MONASH University
Accident Research Centre

CASUALTY CRASH RISKS FOR MOTORCYCLE RIDERS IN VICTORIA: 1994

by

Kathy Diamantopoulou
Michael Skalova
Max Cameron

MONASH UNIVERSITY
ACCIDENT RESEARCH CENTRE

March 1996

Report No. 90

MONASH UNIVERSITY ACCIDENT RESEARCH CENTRE
REPORT DOCUMENTATION PAGE

Report No.	Date	ISBN	Pages
90	March 1996	0 7326 0670 5	vi + 14

Title and sub-title
Casualty Crash Risks For Motorcycle Riders in Victoria: 1994

Author(s)
Kathy Diamantopoulou
Michael Skalova
Max Cameron

Type of Report & Period Covered
GENERAL, 1994

Sponsoring Organisation(s)
This project was funded through the Centre's baseline research program for which grants have been received from:

Royal Automobile Club of Victoria (RACV) Ltd
Ministry for Police and Emergency Services
Roads Corporation (VicRoads)
Transport Accident Commission

Abstract

This report on motorcycle accident risks in Victoria presents the results of an analysis of two different data sets which were provided to MUARC. The first of these was data collected during an exposure survey conducted by Arup Transportation Planning during 1994 on behalf of VicRoads, and the second data set was a file of accident report data, originally collected by the Victoria Police during 1990-94, and subsequently enhanced by VicRoads. Because the MUARC analysis made use of data prepared by others, it should be emphasised that the accuracy of the results depends on the validity of the original data collections.

In Victoria, motorcycle riders travelling on major roads in rural towns apparently had the highest risk of casualty crash involvement, 20 crashes per million kilometres travelled, whilst the respective risks on Melbourne arterial roads and on rural highways were 15 and 0.5 casualty crashes per million kilometres of travel.

For travel on Melbourne arterial roads and in rural towns it was found that as the severity of the crash increased, the risk for motorcycle riders relative to car drivers also increased, with the fatal crash risk for motorcyclists being 32 times the risk for car drivers on average. A different pattern emerged for rural highway travel. There was little difference between the motorcyclist and driver risks for each crash severity level.

Key Words: (IRRD except when marked*)
Motorcycle Rider, Crash Risk, Crash Severity, Exposure, Car Driver

Monash University Accident Research Centre,
Wellington Road, Clayton, Victoria, 3168, Australia.
Telephone: +61 3 9905 4371, Fax: +61 3 9905 4363

Table of Contents

1. INTRODUCTION

VicRoads have expressed a need to assess the relative casualty crash risk of motorcycle riders in Victoria for inclusion in a submission to the Victorian Parliamentary Road Safety Committee. Prior to the announcement of the Victorian State election on 30 March 1996, the Committee had launched an Inquiry into the Review of Motorcycle Safety in Victoria.

An analysis of motorcycle crash risks was undertaken by Monash University Accident Research Centre (MUARC) using the most recent exposure data on motorcycle travel in Victoria. The motorcycle exposure data was obtained from a survey of motorised vehicle travel conducted for VicRoads in 1994 (Arup Transportation Planning, 1995).

Using the VicRoads exposure survey data and information derived from Police accident reports, risk estimates (casualty accident involvement rates per kilometre) were calculated for motorcycle riders on Melbourne arterial roads, in Victorian rural towns and on Victorian rural highways. In addition to casualty crash risks, the risks for motorcyclists involved in fatal and serious casualty crashes (those crashes resulting in a fatality or serious injury), respectively, were estimated for the three locations. Because the analysis made use of data prepared by others, the accuracy of the resultant risk estimates depends on the validity and reliability of the original survey and crash data collections. The results should, therefore, be interpreted with care.

2. CRASH RISKS AND EXPOSURE

Crash risk estimates are determined by dividing the number of crashes by some measure of exposure, often defined as 'the opportunity to have a crash'. Further details of the concept of exposure are given by Cameron and Oxley (1995).

Motorcycle exposure can be measured as the distance travelled on the road, the number of trips of travel, the number of motorcycle licence holders, the number of registered motorcycles, fuel consumption or the number of people in the population. The most recent exposure survey for Victoria was conducted in mid-1994 by Arup Transportation Planning for VicRoads. This survey estimated the distance travelled by vehicle occupants and motorcycle riders in Melbourne, major provincial towns and major rural highways in Victoria. Therefore, for this study, the distance travelled on the road in 1994 will be used as the measure of the exposure for calculation of motorcycle crash risks.

