ANALYSIS OF TRENDS IN
MOTORCYCLE CRASHES
IN VICTORIA

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Abstract
This study has analysed trends in motorcycle casualty crashes in Victoria for the period 1984-1993 in two stages.

Stage 1 examined the trends in Police-reported motorcycle crashes resulting in death or injury in Victoria during 1984-1993. It was found that the trend in motorcycle casualty crashes was different from that for all reported casualty crashes in Victoria since 1989, with the proportion of motorcycle crashes generally increasing since that year.

Stage 2 compared the Victorian trends found in Stage 1 with trends in motorcyclist casualties and casualty crashes obtained from other data sources and jurisdictions. This included a comparison of Victorian motorcyclist fatalities with those in Australia as a whole; a comparison of motorcycle casualty crash trends found in Stage 1 for Victoria with trends in Police-reported casualty crashes in New South Wales during 1984-93; an analysis of the trends in numbers of motorcyclists recorded as admitted to public hospitals in Victoria during the financial years 1987/88 to 1992/93 and a comparison of the numbers of and trends in seriously injured motorcyclists on Police reports with those admitted to Victorian public hospitals during the years 1987/88 to 1992/93.

The two stages of this study are bound together in this publication.

Key Words: (IRRD except when marked*)
Motorcycle, Motorcycle Rider, Pillion Passenger, Road Trauma, Crash, Injury, Fatality, Hospitalisation

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ANALYSIS OF TRENDS IN MOTORCYCLE CRASHES IN VICTORIA

STAGE 1

Analysis of Trends in Police-Reported Motorcycle Crashes in Victoria, 1984-1993

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Contents

1. INTRODUCTION ................................................................. 1

2. GENERAL TRENDS .................................................................. 3
   2.1 NUMBER OF POLICE-REPORTED FATAL CRASHES ................... 3
   2.2 NUMBER OF POLICE-REPORTED CASUALTY CRASHES ............... 4
   2.3 INJURY SEVERITY .......................................................... 5

3. CHARACTERISTICS OF MOTORCYCLE RIDERS AND PILLION
   PASSENGERS IN CRASHES .................................................. 7
   3.1 GENERAL CHARACTERISTICS ......................................... 7
      3.1.1 Sex of Motorcycle Riders and Pillion Passengers ............ 7
      3.1.2 Age of Motorcycle Riders and Pillion Passengers .......... 9
      3.1.3 Licence Type of Motorcycle Rider ............................... 10
   3.2 RIDER BEHAVIOUR ...................................................... 11
      3.2.1 Helmet Usage ..................................................... 11
      3.2.2 BAC Level of Motorcycle Riders ............................... 12

4. CRASH CHARACTERISTICS ................................................. 17
   4.1 SPEED ZONE .................................................................. 17
   4.2 SINGLE/MULTI VEHICLE CRASHES ................................... 18
   4.3 SPEED ZONE BY SINGLE/MULTI VEHICLE CRASHES ............. 20

5. CONCLUSION ...................................................................... 23

REFERENCES ....................................................................... 23

APPENDIX A. LOCATION OF CRASHES ..................................... 25
LIST OF FIGURES

Figure 2.1: Number of Police Reported Motorcycle and All FATAL Crashes (including motorcycle crashes) in Victoria, 1984-1993.................................3

Figure 2.2: Motorcycle Police-Reported FATAL Crashes - Total Numbers and as a Proportion of all Fatal Crashes in Victoria, 1984-1993.................4

Figure 2.3: Number of Police-Reported Motorcycle and All CASUALTY Crashes (including motorcycle crashes) in Victoria, 1984-1993 ......................4

Figure 2.4: Police-Reported Motorcycle CASUALTY Crashes - Total Numbers and as a Proportion of all CASUALTY Crashes in Victoria, 1984-1993.........5

Figure 2.5: Percentage of Police-Reported Motorcycle Rider and Pillion Passenger Casualties (excluding non-injured persons) in Victoria by SEVERITY, 1984-1993 .........................................................6

Figure 2.6: Percentage of Police-Reported Road Casualties (excluding non-injured persons) in Victoria by SEVERITY, 1984-1993 ..............................6

Figure 3.1: FEMALE Motorcycle Riders in Police-Reported CASUALTY Crashes (including non-injured riders) - Total Numbers, and as Proportion of All Victorian Motorcycle Rider Casualties of Known SEX, 1984-1993.............7

Figure 3.2: MALE Motorcycle Riders in Police-Reported CASUALTY Crashes (including non-injured riders) - Total Numbers, and as Proportion of All Victorian Motorcycle Rider Casualties of Known SEX, 1984-1993..............8

Figure 3.3: Pillion Passengers in Police-Reported Motorcycle CASUALTY Crashes (including non-injured passengers) by SEX in Victoria, 1984-1993........9

Figure 3.4: Motorcycle Riders and Pillion Passengers in Police-Reported Casualty Crashes (including non-injured persons) by AGE GROUP in Victoria, 1984-1993 .........................................................10

Figure 3.5: Motorcycle Riders in Police-Reported Casualty Crashes (including non-injured persons) by LICENCE TYPE in Victoria, 1984-1993 .............10

Figure 3.6: Motorcycle Riders and Pillion Passengers Killed or Injured in Police-Reported Crashes with NO HELMET WORN in Victoria - Total Numbers and as a Proportion of Motorcycle Casualties of KNOWN Helmet Status, 1984-1993 ...........................................................................11

Figure 3.7: Proportion of Victorian Motorcycle Riders and All Other Drivers Killed with UNKNOWN BAC, 1984-1993 ........................................13

Figure 3.8: Victorian Motorcycle Riders Killed with ILLEGAL BAC as a Proportion of those with Known BAC, 1984-1993 ........................................14

Figure 3.9: Victorian Drivers Killed (excluding motorcycle riders) with ILLEGAL BAC as a Proportion of those with Known BAC, 1984-1993 .............14

Figure 3.10: Proportion of Victorian Motorcycle Riders and All Other Drivers Seriously Injured with UNKNOWN BAC, 1984-1993 .............................15

Figure 3.11: Victorian Motorcycle Riders Seriously Injured with ILLEGAL BAC as a Proportion of those with Known BAC, 1984-1993 ......................16
STAGE 1: ANALYSIS OF TRENDS IN MOTORCYCLE CRASHES IN VICTORIA
1. INTRODUCTION

The total number of persons killed in road crashes in Victoria annually has declined dramatically over recent years. However, in the three year period from 1990 to 1992, the number of motorcyclists killed in crashes was constant at about 50 per year, and motorcycle fatalities were accounting for an increasing proportion of all road users killed, except in 1993. During 1987 and 1991, motorcycle riders and pillion passengers comprised 10% of road users killed in Victoria, but this increased to 14% in 1992 (Fabre et al., 1994).

These figures prompted this Motorcycle Research Project which involves analysing trends in motorcycle crashes over recent years and investigating why road safety measures have not been as successful in reducing motorcycle crashes as crashes of other road users. A review of countermeasures related to improving motorcycle safety will also be examined.

Stage 1 of this project includes an analysis of trends in Police-reported motorcycle crashes in Victoria over the period 1984 to 1993. Police-reported Victorian motorcycle crash data was obtained from the State Traffic Accident Record (STAR) database. This database generally deals with casualty crashes (i.e. any Police-reported crash in which at least one person sustained some level of injury) only. Hence exposure information has not been incorporated, so the results should be treated with caution.

Blood Alcohol Concentration (BAC) and Helmet Usage data from the STAR database have particular problems, with a high proportion of unknowns for both of these fields. The coding for Helmet Usage is of doubtful accuracy, as it is not known whether the helmet is dislodged from the motorcyclist’s head during the accident.

Stage 2 of this project will examine trends in motorcycle crashes reported in other data collections, to allow comparison with the trends observed in Stage 1. Comparison will be made with Australia-wide fatal motorcycle crashes, Police-reported motorcycle crashes in NSW, and hospital admissions of motorcyclists in Victoria.

The years of the study, 1984 to 1993, refer to calendar years, not financial years. However for the comparison between Police-reported motorcycle injuries and hospital admitted motorcycle injuries in Stage 2, the time period will be redefined in terms of financial years and hence direct comparison with this report may not be possible.
2. GENERAL TRENDS

The crash frequency trends for all Police-reported motorcycle casualty crashes as well as for Police-reported fatal motorcycle crashes in the ten year period, 1984 to 1993 were examined. As a comparison, the general trends for all Police-reported casualty crashes and all Police-reported fatal crashes were also analysed. The trends in the severity of the injury sustained by the motorcycle rider or pillion passenger were further examined.

2.1 NUMBER OF POLICE-REPORTED FATAL CRASHES

Police-reported motorcycle crashes and all Police-reported crashes involving at least one fatality for Victoria during 1984-1993 are depicted in figure 2.1. Generally the changes in fatal motorcycle crashes have followed the same overall trend as all fatal crashes during 1984-1993, with a decline occurring after 1989 in both motorcycle and all fatal crashes.

Figure 2.1: Number of Police-Reported Motorcycle and All FATAL Crashes (including motorcycle crashes) in Victoria, 1984-1993

Note: A motorcycle crash is defined as any Police-reported crash in which at least one motorcycle was involved.

Figure 2.2 displays fatal motorcycle crashes, as well as the proportion of fatal motorcycle crashes to all fatal crashes during 1984-1993.

The ratio of fatal motorcycle crashes to all fatal crashes steadily decreased during 1984-1988 then increased, peaking in 1992 and declined again in 1993. However, the upward trend that occurred in 1991/1992 was not statistically significant, as indicated by the 95% confidence limits plotted in figure 2.2. Hence the peak in 1992 was likely to have been due to chance.
2.2 NUMBER OF POLICE-REPORTED CASUALTY CRASHES

The patterns depicted in figures 2.3 and 2.4 include only Police-reported crashes in which at least one person sustained some type of injury. These crashes will be referred to as Police-reported casualty crashes.

Figure 2.3: Number of Police-Reported Motorcycle and All CASUALTY Crashes (including motorcycle crashes) in Victoria, 1984-1993
casualties were fatalities or serious injuries, whereas only between 30% and 35% of all casualties resulted in the same injury severity. For both motorcycle casualties and all casualties a marginal downward trend in injury severity occurred between 1984 and 1993. This may, however, have been the result of changes in reporting criteria for a serious injury or changes in practice regarding hospital admissions.

Figure 2.5: Percentage of Police-Reported Motorcycle Rider and Pillion Passenger Casualties (excluding non-injured persons) in Victoria by SEVERITY, 1984-1993

Figure 2.6: Percentage of Police-Reported Road Casualties (excluding non-injured persons) in Victoria by SEVERITY, 1984-1993
3. CHARACTERISTICS OF MOTORCYCLE RIDERS AND PILLION PASSENGERS IN CRASHES

3.1 GENERAL CHARACTERISTICS

The trends in motorcycle casualties for both riders and pillion passengers were analysed by sex, age and the type of licence held by the rider for 1984-1993. For this section, a motorcycle casualty refers to any person involved in a Police-reported crash whether they were injured or not. However, it should be noted that the crash must have included at least one injured person (not necessarily a motorcyclist).

3.1.1 Sex of Motorcycle Riders and Pillion Passengers

Figures 3.1 and 3.2 depict the trends in female and male motorcycle rider casualties respectively, between 1984-1993 in Victoria. Pillion-passenger casualties are not included in these charts.

Figure 3.1: FEMALE Motorcycle Riders in Police-Reported CASUALTY Crashes (including non-injured riders) - Total Numbers, and as Proportion of All Victorian Motorcycle Rider Casualties of Known SEX, 1984-1993
As expected, motorcycle riders in casualty crashes are predominantly male. However, the ten year trend indicates a slight increase in the female to male ratio. Referring to figure 3.1, the number of female motorcycle rider casualties was somewhat larger in 1989 than in the other years. However, the 95% confidence limits placed on the proportion of female motorcycle riders showed no significant difference between 1989 and the rest of the ten-year period. Thus the increase in the female to male ratio that appeared to occur after 1989 was not statistically significant, and was probably due to chance.

The trends in male and female pillion passenger casualties (including non-injured persons) for 1984-1993 are presented in figure 3.3.

The frequency of pillion passengers in casualty crashes in Victoria has decreased steadily for both male and female passengers throughout the ten year period. However the decline in male passengers is greater than for females - particularly in 1990-1991. After 1991 the number of female pillion passenger casualties exceeded that of males.
3.1.2 Age of Motorcycle Riders and Pillion Passengers

Figure 3.4 represents the trends in motorcycle rider and pillion-passenger casualties (including non-injured persons) in Victoria, 1984-1993 for the following age-groups:

- 1 year to 16 years
- 17 years to 20 years
- 21 years to 25 years
- 26 years to 37 years
- 38 years and above.

A consistent decline in motorcycle casualties occurred in the younger age-groups, 17 years to 20 years, and 21 years to 25 years (figure 3.4). However this decrease was not matched by riders and pillion passengers aged between 26 and 37 years. For this age group, motorcycle casualties steadily increased until 1989, then declined thereafter.

The frequency of young (aged 16 years and under) motorcycle casualties peaked in 1989, then declined steadily. By 1993 there were approximately four times fewer young motorcycle casualties than in 1989. However, casualties amongst motorcycle riders and pillion passengers aged 38 years and above steadily increased during 1984-1993. The decrease in the number of motorcycle casualties aged under 26 years during 1984-1993 may partly be due to new licensing procedures introduced in 1984/1985. However, other factors may also have contributed to the decline in the younger age-groups and in the slight increase in the oldest age-group. Identification and further investigation of these factors is thus warranted.
3.1.3 Licence Type of Motorcycle Rider

Age is one possible measure of riding experience of a motorcycle rider. The type of licence held by the motorcycle rider is an alternative measure. Figure 3.5 gives the motorcycle casualties by licence type, thus allowing for a comparison between the two measures to be made.
Probationary licence casualties decreased progressively between 1984 and 1989, and remained fairly constant thereafter. A marginal increase in motorcycle learner casualties occurred during the ten year period.

In 1984 the number of standard licence casualties was only slightly larger than probationary licences, but by 1993 this ratio had increased to approximately five. Changes in licensing rules - ages and rights for different licence types - as well as the duration in years of the probationary phase can explain these changes in accident numbers.

3.2 RIDER BEHAVIOUR

Motorcycle casualties during 1984-1993 were analysed by factors relating to rider behaviour. Helmet usage by riders and pillion passengers, and the BAC reading of a motorcycle rider involved in a crash were considered as possible behavioural factors.

Figure 3.6: Motorcycle Riders and Pillion Passengers Killed or Injured in Police-Reported Crashes with NO HELMET WORN in Victoria - Total Numbers and as a Proportion of Motorcycle Casualties of KNOWN Helmet Status, 1984-1993

3.2.1 Helmet Usage

The frequency of motorcycle riders and pillion passengers who were reported to not have worn a helmet in a crash in Victoria in 1984-1993 is given in figure 3.6. Non-helmet usage is also presented as a proportion of all motorcycle casualties with known helmet status. The helmet usage data may be questionable as it is not known whether the helmet is dislodged from the motorcyclist’s head during the accident. Further,
only 74% of the total motorcycle casualties during 1984-1993 had known helmet usage status. Therefore the non-helmet usage figures are likely to be unreliable. The relatively large widths of the 95% confidence limits depicted in figure 3.6 confirm this.

The trend in casualties for motorcycle riders and pillion passengers without helmet usage shows some improvement after an early rise. However, this improvement was not statistically significant due to the overlap of the 95% error bars in the ten-year period.

3.2.2 BAC Level of Motorcycle Riders

Only motorcycle riders and other drivers who were killed in Police-reported crashes were used for figures 3.7, 3.8 and 3.9, since a substantial proportion of the injured casualties had unknown BAC readings. Further, the practice of taking blood samples in hospitals to determine alcohol content changed in about 1989 (South, 1994). An industrial campaign by medical staff in hospital Emergency Departments in October 1989 disrupted the taking of samples, making comparisons with BAC readings from earlier years difficult. After 1991 hospitals agreed to adopt a Code of Practice to take blood samples from all drink-drivers whereas previously many hospitals took samples only from drivers that were suspected to have been drinking. However the degree to which this Code of Practice has been adhered to by hospitals is unknown, and not all hospitals adopted the Code of Practice. Because of these changes the proportion of hospitalised drivers and motorcycle riders not tested has increased since 1990. South (1994) gives the unknown BAC proportion since 1990 as 43%-52% compared with 20%-38% in the 1980's.

These changes made to the taking of blood samples would mainly have affected seriously injured riders and drivers after 1989, but less so those killed. Hence fatal and seriously injured motorcycle riders and other drivers were analysed separately.

