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ROAD FATALITY RATES IN AUSTRALIA 1984-85: SUMMARY REPORT

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Abstract
This report describes the road crash fatality risks of Australians in 1984-85.

Risk measurements or fatality rates are calculated as the average number of fatalities per distance travelled, time spent travelling and number of trips. They are estimated for five groups of road user (car drivers, car passengers, motorcycle riders, bicyclists and pedestrians) tabulated for sex, age and each of five factors (time of day, day of week, season, State or Territory and holiday/non-holiday period).

The sources of the data are the FORS Fatal File for 1984 and 1985, and the Survey of Day-to-Day Travel in Australia 1985/86. This report is a summary of Report CR 70.

Keywords
Fatality rate; fatality risk; risk exposure; road crashes; travel survey

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STATISTICAL DATA ANALYSTS

Road Fatality Rates in Australia 1984-85
Summary Report

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June 1989

EXECUTIVE SUMMARY

This report describes the road crash fatality risks of various groups of Australian road users. **Risk measurements or fatality rates were calculated as** the average number of fatalities per ten million kilometres travelled, per million hours of travel and per one million trips taken.

The FORS Fatal File for the two years 1984 and 1985 provided details of road crash fatalities while estimates of travel were obtained from the Survey of Day-to-Day Travel in Australia 1985-86. The two data sources were combined to estimate fatality rates for car drivers, car passengers, motor cycle riders, bicyclists and pedestrians. **For each of these groups, fatality and travel** information was tabulated for sex, age and each of five factors: time of day, day of week, season, State or Territory and holiday/non-holiday periods within each State or Territory.

These measures of fatality rates are superior to traditional estimates which are based only on population figures with risk defined as deaths per person per year. These latter estimates can be seriously misleading since they do not take into account differences in the amount of travel undertaken by individuals within the population.

The major findings for specific categories of road users are given below.

Car drivers

The fatality rate for car drivers was markedly different for various age groups, being highest for young drivers, at a minimum for those in middle age but rising again for drivers over 60. **Fatality rates for males were** higher than for females especially for young drivers. **Night time rates for** all drivers were about 10 times higher than daytime rates. **Friday and** Saturday nights were the most dangerous times of the week especially for drivers under 20.

Car passengers

For car passengers, the lowest fatality rate was found for those under 15 years old, and this was about one-quarter that of the 16 to 25 age group. Above age 25 fatality rates decreased, reaching a minimum at about age 45 before rising again for older passengers.

Night time rates were higher than those during the day, especially for young male passengers.

Motor cyclists

Male motor cyclists generally had twice the fatality rate of females, and they were at particular risk at night and on the weekend. Generally, young males were more at risk than older males. The fatality rate of male motor cyclists during Winter was only two-fifths of that at other times of the year.

Bicyclists

Bicyclists under the age of 13 had the highest fatality rates, while risk levels were lowest for those between the ages of 20 and 30. In general, male cyclists had twice the fatality rate of females and night time travel by all cyclists was about 4 times riskier than daytime travel.

Pedestrians

Fatality rates were highest for pedestrians over the age of 65, and varied little for those under the age of 50. In general, males had higher fatality rates. Travel was riskier at night and during the weekends, particularly for males and for young pedestrians. The fatality rate was lower during the Summer months.

Intermodal comparisons

Overall, the fatality rates of car drivers and car passengers are similar, although the relative risk varies with age and sex. These two modes of travel have a lower risk than the other three, particularly at night.

Overall, motor cyclists have a fatality rate per kilometre travelled 19 times that of car drivers, although this relative risk decreases with age. It is also greater during the day (when motor cyclists have the highest risk of all modes) than at night.

The overall relative risk of pedestrians compared with bicyclists is about 3 for distance travelled and 1.3 for time spent travelling. At night, pedestrians have the highest risk of all modes including bicyclists. During the day bicyclists and pedestrians have a similar fatality risk.

A summary of all analysis results is given in Table 1. These results are discussed in greater detail in Chapters 2 to 8. Generally it can be seen that for all road users, males are at higher risk than females and that fatality rates vary greatly with the age of the traveller and the time of day at which travel occurs.

A separate technical document is also available which describes in more detail the results of all statistical analyses undertaken (INTSTAT, 1989).

Table 1. Summary of variation in fatality rates with factors examined in this report. If the name of a factor is listed for a mode of travel this indicates that the main effect of this factor is statistically significant at the 5% level (tod = time of day, dow = day of week and hol=holiday versus non-holiday). Statistically significant interactions are also shown. **For example, age.sex** indicates that the variation of fatality rates with age differs with sex.

	Age	Sex	Time of day	Day of week	Season	State	Holiday
Car drivers	age age.sex age.tod age.dow	sex sex.age	tod tod.age tod.dow[1]	dow dow.age[1] dow.tod[1]		state	
Car passengers	age age.sex age.tod	sex sex.age sex.dow	tod tod.age	dow dow.sex		state	hol
Motor cyclists	age age.tod	[2]	tod tod.age	dow	season		
Bicyclists	age age.hol	sex	tod				 hol.age
Pedestrians	age age.sex age.tod age.dow	sex sex.age sex.dow	tod tod.age	dow dow.age dow.sex	season	state	

[1] For each mode, the interactions examined were age and sex by each other factor and state by holiday. In addition, time of day by day of week was examined for car drivers only.

