time of week

For evening and nighttimes (4pm to 6am), driver fatality rates are lower during the week (Figure 3.2.3a) than at the weekend (Figure 3.2.3b) and for daytime (6am to 4pm) the rates are similar.

However, the average annual % decreases were all greater at the weekend than during the week.

During the week, driver fatality rates are higher in the day and evening (6am to midnight) than at night (midnight to 6am). Greater % decreases occurred for the evening (4pm to midnight; 3.6%) than during the day (6am to 4pm; 0.7%) with the night (midnight to 6am; 3.2%) being intermediate. This means that the fatality rate in the day (6am to 4pm) changed from being intermediate between the evening (4pm to midnight) and night (midnight to 6pm) rates in 1970 to being similar to the evening rates by 1990.

During the weekend, driver fatality rates are highest in the evening and night (4pm to 6am) and lowest in the morning (6am to 10am), with the daytime (10am to 4pm) being intermediate. In 1970, rates in the evening (4pm to midnight) were higher than those at night (midnight to 6am), but by 1990 these rates were similar.

The order of the five weekend periods for the size of the average annual % decrease is the ame as that for the magnitude of the fatality rates. This means that the variation in fatality rate between all periods has decreased. The greatest annual % decrease was for the evening (4pm to midnight; 5.5%), and the least for the morning (6am to 10am; 1.3%). For each weekend period the % decrease was greater than for the corresponding period during the week. This means that the difference between the weekend and the week has also narrowed.

The variation between times of the week in % decreases was statistically significant ($F_{9,908} = 19$, p < 0.001).

Month

Monthly driver fatality rates for males and for females show considerable variation about the long-term trend (Figure 3.2.4). There appears to be little systematic variation in the average annual % decrease in driver fatality rates with month (Figures 3.3.4a and 3.3.4b; between months $F_{11,996} = 1.8$, p > 0.05; seasonal sinusoidal variation $F_{2,996} = 1.0$, p > 0.05).




Figure 3.3.1 Average annual X change in population fatality rates of drivers a. for males and females by age group





3 Annual X change in fatality rate 2 1 0 Females -1 -2 -3 -4 Males -5 -6 -7 Saturday Sunday Monday Thursday Friday

Time of week

Note: Shaded areas denote night (6pm to 6am)

3.3 Average annual % decrease in fatality rates

The average annual % decrease in driver fatality rates differed for males and females (Figure 3.2.1) but generally not by age group (Figure 3.2.2). However, from Figure 3.3.1a it is apparent, with the exception of females aged 70 years and over, that the trend with age for males is opposite to that for females. This interaction between sex and a linear term for age is statistically significant ($F_{1,623} = 11$, p < 0.001 for persons aged 17 to 69).

For males the magnitude of the average annual % decrease in fatality rates declines with age.

Females aged 17 to 29 years showed an annual % increase of 1% or more, whereas those aged 30 to 69 years showed a slight decrease. Females aged 70 and over had an increase of 3.6%, but there were only 244 recorded fatalities in this group over the 20 year period. This estimate is not reliable and in any case the increase in absolute terms is very small (less than one extra fatality per year).

Table 3.3.1	Average a	annual	<pre>% decrease</pre>	in	driver	fata	lity r	ates	(dea	iths pe	r pe	erson)	betwe	en
	1970 and	1990,	classified	Ъу	gender,	ЬУ	gender	and	age	group,	Ьу	gender	and	time
	of week,	and by	gender and	d S'	tate.									

	Ge				
Group	Males	Females	Persons		
Total	3.8	+0.5	3.0		
Age group 0- 4					
5-16	2.2	2.4	2.2		
17~19	4.2	+1.5	3.3		
20-24	4.2	+1.3	3.3		
25-29	3.9	+1.0	3.1		
30-39	3.6	0.5	3.0		
40-49	3.7	0.0	3.0		
50-59	3.1	0.1	2.6		
60-69	4.0	1.6	3.5		
70+	2.5	+3.6	1.4		
Time of week					
Weekday					
0000-0600	2.9	+2.0	2.4		
0600-1000	1.1	+2.9	0.2		
1000-1600	2.0	+1.6	1.0		
1 600-2000	4.0	0.2	3.3		
2000-2400	4.4	0.2	3.9		
Weekend					
0000-0600	4.1	+1.1	3.5		
0600-1000	1.8	+0.5	1.3		
1000-1600	3.9	0.3	3.0		
1600-2000	6.1	2.1	5.5		
2000-2400	5.9	2.7	5.5		
State					
Western Australia	5.9	1.4	5.2		
Queensland	5.6	+0.0	4.5		
South Australia	4.3	+0.6	3.6		
New South Wales	3.4	+0.6	2.7		
Victoria	3.3	+0.6	2.5		
Tasmania	3.0	+0.8	2.2		

Notes: All changes are decreases, except those marked '+' See Appendix 1 for data details



Figure 3.3.2 Average annual % change in population fatality rate of drivers a. for males and females by State

b. for each State by age group



Male-female differences in the pattern of average annual & decrease in driver fatality rates with time of week were not statistically significant ($F_{9,805} = 0.3$, p > 0.05; Figure 3.3.1b; Table 3.3.1). Similarly, male-female differences in the pattern of variation with State were also not statistically significant ($F_{5,800} = 0.7$, p > 0.05; Figure 3.3.2a; Table 3.3.1). State differences in the age-related variation in the average annual & change in driver fatality rates were not statistically significant ($F_{40,765} = 1.1$, p > 0.05; Figure 3.3.2b; Table 3.3.2).

Table 3.3.2 Average annual % decrease in driver fatality rates (deaths per person) between 1970 and 1990, classified by age group, by age group and State, and by age group and time of week.