Figure 3.7 depicts the proportion of killed motorcycle riders and other drivers with unknown BAC readings. After 1990 the proportion of Victorian drivers killed with unknown BAC shows a similar trend as the corresponding motorcycle proportion. However in 1990 the motorcycle unknown BAC rate dropped to almost a third of the 1988 proportion, whereas the corresponding proportion for other drivers alternately decreased then increased during 1988-1990.
The proportion of unknown BAC readings for drivers and motorcycle riders killed in road accidents for 1984-1991 agree with the figures presented in South’s (1994) report. However the unknown BAC rate in 1992 of 21% was larger than South’s unknown rate of 2%. Similarly in 1993, 16% of drivers and motorcycle riders killed had unknown BACs compared with South’s figure of 2%. This discrepancy is due to the preliminary nature of the 1992 and 1993 crash data files used for this report. South apparently used more recent files containing fewer unknown BAC values.

BAC readings for persons killed in road accidents in Victoria are taken by the Coroner’s Forensic Department. These BAC figures often take many months (typically 6 months) to be added to the STAR database. Because of this, BAC levels during 1992 and 1993 should be treated with caution. However, it should be noted that the percentage of killed drivers and motorcycle riders who were over 0.05g/100ml was found to be 23% during 1992 compared with 21% given in South’s report. The corresponding 1993 proportions were the same at 28%.

The proportions of motorcycle riders and other drivers killed with illegal* BAC readings in Victoria during 1984-93, are given in figures 3.8 and 3.9 respectively.

* An illegal BAC reading is defined as a BAC > 0.05g/100ml.
For both motorcycle riders and all other drivers, the highest proportion of fatalities occurred where the illegal BAC level was excessive (0.151g/100ml or above). After 1988 the proportion of all other drivers killed with illegal BAC readings steadily declined, with 1992 being an unusually low year (figure 3.9). However, for motorcycle riders the percentage of illegal BAC trends fluctuated somewhat randomly, declining after 1989 to below 30%. Similarly, the percentage with excessive illegal BAC readings declined during the same period, particularly in 1993.
Figure 3.10 depicts the proportions of seriously injured motorcycle riders and other drivers in Victoria with unknown BAC readings. Seriously injured Victorian drivers and motorcycle riders show similar trends in their unknown BAC level proportions. The unknown BAC rates decreased during 1984-1988, and then increased from 1989 to 1992 before levelling off.

Figure 3.10: Proportion of Victorian Motorcycle Riders and All Other Drivers Seriously Injured with UNKNOWN BAC, 1984-1993

The unknown BAC rates for seriously injured drivers and motorcycle riders throughout the ten year period exhibit different trends to the corresponding fatal unknown BAC rates reflected in figure 3.7. The seriously injured motorcycle riders showed a sharp increase in unknown BAC rates after 1989 (corresponding to the change in taking of blood samples). The proportions of unknown BACs for seriously injured drivers and motorcycle riders agree with those given by South (1994).

Figures 3.11 and 3.12 depict the proportion of seriously injured motorcycle riders and other drivers in Victoria with illegal BAC readings.

In general the motorcycle riders had lower, illegal BAC readings than other drivers. Victorian drivers exhibited excessive BAC readings of 0.151g/100ml or more in greater proportions than motorcycle riders in the ten year period. However, it should be noted that the apparent increase in illegal BAC levels after 1988 for motorcycle riders and other drivers may be due to the inconsistencies of the data set, as well as to the bias that would have resulted in blood samples being more frequently taken from intoxicated drivers rather than from sober drivers in hospitals after 1989.
Figure 3.11: Victorian Motorcycle Riders Seriously Injured with ILLEGAL BAC as a Proportion of those with Known BAC, 1984-1993

Figure 3.12: Victorian Drivers (excluding motorcycle riders) Seriously Injured with ILLEGAL BAC as a Proportion of those with Known BAC, 1984-1993
4. CRASH CHARACTERISTICS

Motorcycle crash trends in Victoria for 1984-1993 were analysed by the speed zone of the crash, as well as the number of vehicles involved in the crash. The speed zone is used as a proxy location variable, with lower speeds likely to reflect Victorian cities or towns, and high speeds open roads and highways. As before, a casualty crash refers to any Police-reported crash in which at least one person was injured.

4.1 SPEED ZONE

The trends presented in figures 4.1 and 4.2 reflect the overall trends of figure 2.3. However in the higher speed zones of 80km/h or greater, the frequency of motorcycle crashes show no reduction. The trend is consistent over the ten year period. Most of the decrease in motorcycle crashes has been among those occurring in low (75km/h or lower) speed zones.

Figure 4.1: Number of Police-Reported Motorcycle Casualty Crashes in Victoria by SPEED ZONE, 1984-1993

![Graph showing the number of motorcycle casualty crashes in Victoria by speed zone from 1984 to 1993.](image-url)
Figure 4.2: Number of Police-Reported Casualty Crashes (including Motorcycle crashes) in Victoria by SPEED ZONE, 1984-1993

NOTE: Analogous graphs to figures 4.1 and 4.2 are attached at the end of the document (Appendix A). These graphs give the number of motorcycle crashes and all crashes by location (ie: Metropolitan Melbourne and Rest of Victoria). These ‘location’ graphs are less informative than the speed zone graphs due to the wide range of speed limits that exist in both parts of Victoria, but may be used for comparison purposes with the hospital admissions data in which only the location of the victim’s residence is known. However these comparisons may be questionable because hospital ‘locations’ are based on residential address not the actual crash location.

4.2 SINGLE/MULTI VEHICLE CRASHES

A multi-vehicle crash is one in which two or more vehicles (including trams, trains, bicycles) were involved, whereas only one vehicle is involved in a single-vehicle crash.

The total number of casualty crashes given in figure 4.4 reflect the overall figures in figure 2.3. The motorcycle crash data (figure 4.3), however, show a definite decrease in multi-vehicle crashes throughout 1984-1989, compared with an increase in these crashes for all vehicles during the same period. After 1989 both groups show somewhat similar reductions. Thus it appears that some factor was operating on multi-vehicle motorcycle crashes which did not apply to all vehicle crashes during the period 1984 to 1989.

Single-vehicle motorcycle crashes peaked in 1988, and have decreased since then but not as steeply as the reductions in all crashes.
Figures 4.5 and 4.6 depict the trends in single-vehicle and multi-vehicle crashes in Victoria during 1984-1993. Note that the only vehicle involved in a single-vehicle motorcycle crash is a motorcycle. A marginal increase in the motorcycle proportion of single-vehicle crashes has occurred from 1989 onwards (figure 4.5). However, the motorcycle proportion of multi-vehicle crashes (figure 4.6) dropped steadily from 1984 to 1989, increased slightly during 1990-1991, before levelling off thereafter. The 1984 to 1988 increase was statistically significant as was the increase between the 1989 and 1990-1993 multi-vehicle motorcycle to all vehicle ratio.
4.3  SPEED ZONE BY SINGLE/MULTI VEHICLE CRASHES

Figure 4.7 represents the trends in Police-reported motorcycle casualty crashes that occurred in low speed zones (75km/h or lower) for single-vehicle and multi-vehicle crashes in Victoria, 1984-1993. The corresponding ‘all vehicle’ low speed, single/multi vehicle crashes are given in figure 4.8.
There has been a steady decrease in multi-vehicle motorcycle crashes (figure 4.7) in low speed zones, whilst single-vehicle motorcycle crashes follow the general crash trends of figure 4.3.

**Figure 4.7:** Police-Reported MOTORCYCLE Casualty Crashes in LOW SPEED Zones by SINGLE/MULTI Vehicle in Victoria, 1984-1993

![Graph showing the decrease in multi-vehicle motorcycle crashes in low speed zones from 1984 to 1993.](image)

**Figure 4.8:** Police-Reported Casualty Crashes (including Motorcycle Crashes) in LOW SPEED Zones by SINGLE/MULTI Vehicle for Victoria, 1984-1993

![Graph showing the trend in total crashes, including motorcycle crashes, in low speed zones from 1984 to 1993.](image)

In high speed zones (figure 4.9), the patterns for multi-vehicle motorcycle casualty crashes follow the general crash trends of figure 4.3. However, the single-vehicle high speed zone data appear to fluctuate randomly. Thus, the reduction that occurred in multi-vehicle motorcycle crashes, depicted in figure 4.3, was primarily due to a reduction in multi-vehicle motorcycle crashes that occurred in lower speed zones in Victoria. This progressive reduction in low speed, multi-vehicle motorcycle crashes
warrants further investigation. It should further be noted that there are more single-vehicle crashes in high speed zones than in low speed zones.

Figure 4.9: Police-Reported Motorcycle Casualty Crashes in HIGH SPEED Zones by SINGLE/MULTI Vehicle in Victoria, 1984-1993

For all Victorian casualty crashes in low speed zones (figure 4.8) the peak that occurred around 1988 is less obvious for single-vehicle crashes than multi-vehicle crashes. Single-vehicle and multi-vehicle crashes follow similar trends in high speed zones for Victorian casualty crashes, peaking in 1989 and then steadily decreasing (figure 4.10).

Figure 4.10: Police-Reported Casualty Crashes (including Motorcycle crashes) in HIGH SPEED Zones by SINGLE/MULTI Vehicle in Victoria, 1984-1993
5. CONCLUSION

Stage 1 of the Motorcycle Research Project aimed to analyse trends in Police-reported motorcycle crashes in Victoria during 1984-1993. The frequency of motorcycle casualty crashes declined regularly during 1987-1993, and a significant reduction in the ratio of motorcycle casualty crashes to all casualty crashes occurred between 1984 and 1989. However, a significant increase occurred between 1989 and 1993 in the motorcycle to all vehicle casualty crash ratio. The increase observed in fatal motorcycle crashes during 1991-1992 was not statistically significant.

The decrease in motorcycle casualty crashes over the ten year period was primarily for crashes that occurred in low speed zones. High speed zone crashes showed no such reduction. There has been a progressive decrease in multi-vehicle motorcycle crashes during 1984-1993, whereas only a marginal decrease occurred in single-vehicle motorcycle crashes from 1990 onwards. The reduction that occurred in multi-vehicle motorcycle crashes was primarily due to the crashes that occurred in low Victorian speed zones (75km/h or lower). The progressive reduction in multi-vehicle crashes involving motorcycles in lower speed zones warrants further investigation.

Motorcycle crashes were more severe than all crashes. Up to 50% of motorcycle casualties were fatal or severe injuries, compared with 35% for all crashes. Furthermore in Victoria, motorcycle riders killed or seriously injured were less likely to have excessive BAC readings above 0.15g/100ml than other drivers during 1984-1993. It should be noted however, that the proportion of seriously injured riders with unknown BAC readings increased substantially after 1989. This is likely to be due to the changes in 1989 in the practice of taking blood samples in hospitals to determine alcohol concentration.

Motorcycle rider casualties were predominantly male throughout the ten year period, whereas female pillion passenger casualties exceeded those of males after 1991.

A consistent decline in motorcycle casualties occurred for persons aged 25 years and below during 1984-1993, whereas those riders aged over 37 years showed a steady increase. The number of motorcycle casualties for under-age riders and pillion passengers also dropped after 1989. A sharp decrease in probationary licence holder casualties occurred by 1989 and remained constant thereafter, whereas unlicensed rider casualties declined steadily throughout the ten year period.

REFERENCES


APPENDIX A. LOCATION OF CRASHES

Figure A1: Number of Police-Reported Motorcycle Casualty Crashes in Victoria by LOCATION, 1984-1993

Figure A2: Number of Police-Reported Casualty Crashes (including Motorcycle crashes) in Victoria by LOCATION, 1984-1993

Note: 'Melbourne' refers to Local Government Areas with VicRoads codes <100.
'Rest of Victoria' refers to Local Government Areas with VicRoads codes ≥100.
ANALYSIS OF TRENDS IN MOTORCYCLE CRASHES IN VICTORIA

STAGE 2

Comparison of Police Reported Motorcycle Casualty Crashes in Victoria, 1984-93, with:

(a) Motorcyclist Fatalities in Australia

(b) Police Reported Motorcycle Casualty Crashes in New South Wales

(c) Hospital Admission Records for Motorcyclists in Victoria

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Contents

EXECUTIVE SUMMARY ...........................................................................................................v

1. BACKGROUND AND OVERVIEW .......................................................................................1

2. MOTORCYCLIST FATALITIES IN AUSTRALIA .....................................................................3
  2.1 INTRODUCTION ..................................................................................................................3
  2.2 MOTORCYCLE RIDER AND PILLION PASSENGER FATALITIES ....................................3
    2.2.1 Sex of Motorcyclist .........................................................................................................5
    2.2.2 Age of Motorcyclist .........................................................................................................6
  2.3 SUMMARY .............................................................................................................................7

3. TRENDS IN POLICE REPORTED MOTORCYCLE CASUALTY CRASHES IN NEW SOUTH WALES ..........................................................................................................................9
  3.1 INTRODUCTION ..................................................................................................................9
  3.2 GENERAL MOTORCYCLE TRENDS FOR VICTORIA AND NEW SOUTH WALES .........9
    3.2.1 Police-Reported Fatal Crashes .......................................................................................10
    3.2.2 Police-Reported Casualty Crashes ...............................................................................12
    3.2.3 Injury Severity ..............................................................................................................14
  3.3 CHARACTERISTICS OF MOTORCYCLE RIDERS AND PILLION PASSENGERS IN NEW SOUTH WALES AND VICTORIA ..............................................................15
    3.3.1 Sex of Motorcycle Riders and Pillion Passengers ......................................................15
    3.3.2 Age of Motorcycle Riders and Pillion Passengers .....................................................17
    3.3.3 Licence Type of Motorcycle Rider ..................................................................................19
    3.3.4 Helmet Usage ...............................................................................................................21
    3.3.5 BAC of Motorcycle Riders ............................................................................................22
  3.4 NEW SOUTH WALES AND VICTORIAN CASUALTY CRASH CHARACTERISTICS .......26
    3.4.1 Speed Zone ..................................................................................................................26
    3.4.2 Single/Multi Vehicle Casualty Crashes ..........................................................................27
    3.4.3 Speed Zone by Single/Multi Vehicle Casualty Crashes ..............................................29
  3.5 SUMMARY ..........................................................................................................................31

4. ANALYSIS OF TRENDS OF HOSPITAL ADMISSION RECORDS FOR MOTORCYCLISTS IN VICTORIA ..................................................................................................................33
  4.1 INTRODUCTION ..................................................................................................................33
  4.2 GENERAL TRENDS (VICTORIAN INPATIENT MINIMUM DATA SET) .........................34
    4.2.1 Number of Persons Hospitalised ..................................................................................34
    4.2.2 Motorcycle Riders and Pillion Passengers ..................................................................35
    4.2.3 On-Road Vs Off-Road ..................................................................................................37
  4.3 PERSON CHARACTERISTICS .............................................................................................38
    4.3.1 Sex .................................................................................................................................38
    4.3.2 Age .................................................................................................................................41
  4.4 INJURY SEVERITY .................................................................................................................42
4.4.1 Length of Hospitalisation ................................................................. 42
4.4.2 Nature of Injury and Body Part Injured ............................................. 44
4.5 CRASH CHARACTERISTICS .................................................................. 46
  4.5.1 Multi/Single Vehicle Injury Hospitalisations ................................. 46
4.6 LOCATION ............................................................................................ 49
  4.6.1 Residential Location ................................................................. 49
  4.6.2 Health Region ............................................................................. 49
4.7 SUMMARY ............................................................................................ 51

5. COMPARISON OF TRENDS IN INJURED MOTORCYCLISTS AS
RECORDED IN THE POLICE REPORTED VICROADS ACCIDENT
DATABASE AND THE HOSPITAL ADMISSION DATABASE IN
VICTORIA.................................................................................................. 53

5.1 INTRODUCTION ...................................................................................... 53
5.2 GENERAL TRENDS .............................................................................. 55
  5.2.1 Overall Frequency of Injuries ...................................................... 55
  5.2.2 Motorcycle Riders and Pillion Passengers ................................. 58
5.3 PERSON CHARACTERISTICS ............................................................... 59
  5.3.1 Sex ............................................................................................ 59
  5.3.2 Age .......................................................................................... 62
5.4 ACCIDENT CHARACTERISTICS .......................................................... 67
  5.4.1 Seriously Injured Motorcyclists in Multi/Single Vehicle Crashes ... 67
5.5 LOCATION ............................................................................................ 70
  5.5.1 Melbourne Vs Rest of Victoria .................................................... 70
5.6 DISCUSSION ........................................................................................ 71

6. CONCLUSIONS ....................................................................................... 75

7. RECOMMENDATIONS ........................................................................... 76

REFERENCES ............................................................................................ 77

APPENDIX. KILLED MOTORCYCLISTS BY BAC AND LICENCE TYPE
FOR VICTORIA AND NEW SOUTH WALES, 1984-1993 ......................... 79
ANALYSIS OF TRENDS IN MOTORCYCLE CRASHES
STAGE 2

EXECUTIVE SUMMARY

This is the second of two reports which examine trends in motorcycle crashes and injuries reported to the Police in Victoria. This report compares these trends with trends in motorcyclist fatalities throughout Australia, motorcycle crashes and injuries in New South Wales, and motorcyclist hospital admission records in Victoria. A comparison of numbers of seriously injured motorcyclists recorded in Police report files and in hospital admission records is also made in this report.