[2] Although female motor cyclists have half the fatality rate of males, this is not statistically significant because there are very few female motor cyclists. **For this mode, females were therefore not included in the analyses of other factors.**

Road Fatality Rates in Australia 1984–85
Summary Report

CONTENTS

1. Introduction and overview

Rationale

Road crash fatality rates vary for different groups in the Australian population and possibly with the time of day, week or year. Such variation has important implications for road safety policy.

For any particular group, the road crash fatality rate per person per year can be calculated using the number of fatalities for that group in a year and the number of people in that group. In this case, the fatality rate equals the number of fatalities divided by the population of the group.

However, this calculation does not take into account that the amount of travel undertaken may differ between groups. For example, male 18 year-old car drivers have a much higher fatality rate per person than female 50 year-old car drivers. There are two possible reasons for such a difference. Firstly, the 18 year-olds may be intrinsically more at risk of having a fatal crash. Secondly, they may drive further and more frequently, so that they have a higher opportunity for crashes. Either or both of these two factors may be operating. Similarly, for all drivers the number of fatalities differs with the time of day. This may be because the amount of travel varies over the 24 hours in a day and/or the risk of a fatal crash varies over this period.

To distinguish between the two effects it is necessary to have an estimate of the amount of travel undertaken by different groups of Australians in various time periods. It is then possible to calculate the fatality rate per unit of distance travelled, for example, although other measures of travel could also be used. By using distance travelled rather than population as the "at-risk" measure, a more useful estimate of the risk of fatality is obtained. Variation in the number of fatalities can then be partitioned into variation due to the risk of fatality and variation due to distance travelled. These two components have different policy implications.

This document is a summary of a more detailed report which examines the fatality rates resulting from the travel of Australians in the two years 1984 and 1985 (INTSTAT, 1989). Two sources of data were used. The FORS Fatal File for 1984–85 provides details of road crash fatalities for these two years in Australia. Estimates of travel were obtained from the Survey of Day-to-Day Travel in Australia 1985–86 (SOCIALDATA, 1987; INTSTAT, 1987, 1988).

Data sources

The FORS Fatal File contains detailed information on all fatal road crashes in Australia. At the time this report was being written, data were held for crashes between 1981 and 1985, although only data for 1984 and 1985 are analysed here.

The Travel Survey was of a geographically stratified, random sample of households throughout Australia. For a randomly chosen day in the year-long survey period, details of all trips made by all members of each selected household were collected on a self-completion, mail questionnaire. The final data set contains details of 145 000 trips of 45 000 persons from 18 000 households. It enables estimates of day-to-day travel for the Australian population to be made in terms of distance travelled, time spent travelling and number of trips undertaken.

Both sets of data cover five modes of travel - as a car driver, car passenger, motor cycle rider, bicyclist or pedestrian. By combining the two data sources, fatality rates for these five modes can be estimated. The Travel Survey was used to estimate the amount of travel that occurred in Australia in 1984 and 1985. Because the Travel Survey was limited to persons aged 9 or older, fatalities of persons younger than 9 years old could not be included in this report.

As with any survey, especially when it is performed for the first time, the Travel Survey has several limitations (INTSTAT, 1987, 1988). Four limitations of this survey are of particular relevance to this report. First, although the survey was designed as a random sample of Australians, some persons selected for the survey declined to participate in it. Others participated on a day other than the one they were originally assigned. Second, many respondents underreported the number of trips, especially pedestrian trip segments which were part of trips by other modes. Third, the sample size is such that estimates of the amount of travel for less common modes of travel and for small groups are poorly defined. Fourth, the geographical stratification of the survey means that estimates for regions outside capital cities are probably biased.

Despite these limitations, the Travel Survey provides reasonable estimates of travel by Australian road users, and their use in an analysis of fatality rates is appropriate.

Report structure

Results from analyses of the five modes of travel are summarised in Chapters 2 to 6. Factors considered in these analyses are age, sex, time of day, day of week, season, State or Territory and holiday/non-holiday periods within each State or Territory.

Chapter 7 is an overall discussion of the variation in results due to using the different at-risk measures in analyses, and summarises the comparisons of the measures given in each section of Chapters 2 to 6. The results of analyses of comparisons of fatality rates between modes of travel are given in Chapter 8.

The figures in each chapter are graphed on the log scale. This is done so that the patterns in the fatality risk represented by the graphs can be clearly seen. On a simple linear scale most of the graph would be flat, except for a few points of very high risk which would swamp the rest. Using the log scale compresses the high-risk part of the graph and expands the low-risk part, so that comparisons between all ages and times of day, and so on, can be made. However, the basic pattern remains the same and the absolute fatality rate can be read from the scale on the right hand side of the log-scale graph. The use of log-scale graphs is also consistent with the statistical models in the analysis, which are based on the assumption that the factors under study have multiplicative, rather than additive, effects.

Log-linear modelling of rates

For this report, the fatality rates have been analysed using the technique of log-linear modelling (Bishop et al., 1978). Conclusions from these models have been used to guide the text, and the smooth curves in the figures in this report show the estimated rates from log-linear models. The models were fitted using GLIM 3.77 (NAG, 1986).

The log-linear models for the fatality rate are regression-like models for the logarithm of the fatality rate. Differences between the log rates can be exponentiated and interpreted in terms of percentage differences in fatality rates, or as relative rates. Intermodal comparisons (for example, between car driver and car passenger risks) were also performed using log-linear models.

The different bases for the rates (population, distance, time and number of trips) cannot be included simultaneously in the log-linear models, although the method of analysis is the same for each measure of the at-risk quantity. For each mode and factor, the results for the four at-risk measures were compared.