	Age group										
Group	5-16	17-19	20-24	25-29	30-39	40-49	50-59	60-69	70+	A11	
Total	2.2	3.3	3.3	3.1	3.0	3.0	2.6	3.5	1.4	3.0	
State											
New South Wales	2.2	2.8	3.0	2.9	3.0	2.2	2.3	3.0	1.4	2.7	
Victoria	1.5	2.8	3.0	2.4	2.2	3.0	2.1	3.1	1.0	2.5	
Queensland	6.9	4.6	5.2	6.2	3.8	5.7	4.7	3.3	+0.3	4.5	
South Australia	+0.3	4.2	3.3	1.7	2.5	4.6	2.6	7.1	5.6	3.6	
Western Australia	7.5	5.8	3.6	4.5	7.9	3.9	3.4	5.7	4.3	5.2	
Tasmanla	3.8	2.9	4.5	1.0	1.1	2.3	2.4	4.7	+2.7	2.2	
Time of wask											
Weekday											
0000-0600	+1.2	3.6	2.6	4.3	1.6	1.0	+1.0	3.8	+6.4	2.4	
0600-1000	+3.1	+0.3	0.7	0.4	0.5	+0.6	+1.9	2.3	2.0	0.2	
1000-1600	+4.2	0.2	2.0	0.B	1.4	0.6	0.9	2.1	0.0	1.0	
1600-2000	+0.7	1.7	3.3	2.3	3.5	4.0	3.1	5.4	3.1	3.3	
2000-2400	3.8	4.5	4.3	2.6	3.2	3.9	4.0	5.0	5.3	3.9	
Week end											
0000-0600	2.2	3.4	3.1	4.8	3.1	3.6	7.8	+1.2	2.2	3.5	
0600-1000	5.2	0.2	1.6	2.6	5.5	1.4	0.6	+5.6	+4.8	1.3	
1000-1600	2.1	1.7	2.3	3.4	4.3	4.3	4.5	1.9	2.2	3.0	
1600-2000	7.6	6.2	5.6	3.4	4.9	6.0	5.6	8.2	3.2	5.5	
2000-2400	8.5	5.8	5.1	5.1	5.0	6.2	5.9	6.4	4.0	5.5	

Notes: All changes are decreases, except those marked '+ See Appendix 1 for data details

Figure 3.3.3 Average annual % change in population fatality rates of drivers a. for selected times of the week by age group



b. for selected age groups by time of week



Time of week

The time of week variation appears to differ according to age group (Figures 3.3.3a and 3.3.3b). The oldest (60 years and over), and to a lesser extent the youngest (24 and under) age groups, tend to vary more with time of week than do the other age groups. However, this variation is not statistically significant ($F_{72,877} = 1.3$, p > 0.05; **Table 3.3.2**).

Figure 3.3.4 Average annual % change in population fatality rate of drivers a. for males and females by month



b, for selected age groups by month



Note: January to March are repeated

There is no statistically significant difference with month in the gender (Figure 3.3.4a) or age-related (Figure 3.3.4b) variation in the average annual % change in driver fatality rates (sex x month interaction $F_{11,876} = 0.6$, p > 0.05; age x month interaction $F_{88,876} = 0.8$, p > 0.05; Table 3.3.3).

Table 3.3.3 Average annual % decrease in driver fatality rates (deaths per person) between 1970 and 1990, classified by month, by month and gender, and by month and age group.

	Month												
Group	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	A11
Total	2.6	3.1	1.7	4.0	3.5	3.0	3.3	3.7	2.5	2.8	3.2	3.3	3.1
Gender													
Males	3.4	3.6	2.5	4.7	4.1	3.6	4.3	4.3	3.3	3.3	4.0	4.3	3.8
Females	+1.1	0.2	+1.8	0.6	0.6	+0.2	+0.9	0.8	+1.4	0.4	+0.7	+0.8	+0.4
Age group													
5-16	+3.6	3.7	1.7	3.8	6.6	12.4	7.4	1.2	0.7	+1.5	+1.4	0.3	1.8
17-19	3.9	2.8	2.7	4.3	3.3	2.3	3.1	4.0	0.7	2.9	3.8	4.2	3.2
20-24	4.0	2.8	3.1	3.9	4.1	3.8	2.5	3.7	2.5	2.0	4.0	4.2	3.4
25-29	+0.5	3.7	0.1	5.1	3.8	3.8	2.9	4.8	3.7	2.5	2.1	4.3	3.1
30-39	2.4	5.0	0.7	3.8	2.4	3.8	2.3	3.9	3.5	3.7	3.2	3.1	3.1
40-49	1.7	2.2	1.7	3.3	3.1	1.9	4.8	3.2	2.7	3.6	4.1	2,9	3.0
50-59	1.5	1.7	1.0	2.6	3.0	1.9	4.9	4.4	3.8	2.3	2.8	2.8	2.8
60-69	4.4	3.7	3.2	4.9	5.8	3.3	5.5	3.6	2.4	0.7	3.0	1.5	3.5
70+	2.3	1.6	0.1	4.0	2.8	0.7	0.1	1,5	1.0	3.6	1.2	+0.1	1.5

Notes: All changes are decreases, except those marked '+ See Appendix 1 for data details

4. Passengers

- Fatality rates, per 100,000 persons, for passengers have fallen by an average of 3.9% each year between 1970 and 1990.
- Of the six States, Victoria and Queensland had the largest average annual % decreases and Western Australia and New South Wales had the smallest.
- The decrease for males (an average of 4.2% each year) was slightly greater than that for females (an average of 3.5% each year).
- The average percentage decrease varied with age. The 40 to 69 year age groups had the greatest decrease (an average of 5.0% each year), followed by 17 to 19 year olds (an average of 4.3% each year). The 20 to 24 year age group had the least decrease (an average of 1.9% each year).
 - the difference between males and females was greatest for persons aged 50 and older.

 The average annual percentage decrease was greater for the weekend than for during the week.