First Report

The first report examined trends in Police-reported motorcycle crashes resulting in death or injury in Victoria during 1984-93. It was found that the trend in motorcycle casualty crashes was different from that for all reported casualty crashes in Victoria since 1989, with the proportion of motorcycle crashes generally increasing since that year. The number of motorcycle casualty crashes in Victoria has decreased even since 1987, but at a slower rate than casualty crashes generally. Further details are given in the Stage 1 Report (Diamantopoulou, Dyte and Cameron 1995) which should be read as a companion document to this report.

Comparison with motorcyclist fatalities throughout Australia

Australia-wide, it was found that the number of motorcyclists killed during 1984-93 had decreased more rapidly than in Victoria. In New South Wales in particular, the proportion of fatal crashes involving motorcycles had been halved, compared with essentially no change in Victoria.

Comparison with motorcycle crashes and injuries in New South Wales

In Victoria, the decrease in motorcycle casualty crashes was primarily multi-vehicle crashes occurring in low speed zones of 75 km/h or lower, whereas in New South Wales, the decline in motorcycle casualty crashes was in both low and high speed zones, and in both single- and multi-vehicle crashes.

Reliable information on blood alcohol concentration (BAC) levels was available only for motorcycle riders who were killed. In New South Wales, the proportion of killed riders with excessive BAC readings (above 0.15 g/100ml) increased substantially during 1984-93, whereas in Victoria, the proportion was more than halved during 1989-93.

Both States were consistent in showing the greatest decreases in motorcyclist casualties among those aged under 26 years, whilst those aged over 37 years showed an increasing trend in deaths and injuries.
Trends in motorcyclist hospital admissions in Victoria

An alternative source of data on motorcyclist injuries in Victoria was public hospital admission records, available for 1987/88 to 1992/93. This data source confirmed that serious motorcyclist injuries did not reduce as rapidly as other road traffic injuries resulting in hospital admission during the period. The data also showed that for motorcyclists aged under 15 years, hospital admissions from off-road crashes were more numerous than those from crashes on-road. In other respects, the hospital admission records reflected the findings from Police reports, except that admissions eventuated from a greater proportion of single motorcycle crashes.

Comparison of data from Police reports and hospital admissions in Victoria

When the two sources of data on motorcyclist serious injuries in Victoria were compared, it was found that substantially fewer serious injuries were recorded in the database of Police crash reports held by VicRoads than were recorded as admitted to hospital. The reverse was true for serious road traffic injuries generally, probably emanating from the known practice whereby the VicRoads database records as "serious injury" many cases of injury which did not result in hospital admission. Thus providing the hospital coding of on-road/off-road motorcycle injuries is correct, the extent of under-reporting of motorcyclist hospital admissions in the database of Police crash records may be even greater than has been indicated.

Recommendations for further investigation

1. The principal area of improvement in motorcyclist trauma in Victoria during 1984-93 was from the reduction in multi-vehicle crashes in the low speed zones of 75 km/h or lower. Factors which may explain this improvement, in contrast with other crash types, should be investigated.

2. The creation of a linked file matching motorcyclists recorded on Police reports with records of motorcyclist hospital admissions would be valuable for research to understand the extent to which the admissions are reported to the Police, the extent of miscoding on the hospital database and to gain some understanding of the error in the injury severity levels recorded by both VicRoads and the Police.

3. For a fuller understanding of the injury recording practices used by the Police, a file linking motorcyclists recorded on Police reports would need to be linked with hospital admission records, Accident and Emergency Department (non-admission) records, and records of injury treatments by General Practitioners.
1. BACKGROUND AND OVERVIEW

This report presents the results of the second stage of a project to analyse trends in motorcycle casualty crashes in Victoria. The first stage of this project was focused on Police-reported motorcycle crashes resulting in death or injury in Victoria during the years 1984-93. Trends in the motorcycle crashes and motorcyclist casualties were compared with trends in all reported crashes and casualties to all road users in Victoria. The trends were examined separately for the different injury severity levels and by characteristics of the motorcyclists, their behaviours and the road environments in which they crashed. Further details are given in the Stage 1 Report (Diamantopoulou, Dyte and Cameron 1995) which should be read as a companion document to this report.

Stage 2 of the project was carried out in four components which are reported separately in the following chapters:

1. A comparison of trends in Victorian motorcyclist casualties with those in Australia as a whole. Readily available data covering all States and Territories only covered motorcyclist fatalities, so this chapter is confined to those casualties who were killed during the years 1984-93.

2. A comparison of trends in Police-reported motorcyclist casualties and casualty crashes in New South Wales with those in Victoria during the same period, 1984-93. Motorcyclist casualties in New South Wales represent a major proportion of national motorcyclist trauma, thus allowing the Victorian trends to be seen in a broader context.

3. Trends in numbers of motorcyclists recorded as admitted to public hospitals in Victoria during the financial years 1987/88 to 1992/93 (the only years for which reliable data was available at the time of analysis). This alternative data source covered a larger and more comprehensive set of motorcyclist casualties, albeit limited to hospital admissions, than the seriously injured motorcyclists recorded in Police crash reports.

4. A comparison of numbers of and trends in seriously injured motorcyclists on Police reports with those admitted to Victorian public hospitals during the years 1987/88 to 1992/93. This comparison allowed an examination of the reporting of serious motorcyclist trauma to the Police, and the reliability of the recording of injury severity from that source.

The final chapters of this report draw together the key conclusions from each of the above four components and make a number of recommendations for further research.
2. MOTOCYCLIST FATALITIES IN AUSTRALIA

2.1 INTRODUCTION

In Victoria a decline occurred in the number of fatal motorcycle crashes after 1989, decreasing to approximately 50 fatal crashes per year (see Stage 1 Report). However, during 1990-1992 the proportion of fatal motorcycle out of all fatal crashes steadily increased. Is this trend indicative of fatal motorcycle crashes across Australia or has the proportion of fatal motorcycle crashes in Victoria increased in recent years in comparison with Australia?

To answer the above question, the trends in motorcycle rider and pillion passenger fatalities for Australia and Victoria during 1984-1993 were examined using data published in FORS (1994). The FORS report did not present fatal motorcycle crash information, only the number of motorcyclist fatalities for 1980-1994 were given. Hence comparison of fatal motorcycle trends in Australia will have to be restricted to fatalities instead of fatal crashes.

In addition to the comparison of Australian and Victorian motorcyclists killed, trends in motorcycle rider and pillion passenger fatalities for Australia were examined by age and sex.

2.2 MOTORCYCLE RIDER AND PILLION PASSENGER FATALITIES

The number of motorcycle rider and pillion passengers killed during 1984-1993 in Victoria and Australia are displayed in figure 2.1. Motorcyclist fatalities in Victoria declined steadily between 1984-1993. The reduction in Victoria reflected the decrease that occurred in the number of motorcyclists killed across Australia for the same period. By 1993, the number of motorcyclists killed was almost half the fatality frequency of 1984 for both Victoria and Australia.

Although the number of Victorian motorcycle riders and pillion passengers killed declined during 1984-1993, there was an increase in the Victorian proportion of Australian motorcyclist fatalities between 1985-1992 (Figure 2.2). A statistically significant increase in the proportion occurred between 1985-1987 (approximately 18%) and 1992 (28%). After 1992 the Victorian proportion declined to 21%. Thus the number of motorcyclists killed across Australia must have decreased more rapidly than those killed in Victoria, especially in 1992. It should be noted that whilst the Victorian fatal proportion was increasing during 1985-1993, the New South Wales proportion of all motorcyclists killed decreased considerably from 41% in 1986 to 23% in 1993. This decrease would have contributed substantially to the Australian motorcyclist fatality reduction. Furthermore, in 1984 the number of motorcyclists killed in Australia, Victoria and New South Wales were 390, 80 and 153 respectively. By 1993 the corresponding frequencies had decreased to 203, 43 and 46 fatalities.
Figure 2.1: Number of Motorcycle Rider and Pillion Passenger Fatalities in VICTORIA and AUSTRALIA, 1984-1993

Figure 2.2: Number of Motorcycle Rider and Pillion Passenger Fatalities in VICTORIA and as a proportion of all AUSTRALIAN Motorcycle Rider and Pillion Passenger Fatalities, 1984-1993
2.2.1 Sex of Motorcyclist

The number of female motorcyclists killed in Australia generally decreased during the ten-year period, with the greatest fatality frequency occurring in 1987 at 25 fatalities and the least in 1992 at 11 (Figure 2.3). Similarly, male motorcyclist fatalities declined steadily during 1984-1993, although the male fatality frequency always outnumbered that of females.

Figure 2.3 also gives the female proportion of motorcycle rider and pillion passenger fatalities for Australia. A decrease occurred in the female proportion during 1984-1988 and increased thereafter. The proportion of female motorcyclists killed in Australia peaked in 1987 at almost 8% and was lowest the following year at 4%. However this drop was not statistically significant as depicted by the overlapping 95% confidence limits. Generally the relatively large widths of the confidence intervals show that the changes in the female ratio were not statistically significant during the ten-year period.

Figure 2.3: FEMALE Motorcycle Rider and Pillion Passenger Fatalities in AUSTRALIA - Total Numbers, and as Proportion of all Motorcyclist Fatalities, 1984-1993
2.2.2 Age of Motorcyclist

The 1984-1993 trends in the number of motorcycle riders and pillion passengers killed in Australia were analysed by the age of the motorcyclist. The motorcyclist’s age was grouped into the following categories:

- 16 years and under
- 17 years to 25 years
- 26 years to 39 years
- 40 years and above.

The trends in the motorcyclist’s age for Australia are displayed in Figure 2.4. The number of motorcyclists killed in the oldest age group of 40 years and above steadily increased during 1984-1993. By 1991 the number of motorcyclists killed had more than doubled the 1984 fatality frequency. All other age groups showed declines in the number of riders and passengers killed during the ten-year period. The greatest reductions occurred for the two youngest age groups, [0-16] years and [17-25] years. By 1993 the number of motorcyclists killed was approximately one third of the fatality frequency of 1984 for both the younger age-groups.

Figure 2.4: Number of Motorcycle Rider and Pillion Passenger Fatalities in AUSTRALIA by AGE (where known), 1984-1993
2.3 SUMMARY

During 1984-1993 the number of motorcycle riders and pillion passengers killed decreased progressively in Victoria and across Australia. By 1993 the number of motorcyclist fatalities was almost half the 1984 fatality frequency. However the number of motorcyclists killed in Australia decreased more rapidly than in Victoria because a significant increase in the Victorian proportion of Australian motorcyclists killed occurred during 1985-1992. The proportion of Australian motorcyclists killed in Victoria increased by 10% during this time.

Although there was a marginal increase in the female proportion of motorcyclists killed in Australia after 1988, the ratio of female to male motorcyclists killed remained relatively constant during the ten-year period. Changes in the age trends of killed motorcyclists did occur however. Generally the number of older (40 years and above) motorcyclists killed increased during 1984-1993. Younger motorcycle riders and pillion passengers showed the opposite trend. The number of motorcyclists killed who were under 26 years of age had decreased substantially by 1993 across Australia.
3. TRENDS IN POLICE REPORTED MOTORCYCLE CASUALTY CRASHES IN NEW SOUTH WALES

3.1 INTRODUCTION

This chapter of the Stage 2 Report will focus on the second component of the project by analysing and comparing Police-reported motorcycle casualty crashes in Victoria and New South Wales during 1984-1993.

Police-reported New South Wales motorcycle crash data was extracted from the NSW RTA Traffic Accident Information Database. The New South Wales data was extracted to be as comparable (with regard to injury severity, age, sex, BAC and licence type categories) to the Victorian data in the Stage 1 Report as possible. However, some unavoidable differences between the New South Wales and Victorian crash data should be noted.

While it is possible to obtain non-casualty crashes from the New South Wales database (this data was not extracted for this study), persons involved in a casualty crash only include those injured in the crash. Therefore, sex and age data excludes non-injured persons unlike the Victorian data in the Stage 1 Report. Licence type, however, is stored with the vehicle records, and so is available for injured and non-injured motorcycle riders, thus matching the Victorian data. The variable ACCMC (which indicates if a motorcycle was involved in a crash) is apparently incomplete, resulting in possible underestimation of motorcycle crash numbers. As licence data was matched using this variable, this variable will be incomplete also.

Injury severity in the New South Wales database records if a person involved in a crash was admitted to hospital instead of an assessment of serious injury. Since the Victorian data includes serious injuries that are not necessarily hospital admissions, the New South Wales numbers may tend to be lower for this injury severity category.

Difficulty in extracting the number of vehicles involved in a crash resulted in the single/multi-vehicle breakdown being performed on motorised vehicles only for New South Wales, hence a bicycle/motorcycle crash, for example, would be considered as a single-vehicle crash in this study, unlike in the Stage 1 Report.

3.2 GENERAL MOTORCYCLE TRENDS FOR VICTORIA AND NEW SOUTH WALES

The trends in Police-reported casualty and fatal motorcycle crashes for Victoria and New South Wales were examined and compared for the ten year period 1984-1993. Motorcycle crashes were analysed as frequencies and as proportions of all fatal or casualty crashes occurring in Victoria or New South Wales. The trends in the severity of the injury sustained by the motorcycle rider or pillion passenger were further compared for each state.
3.2.1 Police-Reported Fatal Crashes

The number of Police-reported fatal motorcycle crashes and all fatal crashes occurring in New South Wales during 1984-1993 are displayed in Figure 3.1. A rapid decline in the frequency of fatal motorcycle crashes occurred between 1986 and 1993, and by 1993 the motorcycle crash frequency had declined by approximately 70%. Furthermore, the motorcycle decrease reflects the decline occurring for all fatal crashes in New South Wales during the same time period. In comparison, fatal motorcycle crash trends in Victoria for 1984-1993 (Stage 1 Report) showed a less steep decline, with the crash frequency reducing by almost 40% in Victoria during the ten year period.

It should be noted that in 1984 the number of fatal motorcycle crashes in New South Wales (160 crashes) was relatively large compared with the Victorian frequency (74 crashes). However by 1993 the motorcycle fatal crash frequencies in both states were similar at 46 crashes for New South Wales and 43 crashes for Victoria.

Figure 3.1: Number of Police-Reported Motorcycle and All FATAL Crashes (including motorcycle crashes) in NSW, 1984-1993

Figures 3.2 and 3.3 depict the number of fatal motorcycle crashes, as well as the proportion of fatal motorcycle crashes to all fatal crashes during 1984-1993 for Victoria and New South Wales respectively. For Victoria the ratio of fatal motorcycle crashes to all fatal crashes progressively decreased between 1984-1989 and then increased after 1989, however this upward trend was not statistically significant. Furthermore there was no significant change in the motorcycle proportion of fatal crashes for 1984-1993.

Although the decline in fatal motorcycle crashes in New South Wales reflected the overall decline occurring for all fatal crashes, there was a significant decrease of 50% in the motorcycle proportion of all fatal crashes between 1984 and 1991-1993. This decrease contrasts with the non-significant trend for Victoria.
Figure 3.2: Motorcycle Police-Reported FATAL Crashes - Total Numbers and as a Proportion of all Fatal Crashes in VICTORIA, 1984-1993

Figure 3.3: Motorcycle Police-Reported FATAL Crashes - Total Numbers and as a Proportion of all Fatal Crashes in NSW, 1984-1993

STAGE 2: ANALYSIS OF TRENDS IN MOTORCYCLE CRASHES IN VICTORIA 11
3.2.2 Police-Reported Casualty Crashes

The trends presented in Figures 3.4, 3.5 and 3.6 include only Police-reported crashes in which at least one person sustained some level of injury. These crashes will be referred to as casualty crashes.

The number of motorcycle casualty crashes in New South Wales decreased steadily during 1984-1993 (Figure 3.4), peaking at 5643 crashes in 1984 and declining progressively thereafter to a low of 1915 in 1993. By 1993 the motorcycle crash frequency was two-thirds of what it was in 1984. The all casualty crash frequency remained relatively constant between 1984-1988, and then declined after 1988, although not as rapidly as the number of motorcycle crashes. A steady and statistically significant decrease occurred in the ratio of motorcycle to all casualty crashes during 1984-1993, with the ratio decreasing from 21% in 1984 to 10% in 1993 (Figure 3.6).

For Victoria, the number of motorcycle casualty crashes peaked in 1987 and displayed progressive reductions thereafter (Figure 3.5). Although a reduction of almost 20% occurred in the motorcycle casualty crash frequency between 1989 and 1993, there was a significant increase in the ratio of motorcycle casualty crashes to all casualty crashes as depicted by the non-overlapping 95% confidence limits in figure 3.5. Conversely, there was a marginal increase in the number of motorcycle casualty crashes between 1984 and 1989, but a statistically significant reduction in the motorcycle proportion of all casualty crashes. These variations in the ratio reflect the fact that motorcycle casualty crashes did not mirror the pattern of changes in total casualty crashes during the period.