Figure 1

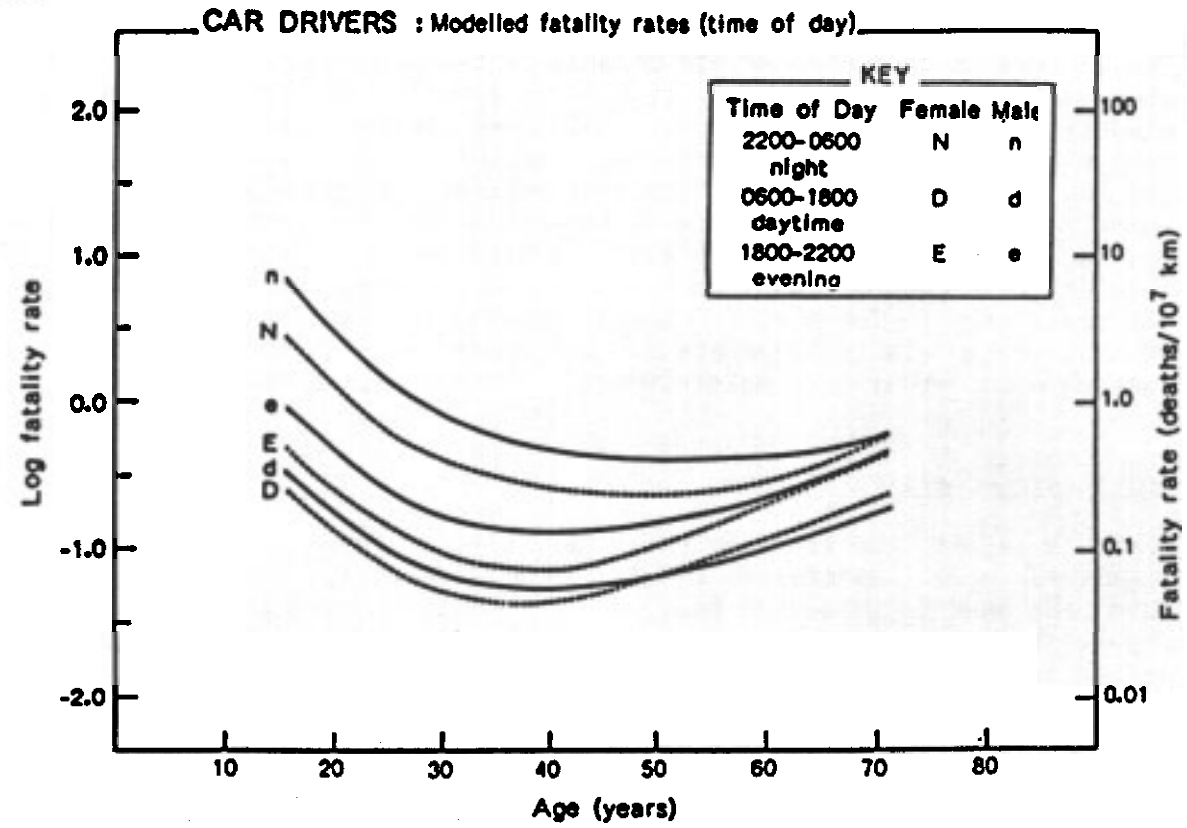
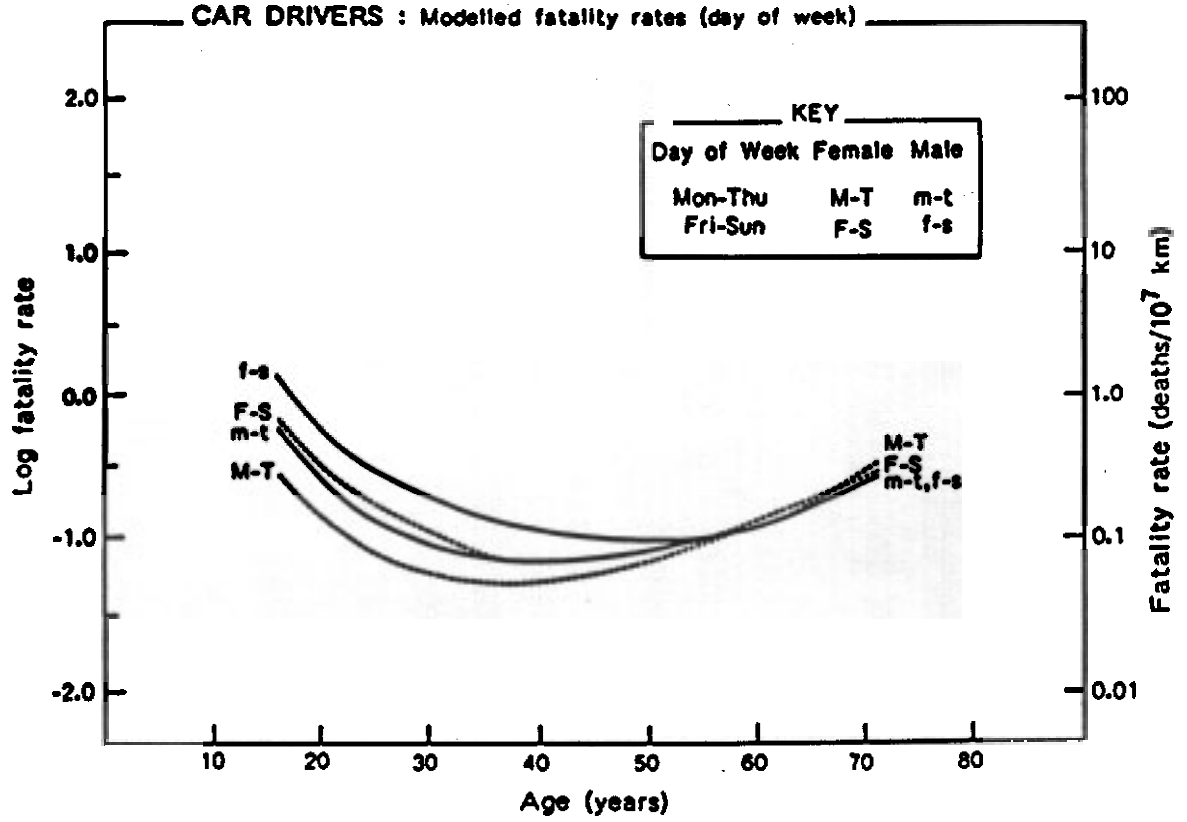