- For weekdays, evening (4pm to midnight) had a larger decrease (average of 4.4% each year) than other times of the day (average of 1.9% each year).
- For weekends, evening (4pm to midnight) also had a larger decrease (average of 6.2% each year) than other times of the day (average of 4.4% each year).
- The average annual percentage decrease in fatality rates did not vary greatly with month or season.
- All the above results are for fatality rates calculated as the number of passenger fatalities per person. The average annual decrease was greater when the fatality rates are calculated as the number of passenger fatalities per registered vehicle or per kilometre of travel. The overall average percentage decreases in the latter rates were both 6.5% for each year between 1970 and 1990.

Figure 4.1.1 Fatality rates of passengers between 1970 and 1990 a. per 10⁵ persons with fitted linear and quadratic trends



b. per 10⁵ persons, per 10⁴ registered vehicles and per 10⁸ vehicle kilometres



4.1 Fatality rates between 1970 and 1990

Overall

Passenger fatality rates have fallen from 9.4 deaths/100,000 persons in 1970 to 3.6 deaths/100,000 persons in 1990 (Table 4.1.1; Figure 4.1.1a). The average % decrease in the rate was 3.9% each year, giving an estimated decrease over twenty years of 55%. A 95% confidence interval for the annual % decrease is 3.6 to 4.2%.

For 1970 to 1990 overall, the description of the passenger fatality rate as decreasing by an average of 3.9% annually provides an acceptable fit to the data. This did not necessarily apply for shorter time periods. For example, there was little change between 1983 and 1989. However, modelling the annual % change as a smoothly varying curve did not give a markedly better description of the data (see the estimated quadratic curve in Figure 4.1.1a).

The fatality rates in Figure 4.1.1a are deaths/100,000 person-years. Figure 4.1.1b shows this fatality rate, together with fatality rates expressed as deaths/10,000 registered vehicles and deaths/100 million vehicle kilometres of travel. The average annual % decrease is similar (6.0% and 6.1% respectively) for these last two rates, and is greater than for the population based rate (3.9%). That is, even though the number and use of vehicles grew between 1970 and 1990, the passenger fatality rate decreased over this period. Except for analyses by State, all later analyses are of the population based rate only (see Sections 1.2 and 2.1).

Table 4.1.1 Passenger fatality rates between 1970 and 1990, classified by type of rate $(/10^5 \text{ persons}, /10^4 \text{ registered vehicles and }/10^8 \text{ vehicle kilometres}).$

	Fata	lity rate deno	minator	
Year	Persons	Vehicles	Kilometres	Deaths
1970	9.4	2.59	1.58	888
1971	8.2	2.21	1.35	798
1972	7.2	1.87	1.15	705
1973	7.8	1.94	1.20	744
1974	6.8	1.66	1.04	696
1975	7.8	1.82	1.16	967
1976	7.1	1.57	. 99	942
1977	6.8	1,49	. 94	841
1978	7.5	1.57	1.00	1046
1979	6.7	1.39	.89	962
1980	5.9	1.19	.75	B50
1981	6.1	1.19	.75	884
1982	5.9	3,09	.70	850
1983	4.6	.86	. 55	687
1984	4.9	. 90	. 57	744
1985	4.9	. 89	. 56	770
1986	4.6	. 82	. 51	731
1987	4.6	. 87	. 50	680
1988	4.9	. 87	. 52	727
1989	4.7	.83	. 4 9	777
C 1990	3.6	. 64	. 37	556

Years of data: Passenger deaths in New South Wales (1970-90), Victoria (1970-1990), Queensland (1975-1990), South Australia (1970-1989 except 1977, 1987 and 1988), Western Australia (1976-1990), Tasmania (1970-1990), Northern Territory (1989-1990) and the Australian Capital Territory (1985-1989).

At-risk information is from sources described in Section 1.2.

States and Territories

Population rates for passenger deaths are higher in the Northern Territory than elsewhere, and may be lower than elsewhere in the ACT (Figure 4.1.2a). Of the States (Figure 4.1.2b), Queensland had high rates, while Victoria had low rates.

There was statistically significant variation between States in the average annual & change $\{F_{5,1054} = 3.0, 0.01 . The largest & decreases were for Victoria and Queensland (4.7% and 4.5% respectively), and the least were for Western Australia and New South Wales (both 3.4%).$

These patterns are broadly similar when the rates are expressed as deaths per 10,000 registered vehicles (Figures 4.1.3a and 4.1.3b). The relative ordering of rates between the States is almost the same as for the population rates. One exception is that the percentage decrease for New South Wales is similar to those of most of the other States.





b. for each State (with fitted trends)



Figure 4.1.3 Vehicle fatality rates of passengers between 1970 and 1990 a. for each State and Territory



b. for each State (with fitted trends)



Gender

Male passenger fatality rates were about 20% higher than those for females.

The annual & decrease was 4.2% for males and 3.5% for females. While these decreases are similar, the male % change was statistically significantly greater ($F_{1,1058} = 7.3$, p < 0.001; estimated difference of 0.8% with a 95% confidence interval of 0.2% to 1.4%). The description of the changes for males and for females as an average constant % change between 1970 and 1990 provides an adequate fit to the data (Figure 4.2.1).

Age group

Passenger fatality rates are highest for 17 to 19 year olds. The age-specific rates for adults are successively lower for each older age group between age groups 17-19 and 40-49, and are successively higher for each older age group. The rates for persons aged 70 or older are similar to those for persons in their 20's. The rates for children aged 16 or younger are similar to those of persons in their 30's and 40's. These patterns held throughout the period from 1970 to 1990 (Figures 4.2.2a and 4.2.2b).

Persons in their 40's, 50's and 60's had the greatest average annual % decrease (5.0%). The 17-19 year olds also had a high average annual % decrease (4.3%). Lesser decreases occurred for the other age groups (3.3% overall). The 25 to 29 year age group had the lowest decrease (1.9%). The variation in % changes between age groups was statistically significant ($F_{9,1050} = 4.0$, p < 0.001).