2.1 EXPOSURE SURVEY DATA

The 1994 exposure survey estimated the distance travelled by vehicle occupants for three areas of Victoria, namely metropolitan Melbourne, major rural towns and selected rural highways during an average non-holiday week in July-August 1994. The survey involved interviewing the rider of a motorcycle or the driver of a car and observing the motorcycle or car and their occupants at a signalised intersection when the vehicle was stopped at a red light signal. Exposure information was obtained for occupants of cars and car derivatives, motorcycle riders and pillion passengers.

For Melbourne, the survey was conducted on a sample of arterial roads at signalised intersections, with the estimated distance being the distance travelled along arterial roads in the sampleable area, comprising 38 of the 56 pre-1995 Local Government Areas (LGAs).

The Victorian rural towns sampled were Inner and Outer Geelong, Inner and Outer Ballarat, Inner and Outer Bendigo, Shepparton and Morwell, with interviews and observations conducted on main and arterial roads at signalised intersections in these towns. Five major highways were selected as the sample of Victorian rural highways - Calder Highway, Gouldburn Valley Highway, Princes Highway East, Princes Highway West and Western Highway. The survey was conducted at permanent or temporary traffic signals on these highways.

For each of the three samples, different weights were given to each motorcycle rider and car driver to reflect their contribution to the total weekly distance travelled. The weighting procedure took into account such factors as the traffic volume and the length of road travelled.

Greater detail on the exposure survey methodology and the weighting procedure used can be found in Arup Transportation Planning (1995).

2.2 CRASH DATA

The VicRoads enhanced database derived from Police accident reports was used to obtain the crash data needed to estimate the crash risks. Casualty crashes that occurred in non-holiday periods (37 full weeks per year) during 1990-94 were extracted from the database. To ensure the crash data was as comparable to the exposure survey data as possible, the following selection criteria was used to extract the relevant crash data.

For the Melbourne sample, motorcycle riders involved in casualty crashes that occurred on arterial roads in the same 38 Local Government Areas as the exposure survey were selected. Similarly, all motorcycle casualty crashes occurring on arterial or main roads in the five provincial towns surveyed were chosen. In the exposure survey, the rural highway sample was restricted to 100 k/h and 110 k/h sections of the selected five highways between various kilometre posts. Motorcycle casualty crashes were selected only for these highway sections, including crashes that occurred in the intervening towns.

For all three samples, only casualty crashes involving motorcycle riders not pillion passengers were chosen. Further, only crashes involving motorcycles registered in Victoria were selected. It should be noted, however, for the non-holiday periods considered, there were no crashes involving motorcycles registered outside of Victoria.

Instead of using the 1994 casualty crashes alone to estimate the 1994 motorcycle crash risks, crashes occurring in 1990-94 were used to increase crash frequencies. Further, since the motorcycle crashes occurred over a 185 non-holiday week period, but the exposure survey estimated the distance travelled in an average non-holiday week, the exposure measures were multiplied by a factor of 185 to be compatible with the crash data.

These selection criteria were also used to estimate casualty crash risks for drivers in Victoria during 1994. Greater detail of the driver crash risks can be found in a report which estimated the crash risks of various road user groups in Victoria (Diamantopoulou et al, 1996). The motorcycle crash risks presented in the following sections will be compared with the corresponding driver risks found in Diamantopoulou et al.

3. MOTORCYCLE CRASH RISKS

On the selected arterial roads during July-August 1994, 46 motorcycle riders were surveyed. The corresponding numbers of riders surveyed in rural towns and on rural highways were 53 and 52, respectively. The estimated distance travelled in an average week during 1994 by motorcyclists was 792,300, 99,100 and 1,326,100 kilometres on Melbourne arterial roads, in Victorian rural towns and on rural highways, respectively (Arup Transportation Planning, 1995).

3.1 PROPORTION OF MOTORCYCLE TRAVEL

Table 3.1 gives the proportion of travel comprised by motorcycles on Melbourne arterial roads, in Victorian rural towns and on Victorian rural highways for 1994, as well as the distance travelled by cars and car derivatives. The exposure estimates for cars were obtained from Diamantopoulou et al (1996). It should be noted however, that the motorcycle exposure figures include travel by motorcycles not registered in Victoria, but the distance travelled by cars is only for Victorian registered cars. The percentage of travel by motorcycles for the three locations, therefore, may be slight overestimates.

Motorcycles apparently comprised a larger proportion of total travel on Victorian rural highways (5.9%) than on either Melbourne arterial roads or in rural towns (no more than 0.5% of total travel was conducted by motorcycles in each of these two locations).