Figure 2



2. Car drivers

The fatality rate per distance driven is highest for the youngest drivers (age 16) and lowest between ages 30 and 60.

Overall, males have average age-specific fatality rates approximately 1.5 times those of females. However, young adult males have a fatality rate double that of similar aged females. For older adults, the fatality rates of males approach those of females.

Fatality rates vary greatly with time of day (see Figure 1). Overall, rates at night were 10 times those during the day, with rates in the evening intermediate at about 4 times the daytime rates. The day-night difference is greatest for drivers under 21.

The fatality rate at the weekend is 1.7 times that for Monday to Thursday, with that for Friday half-way in between. This day-to-day variation is largely confined to the younger drivers (see Figure 2). For all drivers, late Friday and Saturday nights are particularly risky for fatalities, more so than would be expected by simply multiplying weekend and late night effects. Fatality rates vary 40-fold, from a minimum in the middle of the day on Monday to Thursday, to a maximum during early weekend mornings.

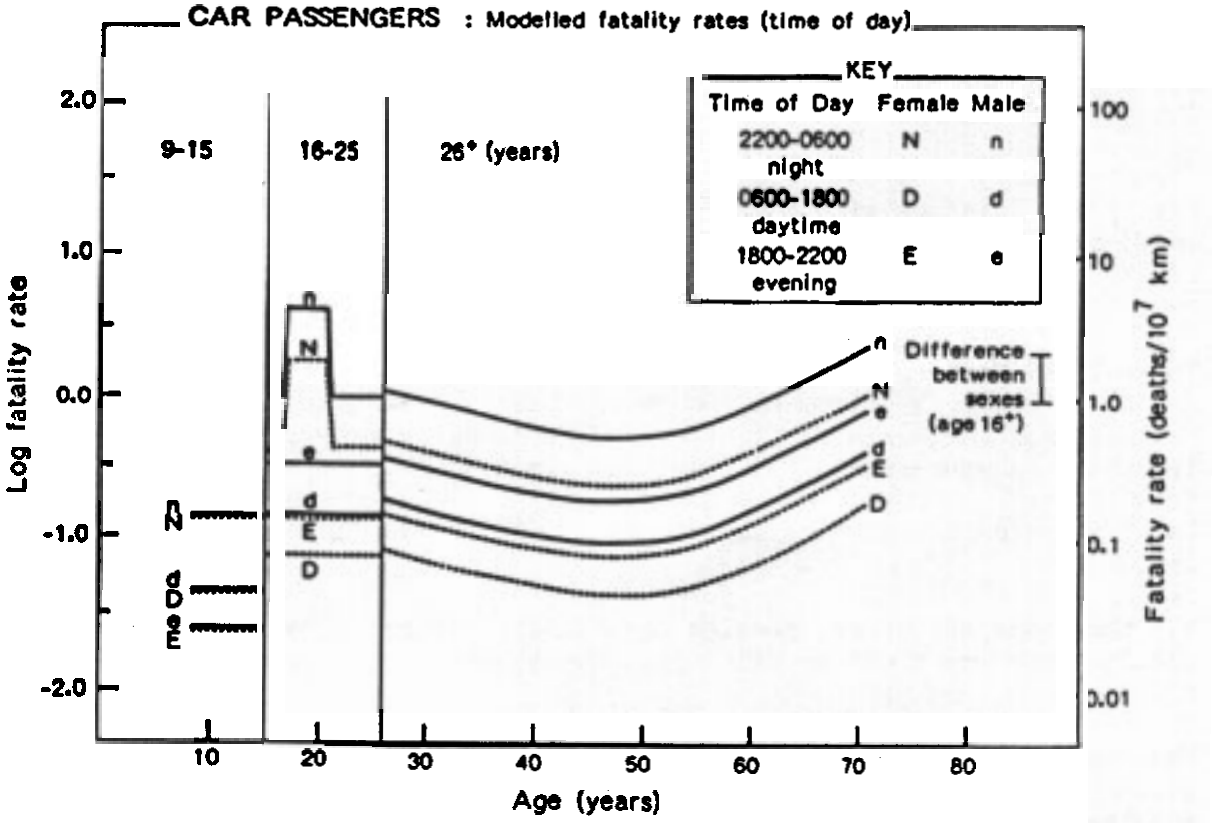
The ACT and Western Australia have the lowest fatality rates, followed, in ascending order, by Victoria, New South Wales, South Australia, Queensland, Tasmania and the Northern Territory. The fatality rate in the Northern Territory is approximately 3 times that in the ACT.