Figure 4.2.1 Fatality rates of passengers between 1970 and 1990 for males and females



Figure 4.2.2 Population fatality rates of passengers between 1970 and 1990 a. for persons aged 0 to 39 years (in 6 age groups)



b. for persons aged 30 years and older (in 5 age groups)



Note: 30-39 age group is repeated in both graphs

Figure 4.2.3 Population fatality rates of passengers between 1970 and 1990 a. during the week



b. during the weekend



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Time of week

For each time of day, passenger fatality rates are lower during the week (Figure 4.2.3a) than at the weekend (Figure 4.2.3b).

However, the average annual % decreases were greater at the weekend than during the week

During the week, passenger fatality rates are highest in the day and evening (10am to midnight) than in the night and morning (midnight to 10am). Greater & decreases occurred for the evening (4pm to midnight; 4.4%) than at the other times (midnight to 4pm; 1.9%). This means that the fatality rate in the day (10am to 4pm) changed from being intermediate between the evening (4pm to midnight) and night/morning (midnight to 10am) rates in 1970 to being similar to the evening rates by 1990.

During the weekend, passenger fatality rates are lowest in the morning (6am to 10am). In 1970, rates in the evening (4pm to midnight) were higher than those for the day (10am to 4pm) and night (midnight to 6am), but by 1990 these rates were similar.

The greatest annual % decrease was for the evening (4pm to midnight), and this change (6.2%) was greater than that for the same period during the week (4.4\%). The % decrease for the other times during the weekend (midnight to 4pm; 3.7%) was also greater than for the same period during the week (1.9%).

The variation between times of the week in % decreases was statistically significant ($F_{9,1050} = F_{1,1050} = 0.001$).

Month

Monthly passenger fatality rates for males and for females show considerable variation about the long-term trend (Figure 4.2.4). There appears to be little systematic variation in the average annual 8 decrease in passenger fatality rates with month (between months $F_{11,1128} = 1.6$, p > 0.05; seasonal sinusoidal variation $F_{2,1128} = 0.3$, p > 0.05).

Figure 4.2.4 Population fatality rates of passengers between 1970 and 1990 by month



Figure 4.3.1 Average annual X change in population fatality rate of passengers a. for males and females by age group







Time of week

Note: Shaded areas denote night (6pm to 6am)

Trends in road crash fatality rates in Australia 1970-1990: Passengers

4.3 Average annual % decrease in fatality rates

The average annual % decrease in passenger fatality rates differed for males and females (Figure 4.2.1) and by age group (Figure 4.2.2). It also appears that the gender difference varies with age group (Figure 4.3.1a; Table 4.3.1; interaction $F_{9,936} = 2.7$, 0.001 < p < 0.01).

Males aged 50 or older showed a much greater annual decrease (5.8%) than similarly aged females (3.5%). For children and teenagers, the average annual decrease was slightly greater for males than for females, while the converse held for persons in their 30's and 40's.

Table 4.3.1 Average annual % decrease in passenger fatality rates (deaths per person) between 1970 and 1990, classified by gender, gender and age group, gender and time of week, and by gender and State.

	Ge	ender	
Group	Males	Females	Persons
Total	4.2	3.5	3.9
Age group			
0-4	3.1	3.0	3.0
5-16	4.3	2.9	3.7
17-19	4.8	3.5	4.3
20~24	3.7	1.8	3.1
25-29	0.9	3.6	1.9
30-39	3.7	4.9	4.2
40-49	5.3	5.6	5.5
50-59	6.6	3.7	4.6
60-69	6.7	4.0	4.8
70+	4.0	2.9	3.2
TIME OI WEEK			
DOUD-OKOO HEEKGEY	2 9	0.5	2 0
D600-1000	2.9	2.0	2.0
1000-1600	2.0	2.0	2.0
1600-2000	2.J 5 1	3.0	4 5
2000-2400	4 2	3.5	4.3
Weekend	1.2	1.5	1.5
0000-0600	3.9	5.3	4.4
- 0600-1000	3.1	2.3	2.7
1000-1600	3.1	3.4	3.3
1600-2000	6.4	6.3	6.3
2000-2400	6.7	4.9	6.0
State			
Queensland	5.5	3.6	4.7
Victoria	5.1	4.2	4,5
Tasmania	4.6	3.6	4.2
South Australia	3.7	4.4	4.0
New South Wales	3.6	3.1	3.4
Western Australia	3.3	3.4	3.4

Notes: All changes are decreases, except those marked '+' See Appendix 1 for data details

Figure 4.3.2 Average annual % change in population fatality rate of passengers a. for males and females by State



b. for each State by age group



Male-female differences in the pattern of average annual & decrease in passenger fatality rates with time of week were not statistically significant ($F_{9,936} = 1.5$, p > 0.05; Figure 4.3.1b; Table 4.3.1). Similarly, male-female differences in the pattern of variation with State were also not statistically significant ($F_{5,931} = 1.6$, p > 0.05; Figure 4.3.2a; Table 4.3.1). State differences in the age-related variation in the average annual & change in passenger fatality rates were not statistically significant ($F_{45,891} = 1.3$, p > 0.05; Figure 4.3.2b; Table 4.3.2).

Table 4.3.2	Average annual % decrease in passenger fatality rates (deaths per person) between
	1970 and 1990, classified by age group, by age group and State, and by age group
	and time of week.