Figure 3.4: Number of Police-Reported Motorcycle and All CASUALTY Crashes (including motorcycle crashes) in NSW, 1984-1993
Figure 3.5: Police-Reported Motorcycle CASUALTY Crashes - Total Numbers and as a Proportion of all CASUALTY Crashes in VICTORIA, 1984-1993

Figure 3.6: Police-Reported Motorcycle CASUALTY Crashes - Total Numbers and as a Proportion of all CASUALTY Crashes in NSW, 1984-1993
3.2.3 Injury Severity

The injury severity level for persons killed or injured in motorcycle casualty crashes and all casualty crashes for Victoria and New South Wales are given in Figures 3.7 and 3.8 respectively. For New South Wales, the middle grading of severity is an 'admitted injury' which has the injured person admitted to hospital. The corresponding severity level for the Victorian data is a 'serious injury' which includes hospital admissions as well as persons who were transported to hospital without necessarily requiring hospitalisation. For this reason the proportion of admitted injuries in New South Wales is likely to be smaller than the proportion of serious injuries in Victoria.

In Victoria, a marginal downward trend occurred in the percentage of motorcycle riders and pillion passengers killed or seriously injured during 1984-1993 (Figure 3.7). The proportion of motorcyclist fatalities decreased from 3% in 1984 to 2% in 1993, whilst the proportion of serious injuries peaked in 1987 at 48% and was lowest in 1992 at 39%.

The proportion of motorcycle riders and pillion passengers with admitted injuries remained relatively constant in New South Wales during 1984-1993, ranging from 29% in 1985 to 34% in 1991 (Figure 3.8). These proportions are generally smaller than the 'serious injury' proportions in Victoria because of the inclusion of non-hospitalised admissions amongst the Victorian serious injuries. The proportion of motorcyclist fatalities in New South Wales was similar to that of Victoria, although no trend was apparent.

Figure 3.7: Percentage of Police-Reported Motorcycle Rider and Pillion Passenger Casualties (excluding non-injured persons) in VICTORIA by SEVERITY, 1984-1993
3.3 CHARACTERISTICS OF MOTORCYCLE RIDERS AND PILLION PASSENGERS IN NEW SOUTH WALES AND VICTORIA

For Victoria and New South Wales, the trends in motorcyclist casualties were analysed by the motorcycle rider's and pillion passenger's sex, age and helmet usage, and by the rider's licence status and BAC reading. Helmet usage and BAC level were considered as possible factors relating to a rider's behaviour.

3.3.1 Sex of Motorcycle Riders and Pillion Passengers

To compare sex differences between motorcycle riders involved in casualty crashes in Victoria and New South Wales, the female motorcycle frequency and the female proportion of motorcycle riders were considered. Male motorcycle proportions can be considered as complements of the female figures.

The trends in female motorcycle rider casualties during 1984-1994 for Victoria and New South Wales are displayed in Figures 3.9 and 3.10 respectively. The New South Wales casualties exclude non-injured riders whereas the Victorian data used here does not. This is due to the New South Wales database only having a record of persons injured in a casualty crash unlike the Victorian database. The subset of injured motorcyclists in casualty accidents in Victoria was not accessed due to time constraints. Hence the number of motorcycle riders involved in casualty crashes in New South Wales are likely to be underestimates of the true frequency when
In Victoria, motorcycle riders involved in casualty crashes were predominantly male with proportions of at least 94% during 1984-1993 (Figure 3.9). Statistically there was no difference between the peak that occurred in the female proportion of motorcycle riders in 1989 and the proportion for the rest of the ten-year period. Thus the ratio of female to male riders did not change during 1984-1993 in Victoria.
For New South Wales, the number of female motorcycle riders in casualty crashes decreased steadily during 1984-1993, reflecting the general decline that occurred for all casualty crashes as in Figure 3.6. Similarly to Victoria, the proportion of male riders in casualty crashes was at least 94% during the ten-year period.

Figure 3.11 gives the trends for male and female pillion passengers involved in casualty crashes in New South Wales during 1984-1993. A steady decline occurred in the frequency of pillion passengers involved in casualty crashes for both sexes during the ten-year period. After 1990 there were generally more female than male pillion passengers in casualty crashes. This is similar to the pattern occurring for pillion passenger casualties in Victoria (see Stage 1 Report).

**Figure 3.11: Pillion Passengers in Police-Reported Motorcycle CASUALTY Crashes (excluding non-injured passengers) by SEX in NSW, 1984-1993**

3.3.2 Age of Motorcycle Riders and Pillion Passengers

The age of motorcycle riders and pillion passengers in Police-Reported casualty crashes for Victoria and New South Wales has been grouped into the following categories:

- 16 years and under
- 17 years to 20 years
- 21 years to 25 years
- 26 years to 37 years
- 38 years and above.
For Victoria in 1984, the greatest number of motorcycle casualties were for persons aged 21-25 years, but by 1993 the majority of casualties were for the older age-group, 26-37 years (Figure 3.12). Generally, a decline in the number of casualties occurred for younger motorcycle riders and pillion passengers aged under 26 years during 1984-1993. Conversely, riders and pillion passengers aged 26 years and over who were involved in casualty crashes, showed an increasing trend for the ten-year period. The greatest increase, approximately 60%, occurred for older motorcyclists, aged 38 years and above.
In 1984 for New South Wales, the largest number of motorcycle casualties were for young persons aged 17-20 years (Figure 3.13). By 1993 motorcyclists aged 26-37 years made up the majority of casualties as in Victoria. A rapid decline in the casualty frequency occurred for younger riders and passengers especially those aged 17-25 years during 1984-1993. This decreasing trend mirrored the overall motorcycle casualty crash decline depicted in Figure 3.4. Motorcyclists aged 38 years and over, however, showed a marginal increasing trend. Thus the decline in motorcycle casualties during 1984-1993 was mainly for riders and pillion passengers aged under 26 years.

3.3.3 Licence Type of Motorcycle Rider

For Victoria the motorcycle licence types were ‘learner’, ‘probationary’, ‘standard’ and ‘unlicensed’. New South Wales had the same licence categories, except that ‘probationary’ licences are known as ‘provisional’ licences.

Figure 3.14 shows the trends in licence type of motorcycle casualties during 1984-1993 for Victoria. The number of casualties for inexperienced riders, holding probationary licences, have decreased progressively between 1984-1989 and remained constant thereafter. Conversely motorcycle riders with standard licences had an increasing casualty frequency until 1989 which then declined. Moreover in 1984 there were 148 more standard licence casualties than probationary ones, but by 1993 the difference was almost five and a half times as large, with 820 more standard than probationary licence casualties. A marginal increase in the number of learner casualties occurred between 1984-1993.

The trends in motorcycle casualties by licence type differed for New South Wales (Figure 3.15). Unlike Victoria, provisional licence casualties marginally increased between 1984-1989 before declining thereafter. Learner casualties in New South Wales did not display the increase that occurred in Victoria during 1984-1993. The opposite trend occurred with learner casualties decreasing rapidly from 1,336 crashes in 1984 to 171 crashes in 1993. The number of casualties for motorcycle riders holding standard licences decreased steadily during the ten-year period as well.

It should be noted, however, the trends displayed in Figure 3.14 could be partially explained by the changes that have occurred during the past ten years in motorcycle licensing in Victoria, detailed in VicRoads (1991).

As a result of the Road Safety Act, enacted on 1 March 1987, the number of probationary licence holders has decreased since 1986. After 1 March 1987, all third year probationary riders became full licence holders and the consequences of most traffic offences were relaxed. Offences which would have led to licence cancellation, were reduced to licence suspension. Furthermore, the introduction of a dual licence system for car and motorcycle licence holders in 1986, meant that the probationary period of two years became licence dependent and not vehicle dependent. Thus a person with a full car licence could be issued with a full (but restricted) motorcycle licence on passing the probationary licence test.
The increase in casualty crashes for probationary riders in Victoria after 1990 could be explained by changes in the probationary period duration. In August 1990, the probationary period for motorcycle riders changed from two to three years hence increasing the time a rider held a probationary licence.

For New South Wales the licensing changes for motorcycle riders that happened in Victoria during 1984-1993 did not occur.

**Figure 3.14:** Motorcycle Riders in Police-Reported Casualty Crashes (including non-injured persons) by LICENCE TYPE in VICTORIA, 1984-1993

**Figure 3.15:** Motorcycle Riders in Police-Reported Casualty Crashes (including non-injured persons) by LICENCE TYPE in NSW, 1984-1993
3.3.4 Helmet Usage

The trends in the number of motorcycle riders and passengers killed or injured who were *not* wearing a helmet in a crash are given in Figures 3.16 and 3.17 for Victoria and New South Wales respectively. The non-helmet usage proportion of motorcyclists with known helmet status is also depicted in the charts.

**Figure 3.16**: Motorcycle Riders and Pillion Passengers Killed or Injured in Police-Reported Crashes coded as NOT WEARING HELMET in VICTORIA - Total Numbers and as a Proportion of Motorcycle Casualties of KNOWN Helmet Status, 1984-1993

**Figure 3.17**: Motorcycle Riders and Pillion Passengers Killed or Injured in Police-Reported Crashes coded as NOT WEARING HELMET in NSW - Total Numbers and as a Proportion of Motorcycle Casualties of KNOWN Helmet Status, 1984-1993
3.3.4 Helmet Usage

The trends in the number of motorcycle riders and passengers killed or injured who were not wearing a helmet in a crash are given in Figures 3.16 and 3.17 for Victoria and New South Wales respectively. The non-helmet usage proportion of motorcyclists with known helmet status is also depicted in the charts.

Figure 3.16: Motorcycle Riders and Pillion Passengers Killed or Injured in Police-Reported Crashes coded as NOT WEARING HELMET in VICTORIA - Total Numbers and as a Proportion of Motorcycle Casualties of KNOWN Helmet Status, 1984-1993

Figure 3.17: Motorcycle Riders and Pillion Passengers Killed or Injured in Police-Reported Crashes coded as NOT WEARING HELMET in NSW - Total Numbers and as a Proportion of Motorcycle Casualties of KNOWN Helmet Status, 1984-1993
In Victoria the number of injured motorcyclists not wearing a helmet increased between 1984-1988 before decreasing again to its original level by 1993. However the increase in the proportion of non-helmet wearers was not statistically significant.

In New South Wales an increase occurred in the non-helmet wearing proportion between 1984-1987. Unlike Victoria, the increase in the proportion from 4% to 7% was statistically significant. The increase, however, was short-lived - between 1988 and 1991-1993 there was a significant decline in the proportion of non-helmet wearing rates. By 1993, the non-helmet proportion of motorcycle riders and passengers with known helmet status had returned to its original level.

3.3.5 BAC of Motorcycle Riders

The proportion of motorcycle riders with Blood Alcohol Concentration (BAC) known to be above 0.01g/100ml has been analysed separately for killed riders and for those with serious or admitted injuries. The reason for analysing the killed riders separately is because there are fewer 'not knowns' among the killed riders and the severity of the injury is known for certain. Furthermore, the changes that occurred in the practice of taking blood samples to determine alcohol content in Victorian hospitals in 1989 would mainly have affected seriously injured riders and drivers, but less so those killed. The Stage 1 Report gives a more comprehensive discussion on the changes made to the taking of blood samples in Victoria.

Figure 3.18 depicts the proportion of killed motorcycle riders with unknown BAC readings in New South Wales during 1984-1993. The proportion of riders killed with unknown BAC peaked in 1989 at approximately 19%, and generally declined thereafter to a low of 2.4% in 1993.

The New South Wales' proportion is similar to South's (1994) unknown BAC figure of 2% for killed motorcycle riders in Victoria. Furthermore, using South's unknown BAC proportions for killed motorcyclists for 1992/1993, the trends in unknown BACs for New South Wales are generally similar to the Victorian trends during 1984-1993 (see Stage 1 Report). South's figures were used as a comparison rather than the Police accident data, because of the preliminary nature of the 1992 and 1993 BAC values in the Police accident database. South apparently used more recent data files containing fewer unknown BAC values than the Victorian crash data files used in this report.
In Victoria during 1984-1992 the greatest proportion of motorcycle riders killed with known BAC had excessive BAC readings of 0.151g/100ml and above, ranging from 15% in 1984 to 28% in 1989 (Figure 3.19). However in 1993 there were less riders killed with excessive BACs (>0.150g/100ml) than with high BACs in the range between 0.101g/100ml and 0.150g/100ml. In 1988 16% of riders killed had low positive BAC levels between 0.011g/100ml and 0.050g/100ml, however by 1992 there were no riders killed with BAC readings in this range. It should be noted, though, there were only 11 riders killed in 1992 with BAC>0.010g/100ml compared with 22 in 1988. Generally the proportion of motorcycle riders killed with BAC levels above 0.010g/100ml increased between 1984-1989 (peaking in 1987 at 48%) and then decreased to 35% by 1993.

Figure 3.20 gives the corresponding New South Wales trends to Figure 3.19 for riders killed with BAC levels above 0.010g/100ml. The proportion of motorcycle riders killed with excessive BAC readings (>0.150g/100ml) increased substantially between 1984 (10%) and 1993 (28%). This contrasts with the Victorian trends, where only 12% of riders had BACs of 0.151g/100ml and above in 1993. For New South Wales only 7% of killed motorcycle riders with known BAC levels in excess of 0.010g/100ml had readings below 0.151g/100ml in 1993.

The greatest proportion of motorcycle riders killed with low positive BAC levels (0.011g/100ml to 0.050g/100ml) occurred in 1987 in New South Wales at 13%, whereas in Victoria the peak occurred a year later in 1988. However as for Victoria, the smallest proportion of riders killed with low positive BACs occurred in 1992 at 2%, although only 19 riders with BAC >0.010g/100ml were killed in New South Wales in 1992 compared with 48 in 1987.
Overall the proportion of riders with BAC levels above 0.010g/100ml decreased between 1987-1989 from 47% to 32%, then marginally increased to 35% in 1993 in New South Wales.

**Figure 3.19:** VICTORIAN Motorcycle Riders Killed with BAC >0.010g/100ml as a Proportion of those with Known BAC, 1984-1993

**Figure 3.20:** NSW Motorcycle Riders Killed with BAC >0.010g/100ml as a Proportion of those with Known BAC, 1984-1993

* Number of motorcycle riders killed with BAC > 0.010g/100ml for a particular year.

** Number of motorcycle riders killed with known BAC for a particular year.

*** Number of motorcycle riders killed for a particular year.
The proportion of motorcycle riders admitted to hospital with unknown BAC in New South Wales during 1984-1993 is depicted in Figure 3.21. The unknown BAC proportion decreased considerably from 22% in 1984 to 4% in 1987, then gradually increased to 10% by 1993. This trend differs from the Victorian unknown BAC proportions for seriously injured riders which displayed a sharp increase after 1989 (Stage 1 Report).

Figure 3.21: Proportion of NSW Motorcycle Riders Admitted to Hospital with UNKNOWN BAC, 1984-1993

Figure 3.22: NSW Motorcycle Riders Admitted to Hospital with BAC > 0.010g/100ml as a Proportion of those with Known BAC, 1984-1993

* Number of motorcycle riders admitted to hospital with BAC > 0.010g/100ml for a particular year.
** Number of motorcycle riders admitted to hospital with known BAC for a particular year.
*** Number of motorcycle riders admitted to hospital for a particular year.
Of those motorcycle riders with known BAC who sustained a hospital admitted injury in New South Wales, the proportion of riders with BAC levels above 0.010g/100ml marginally increased between 1984-1988 to 24% and declined to 15% by 1993 (Figure 3.22). In contrast, in Victoria almost 30% of seriously injured motorcycle riders had BACs above 0.050g/100ml in 1993 - this, however, may be a consequence of the changes made to blood sampling laws in 1989 in Victoria (Stage 1 Report) and cannot be considered a reliable figure. For this reason, the Victorian distribution of BAC readings of seriously injured motorcyclists is not re-analysed here.

It should be noted that changes in the past ten years in BAC restrictions and motorcycle licensing within Victoria and New South Wales, could explain many of the trends shown in fatal crashes by BAC levels (Figures 3.19 and 3.20) and in casualty crash trends by licence type (Figures 3.14 and 3.15). For this reason, the proportion of motorcycle riders killed in Victoria and New South Wales are presented for each of the four licence types (learner, probationary/provisional, standard and unlicensed), by BAC level in the Appendix.

3.4 NEW SOUTH WALES AND VICTORIAN CASUALTY CRASH CHARACTERISTICS

This section investigates trends in Police-reported motorcycle casualty crashes by speed zone and by the number of vehicles involved in the crash. Two speed zones were used:

- low speed zone (75 km/h or lower) and
- high speed zone (80 km/h or higher).