Fatality rates do not vary significantly with season and holiday-non holiday periods.

All the above car driver results for fatality rates per distance driven are similar when expressed as rates per time spent driving or rates per number of trips.

When the rates are expressed as fatalities of car drivers per head of population (without taking into account the amount of travel undertaken), the results are broadly similar except that: (1) the relative risk of males to females no longer decreases with age but is similar at all ages, (2) the variation in fatality rates with age is less, and (3) fatality rates are higher during the day than at night instead of being much greater at night.

Figure 3


CAR PASSENGERS : Modelled fatality rates (time of day)
KEY
Time of Day Female Male
2200-0600 night N n
0600-1800 daytime D d
1800-2200 evening E e
9-15
16-25
26+ (years)
Difference between sexes (age 16+)
Log fatality rate
Fatality rate (deaths/10^7 km)
Age (years)
2.0
1.0
0.0
-1.0
-2.0
100
10
1.0
0.1
0.01
10
20
30
40
50
60
70
80

3. Car passengers

The average fatality rates per distance travelled for car drivers and passengers are similar.

Fatality rates vary with age. The 9 to 15 year old passengers have the lowest fatality rates. Sixteen to 25 year old passengers have fatality rates over 4 times that of 9 to 15 year olds, and about double that of 45 year olds. The graph of the fatality rate is U-shaped between ages 25 and 70, with a minimum at about age 45, and similar rates at ages 25 and 70 (see Figure 3).

Male car passengers have a fatality rate 2.3 times that of females, except for ages 9 to 15 for which there is no difference in rates between the sexes.

Overall, night time fatality rates are 6 times those during the day, and 3 times those in the evening. But for passengers aged 17 to 20 the night time is particularly risky - about a 30-fold risk compared with the day time for males.

Overall, for passengers over age 15, males have a greater risk at the weekend than during the week, whereas the opposite holds for females. However, for females this weekend-weekday difference is confined to those of age 26 and older.

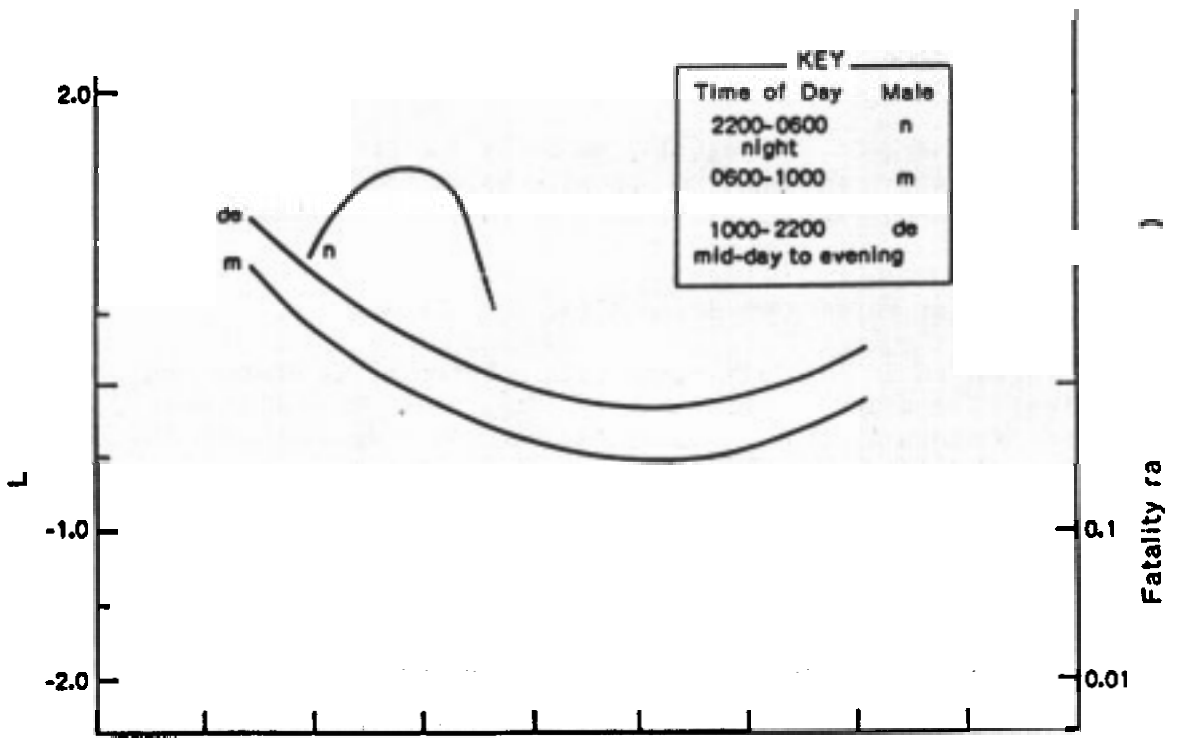
Fatality rates for passengers are similar for all seasons.

A 5-fold variation in fatality rates occurs between the States and Territories. The order of the fatality rates was: the ACT (lowest), Victoria, Queensland, Western Australia, Tasmania, New South Wales, South Australia and the Northern Territory.

The fatality rate during the holidays was two thirds that during the rest of the year.

All the above car passenger results for the rate per distance travelled hold also for the rate per time spent travelling and rate per number of trips.