					Ag	e group	•				
Group	0-4	5-16	17-19	20-24	25-29	30-39	40-49	50-59	.60-69	70+	A11
Total	3.0	3.7	4.6	3.1	1.9	4.2	5.5	4.6	4.8	3.2	3.9
State											
Queensland	5.0	5.9	5.5	4.6	2.1	3.2	8.7	2.2	4.7	1.8	4.7
Victoria	3.8	4.4	5.4	4.2	0.7	4.7	6.7	5.1	4.8	2.7	4.5
Tasmania	+1.6	+0.6	12.2	0.7	2.7	0.2	7.3	1.7	5.6	6.3	4.2
South Australia	2.5	2.6	4.3	4.6	0.0	1.4	4.9	7.4	7.2	4.6	4.0
New South Wales	2.2	2.7	3.6	2.3	2.8	4.6	4.2	4.5	4.6	3.5	3.4
Western Australia	2.6	7.7	3.5	1.0	+1.3	3.3	4.7	4.6	3.4	2.2	3.4
Time of week											
Weekday											
0000-0600	+3.4	2.6	3.9	2.7	+2.2	2.9	1.6	+0.5	+2.4	+1.5	2.0
0600-1000	0.9	0.2	+0.9	1.3	2.3	5.7	6.0	4.0	1.8	1.1	2.0
1000-1600	0.7	0.4	0.5	2.6	0.2	1.7	3.1	1.4	3.7	2.0	1.7
1600-2000	3.8	3.3	5.2	3.8	2.6	3.3	7.8	5.5	6.3	4.3	4.5
2000-2400	4.1	3.4	5.6	3.4	1.2	3.7	4.8	7.0	6.0	4.8	4.3
Week end											
0000-0600	7.7	4.3	4.3	3.2	1.5	6.5	9.5	8.2	5.6	4.6	4.4
0600-1000	1.9	0.1	3.6	+0.1	3.2	5.2	8.9	1.8	3.5	5.1	2.7
1000-1600	3.0	5.7	1.5	+0.7	3.3	3.7	4.0	4.4	4.4	2.9	3.3
1600-2000	6.6	6.1	6.2	4.4	6.5	4.9	8.8	8.7	8.8	5.6	6.3
2000-2400	5.5	6.4	6.3	5.4	3.3	6.6	4.6	9.1	5.8	5.0	6.0

Notes: All changes are decreases, except those marked '+' See Appendix 1 for data details

Figure 4.3.3 Average annual X change in population fatality rate of passengers a. for selected times of the week by age group



b. for selected age groups by time of week



Time of week

Note: Shaded areas denote night (6am to 6pm)

Trends in road crash fatality rates in Australia 1970-1990: Passengers

There was no statistically significant interaction between age and time of week ($F_{81,939} = 1.1$, p > 0.05; Figures 4.3.3a and 4.3.3b; Table 4.3.2). Evening (4pm to midnight) has the greatest estimated decline for almost all age groups both at the weekend and during the week.

Figure 4.3.4 Average annual % change in population fatality rate of passengers a. for males and females by month



Month

b. for selected age groups by month



Month

Note: January to March are repeated

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There was no statistically significant difference with month in the gender or age-related variation in the average annual % change in passenger fatality rates (sex x month interaction $F_{11,995} = 1.0$, p > 0.05; age x month interaction $F_{99,995} = 0.9$, p > 0.05; Figures 4.3.4a and 4.3.4b; Table 4.3.3).

Table 4.3.3 Average annual % decrease in passenger fatality rates (deaths per person) between 1970 and 1990, classified by month, by month and gender, and by month and age group.

	Month												
Group	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	A11
Total	3.6	3,6	4.4	4.5	3.7	3.5	3.2	5.0	3.4	4.0	4.5	2.9	3.8
Gender													
Males	3.4	4.0	5.7	4.6	3.5	4.6	3.8	5.5	2.8	5.2	4.4	3.3	4.2
Females	3.7	3.1	3.0	4.3	3.8	2.4	2.6	4.4	4.0	2.7	4.6	2.6	3.4
Age group													
0-4	0.6	0.2	4.2	4.1	2.1	4.6	3.0	2.9	0.6	3.4	5.9	4.6	3.1
5-16	4.0	4.0	3.1	3.9	3.4	4.9	3.5	4.6	3.1	4.2	4.9	1.9	3.7
17-19	3.3	3.9	7.1	4.5	5.0	2.4	3.4	6.2	3.5	4.2	2.5	4.6	4.3
20-24	2.5	3.0	3.3	1.9	2.8	4.3	1.4	6.0	0.6	2.0	5.1	2.9	3.0
25-29	1.0	2.8	+0.2	2.4	2.8	4.4	5.1	0.5	2.0	4.3	1.8	+2.9	1.8
30-39	2.8	5.2	7.9	4.8	3.4	3.9	1.7	2.9	4.1	5.4	5.6	3.4	4.3
40-49	6.5	6.8	6.5	7.5	3.8	4.B	5.3	6.8	4.0	4.7	5.2	2.2	5.2
50-59	6.8	4.0	5.3	5.3	5.6	1.4	2.9	6.4	4.5	4.6	7.0	3.0	4.7
60-69	3.5	4.5	2.0	7.0	4.5	4.5	2.6	5.5	6.2	6.3	5.4	4.2	4.7
70+	5.9	1.3	0.6	5.1	2.1	1.4	5.7	3.5	6.7	2.8	3.5	1.8	3.3

Notes: All changes are decreases, except those marked '+' See Appendix 1 for data details

5. Pedestrians

- Fatality rates, per 100,000 persons, for pedestrians have fallen by an average of 4.0% each year between 1970 and 1990.
- Of the six States, Western Australia and Queensland had the greatest average annual % decreases, and New South Wales and South Australia had the least.
- Between 1970 and 1990, male pedestrian fatality rates remained about twice those of females.
- The average annual percentage decrease varied with age. The 40 to 69 year age groups had the greatest decrease (an average of between 5 to 6% each year). Other ages had a lesser decrease, except for 17 to 29 year olds for whom there was an average increase of 1.1% per year.
 - the difference between males and females was generally less at older age groups (except for persons aged 70 years or older).
- The average annual percentage decrease was greater for the weekend than for during the week, except for the morning period (6am to 10am).
- For weekdays, evening (4pm to midnight) had a larger decrease (average of 5.1% each year) than other times of the day (average of 1.6% each year).
- For weekends, evening (4pm to midnight) also had a larger decrease (average of 6.8% each year) than other times of the day (average of 1.8% each year).
- The average annual percentage decrease in fatality rates did not vary greatly with month or season.
- All the above results are for fatality rates calculated as the number of pedestrian fatalities per person. The average annual decrease was greater when the fatality rates are calculated as the number of pedestrian fatalities per registered vehicle or per kilometre of travel. The overall average percentage decreases in the latter rates were 6.3% and 6.4%, respectively, for each year between 1970 and 1990.