It should be noted that speed zoning policies differ between the two states and so characteristics of locations with similar zoning may differ.

Casualty crashes are further categorised into crash type, in which a single-vehicle crash involves only one vehicle, whilst a multi-vehicle crash has more than one vehicle. However, New South Wales crashes involving a motorcycle and a bicycle are classed as single-vehicle crashes, since the NSW database extracted motorised vehicles only, thereby omitting bicycles from the count of the number of vehicles in the crash.

3.4.1 Speed Zone

In Victoria, most of the decrease that occurred in the motorcycle casualty crash frequency depicted in Figure 3.5 has been amongst casualty crashes occurring in low speed zones, with a decline occurring between 1987-1993 (Figure 3.23). The number of motorcycle casualty crashes in high speed zones remained relatively constant during the ten-year period.

In contrast, the decreasing trends that occurred in all motorcycle casualty crashes in New South Wales, occurred in both low and high speed zones (Figure 3.24). However there was a considerably steeper reduction in the motorcycle casualty crash frequency for low speed zones than for high speed zones.
However there was a considerably steeper reduction in the motorcycle casualty crash frequency for low speed zones than for high speed zones.

**Figure 3.23:** Number of Police-Reported Motorcycle Casualty Crashes in VICTORIA by SPEED ZONE, 1984-1993

![Graph showing motorcycle casualties by speed zone in Victoria](image)

**Figure 3.24:** Number of Police-Reported Motorcycle Casualty Crashes in NSW by SPEED ZONE, 1984-1993

![Graph showing motorcycle casualties by speed zone in NSW](image)

### 3.4.2 Single/Multi Vehicle Casualty Crashes

For Victoria a decrease in the number of multi-vehicle casualty crashes occurred between 1984-1989 (Figure 3.25), compared with an increase for all vehicle casualty crashes in the same period. Single-vehicle motorcycle casualty crashes did not show the decline that occurred in multi-vehicle motorcycle casualty crashes, instead an increase occurred between 1984-1988. After 1989 the single-vehicle motorcycle
casualty crash frequency lessened marginally in similar proportions to the multi-vehicle motorcycle casualty crash frequency.

Figure 3.25: Number of Police-Reported Motorcycle Casualty Crashes in VICTORIA by SINGLE/MULTI Vehicle, 1984-1993

In New South Wales, similar reductions of approximately 66% occurred for motorcycle single and multi-vehicle casualty crashes during 1984-1993 (Figure 3.26). These trends mirrored the overall motorcycle casualty crash frequency reduction displayed in Figure 3.4.

Figures 3.27 and 3.28 give the motorcycle proportion of all single-vehicle and all multi-vehicle casualty crashes respectively for New South Wales. The corresponding Victorian figures can be found in the Stage 1 Report.
A progressively significant reduction in the motorcycle proportion of all single-vehicle casualty crashes occurred between 1985-1989 in New South Wales, and declined moderately thereafter. By 1993 the ratio of motorcycle to all single vehicle casualty crashes had almost halved to 9%. Similarly, a significant decline in the motorcycle proportion of all multi-vehicle casualty crashes occurred between 1984 (21%) and 1990 (10%) as depicted by the non-overlapping 95% confidence limits in Figure 3.28. The ratio remained relatively constant thereafter.
3.4.3 Speed Zone by Single/Multi Vehicle Casualty Crashes

The decline that occurred in motorcycle casualty crashes during 1984-1993 in Victoria was primarily for multi-vehicle casualty crashes in low speed zones (Figure 3.29). For single-vehicle casualty crashes in low speed zones, a 51% increase resulted during 1984-1988, whereas an 11% decrease occurred for multi-vehicle casualty crashes during the same period. However, during 1988-1993, similar reductions occurred for both single and multi-vehicle casualty crashes (28% and 26% reductions for single and multi-vehicle crashes respectively).

Figure 3.29: Police-Reported MOTORCYCLE Casualty Crashes in LOW SPEED Zones by SINGLE/MULTI Vehicle in VICTORIA, 1984-1993

Figure 3.30: Police-Reported MOTORCYCLE Casualty Crashes in LOW SPEED Zones by SINGLE/MULTI MOTORISED Vehicle in NSW, 1984-1993
Figure 3.30 gives the number of motorcycle casualty crashes in low speed zones by single and multi-vehicle crash types in New South Wales. Both types of crashes, single and multi-vehicle, showed similar steady reductions during 1984-1993 in low speed zones.

3.5 SUMMARY

In New South Wales the number of fatal motorcycle crashes declined rapidly during 1984-1993 reflecting the decline that occurred for all fatal crashes. Furthermore a decrease of 50% (from 18% to 9%) occurred in the motorcycle proportion of fatal crashes between 1984 and 1991/1993, in contrast with no significant change in Victoria.

Although the number of motorcycle casualty crashes declined steadily in Victoria during 1989-1993 the decline was less than for total casualty crashes, hence there was a significant increase in the motorcycle proportion of all casualty crashes during this time. In New South Wales, however, the decline in the motorcycle casualty crash frequency was matched with a decrease in the motorcycle proportion from 21% in 1984 to 10% in 1993.

For Victoria, the decline in the number of motorcycle casualty crashes was primarily for multi-vehicle casualty crashes occurring in low speed zones of 75 km/h or lower. No decline was evident for high speed zones (80 km/h or higher) or for single-vehicle motorcycle casualty crashes. In New South Wales the progressive decline occurring for motorcycle casualty crashes was reflected in both low and high speed zones, and in both crash types - single and multi-vehicle. Factors that may have led to the multi-vehicle motorcycle casualty crash reduction in low speed zones for Victoria but not for New South Wales warrant further investigation.

A marginal downward trend occurred in the proportion of all injured motorcyclists who were killed or seriously injured in Victoria, whereas the corresponding proportion remained relatively constant in New South Wales. There were, however, fewer hospital-admitted injuries in New South Wales than there were serious injuries in Victoria, because persons classified by the Victoria Police as having sustained serious injuries may not necessarily be hospitalised.

Motorcycle riders killed with BAC readings of at least 0.151g/100ml increased substantially in New South Wales from 10% in 1984 to 28% in 1993. In contrast, for Victoria, a decline occurred between 1989-1993, with the proportion of killed riders having excessive BACs decreasing from a peak of 27% in 1989 to 12% in 1993. Furthermore the number of killed riders with unknown BAC rates was similar for both states. However the trends in the unknown BAC proportions for riders with serious or admitted injuries differed. In Victoria a sharp increase occurred after 1989, probably due to the changes made to the taking of blood samples in hospitals about this time. This trend did not occur in New South Wales - only a marginal increase occurred in the unknown BAC proportion for riders with admitted injuries after 1989.
Little change occurred in the proportion of female motorcycle riders in casualty crashes, but after 1990 female pillion passengers out-numbered males in both states. For casualty crashes in both New South Wales and Victoria, younger motorcyclists aged under 26 years, exhibited the greatest decrease during 1984-1993 whilst those aged over 37 years showed an increasing trend.

Although age trends were similar in both states the trends in the licence status of inexperienced motorcycle riders involved in casualty crashes differed. In New South Wales learner casualties decreased considerably (87%) but in Victoria they increased marginally during 1984-1993. However, provisional licence casualties marginally increased in New South Wales for 1984-1989 unlike in Victoria where a considerable decrease (74%) occurred.

The proportion of motorcyclists *not* wearing a helmet significantly declined in New South Wales after 1988 (from 7.2% to 3.4%) while the proportion in Victoria remained in the range 3%-4%.
4. ANALYSIS OF TRENDS OF HOSPITAL ADMISSION RECORDS FOR MOTORCYCLISTS IN VICTORIA

4.1 INTRODUCTION

Six years of data using the Victorian Inpatient Minimum Data set (VIMD) have been analysed to investigate the trends associated with motorcyclist injuries, and motorcyclist injuries in the context of all Motor Vehicle Traffic (MVT) injuries (note, traffic includes motorcyclist injuries). The Victorian Inpatient Minimum Data set is a database of all people admitted to public hospitals in Victoria. The subset of the database described here is injury based which means that the data relates to the number of people injured, rather than to the number of crashes recorded (as is the case with the VicRoads enhanced version of the State Traffic Accident Record (STAR) "police-reported" crash database). Although the police reported road accident database can be used for a variety of means (e.g., accident based, vehicle based, person based), the information is initially recorded on the basis of a crash occurring. Thus, the reporting police officer primarily collects information about the circumstances contributing to the crash event (e.g., hazardous road conditions, faulty traffic lights), with the person-based information providing secondary data about why the crash occurred (e.g., BAC level).

The data was extracted according to injury E-codes. E-codes (injury variable) are derived from the International Classification of Diseases - Version 9, and describe the cause of the injury. The database also contains N-codes (diagnosis variable) which provide information about the nature of the injury and body part injured.

Given that the data is collected to assist the Victorian Department of Health and Community Services with the provision of health care needs, the data is reported according to financial year. Although data is available for the financial year 1986/87, it was omitted for the purposes of this study due to a number of issues relating to the accuracy and completeness of data. Data was not yet available for 1993/94 at the time of the analyses. Furthermore, private hospital admissions data collected during 1992/93 was excluded from the analysis on the basis that it would inflate the figures for that year. Data relating to private hospitals is not available for any other year. According to Victorian hospital admissions data, on-and-off-road MVT injury admissions comprised only 1.1% of all injury admissions in private hospitals in 1992/93.

It should be noted that the words motorcycle and motorcyclist include both the motorcycle rider and pillion passenger. The latter two terms are used separately when referring exclusively to the motorcycle rider or pillion passenger.

An attempt was made to exclude deaths from the sample but this did not prove possible. It appears there have been changes in coding over the years which have resulted in errors in categorising deaths. Although fairly sure of the code for deaths for the financial years 1989/90 - 1992/93, it was not possible to locate the appropriate codes for 1987/88 - 1988/89. Rather than subtract the 47 cases assumed to be deaths...
(0.7% error), and apply a similar ratio to the previous years of data, it was decided to leave the data intact and not make any further assumptions. Hence, deaths occurring following hospital admission are included in the sample.

In reference to the section dealing with the nature of injuries, it should be noted that the number of injuries recorded exceeds the total number of people injured. Rather than simply relate to primary diagnosis, the data refers to up to five types of injury coded for each patient. Therefore, up to five injury codes can be found for any one motorcyclist injured.

Note, the following data refers only to traffic injuries, i.e., injuries sustained on-road (MVT). However, section 2.3 is included to highlight the overall difference between on -and -off-road crashes.

4.2 GENERAL TRENDS (VICTORIAN INPATIENT MINIMUM DATA SET)

4.2.1 Number of Persons Hospitalised

The number of persons hospitalised as a result of motor vehicle traffic (MVT) and motorcyclist injuries (including pillion passengers) has decreased steadily since 1987/88, before increasing again slightly during the 1992/1993 financial year (Figure 4.1). Few differences were found between the trends in numbers of people hospitalised as a result of MVT and motorcyclist injuries.

Figure 4.1: Persons hospitalised as a result of Motor Vehicle Traffic (MVT) and Motorcycle crashes (including pillion passengers) in Victoria, 1987/88 -1992/93
Motorcyclists hospitalised as a proportion of all MVT injury hospitalisations have increased steadily since 1988/89, peaking in 1991/92, before decreasing slightly in 1992/93 (Figure 4.2). Despite an overall decrease in the number of motorcyclists hospitalised in Victoria, the ratio of motorcyclist injury hospitalisations increased (from 15.3% in 1988/89 to 17.4% in 1992/93) as a proportion of all MVT injury hospitalisations. This suggests motorcyclist injury hospitalisations are not reducing as steadily as for other MVT injury hospitalisations.

**Figure 4.2:** Motorcyclists hospitalised (including pillion passengers) - Total numbers and as a percentage of all MVT hospitalisations in Victoria, 1987/88 - 1992/93

![Graph showing motorcyclists hospitalised and as a percentage of all MVT hospitalisations]

### 4.2.2 Motorcycle Riders and Pillion Passengers

Clearly, more Victorians were hospitalised as a result of crashes whilst riding a motorcycle (over 90%) as opposed to being a pillion passenger during the past six years (Figure 4.3). Although the number of motorcycle riders hospitalised has decreased since 1987/88, the number of pillion passengers hospitalised has remained fairly constant, before decreasing in 1991/92 and 1992/93.
Although the number of people hospitalised as pillion passengers varied over the years, peaking in 1988/89 and again in 1990/91, the trend depicted in Figure 4.4 has been inconsistent. Since 1990/91, the number of pillion passengers hospitalised in Victoria has decreased.

Similarly, pillion passenger injury hospitalisations as a proportion of all motorcyclist hospitalisations have decreased since 1990/91, falling to below 6% in 1992/93.
4.2.3 On-Road Vs Off-Road

Although the number of motorcyclist traffic hospitalisations has steadily decreased since 1987/88, motorcyclist non-traffic hospitalisations increased between 1988/89 and 1990/91, before decreasing slightly since 1990/91 (Figure 4.5).

The total number of off-road (n=2576) motorcyclist hospitalisations is less than half the number of on-road (n=6,320) hospitalisations.

Figure 4.5: Number of motorcyclists hospitalised as a result of Motorcyclist Traffic and Motorcyclist Non-Traffic injuries in Victoria, 1987/88 - 1992/93

Figure 4.6: Average number of Motorcyclist Traffic and Motorcyclist Non-Traffic injury hospitalisations per year in Victoria, 1987/88 - 1992/93
As shown in Figure 4.6, the average number of motorcyclist traffic hospitalisations per year far exceeded that of motorcyclist non-traffic hospitalisations from about the age of 15 years, peaking at age 20-24 years, before levelling out at around 55 years of age. Of importance was the finding that motorcycle non-traffic hospitalisations (n=744) were more predominant than motorcycle traffic hospitalisations (n=259) in the less than 15 year old age group across the six years. Almost triple the number of 10-14 year olds were admitted to hospital with off-road motorcycle injuries than on-road injuries. It should be noted that in a previous study by Haworth, Ozanne-Smith, Fox and Brumen (1994) it was found that 22% of under 21 year old on-road motorcycle riders hospitalisations were under the licensing age of 17 years and 9 months.

4.3 PERSON CHARACTERISTICS

For comparative purposes, the remainder of this report will refer only to on-road motorcycle injuries.

4.3.1 Sex

Clearly, males consistently comprised over 90% of all motorcyclists hospitalised in Victoria, with a slight increase in the proportion of females hospitalised since 1987/88 (Figure 4.7).

**Figure 4.7:** Motorcyclists hospitalised (including pillion passengers) in Victoria by Gender (proportional), 1987/88 - 1992/93

Males comprised approximately 95% of all motorcycle rider injury hospitalisations in Victoria across the six financial years of data. The percentage of female motorcycle riders hospitalised varied between 4.4% and 5.4% across the six years. No clear trends were evident in Figure 4.8.
Although males comprised the majority of pillion passenger injury hospitalisations in Victoria until 1990/91 (average 59.3%), as seen in Figure 4.9, this trend reversed in 1991/92 - 1992/93 with females comprising the majority of pillion passengers hospitalised (average 56.4%). However, it is not known whether this indicates an increase in the number of female pillion passengers in Victoria, as the relative rates of riding and being a passenger are unknown.

Although the overall proportion of motorcycle riders hospitalised who were male remained constant at approximately 95% (Figure 4.10), the proportion of pillion passengers hospitalised who were male decreased dramatically since 1991/92.
(approximately 17%). Proportionally, male motorcycle riders were hospitalised almost twice as often as pillion passengers in Victoria.

**Figure 4.10:** Male Motorcycle Riders and Pillion Passengers hospitalised in Victoria, 1987/88 - 1992/93

This trend is reversed for females (Figure 4.11) in that the proportion of females hospitalised as a result of motorcycle rider related injuries remained fairly constant at approximately 5%, while the proportion of female pillion passenger hospitalisations increased somewhat from approximately 40% to 57% in 1991/92. Given that the overall number of female pillion passenger hospitalisations has continued to decrease (Figure 4.4), the increase in proportion of female pillion passenger hospitalisations
appears to be a function of female pillion passengers hospitalisations not decreasing at the same rate as male pillion passenger hospitalisations.

4.3.2 Age

Although 15-19 year olds were the predominant age group hospitalised in 1988/89, this trend shifted during 1989/90, with people aged 20-24 years becoming the predominant age group hospitalised (Figure 4.12). Although the 15-19 year old age group had generally decreased in frequency over the years, the 20-24 year age group decreased up to 1990/91, before increasing slightly.

Although not shown, the younger age group (0-14 years) was predominantly made up of people aged 10-14 years (74%), followed by the 5-9 year olds (19%), and the 0-4 year age group (7%).

Of interest is the finding that the 35-39 age group has not decreased to any extent over the period, while the 40+ age group has steadily increased in frequency over the years, perhaps indicating that motorcycle users are an ageing population, or that more people in these age groups are choosing to use this means of transport.