The results for the rate per person per year (that is, based on population only), are generally similar except that: (1) the difference between sexes is less, (2) the variation with age is less, (3) the night time rate is less than the day time rate, and (4) the difference between weekend and weekdays is less.


KEY
Time of Day
Male
2200-0600
night
n
0600-1000
m
1000-2200
mid-day to evening
de
2.0
-1.0
-2.0
0.1
0.01
Fatality ra

4. Motor cyclists

Female motor cyclists have half the fatality rate of males although this was not statistically significant because of the small number of female motor cyclists. Because of the limited data for females only males were analysed further.

Male fatality rates are generally higher for young motor cyclists but the variation with age differs between day and night times (see Figure 4).

Overall motor cycling is more risky at night than during the day. Fatality rates during the day are highest for young motor cyclists. Fatality rates during the night are highest for males aged 25 to 30 years.

Weekend fatality rates are 2.6 times those during the week. The fatality rate in Winter is about 40% of that in the other seasons.

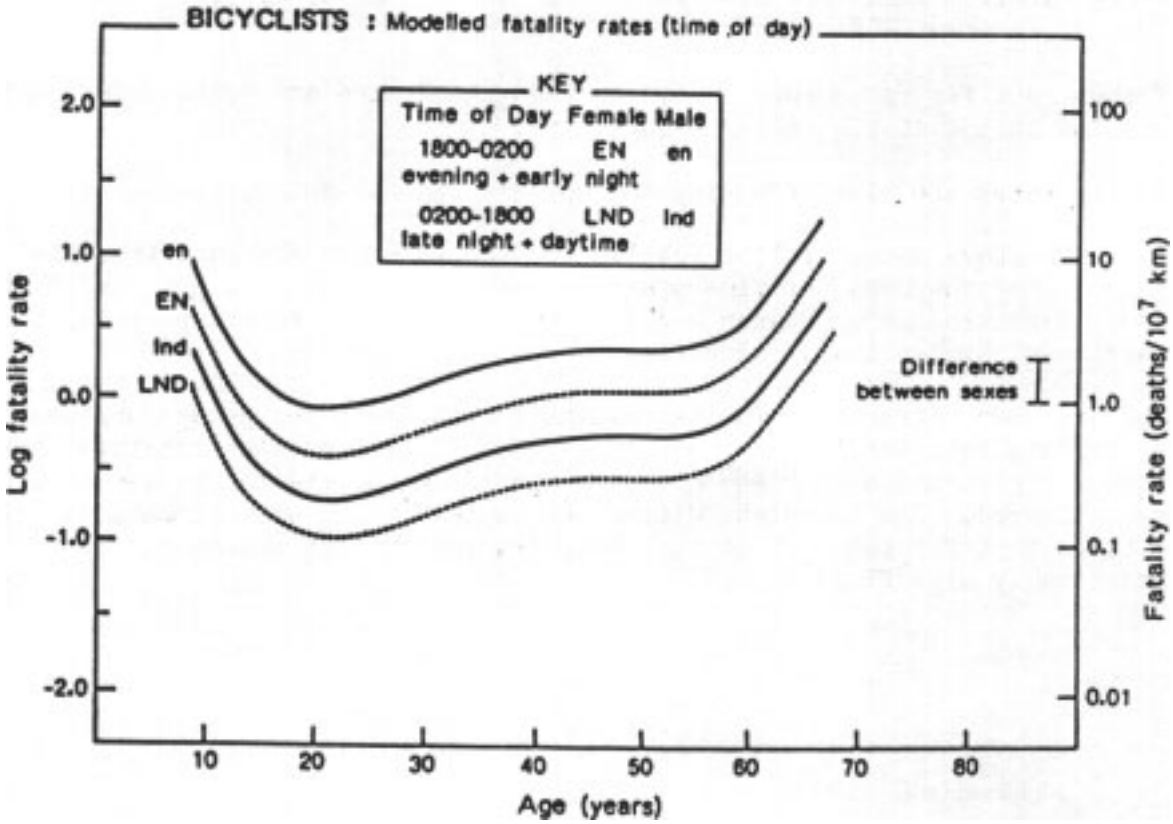
Although fatality rates vary 6-fold between the States and Territories, this variation is not statistically significant.

Fatality rates are similar during the holiday and non-holiday periods.

All of the above motor cyclist results for the rate per distance travelled also hold for the rate per time spent travelling and the rate per number of trips. Variation among States and Territories has a different pattern, but it is still not statistically significant.

There are some differences in the results for the rate per person per year. The fatality rate for females is only 5% that for males. The relative risks of the youngest and oldest age groups compared to the middle age groups are underestimated. The day-night difference is less. The weekend rate is only 1.4 times that for the rest of the week. Variation with season is not statistically significant.

Figure 5


BICYCLISTS : Modelled fatality rates (time of day)
KEY
Time of Day Female Male
1800-0200 EN en
evening + early night
0200-1800 LND lnd
late night + daytime
en
EN
lnd
LND
Difference between sexes
Log fatality rate
2.0
1.0
0.0
-1.0
-2.0
Fatality rate (deaths/10^7 km)
100
10
1.0
0.1
0.01
10
20
30
40
50
60
70
80
Age (years)

5. Bicyclists

The fatality rate per distance travelled is highest for the youngest (9 to 12 year olds) and the oldest (aged 65 and over) bicyclists (see Figure 5).

Females have a fatality rate about half that of males.

Cycling at night is 4 times as risky as during the day.