Figure 5.1.1 Fatality rates of pedestrians between 1970 and 1990 a. per 10⁵ persons with fitted linear and quadratic trends

b. per 10⁵ persons, per 10⁴ registered vehicles and per 10⁸ vehicle kilometres



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Overall

Pedestrian fatality rates have fallen from 6.4 deaths/100,000 persons in 1970 to 2.5 deaths/100,000 persons in 1990 (Table 5.1.1; Figure 5.1.1a). The average & decrease in the rate was 4.0% each year, giving an estimated decrease over twenty years of 56%. A 95% confidence interval for the annual % decrease is 3.7 to 4.4%.

For 1970 to 1990 overall, the description of the total fatality rate as decreasing by an average of 4.0% annually provides an acceptable fit to the data. This did not necessarily apply for shorter time periods. For example, there was little change between 1983 and 1988.

The fatality rates in Figure 5.1.1a are deaths/100,000 person-years. Figure 5.1.1b shows this fatality rate, together with fatality rates expressed as deaths/10,000 registered vehicles and deaths/100 million vehicle kilometres of travel. The average annual % decrease is similar (6.3% and 6.4% respectively) for these last two rates, and is greater than for the population based rate (4.0%). Therefore, even though the number and use of vehicles grew between 1970 and 1990, the pedestrian rate decreased over this period. However, trends in the amount of pedestrian travel are not known.

Table 5.1.1	Pedestrian fatality rates between 1970 and 1990, classified by type of rate $(/10^{-1})$
,	persons, $/10^4$ registered vehicles and $/10^8$ vehicle kilometres).

Fatality rate denominator									
Year	Persons	Vehicles	Kilometres	Deaths					
1970	6.4	1,74	1.07	624					
1971	5.6	1,49	.92	559					
1972	5.6	1,42	.89	563					
1973	5.6	1.37	.86	571					
1974	5.5	1.28	.82	567					
1975	5.2	1.15	.75	641					
1976	4.9	1.04	.68	651					
1977	5.2	1.09	.70	638					
197B	4.9	.99	. 65	691					
1979	4.5	.89	.58	644					
1980	4.4	.85	.55	637					
1981	4.2	80	.52	622					
1982	3.9	.71	.47	589					
1983	3.3	59	.39	503					
1984	3.5	51	.40	532					
1985	3.4	59	.38	537					
1986	3.4	58	.37	538					
1997	3.1		.33	454					
1999	3 3		.35	503					
1090	3.0	- 50	31	500					
1990	2.5	.42	.25	382					

Years of data: Pedestrian deaths in New South Wales (1970-90), Victoria (1970-1990), Queensland (1975-1990), South Australia (1970-1989 except 1977, 1987 and 1988), Western Australia (1976-1990), Tasmania (1970-1990), Northern Territory (1989-1990) and the Australian Capital Territory (1985-1989). At-risk information is from sources described in Section 1.2.

States and Territories

Population rates for pedestrian deaths are higher in the Northern Territory than elsewhere, and may be lower than elsewhere in the ACT (Figure 5.1.2a). Of the States (Figure 5.1.2b), New South Wales had high rates during the 1980's, while Queensland had low rates throughout this period.

There was statistically significant variation between States in the average annual & change $(F_{5,1014} = 2.7, 0.01 Figure 5.1.3). The largest & decrease was for Western Australia (6.0%) which changed from having the highest fatality rate in 1976 to the lowest fatality rate in 1989. Queensland had the next largest decrease (5.0%). The least % decreases were for South Australia (3.4%) and New South Wales (3.6%).$

These patterns are broadly similar when the rates are expressed as deaths per 10,000 registered vehicles (Figures 5.1.3a and 5.1.3b). However, the differences between States are not nearly as pronounced. In particular, percentage decreases for Queensland and Western Australia are much less and Queensland has one of the lowest decreases.

Figure 5.1.2 Fatality rates of pedestrians between 1970 and 1990 a. for each State and Territory



b. for each State (with fitted trends)



72.





b. for each State (with fitted trends)



73.

5.2 Variation in fatality rates

Gender

Male pedestrian fatality rates have remained about twice those for females. The average annual & decrease was similar for males (4.2%) and females (3.8%). The difference between the genders is not statistically significant ($F_{1,1018} = 1.1$, p > 0.05). The description of the changes for males and for females as an average constant & decrease between 1970 and 1990 can be seen to provide a good fit to the data (Figure 5.2.1).

Age group

Pedestrian fatality rates are highest for persons 70 years or older. The age-specific rates for adults are lower for each younger age group until the 30 to 39 year age group.

Each of the five age groups from 30 years and older has had a large annual average & decrease, so their relative ordering has remained the same throughout the twenty year period. However, persons aged 40 to 69 years had the largest decreases of between 5% and 6%. This means that although persons older than 69 years had a decrease of 4.2%, in 1990, the ratio of their fatality rate compared with that of the 60 to 69 year olds, has increased from about double to about triple.

Persons aged 17 to 29 years had an annual average % increase in pedestrian fatality rates (+1.1%). This meant that they changed from having one of the lowest fatality rates in 1970 to having rates similar to 50 year olds by 1990.

Pedestrian fatality rates for children aged 16 or younger were similar to those of 40 year olds, although their average annual % decrease is slightly lower (3.7%; Figures 5.2.2a and 5.2.2b).

The variation in % changes between age groups was statistically significant $\{F_{9,1010} = 19, p < 0.001\}$.