**Figure 4.12**: Victorian Motorcyclist injury hospitalisations (including pillion passengers) by Age, 1987/88 - 1992/93
4.4 INJURY SEVERITY

4.4.1 Length of Hospitalisation

As an indicator of injury severity, Figure 4.13 suggests that approximately half of all hospitalised motorcyclists stayed in hospital for at least 5-7 days hospitalisation. There was a slight shift in frequency since 1989/90 whereby the length of hospitalisation progressively decreased. This was followed by an increase in same day admissions in 1992/93. Whether this indicates a decrease in injury severity, or a shift in hospital management of patients due to the introduction of case-mix funding in Victoria is not clear.

Also, since there was an increase in the number of motorcyclists killed on-road between 1992 and 1993, this may partially explain the decrease in length of stay in hospital (i.e., increase in the number of people dying soon after admission to hospital).

Little difference was found between the length of hospitalisation for motorcycle riders and pillion passengers. Length of hospitalisation peaked for both motorcycle riders and pillion passengers at between 1-2 days of hospitalisation. The finding that approximately one quarter of all hospitalised motorcyclists stayed in hospital for between 8-20 days, and a further 10% more than 21 days, provides a useful indicator of injury severity.

Figure 4.13: Victorian Motorcyclist injury hospitalisations (including pillion passengers) by Length of Hospitalisation, 1987/88 - 1992/93

As shown in Figure 4.14, approximately half of all motorcycle riders required at least 5-7 days of hospitalisation. This percentage decreased slightly since 1991/92, with fewer patients requiring 8-20 days of hospitalisation, and a greater proportion requiring either 5-7 days or same day admissions. Although this suggests a shift in length of hospitalisation towards fewer days admission, it is not known whether this
reflects a decrease in injury severity or a change in patient management procedures, i.e., the lead up to case-mix funding in Victoria.

Figure 4.14: Motorcycle Riders hospitalised in Victoria by Length of Hospitalisation, 1987/88 - 1992/93

Figure 4.15: Pillion Passengers hospitalised in Victoria by Length of Hospitalisation, 1987/88 - 1992/93

The data relating to pillion passenger injuries during the six years of hospital admission data available is variable (Figure 4.15). No trends were evident although length of hospitalisation appeared to peak in 1988/89 and 1991/92 at approximately 60% for stays greater than 4 days.
4.4.2 Nature of Injury and Body Part Injured

Table 4.1 highlights the types of injury hospitalisations resulting from motorcycle accidents in Victoria by financial year. Both the number of motorcyclists hospitalised and the number of injuries recorded have decreased steadily since 1987/88, but increased slightly in 1992/93.

Fractures accounted for over half of the injuries recorded, with fractures to the lower and upper limbs making up a total of 78% of all fractures over the past six years. Although less frequent, fractures to the skull and face are of concern given the implications for compulsory helmet wearing in Victoria.

Similarly, the high number of intracranial injuries is important (second to fractures) and reflects a high level of injury severity. Although lower in frequency to fractures, head injuries account for 10.8% of all injuries sustained (8% intracranial injury, 2.8% fractured skull), and are particularly costly for the patient and health care system.

Following fractures to the lower limbs, upper limbs, and neck/trunk, hospitalisation due to head injury is the fourth largest class of injuries sustained by motorcyclists (Figure 4.16). Although the number of lower and upper limb fractures has decreased steadily over the years, the number of head injuries decreased until 1989/90, reached a plateau and increased slightly in 1992/93, as a result of increased number of skull fractures being recorded.

The frequency of nerve/spinal cord damage remained constant, yet there was a slight increase in the frequency of internal injuries.

Figure 4.16: Number of specific injuries among Motorcyclists hospitalised (including pillion passengers) in Victoria, 1987/88 - 1992/93
<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Fractures (total)</td>
<td>1,385 55.6</td>
<td>1,247 55.6</td>
<td>1,183 55.9</td>
<td>1,034 53.1</td>
<td>997 52.1</td>
<td>999 50.8</td>
<td>6,845 54.0</td>
<td>8.0</td>
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<td>Fractured Skull</td>
<td>40 2.9</td>
<td>33 2.6</td>
<td>28 2.4</td>
<td>27 2.6</td>
<td>28 2.8</td>
<td>39 3.9</td>
<td>195 2.8</td>
<td>4.9</td>
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<td>Fractured Face</td>
<td>69 5.0</td>
<td>63 5.1</td>
<td>50 4.2</td>
<td>57 5.5</td>
<td>41 4.1</td>
<td>55 5.5</td>
<td>335 4.9</td>
<td>2.0</td>
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<td>Fractured Neck/Trunk</td>
<td>174 12.6</td>
<td>203 16.3</td>
<td>158 13.4</td>
<td>152 14.7</td>
<td>149 14.9</td>
<td>159 15.9</td>
<td>995 14.5</td>
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<td>Fractured Upper Limb</td>
<td>473 34.2</td>
<td>382 30.6</td>
<td>403 34.1</td>
<td>342 33.1</td>
<td>341 34.2</td>
<td>299 29.9</td>
<td>2,240 32.7</td>
<td>44.9</td>
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<td>Fractured Lower Limb</td>
<td>628 45.3</td>
<td>565 45.3</td>
<td>542 45.8</td>
<td>455 44.0</td>
<td>438 43.9</td>
<td>447 44.7</td>
<td>3,075 44.9</td>
<td>8.0</td>
</tr>
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<td>Intracranial Injury</td>
<td>206 8.3</td>
<td>172 7.7</td>
<td>159 7.5</td>
<td>161 8.3</td>
<td>156 8.2</td>
<td>155 7.9</td>
<td>1,009 8.0</td>
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<tr>
<td>Open Lower Limb Wound</td>
<td>140 5.6</td>
<td>161 7.2</td>
<td>126 6.0</td>
<td>144 7.4</td>
<td>144 7.5</td>
<td>132 6.7</td>
<td>847 6.7</td>
<td>4.4</td>
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<td>Open Head/Neck/Trunk Wound</td>
<td>110 4.4</td>
<td>110 4.9</td>
<td>77 3.6</td>
<td>74 3.8</td>
<td>107 5.6</td>
<td>85 4.3</td>
<td>563 4.4</td>
<td>2.7</td>
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<td>Open Upper Limb Wound</td>
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<td>53 2.4</td>
<td>56 2.6</td>
<td>54 2.8</td>
<td>55 2.9</td>
<td>60 3.1</td>
<td>342 2.7</td>
<td>4.8</td>
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<td>Internal Injury</td>
<td>124 5.0</td>
<td>107 4.8</td>
<td>97 4.6</td>
<td>78 4.0</td>
<td>97 5.1</td>
<td>107 5.4</td>
<td>610 4.8</td>
<td>3.9</td>
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<tr>
<td>Dislocations</td>
<td>114 4.6</td>
<td>89 4.0</td>
<td>111 5.2</td>
<td>70 3.6</td>
<td>80 4.2</td>
<td>77 3.9</td>
<td>541 4.3</td>
<td>5.0</td>
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<td>Superficial Injuries</td>
<td>97 3.9</td>
<td>74 3.3</td>
<td>83 3.9</td>
<td>103 5.3</td>
<td>60 3.1</td>
<td>92 4.7</td>
<td>509 4.0</td>
<td>6.7</td>
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<td>Contusions</td>
<td>79 3.2</td>
<td>71 3.2</td>
<td>83 3.9</td>
<td>79 4.1</td>
<td>69 3.6</td>
<td>80 4.1</td>
<td>461 3.6</td>
<td>7.2</td>
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<td>Sprains/Strains</td>
<td>52 2.1</td>
<td>68 3.0</td>
<td>68 3.2</td>
<td>66 3.4</td>
<td>57 3.0</td>
<td>67 3.4</td>
<td>378 3.0</td>
<td>1.1</td>
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<td>Nerve/Spinal Cord Injuries</td>
<td>21 0.8</td>
<td>16 0.7</td>
<td>21 1.0</td>
<td>19 1.0</td>
<td>14 0.7</td>
<td>22 1.1</td>
<td>113 0.9</td>
<td>0.6</td>
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<tr>
<td>Injuries to Blood Vessels</td>
<td>10 0.4</td>
<td>13 0.6</td>
<td>7 0.3</td>
<td>9 0.5</td>
<td>13 0.7</td>
<td>13 0.7</td>
<td>65 0.5</td>
<td>0.2</td>
</tr>
<tr>
<td>Burns</td>
<td>23 0.9</td>
<td>6 0.3</td>
<td>5 0.2</td>
<td>9 0.5</td>
<td>3 0.2</td>
<td>11 0.6</td>
<td>57 0.4</td>
<td>2.3</td>
</tr>
<tr>
<td>Crushing Injuries</td>
<td>3 0.1</td>
<td>5 0.2</td>
<td>3 0.1</td>
<td>3 0.2</td>
<td>8 0.4</td>
<td>2 0.1</td>
<td>24 0.2</td>
<td>0.1</td>
</tr>
<tr>
<td>Traumatic Complications, unspecified</td>
<td>50 2.0</td>
<td>49 2.2</td>
<td>36 1.7</td>
<td>42 2.2</td>
<td>50 2.6</td>
<td>61 3.1</td>
<td>288 3.3</td>
<td>4.4</td>
</tr>
<tr>
<td>Late Effects</td>
<td>15 0.6</td>
<td>0 0.0</td>
<td>1 0.0</td>
<td>3 0.2</td>
<td>2 0.1</td>
<td>2 0.1</td>
<td>23 0.2</td>
<td>0.2</td>
</tr>
<tr>
<td>Total No. of Injuries</td>
<td>2,493</td>
<td>2,241</td>
<td>2,116</td>
<td>1,948</td>
<td>1,912</td>
<td>1,965</td>
<td>12,675</td>
<td>1.1</td>
</tr>
<tr>
<td>Total No. Motorcyclists Injured</td>
<td>1,192 100%</td>
<td>1,147 100%</td>
<td>1,046 100%</td>
<td>991 100%</td>
<td>930 100%</td>
<td>944 100%</td>
<td>6,255 100%</td>
<td></td>
</tr>
</tbody>
</table>
With respect to fractures only, fractures to the lower limbs (average 44.9%), and fractures to the upper limbs (average 32.7%) to a lesser extent, have remained the most frequent type of fracture sustained by motorcyclists over the past six years.

No obvious trends are apparent other than a general downward trend in lower and upper limb fractures over the last few years, and a rise in skull fractures in 1992/93 (Figure 4.17).

Figure 4.17: Number of Motorcyclist fractures in Victoria by Body Part injured, 1987/88 - 1992/93

4.5 CRASH CHARACTERISTICS

4.5.1 Multi/Single Vehicle Injury Hospitalisations

Multi Vehicle Injury Hospitalisations are roughly defined as injuries incurred by motorcyclists as a result of a collision with another vehicle. Single Vehicle Injury Hospitalisations are defined as injuries not incurred in a collision with another vehicle, e.g., loss of control of vehicle, hitting a pedestrian.

The majority of people hospitalised following a MVT accident were injured in a single vehicle crash (average 60.4%). Single and multi vehicle crashes in Victoria have steadily decreased in frequency since 1988/89, before rising again in 1992/93. The magnitude of this trend is similar for both single and multi vehicle injury hospitalisations (Figure 4.18). The Southern Metropolitan Region includes the following Statistical Local Areas; South Melbourne, St Kilda, Oakleigh, Dandenong, Chelsea and Hastings (A.B.S.: 1991 Census).

For motorcyclist hospitalisations, more people have been injured in single vehicle crashes than multi vehicle MVT crashes in Victoria during the past six years.
However, the frequency of single vehicle injuries plateaued in 1989/90, whereas the multi vehicle frequency continued to decrease in magnitude until 1991/92, before rising somewhat in 1992/93.

**Figure 4.18: Number of Motor Vehicle Traffic (MVT) and Motorcyclist injury hospitalisations in Victoria by Single/Multi Vehicle, 1987/88 - 1992/93**

![Motor Vehicle Traffic Hospitalisations](image)

![Motorcyclist Hospitalisations](image)

The frequency of single vehicle motorcyclist injury hospitalisations has decreased steadily since 1987/88, yet single vehicle hospitalisations as a percentage of all single vehicle MVT injury hospitalisations increased until 1991/92 (Figure 4.19). Though small in magnitude, this suggests that while single vehicle motorcyclist injuries have decreased in frequency overall, they have not decreased to the same extent for other single vehicle MVT injuries. Note, caution must be given in interpreting this difference as the increase is only small (from 14.7 to 18.6%).

Similarly, motorcyclist multi vehicle injury hospitalisations have decreased in frequency until 1991/92, before rising slightly in 1992/93 (Figure 4.20). Motorcyclist
multi vehicle injury hospitalisations as a percentage of all MVT multi vehicle hospitalisations have remained constant over the years (average 17.3%), with a slight reduction in 1988/89.

Figure 4.19: Single Vehicle motorcyclist injury hospitalisations (including pillion passengers) - Total numbers and as a percentage of all Victorian Single Vehicle injury hospitalisations, 1987/88 - 1992/93

Figure 4.20: Multi Vehicle motorcyclist injury hospitalisations (including pillion passengers) - Total numbers and as a percentage of all Victorian Multi Vehicle injury hospitalisations, 1987/88 - 1992/93
4.6 LOCATION

4.6.1 Residential Location

Residential location was calculated according to the postcode of where the motorcyclist normally resides, rather than the postcode where the crash occurred, as is the case with police based data. Hence, the following chart does not provide information about where motorcycle crashes occurred.

Figure 4.21: Number of Motorcyclist injury hospitalisations (including pillion passengers) in Victoria by Residential Location, 1987/88 - 1992/93

Clearly, Figure 4.21 shows that the majority of motorcyclist injury hospitalisations occurred in the Melbourne Metropolitan area (57% overall), although their frequency decreased until 1990/91, and then increased slightly. The number of hospitalisations of motorcyclists from Country Victoria (38.8% overall) decreased gradually over the years which suggests either general improvements in motorcycle safety leading to fewer injury hospitalisations, or a decrease in the use of motorcycles in country Victoria. Exposure data are needed in relation to the number of people riding motorcycles and riding distance in order to clarify this.

4.6.2 Health Region

Although the majority of MVT injury hospitalisations involved people residing in the Melbourne Metropolitan Region (64%), the number of injury hospitalisations to people in the Southern Metropolitan Region was particularly high (41% of those residing in the Melbourne Metropolitan Region). The Southern Metropolitan Region includes a large area of Melbourne spanning from South Melbourne, St Kilda, Oakleigh, Dandenong, Chelsea and Hastings.
Similar patterns were evident for motorcyclists in that they predominantly lived in the Southern Metropolitan Region (40% of all persons residing in the Melbourne Metropolitan Region). A total of 60% of hospitalised motorcyclists resided in the Melbourne Metropolitan Region. Other than an increase in the proportion of motorcyclists hospitalised in the Barwon-South Western Region (includes the Great Ocean Road) as compared to MVT hospitalisations overall, few differences were found between the two groups (Figure 4.22).

Figure 4.22: Number of Motor Vehicle Traffic and Motorcyclist (including pillion passengers) injury hospitalisations in Victoria by Health Region of residence, 1987/88 - 1992/93
4.7 SUMMARY

There has been a gradual reduction in the number of persons hospitalised as a result of MVT and motorcyclist injuries since 1987/88, yet motorcyclists hospitalised as a proportion of all MVT injury hospitalisations have increased steadily since 1988/89. Thus, motorcyclist injury hospitalisations have not reduced as steadily as all other MVT injury hospitalisations. This trend differs for off-road motorcyclist injury hospitalisations as the number of persons hospitalised as a result of off-road crashes has only recently began to decrease, i.e., slight decrease since 1990/91. For children less than 15 years of age, off-road motorcyclist injury hospitalisations were more predominant than on-road motorcyclist injury hospitalisations.

The reduction in pillion passenger injury hospitalisations has not been as dramatic as motorcycle rider injury hospitalisations. However, pillion passenger injuries only comprised approximately 10% of all motorcyclist injury hospitalisations. Although female pillion passenger injuries outnumbered male pillion passenger injuries since 1991/92, males comprised approximately 90% of the motorcycle injury population overall.

Motorcyclists aged 15-29 years were the primary age group hospitalised for motorcycle related injuries, with the 20-24 year old age group predominating. The trend for a progressive increase in the number of motorcyclists over 34 years of age being hospitalised suggests that motorcycle users may be an ageing population.

There was a trend towards more motorcyclists being hospitalised for single vehicle related motorcyclist injuries (60.4% overall). Most injuries were sustained by people living in the Melbourne Metropolitan area (57% overall).

Since 1989/90 there has been a steady decrease in the length of hospitalisation in Victoria. At face value this suggests that injuries were less severe, yet another possibility exists that either the injuries were so severe that they resulted in death within the first few days of hospitalisation, or that there had been a shift in hospital management procedures due to the introduction of case-mix funding in Victoria.