Fatality rates do not vary greatly with day of the week, season or State and Territory.

Average fatality rates are similar during holiday and non-holiday periods, although cyclists under 21 may be at increased risk during holidays.

All of the above bicyclist results for the rate per distance travelled hold for the rate per time spent travelling and the rate per number of trips, except that the sex difference is larger and the variation with age is less.

The results for the rate per person per year are generally similar except that: (1) the female rate is only 17% of the male rate, (2) variation with age is much less, and (3) the night time rate is 76% of the day time rate.

Figure 6

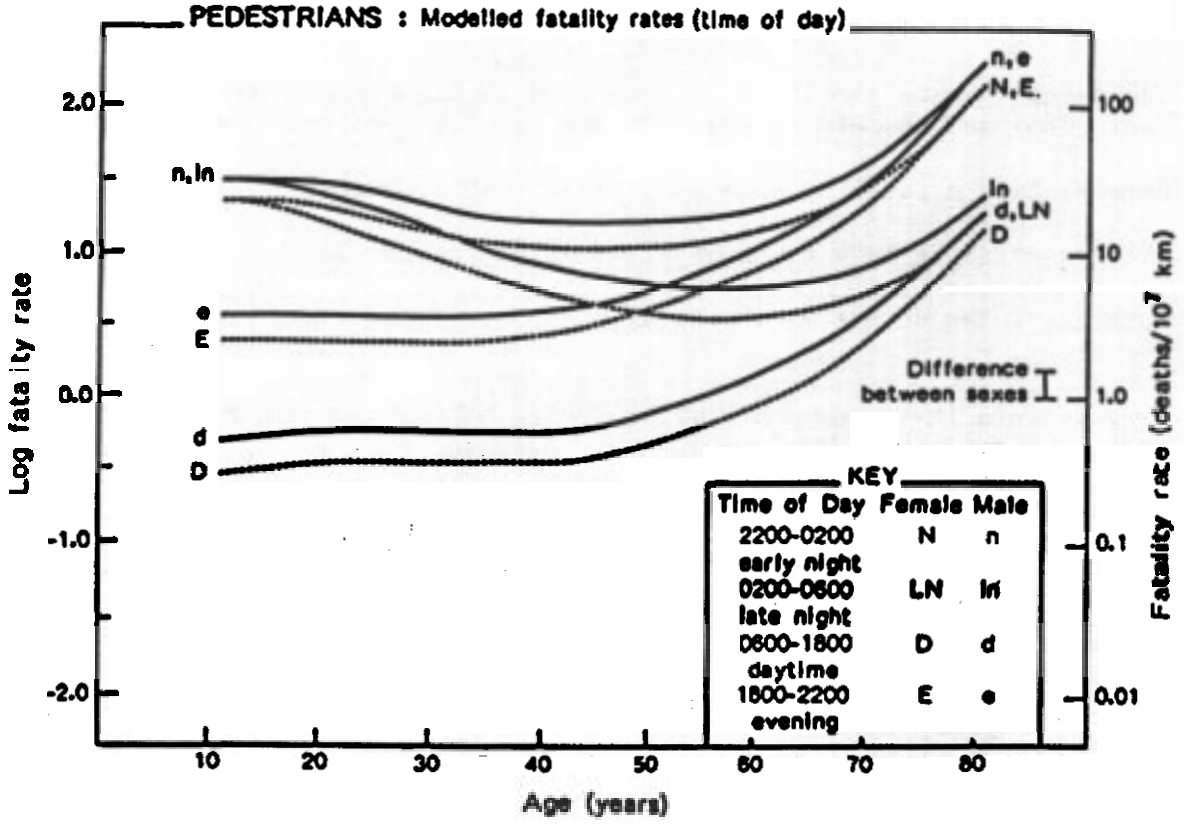
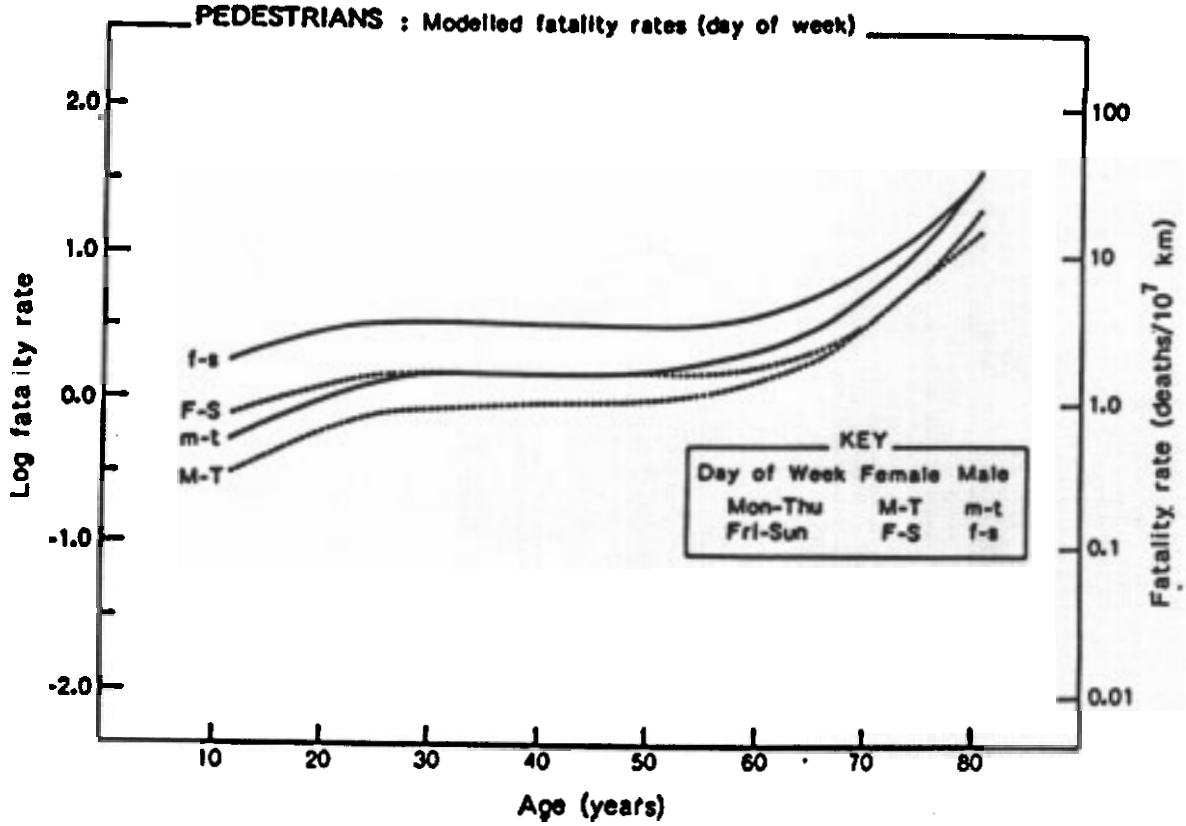