Figure 5.2.1 Population fatality rates of pedestrians between 1970 and 1990 for males and females



Figure 5.2.2 Population fatality rates of pedestrians between 1970 and 1990 a. for persons aged 39 years and younger (in 6 age groups)



b. for persons aged 30 years and older (in 5 age groups)



75.

Figure 5.2.3 Population fatality rates of pedestrians between 1970 and 1990 a. during the week



b. during the weekend



Time of week

Pedestrian fatality rates are similar during the week and at the weekend for the day and early evening periods (10am to 8pm). For late evening and night (8pm to 6am) they are higher at the weekend while for the morning (6am to 10am) they are higher during the week (Figures 5.2.3a and 5.2.3b).

Greater average annual % decreases occurred for the evening (4pm to midnight) both during the week and at the weekend (5.1% and 6.8% respectively) than at the other times (midnight to 4pm; 1.6% and 1.8% respectively). Weekday night (midnight to 6am) was the only weekday time which had a greater average annual % decrease than the corresponding weekend period.

The highest rate during the week was for the early evening (4pm to 8pm) and the lowest is for the night. The highest average annual & decrease during the week was for late evening (8pm to midnight). The fatality rate for this time changed from being intermediate between morning and day (6am to 4pm), and early evening (4pm to 8pm) in 1970 to being lower than the two day periods in 1990. The variation between these four periods (ie except night; midnight to 6am) has lessened considerably over the twenty years.

At the weekend, the highest rates were during the evening (4pm to midnight) and the lowest rate in the morning (6am to 10am).

with the exception of the morning period, the variation in fatality rates for the weekend periods has also decreased. The greatest average annual & decrease was for the evening (4pm to midnight; 6.8%). This meant that, in 1970, rates in the evening (4pm to midnight) were higher than those for the night (midnight to 6am) but by 1990 these rates were similar. The daytime (10am to 4pm) fatality rate was larger than that for night (midnight to 6am) in 1970, but had become less by 1990.

The variation between times of the week in average annual % decreases in the pedestrian fatality rate was statistically significant ($F_{9,1010} = 24$, p < 0.001).

Month

Monthly pedestrian fatality rates for males and for females show considerable variation about the long-term trend (Figure 5.2.4). There appears to be little systematic variation in the average annual & decrease in pedestrian fatality rates with month (Figures 5.3.4a and 5.3.4b; between months $F_{11,1148} = 1.4$, p > 0.05; seasonal sinusoidal variation $F_{2,1148} = 1.2$, p > 0.05).





77.

Figure 5.3.1. Average annual % change in population fatality rate of pedestrians a. for males and females by age group



b. for males and females by time of week



Time of week

Note: Shaded areas denote night (6om to 6am) Trends in road crash fatality rates in Australia 1970-1990: Pedestrians

5.3 Average annual % decrease in fatality rates

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The average annual & decrease in pedestrian fatality rates does not differ between males and females (Figure 5.2.1), but does differ by age group (Figure 5.2.2). Figure 5.3.1a suggests that there may be a gender difference for some age groups but this is not statistically significant (see also Table 5.3.1; interaction $F_{9,896} = 1.8$, p > 0.05).

Males and females aged 16 years and under, or 30 years and older, showed an average annual % decrease of over 3%. Overall, 17 to 29 years olds had an average annual % increase. However, for 17 to 24 year olds, this increase was apparent for females (increase of 2.6%) but not males (0.1% decrease), whereas for 25 to 29 year olds, the opposite was true (male increase of 4.0%, female decrease of 2.2%).

Table 5.3.1 Average annual % decrease in pedestrian fatality rates (deaths per person) between 1970 and 1990, classified by gender, by gender and age group, by gender and time of week, and by gender and State.

	Ge Ge	ender					
Group	Males	Females	Persons				
Total	4.2	3.8	4.0				
Age group							
0-4	3.8	6.0	4.5				
5-16	3.7	3.0	3.4				
17-19	+0.2	+3.6	+0.9				
20-24	0.1	+1.6	+0.2				
20-29	+4.0	4 4	3.5				
40-49	5.6	4.7	5.4				
50-59	6.3	4.8	5.9				
60-69	6.5	4.8	6.0				
70+	4.5	3.9	4.2				
Time of weak							
Weekday 0000-0600	25	1 3	2.2				
0600-1000	1.9	0.8	1.5				
1000-1600	1.4	1.8	1.5				
1600-2000	4.5	4.3	4.4				
2000-2400	6.7	6.0	6.5				
Weekend	0.1	1 4	<u>^</u> 3				
0600-0600	3 4	2.0	2.8				
1000-1600	2.3	4.5	3.2				
1600-2000	6.1	6.2	6.1				
2000-2400	7.3	7.8	7.4				
6b - b -							
Mestern Australia	5 6	7.7	6.3				
Oueensland	4.7	5.4	5.0				
Victoria	4.9	3.8	4.5				
New South Wales	3.6	3.5	3.6				
South Australia	3.2	3.8	3.4				
Tasmania	د . د	2.1	4.7				

Notes: All changes are decreases, except those marked '+' See Appendix 1 for data details
Figure 5.3.2 Average annual % change in population fatality rate of pedestrians a. for males and females by State



b. for each State by age group



80.

Male-female differences in the pattern of average annual & decrease in pedestrian fatality rates with time of week were not statistically significant ($F_{9,896} = 0.7$, p > 0.05; Figure 5.3.1b; Table 5.3.1). Similarly, male-female differences in the pattern of variation with State were also not statistically significant ($F_{5,891} = 0.7$, p > 0.05; Figure 5.3.2a; Table 5.3.1). State differences in the age-related variation in the average annual & change in pedestrian fatality rates were nominally statistically significant ($F_{45,851} = 1.8$, 0.001 < p < 0.01; Figure 5.3.2b; Table 5.3.2). Western Australia, and to a lesser extent, Queensland appear to have a different pattern with age compared with the other States.