There was a trend for fractures accounting for half of the injuries recorded, with most occurring to the lower and upper limbs (78%). Head injuries comprised 10.8% of the injuries sustained.
5. COMPARISON OF TRENDS IN INJURED MOTORCYCLISTS AS RECORDED IN THE POLICE REPORTED VICROADS ACCIDENT DATABASE AND THE HOSPITAL ADMISSION DATABASE IN VICTORIA

5.1 INTRODUCTION

Making a comparison between two different databases is often a very effective means of gaining more information about the factors surrounding an injury event. Comparison between the VicRoads enhanced version of the Police reported State Traffic Accident Record (STAR) database and the hospital admissions database (Victorian Inpatient Minimum Data set - VIMD) provides a more complete understanding of the events surrounding on-road motorcycle crashes that ultimately result in hospital admission. For the purposes of this analysis, the following comparison relates exclusively to on-road motorcycle crashes. It should be noted that only on-road motorcycle accidents need to be reported to the Police, and that information pertaining to off-road accidents are deliberately excluded from the official Police accident database in Victoria.

Injuries per se will not be compared across the two databases as VicRoads data does not include a breakdown of injury types. Rather, comparison between the databases will be attempted only on the variables that are common across each database. However, a number of factors must be considered before any comparisons between the databases can be made.

Firstly, it should be noted that the VicRoads database is essentially 'crash-based' which means that each crash report relates to a particular crash, rather than to a particular person. Although information is obtained for each injured person in the crash, it is recorded within the context of the crash and not the injury sustained, i.e., the information is geared towards an episode rather than a person. In order to make a comparison between the two databases, serious injury cases recorded in the STAR database will be compared to VIMD hospital admission injury cases. The VIMD database is essentially 'person-based' which means that the information coded on the data form relates only to the person injured. That is, a separate form is filled out for each individual involved in the crash.

Motorcycle injuries are included in the definition of Motor Vehicle Traffic (MVT) injuries, i.e., MVT includes all types of motor vehicles involved in crashes, which occur on a public road for both databases.

For VicRoads data, and for the purposes of this comparison, only motorcycle crashes resulting in serious injuries have been included. The reason for this is that the VIMD data only refers to injuries serious enough to warrant hospital admission, and therefore cannot be compared to the less serious injuries classified as "minor" in the VicRoads database. Note, although VicRoads data analysed here excludes fatalities, deaths are
included in the VIMD database due to changes in coding across the years which have made it difficult to exclude deaths from the database.

Prior to 1988 the code “serious” (depicting the severity of the injury sustained) derived from information on the Police report form (No. 510) was fairly synonymous with hospital admission. Since 1988, MVT casualties have been categorised as “fatal”, “major”, “serious”, or “minor” on the Police report form. VicRoads recode this injury data into “fatal”, “serious injury” and “other injury” using additional information recorded by the Police regarding whether the “major” person was taken to hospital. Since 1989 there has been a marked decrease in the number of people coded by VicRoads as “seriously injured”. Unfortunately substantial checks have not been made with the Victorian hospital system to ascertain the magnitude of this shift, nor to ascertain the direction of the error (underreporting versus overreporting). The procedure may create a bias, which is partly reflected in the finding that some injuries are categorised as “serious” by VicRoads yet do not appear in the hospital admissions database. According to the findings of Ozanne-Smith and Haworth (1993), this mismatching of injury severity seems to be more of a problem for Victoria than for other states, and is largely a function of the lack of objectivity in coding injury severity in the VicRoads database.

A problem exists when comparing location across the two databases as the VicRoads subset accessed for this study refers to the location of the crash, whereas the VIMD data refers to the postcode of residence of the hospitalised motorcyclist. (Note, although postcode of residence is available in the VicRoads database, the information was not available in the subset of VicRoads data utilised by this study.) For this reason, location has been divided into Metropolitan Melbourne and Rest of Victoria. Only a crude comparison is made as it is quite common for a person living in Melbourne to be involved in a crash in country Victoria, or vice versa.

The definition used to denote single vehicle crashes versus multi vehicle crashes varies depending on the database being used. That is, single vehicle crashes according to VIMD refer mainly to loss of control of the vehicle, colliding with a pedestrian, and colliding with an object set in motion by another vehicle, whereas single vehicle crashes according to VicRoads refer strictly to situations where one vehicle is involved in the crash. For both databases, multi vehicle crashes refer to crashes where two or more vehicles collide (including pedal cyclist, animal carrying person, animal-drawn vehicle, or streetcar). A problem arises if for example a motorcyclist loses control, hits a pole and then collides with a pedestrian, and the pedestrian is thrown into the path of another vehicle that loses control and runs into a fence, yet at no time do the two vehicles collide. Although this would be coded as a multi vehicle crash in the VicRoads database (i.e., crash involving two or more vehicles), it would be coded as a single vehicle crash in the VIMD database as the collision is not between two vehicles. Thus, a direct comparison cannot be made between Police and hospital admissions data in this instance.

Although it lacks the detail regarding circumstances of the crash contained in the VicRoads database, the VIMD database is considered the most complete database for describing the incidence and prevalence of motorcycle crashes resulting in severe
injury (Ozanne-Smith & Haworth, 1993). The reason for this is that all persons admitted to public hospitals in Victoria are automatically included in the database. The Police, on the other hand are not necessarily requested to attend all on-road motorcycle crashes resulting in serious injury, which means that their database (which excludes off-road injured motorcyclists) is dependent on crash notification for on-road injuries. Note, although the VIMD database is considered the most accurate in terms of injury classification, it may not be complete for motorcyclists due to the small proportion of vehicle users coded as unknown (approximately 7% of all MV traffic admissions). In addition, the VIMD database may also contain motorcyclists who were injured in off-road crashes miscoded as on-road crashes. Thus, a comparison between the two databases serves only as a crude estimate of underreporting of serious motorcyclist injuries to the Police.

It should be noted that since injuries treated in private hospitals have only been included in the database in a substantial way (comprising 18.5% of all injuries versus 1.1% of on-and-off-road MVT injuries) from the first half of 1993, they have been excluded from this analysis to avoid potential bias.

This report should be read in conjunction with the companion Stage 1 report by Diamantopoulou, Dyte and Cameron (1995) which analyses Police reported motorcycle crash data in Victoria between 1984 and 1993.

5.2 GENERAL TRENDS

5.2.1 Overall Frequency of Injuries

There has been an overall reduction in the number of severely injured motorcyclists recorded as on-road casualties in both the hospital admissions (VIMD) and VicRoads enhanced version of the police reported (VicRoads) databases across the six years of data presented. However, there was a slight increase in the number of injured motorcyclists requiring hospital admission (VIMD) in the financial year 1992/93. Similar reductions were apparent for MVT injuries which suggest an overall decrease in the incidence of serious motor vehicle related injuries in Victoria.

Figure 5.1 suggests that fewer seriously injured motorcyclists were recorded in the VicRoads database across the six years of data available (N=5,380), as compared to injured motorcyclists recorded in the hospital admissions data (N=6,320). This indicates an average 15% level of underreporting which ranged from 10% in 1987/88 to 20% in 1992/93. This suggests that the VicRoads database does not contain information on all serious motorcyclist injuries in Victoria.
Two possibilities exist as to why seriously injured motorcyclists were underreported in VicRoads enhanced police data. Firstly, although by law Victorians are required to report all traffic casualties resulting in injury to the police, police are sometimes not notified of crashes where the injuries appear minor, where there is little damage to property, or where the motorcyclist is trying to avoid prosecution because s/he has broken the law, e.g., unlicensed. Secondly, as this comparison only refers to injured motorcyclists classified as serious by VicRoads, it is possible that the reporting police officer underestimated the severity of the motorcyclists injury, coded the injury as minor, and therefore resulted in that motorcyclist wrongly being excluded from this comparison, hence, an element of error. Also, sometimes people present to Emergency Departments some time after the incident complaining of injuries which appeared minor at the time, yet have since required hospital admission.

Although fewer serious motorcyclist injuries were recorded in the VicRoads enhanced version of police reported data in comparison to persons admitted to hospital, this trend reversed for MVT casualty crashes overall. That is, VicRoads reported more MVT casualties as serious than were actually represented in the hospital admissions data. A likely explanation for the under-estimation of severe motorcyclist injuries is underreporting of casualty crashes to the police reported database (Rosman & Knuiman, 1994). It is possible that the police overestimated the severity of MVT injuries, while they underestimated the severity of motorcyclist injuries. Rosman and Knuiman (1994) claim in Western Australia that injury severity is often underreported by police, and that the linkage between police reported and hospital admissions data is poorer for motorcyclists (51.8%) than for MVT injuries (64%) overall. However, whether this can be generalised to Victorian data is difficult given the finding by Ozanne-Smith and Haworth (1993) that Victorian trends do not mirror those of other states, and that there is an anomaly when categorising injury severity on Victorian police report forms.
The Federal Office of Road Safety (FORS, 1993) indicated that little difference was found between Victorian hospital admissions and police derived estimates of hospital admission for MVT hospitalisations overall during 1990. However, this differed according to the types of road user as police derived data was found to underreport motorcyclist hospitalisations by 21%, and overestimate driver admissions by 37%. FORS concluded that this may be due to a mis-classification of the severity of minor injuries (hospitalisation status) on the police form, and the changing of requirements in 1988 whereby police were no longer required to verify admission status for road casualties.

**Figure 5.2:** Comparison of VIMD and VicRoads data - Motorcyclists severely injured (including pillion passengers) as a percentage of all severe MVT injuries in Victoria, 1987/88 - 1992/93

Although a greater number of persons injured as a result of MVT casualty crashes were recorded in the VicRoads data than in the VIMD data (Figure 5.2), severely injured VIMD motorcyclists accounted for a greater percentage of all MVT persons injured than did severely injured VicRoads motorcyclists. Over the six years of data available, on average severely injured VIMD motorcyclists accounted for 16.6% of all persons severely injured as a result of MVT casualty crashes, whereas VicRoads seriously injured motorcyclists accounted for 11.5% of all persons seriously injured in MVT casualty crashes. This suggests that either the severity of VicRoads motorcyclist injuries were underestimated at the time of the crash, and were therefore not included in this comparison (i.e., serious casualties only), that not all motorcyclist casualty crashes that involved serious injury warranting hospital admission were reported to the police, or that the severity of non-motorcyclist injuries were over-estimated.

Overall, an upward trend is evident for motorcyclist injuries as a percentage of all MVT injuries, excepting for the financial year 1992/93. Prior to 1991/92 the percentage of motorcyclists injured as a proportion of all MVT injuries increased for both VicRoads and VIMD serious casualties.
5.2.2 Motorcycle Riders and Pillion Passengers

Although an overall decrease in the number of motorcycle riders severely injured for both VIMD and VicRoads data is evident (Figure 5.3), fewer injuries involving motorcycle riders were recorded in the police enhanced database than the hospital system. Motorcycle riders as a percentage of all motorcyclists injured averaged 92.3% for VIMD data and 91% for VicRoads data. This indicates a consistency in the proportion of motorcycle riders injured in each database, and is particularly evident in later financial years.

Figure 5.3: VIMD and VicRoads comparison of Motorcycle Riders - Total numbers and as a percentage of all motorcyclists severely injured in Victoria, 1987/88 - 1992/93

The frequency of pillion passengers severely injured over the six years of VIMD data has fluctuated. There has been an overall decrease in the number of pillion passengers injured in the VicRoads database, with the number more than halving since 1987/88 (Figure 5.4).

Few differences were apparent with regards to the percentage of pillion passengers injured as a proportion of all motorcyclists injured, yet the percentage of VicRoads reported pillion passenger injuries slightly exceeded the percentage of hospital admission injuries, with VIMD cases averaging 7.7% over the six years and VicRoads data averaging 9%.
5.3 PERSON CHARACTERISTICS

5.3.1 Sex

Figure 5.5 highlights the disparity between the number of male and female motorcyclists injured in Victoria, with females comprising less than 10% of all motorcyclists injured in both data bases. Although there has been a reduction in the number of male and female motorcyclists injured across the six years, the reduction has been less marked for females (1.3% VIMD reduction, 0.7% VicRoads reduction). On average, female motorcyclists in the VIMD database averaged 7.9% of all VIMD motorcyclists severely injured while VicRoads females averaged 8% of all VicRoads motorcyclists severely injured.

Similarly, Figure 5.6. shows that males comprised the majority of motorcycle riders severely injured with females making up approximately 4.9% of the cases in the VIMD database and 4% of the cases in the VicRoads database. Although the number of males injured while riding a motorcycle continued to decrease for both VIMD and VicRoads data, the decrease was less marked for females. Whilst there was a decrease for female riders as reported to the VicRoads database, no trends were apparent for female riders in the VIMD database. However, the number of injuries in the VIMD database continued to out number that of the VicRoads data. Whether these differences are related to chance is unknown.
The differences in frequency between male and female pillion passengers severely injured was less marked than for motorcycle riders (Figure 5.7). Although slightly more males were injured as pillion passengers during the years 1987/88 - 1990/91, this trend reversed during 1991/92. Consequently, females have since outnumbered males with regards to pillion passenger injuries for both VIMD and VicRoads data.
Figure 5.7: VIMD and VicRoads comparison of the number of pillion passengers severely injured in Victoria by gender, 1987/88 - 1992/93
5.3.2 Age

Figure 5.8: VIMD and VicRoads comparison of Motorcyclists severely injured (including pillion passengers) in Victoria by Age and Financial Year

Overall, the age distribution of severely injured motorcyclists remained fairly constant
for both VicRoads and VIMD data (Figure 5.8), with the 20-24 year old age group
predominating throughout the six years of data available (total of 27% VIMD and
31% VicRoads). It should be noted that since the age group span represented in the
17-19 year old group is not synonymous with the 20-24 year age group, caution is
required when making comparisons between the different age groups.

Fewer motorcyclists in the under 17 years age group were represented in the
VicRoads data (total of 178) as opposed to the VIMD data (total of 567). This
suggests that either not all motorcycle casualty crashes where younger motorcyclists
were involved were reported to the police, or they underestimated these injuries as
only minor. Non-reporting of casualty crashes involving motorcyclists below
licensing age would not be surprising. For example, a report carried out by Haworth,
Ozanne-Smith, Fox and Brumen (1994) found that 45.1% of on-road motorcyclists
admitted to hospital who were under the age of 21 years were either unlicensed or
were riding an unregistered motorcycle. Overall, the above age distribution identifies
a bias in the differences in reporting rates between the two databases.

According to VIMD data there appears to be a slight trend towards older persons (30+
years) being injured whilst riding motorcycles.

The age distribution for motorcycle riders mirrors that of the above distribution and is
therefore not presented in a separate chart. A separate group of charts is presented
below depicting the number of pillion passengers injured in each database by age.

Figure 5.9 provides a graphical presentation of motorcyclists injured across each of
the age groups for each of the databases. These results support those previously found
in Figure 5.8, indicating that 2-24 year old motorcyclists were the predominant age
group hospitalised as a result of serious motorcyclist injuries.
Figure 5.9: Comparison of VIMD and VicRoads Motorcyclists severely injured by Age Group and Financial Year

![Comparison of VIMD and VicRoads Motorcyclists severely injured by Age Group and Financial Year](image)

Figure 5.10 highlights the changing age distribution of pillion passengers severely injured in Victoria across the six years of data available, as well as a general reduction in the number of pillion passengers injured by financial year. Whilst VicRoads and VIMD data did not follow the same age trend in earlier years (1987/88 - 1988/89), the reduction in the overall number of pillion passengers injured also reduced the differences between the two databases. Thus, during 1991/92 and 1992/93 few differences were found between VicRoads and VIMD data.

In reference to VicRoads data there has been an enormous shift in the number of pillion passengers injured in each age group. The 20-24 year old age group predominated in the VicRoads data throughout the six years, yet varied widely in frequency. In fact, the frequency of 20-24 year olds in the VicRoads database was more than double that of the VIMD pillion passengers injured for the same age group during 1987/88, and continued to exceed the VIMD cases for a number of years. This in part may be due to improved coding of motorcyclists injured over time, i.e., fewer coded as "unknown". Note the variability across the age groups (e.g., 17-19, 20-24) when making direct comparisons between the age groups.
Although few cases were recorded in the VicRoads data for pillion passengers under the age of 17 years in comparison to VIMD cases, the number of pillion passengers injured in the 10-16 year age group exceeded VIMD cases during 1991/92.

During 1987/88 the 10-16 year age group predominated in frequency for VIMD cases rather than the 20-24 year age group evident throughout other years. Likewise, the frequency of 20-24 year olds was lower during 1990/91, and was exceeded by the 10-16, 17-19 and 25-29 year age groups.
Figure 5.10: VIMD and VicRoads comparison of Pillion Passengers severely injured in Victoria by Age and Financial Year
5.4 ACCIDENT CHARACTERISTICS

5.4.1 Seriously Injured Motorcyclists in Multi/Single Vehicle Crashes

Figure 5.11 shows that there has been a very slight decrease in the number of motorcyclists severely injured in single vehicle casualty crashes in Victoria across the six years of data available. No differences were evident between the two databases, other than that the number of VIMD injuries was double the number of VicRoads injuries.