Figure 7



6. Pedestrians

The fatality rates of pedestrians are almost independent of age below age 50 but the fatality rate curve increases slightly between ages 50 and 65, and sharply thereafter.

Female pedestrians have a fatality rate about two-thirds that of male pedestrians (after controlling for time of day) but there is no difference between the sexes for children aged 9 to 15.

Overall, the fatality rate during late night is 30 times that during the day and 3.5 times that in the evening and early morning. However, the night-day difference in risk generally decreases with age with ratios being 60-fold for 15 year olds, 40 fold at age 30 and only 10-fold at age 75 (see Figure 6).

Overall, weekend fatality rates are 1.6-fold higher than during the week but the weekend-weekday differences are more pronounced for males than females and for younger than older persons (see Figure 7).

Fatality rates are slightly lower in Summer than in the other seasons.

Pedestrian fatality rates vary between the States and Territories. The highest rate is for the Northern Territory, followed by South Australia, the ACT, Western Australia, New South Wales, Tasmania, Victoria and Queensland.

Pedestrian fatality rates are similar during holiday and non-holiday periods.

The above pedestrian results for the rate per distance travelled also hold for the rate per time spent travelling and the rate per number of trips.

The results for the rate per person per year are generally similar except that: (1) late night and day time have similar rates, and (2) the difference between the weekend and the rest of the week is not as great and is not statistically significant.

7. Comparison of at-risk measures

The three exposure measures (distance travelled, travelling time and number of trips) give similar results in all analyses, but distance and time agree more closely than number of trips.

Population as the at-risk measure gives the same results as the exposure measures for only some analyses. **These are usually those for State/Territory,** holidays/non-holidays or season but usually not those for age, sex, time of day or day of week.

Population as the at-risk measure overestimates (underestimates) the relative risk for those groups or times for which the amount of travel is more (less) than average. **The variation in population based fatality rates is usually** less than for the exposure based rates.

For analyses which include interaction terms, the disparity in the patterns of variation between the measures of distance and population may be large.

8. Intermodal comparisons

Overall, fatality rates of car drivers and car passengers are similar. However, there is variation in the relative risk of passengers to drivers with age and sex. Variation with age can mostly be explained by passengers not always travelling with drivers of the same age as themselves. A comparison of driver and passenger risk is difficult because of unknown factors such as how the presence of passengers changes driver behaviour. The relative risk did not vary significantly with time of day, day of week, season or holiday versus non-holiday periods.

Overall, motor cyclists have a fatality rate per kilometre 19 times that of car drivers. This relative risk does not vary with sex, but decreases with age. The relative risk is lowest at night and highest during the middle of the day. It is also lower for Winter than for the other seasons. There is little variation with day of week, State and Territory or holiday versus non-holiday periods.

The overall relative risk of pedestrians compared with bicyclists is about 3 for distance travelled and 1.3 for time spent travelling. However, for both exposure measures the relative risk is much higher at night than during the day. There is little variation in relative risk with age, sex, day of week, season, State or Territory, or holiday versus non-holiday periods. Correction for the possible under-reporting of pedestrian trips would result in the fatality risk of the two modes being similar during the day, but pedestrians would still have a much higher risk at night.

There are a number of problems involved in comparing the fatality rates of two modes of travel. Firstly, such comparisons generally involve two distinct groups of people. Secondly, different modes of travel have different characteristics and purposes. Thirdly, the biases involved in the collection of at-risk data may differ between modes. Lastly, the relative risk will differ between fatality rates for distance travelled and fatality rates for time spent travelling, if the average speeds of the two modes being compared are not similar. The problems of using population (or number of trips) as the at-risk measure are compounded in analyses comparing two modes.

Even so, a comparison of all modes shows that car travellers generally have the lowest fatality risk of all modes, particularly at night. Motor cyclists have the highest risk of all modes during the day. For distance travelled, pedestrians have the highest risk of all modes at night. This result is less clear for time spent travelling.

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