Table 5.3.2	Average annual % decrease in pedestrian fatality rates (deaths per person)
	between 1970 and 1990, classified by age group, by age group and State, and by
	age group and time of week.

				Age g	roup						
Group	0-4	5-16	17-19	20-24	25-29	30-39	40-49	50-59	60-69	70+	A11
Total	4.5	3.4	+0.9	+0.2	+2.8	3.5	5.4	5.9	6.0	4.2	4.0
State											
Western Australia	7.8	0.3	+7.9	7.7	+7.1	4.9	10.4	13.2	14.0	8.4	6.3
Queensland	5.7	3.2	+1.3	+5.1	+1.3	5.0	9.4	9.0	10.0	4.6	5.0
Victoria	5.2	4.6	0.6	2.3	+2.9	5.6	6.5	5.7	6.3	3.6	4.5
New South Wales	4.1	2.8	+2.5	+0.9	+2.B	2.0	3.9	5.9	5.1	4.5	3.6
South Australia	2.5	3.3	2.6	+4.5	+2.2	2.2	8.2	3.5	5.2	4.1	3.4
Tasmania	+0.1	3.6	2.8	0.7	+7.3	13.9	2.7	7.5	5.0	5.8	2.9
Time of week											
Weekday											
0000-0600	+0.3	1.5	+3.3	+2.3	+1.9	+0.2	7.3	8.1	6.3	6.6	2.2
0600-1000	5.9	3.2	+8.3	+4.6	+11.5	2.9	2.2	2.9	1.4	0.2	1.5
1000-1600	3.1	0.8	+4.6	+3.9	+5.0	2.7	2.2	2.0	1.1	1.9	1.5
1600-2000	4.0	4.0	+0.1	0.6	+2.5	3.0	5.7	5.0	6.6	4.3	4.4
2000-2400	5.6	5.8	+2.1	2.6	+1.9	6.1	7.9	8.9	7.4	9.0	6.5
Week end											
0000-0600	7.0	2.1	+2.5	+4.2	+6.6	1.6	3.2	5.8	6.6	11.7	0.3
0600-1000	7.5	3.7	+0.8	4.5	1.5	3.9	2.7	2.3	3.5	1.8	2.8
1000-1600	3.6	4.6	+2.8	1.7	1.9	0.5	+0.6	2.9	4.8	1.7	3.2
1600-2000	9.1	4.3	3.0	0,9	+1.1	1.3	3.2	8.9	7.8	7.0	6.1
2000-2400	4.6	5.2	5.0	3.9	1.0	5.7	8.2	7.3	10.7	10.5	7.4

Notes: All changes are decreases, except those marked '+' See Appendix 1 for data details

Figure 5.3.3 Average annual % change in population fatality rate of pedestrians a. for selected times of the week by age group



b. for selected age groups by time of week



Time of week

Note: Shaded areas denote night (6pm to 6am)

There was no statistically significant interaction between age and time of week ($F_{81,896} = 1.2$, p > 0.05; Figures 5.3.3a and 5.3.3b; Table 5.3.2). However, the large average annual % decreases in pedestrian fatality rates at night appeared to be small or absent for young adults (aged 17 to 29 years) and particularly marked for older adults (aged 30 or older). By contrast, the average annual % decrease in pedestrian fatality rates during the day showed much less variation with age group.

Figure 5.3.4 Average annual % change in populatiom fatality rate of pedestrians a. for males and females by month



b. for selected age groups by month



Note: January to March are repeated

There are nominally statistically significant differences with month in the gender and agerelated variation in the average annual & change in pedestrian fatality rates (sex x month interaction $F_{11,1014} = 2.5$, 0.001 F_{99,1014} = 1.4, 0.01 0.05; Table 5.3.3).

Table 5.3.3 Average annual % decrease in pedestrian fatality rates (deaths per person) between 1970 and 1990, classified by month, by month and gender, and by month and age group.

	Month												
Group	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	A11
Total	3.9	3.6	4.4	4.2	4.5	3.6	4.1	5.6	3.4	4.2	3.9	3.3	4.1
Gender													
Males	3.9	2.6	4.9	4.5	4.5	4.3	4.4	6.1	2.9	4.6	3.3	3.7	4.2
Females	4.1	5.6	3.6	3.5	4.4	2.1	3.6	4.6	4.6	3.5	5.1	2.5	3.9
Age group													
0-4	6.5	5.1	8.3	6.3	3.4	5.8	2.2	+0.5	1.6	3.3	6.8	1.8	4.4
5-16	3.9	3.2	3.0	3.1	5.4	3.3	3.3	4.9	3.8	4.4	2,4	3.2	3.6
17-19	+0.1	+3.4	+1.9	2.3	+2.5	+2.0	+1.3	2.0	+3.8	6.6	+0.3	+3.1	+0.7
20-24	2.3	0.4	+1.6	+4.7	0.4	0.2	+0.1	+2.9	0.3	+3.6	4.9	0.4	+0.1
25-29	5.4	+3.3	+2.2	+6.4	0.0	+4.3	+6.1	1.4	+1.1	+2.5	+4.0	+2.7	+2.2
30-39	5.5	1.9	2.0	4.1	4.1	4.5	4.4	4.4	1.0	2.2	2.9	3.9	3.4
40-49	8.1	3.8	7.0	5.8	5.0	4.3	7.4	6.4	0.8	3.6	7.4	5.6	5.3
50-59	7.9	4.4	5.0	4.9	4.2	5.0	5.1	7.6	7.4	11.7	6.2	3.7	5.8
60-69	3.6	5.1	5.8	7.7	8.1	5.2	7.9	7.6	5.0	2.9	3.7	6.3	6.0
70+	1.2	5.2	5.5	3.6	4.7	3.1	3.3	6.7	4.3	4.7	3.7	4.6	4.4

Notes: All changes are decreases, except those marked '+' See Appendix 1 for data details