Figure 5.11: VIMD and VicRoads comparison of motorcyclists severely injured (including pillion passengers) in single and multi vehicle casualty crashes in Victoria, 1987/88 - 1992/93

On average, single vehicle motorcycle casualty crashes accounted for 60.4% of motorcyclist hospital admissions as opposed to 35.5% of VicRoads serious motorcycle casualties. This is the largest discrepancy between the VIMD and the VicRoads data bases found in this comparison. It may, in part, be due to the different definitions of a single vehicle crash (as discussed in the Introduction), and/or to a tendency for motorcyclists to avoid reporting single vehicle casualty crashes.
There has been a reduction in the number of injuries sustained in multi vehicle casualty crashes over the six years for both VIMD and VicRoads data, yet the differences between the two groups was not as large as for single vehicle casualty crashes. Although VIMD cases exceeded VicRoads cases for single vehicle casualty crashes, this trend reversed for multi vehicle casualty crashes. While VicRoads data reflected a greater number of serious injuries resulting from multi vehicle casualty crashes, VIMD data reported more injuries resulting from single vehicle casualty crashes. On average, multi vehicle motorcyclist casualty crashes accounted for 39.6% of motorcyclist hospital admissions as opposed to 64.5% of VicRoads reported serious motorcyclist casualties.

As reported in an earlier section of the report (Stage 1; Diamantopoulou, Dyte & Cameron, 1995), each year since 1986 VicRoads reported more serious multi vehicle casualty crashes than single vehicle casualty crashes in Victoria, and more motorcyclists were admitted to hospital following single vehicle casualty crashes in Victoria (Stage 2; VIMD). This suggests that the police may have perceived multi vehicle crash injuries as more serious than single vehicle crash injuries. This is not surprising given that the perception of crash severity often escalates in relation to the number of people injured in a crash. Again, there is also the influence of different definitions of a multi-vehicle crash in the two databases.

The trend for motorcycle riders severely injured in single vehicle casualty crashes is similar to that of injured motorcyclists in general, as presented in Figure 5.12, with VIMD cases almost doubling the frequency of VicRoads cases.

Although there has been an overall decrease in the number of pillion passengers severely injured in single vehicle casualty crashes, this trend has been variable due to a sudden increase in the number of injuries recorded during 1990/91. However, both VIMD and VicRoads cases follow similar patterns which suggests that the yearly variation is a true reflection of shifts in single vehicle pillion passenger injuries, rather than due to variations in individual data collection.
Figure 5.12: VIMD and VicRoads comparison of motorcycle riders and pillion passengers severely injured in single vehicle casualty crashes in Victoria, 1987/88 - 1992/93

In contrast to single vehicle casualty crashes the VicRoads serious multi vehicle motorcycle rider injury cases were consistently greater than the VIMD injury cases (Figure 5.13). A slight downward trend was evident for both databases.

As was the case for single vehicle casualty crashes, there was an overall, though irregular, downward trend for pillion passengers. Somewhat fewer cases were recorded in the VIMD database, although similar trends were evident for each year.
5.5 LOCATION

5.5.1 Melbourne Vs Rest of Victoria

The following comparison between VIMD and VicRoads with regards to location should be analysed with caution as this variable has been defined differently by each database. According to VIMD, the location variable reflects the motorcyclists postcode of residence, whereas it refers to the location of the crash in the VicRoads database. It should be noted however, that this is a function of the way the Police reported data was extracted, and not a feature of the database itself. That is, although postcode of residence is available in the VicRoads database, the information was not accessed in the subset of VicRoads data utilised by this study.

To minimise error, location has been divided into two categories, Melbourne Metropolitan versus the Rest of Victoria. Nevertheless, there will be instances where
the motorcyclist lives in country Victoria yet was injured in the Melbourne Metropolitan area, and vice versa for Melbourne residents injured outside the metropolitan area.

Figure 5.14 shows that up to 50% more motorcyclist injuries were recorded in Metropolitan Melbourne than the Rest of Victoria, and that this percentage did not vary much across the six years of data collection. No differences in proportion were evident between the two databases which suggests that the differences in definition approximately cancelled out.

**Figure 5.14: VIMD and VicRoads comparison of the percentage of motorcyclists severely injured (including pillion passengers) in Victoria by location, 1987/88 - 1992/93**

![Diagram showing percentage of severely injured motorcyclists by location and year](image)

### 5.6 DISCUSSION

The findings of the six year trend analysis indicates that there has been a decrease in the number of severe motorcyclist injuries over time for both the hospital admissions and VicRoads enhanced police reported databases. However, fewer serious motorcyclist injuries were recorded in the VicRoads database than were admitted to Victorian hospitals. This is surprising given that the reverse was found for MVT injuries overall - i.e., more MVT injuries were coded as severe by VicRoads than represented in the hospital admissions system. However, it is not known whether the problem is a coding one (interpretation of injury severity) or due to an underreporting of motorcyclist injuries to the police. The latter is supported by the finding of an under-representation of single vehicle casualty crashes in the police reported database and an underreporting of severely injured motorcyclists aged less than 17 years (providing that the VIMD database does not contain a high percentage of off-road motorcyclists miscoded as on-road). This suggests a reluctance to notify the police if only one vehicle is involved in the crash and if the motorcyclist is underage, unlicensed or breaking the law in some way.
A comparison between VicRoads and hospital admitted motorcyclist crash data serves as a useful measure of underreporting and suggests that severe motorcyclist injuries (labelled as 'taken to hospital') were under-represented in the VicRoads database. Given that hospital admissions data is generally regarded as the more complete database in terms of describing the incidence and prevalence of motorcycle crashes resulting in severe injury in Victoria (Ozanne-Smith & Haworth, 1993), one way of calculating the level of underreporting of police reported VicRoads data is to subtract the number of VicRoads casualties from the number of admitted casualties in the VIMD database. Using this formula, the level of underreporting expressed as a percentage of total VIMD injuries has been calculated at an average of 15% across the six years of data (range 10-20%), with the proportion increasing to 20% during 1992/93. This suggests a trend for fewer serious motorcyclist injuries to be recorded in the VicRoads enhanced version of the police reported data. Given the likelihood that some off-road motorcycle casualty crashes may have been wrongly coded as on-road, this figure serves only as a crude estimate of underreporting.

Further research is required to ascertain whether this reflects a problem with reporting (notifying motorcycle casualty crashes to the police) or whether it reflects a difference in coding practices for injuries which result in hospital admission (serious injuries wrongly coded as minor). There may also be over-reporting of motorcyclists as "seriously injured" (taken to mean hospital admitted), but the extent of under-reporting of motorcyclist casualty crashes is so great that it hides this effect. Given the finding that more motorcyclist injury cases were contained in the VicRoads database (see Stage 1 report describing all levels of severity) than the hospital admissions database overall, it remains a possibility that some of the serious motorcyclist injuries appearing in the hospital admissions database were wrongly coded as minor injuries in the VicRoads database. The finding that fewer single vehicle casualty crashes were recorded in the VicRoads data than the hospital admissions database overall (Stages 1 & 2) suggests that the problem is one of notification rather than coding - i.e, not always reported to the police. The results of a VicRoads commissioned Roy Morgan Research Centre (1994) computer assisted random telephone survey of 8,461 households in Victoria (16,843 people) found that only 78% of the people estimated to be involved in road accidents during the past three years who had injuries severe enough to warrant medical treatment were accounted for by the Police accident database. Hence, there is an estimated level of under-reporting in Victoria of 22% (25% estimated level of under-reporting in Melbourne versus 15% for the Rest of Victoria). When broken down according to type of injury accident, the estimated reporting rate for motorcycle accidents (VicRoads Police reported data as a percentage of Roy Morgan Research Centre survey data) was 120.4%. It should be noted however, that this survey refers only to 320 injured participants, of which 17 were motorcyclists (Roy Morgan Research Centre, 1994).

Although this study does not attempt to isolate the reasons for underreporting of single vehicle casualty crashes, it is interesting to note that injuries involving people under the age of 17 years were seriously underreported in the VicRoads police reported database. This may suggest that being unlicensed and the fear of prosecution may be factors related to why all single vehicle motorcycle casualty crashes were not
reported in the VicRoads data. Findings from the Roy Morgan Research Centre (1994) survey also found that road accidents involving young people under the age of 18 years recorded the highest level of under-reporting (42%). On the other hand, the finding that serious motor vehicle crash injuries were overestimated in the VicRoads data suggests that the problem may be one of coding or misinterpretation of injury severity.

Likewise, the fact that serious MVT injuries in the VicRoads database exceed those in VIMD by approximately 23% suggests that the police may have overestimated the severity of motor vehicle injuries, while they underestimated serious motorcyclist injuries by approximately 15%. The possibility also exists that more motorcyclist injuries were recorded in the VicRoads database than the VIMD database due to errors in coding off-road motorcyclist casualty crashes as on-road casualty crashes, or vice versa for VIMD on-road motorcyclist injury admissions. Given that many off-road motorcyclist crashes actually comprise single vehicle casualty crashes, and that these are generally regarded as less severe than multi-vehicle crashes, this would help explain why serious motorcyclist casualty crashes were underestimated in the VicRoads database (or conversely overestimated in the VIMD database). Research aimed at directly linking police with hospital admissions data would help clarify the issues.

Therefore, there is merit in linking hospital admissions and police reported (VicRoads) data to gain a better perspective of the motorcycle injury problem in Victoria. Linking the databases would help to investigate levels of underreporting of motorcyclist injuries to the police. This in turn could affect the allocation of resources to road safety and for reducing the incidence of motorcyclist injuries in Victoria. Although historically the size of the motorcyclist injury problem has been calculated on the basis of VicRoads road statistics, clearly, use of hospital data would provide a fuller understanding of the size of the motorcyclist injury problem. Estimates of the cost of motorcyclist injuries using VicRoads data only, does not provide a fair estimate of the motorcycle injury problem in Victoria, i.e., up to 20% of hospital admissions not classified as serious.

Thus, further research is needed to gain a more accurate understanding of underreporting to the police and to explore coding issues relating to the classification of injury severity. A comparison of VicRoads motorcyclist injuries with a statewide medical based database that collects data at the lower spectrum for minor injuries (e.g., hospital emergency department treatments and possibly GP data) would help to clarify the issue of coding and would provide a clearer perspective of the motorcycle injury problem.

Nevertheless, this research has been instrumental in highlighting the level of underreporting of serious motorcyclist injuries to the police (particularly single vehicle injuries with younger motorcyclists) and in describing trends over time. What this research has not been able to achieve is to quantify the contribution of the various factors which lead to underreporting of motorcyclist injuries to the police. This remains a challenge for future research, particularly in view of the high costs relating to lengthy and often expensive health care for injured motorcyclists.
6. CONCLUSIONS

The first stage of this project examined trends in Police-reported motorcycle crashes resulting in death or injury in Victoria during 1984-93. It was found that the trend in motorcycle casualty crashes was different from that for all reported casualty crashes in Victoria since 1989, with the proportion of motorcycle crashes generally increasing since that year. The number of motorcycle casualty crashes in Victoria has decreased even since 1987, but at a slower rate than casualty crashes generally.

Stage 2 of the project compared these findings with those elsewhere in Australia and in another data source from Victoria.

Australia-wide, it was found that the number of motorcyclists killed during 1984-93 had decreased more rapidly than in Victoria. In New South Wales in particular, the proportion of fatal crashes involving motorcycles had been halved, compared with essentially no change in Victoria. Similar findings were apparent when trends in motorcycle casualty crashes were compared in the two States.

A notable difference between the two States was that, in Victoria, the decrease in motorcycle casualty crashes was primarily multi-vehicle crashes occurring in low speed zones of 75 km/h or lower, whereas in New South Wales, the decline in motorcycle casualty crashes was in both low and high speed zones, and in both single- and multi-vehicle crashes. Reliable information on blood alcohol levels was available only for motorcycle riders who were killed. Another notable difference was that, in New South Wales, the proportion of killed riders with excessive BAC readings (above 0.15 g/100ml) increased substantially during 1984-93, whereas in Victoria, the proportion was more than halved during 1989-93. However, both States were consistent in showing the greatest decreases in motorcyclist casualties among those aged under 26 years, whilst those aged over 37 years showed an increasing trend in deaths and injuries.

An alternative source of data on motorcyclist injuries in Victoria was public hospital admission records, available for 1987/88 to 1992/93. This data source confirmed that serious motorcyclist injuries did not reduce as rapidly as other road traffic injuries resulting in hospital admission during the period. The data also showed that for motorcyclists aged under 15 years, hospital admissions from off-road crashes were more numerous than those from crashes on-road. In other respects, the hospital admission records reflected the findings from Police reports, except that admissions eventuated from a greater proportion of single motorcycle crashes.

When the two sources of data on motorcyclist serious injuries in Victoria were compared, it was found that substantially fewer serious injuries were recorded in the database of Police crash reports held by VicRoads than were recorded as admitted to hospital. The reverse was true for serious road traffic injuries generally, probably emanating from the known practice whereby the VicRoads database records as "serious injury" many cases of injury which did not result in hospital admission. Thus the extent of under-reporting of motorcyclist hospital admissions in the database of
Police crash records may be even greater than has been indicated. Further investigation of this issue is warranted.

7. RECOMMENDATIONS

This project led to a number of recommendations for further investigation and research:

1. The principal area of improvement in motorcyclist trauma in Victoria during 1984-93 was from the reduction in multi-vehicle crashes in the low speed zones of 75 km/h or lower. Factors which may explain this improvement, in contrast with other crash types, should be investigated.

2. The creation of a linked file matching motorcyclists recorded on Police reports with records of motorcyclist hospital admissions would be valuable for research to understand the extent to which the admissions are reported to the Police, and to gain some understanding of the injury severity levels which they record.

3. For a fuller understanding of the injury recording practices used by the Police, a file linking motorcyclists recorded on Police reports should be linked with hospital admission records, Accident and Emergency Department (non-admission) records, and records of injury treatments by General Practitioners. Data systems covering the first two of these non-Police sources exist for the Latrobe Valley in Victoria, and it is understood that a system covering the third source will be created soon. The availability of these systems consolidating data on all levels of injury treatment should be used to create a linkage with Police reports on crashes in the same region.
REFERENCES


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STAGE 2: ANALYSIS OF TRENDS IN MOTORCYCLE CRASHES IN VICTORIA 77
APPENDIX

KILLED MOTORCYCLISTS BY BAC AND LICENCE TYPE
FOR VICTORIA AND NEW SOUTH WALES,
1984-1993
Figure A1: VICTORIAN LEARNER Motorcycle Riders Killed with BAC > 0.010g/100ml as a Proportion of Learner Riders Killed with KNOWN BAC, 1984-1993

Figure A2: NSW LEARNER Motorcycle Riders Killed with BAC > 0.010g/100ml as a Proportion of Learner Riders Killed with KNOWN BAC, 1984-1993

* Number of learner riders killed with BAC > 0.010g/100ml.
** Number of learner riders killed with known BAC.
*** Number of learner riders killed.
Figure A3: VICTORIAN PROBATIONARY Motorcycle Riders Killed with BAC>0.010g/100ml as a Proportion of Probationary Riders Killed with KNOWN BAC, 1984-1993

Figure A4: NSW PROVISIONAL Motorcycle Riders Killed with BAC>0.010g/100ml as a Proportion of Provisional Riders Killed with KNOWN BAC, 1984-1993

* Number of probationary/provisional riders killed with BAC>0.010g/100ml.
** Number of probationary/provisional riders killed with known BAC.
*** Number of probationary/provisional riders killed.

82 MONASH UNIVERSITY ACCIDENT RESEARCH CENTRE
Figure A5:  VICTORIAN STANDARD Licence Motorcycle Riders Killed with BAC>0.010g/100ml as a Proportion of Standard Licence Riders Killed with KNOWN BAC, 1984-1993

Figure A6:  NSW STANDARD Licence Motorcycle Riders Killed with BAC>0.010g/100ml as a Proportion of Standard Licence Riders Killed with KNOWN BAC, 1984-1993

* Number of standard licence riders killed with BAC>0.010g/100ml.
** Number of standard licence riders killed with known BAC.
*** Number of standard licence riders killed.
Figure A7: VICTORIAN UNLICENSED Motorcycle Riders Killed with BAC > 0.010g/100ml as a Proportion of Unlicensed Riders Killed with KNOWN BAC, 1984-1993

Figure A8: NSW UNLICENSED Motorcycle Riders Killed with BAC > 0.010g/100ml as a Proportion of Unlicensed Riders Killed with KNOWN BAC, 1984-1993

* Number of unlicensed riders killed with BAC > 0.010g/100ml.
** Number of unlicensed riders killed with known BAC.
*** Number of unlicensed riders killed.

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