Table 3.1: Percentage of Travel by MOTORCYCLES during 1994 for Melbourne, Victorian Rural Towns and Rural Highways

	Distance Travelled in an Average Week during 1994 (km)		Proportion of Motorcycle Travel
LOCATION	Motorcycle	Car or Car Derivative	
Melbourne	792,300	258,275,000	0.3%
Rural Towns	99,100	19,794,000	0.5%
Rural Highways	1,326,100	21,168,600	5.9%

3.2 CASUALTY CRASH RISKS

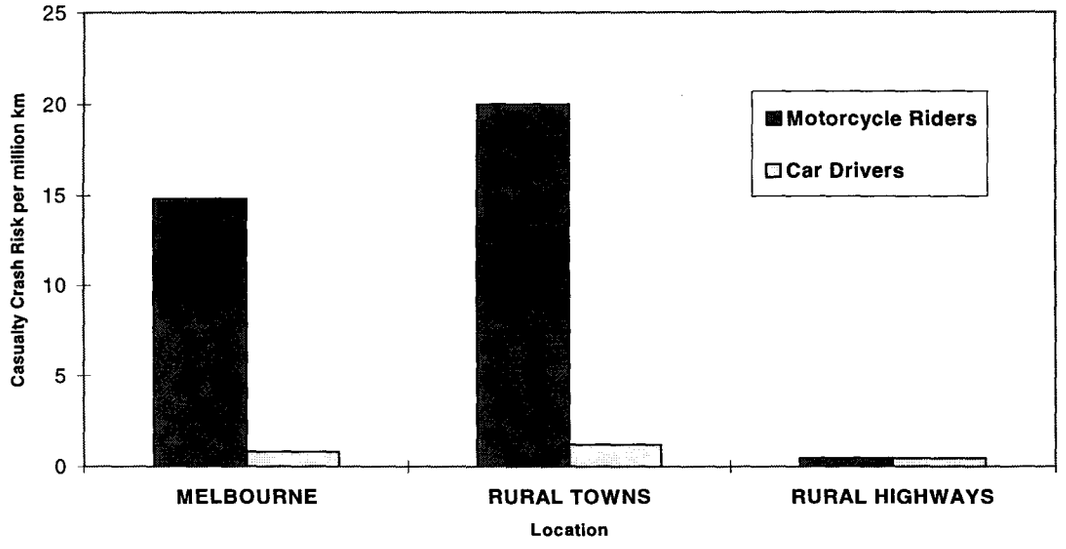
Casualty crash risks were estimated for motorcycle riders in Melbourne, in rural towns and on rural highways of Victoria. The motorcycle risks were then compared with the corresponding driver casualty crash risks.

Table 3.2 and Figure 3.1 display the casualty crash involvements during 1990-94, the aggregate exposure estimates (185 non-holiday weeks), and the estimated casualty crash risks (per million kilometres of travel) for motorcycle riders and car drivers for the three locations. The estimated crash risks for drivers have been obtained from Diamantopoulou et al (1996). It should be noted that when comparing motorcycle rider risk estimates with driver risk estimates, the rider risks are estimates for all observed and crash-involved motorcycles, whereas the driver risks are only for vehicles registered in Victoria.

Table 3.2: CASUALTY CRASH Risk for Motorcycle Riders and Car Drivers in Melbourne, Victorian Rural Towns and on Victorian Rural Highways during 1994

		Melbourne	Rural Towns	Rural Highways
Motorcycle Rider	Casualty Crash Involvement	2,169	367	114
	Exposure Estimate (million km)	146.6	18.3	245.3
	Casualty Crash Risk	**14.80**	**20.02**	**0.47**
Car Driver	Casualty Crash Involvement	39,172	4,448	1,794
	Exposure Estimate (million km)	47,780.9	3,661.9	3,916.2
	Casualty Crash Risk	**0.82**	**1.21**	**0.46**

Figure 3.1: CASUALTY CRASH Risk for Motorcycle Riders and Car Drivers during 1994 by LOCATION



On Melbourne arterial roads, motorcyclists had an estimated risk of 14.8 casualty crashes per million kilometres travelled. The motorcycle casualty crash risk was 18 times larger than the corresponding risk estimate for car drivers. In Victorian rural towns, the motorcycle casualty crash risk was greater than the estimate found for Melbourne (20 casualty crashes per million kilometres travelled), and was 16.5 times greater than the corresponding car driver risk in rural towns.

For travel on Victorian rural highways, motorcycle riders had a similar risk of casualty crash involvement as car drivers, approximately 0.5 casualty crashes per million kilometres. The motorcycle casualty crash risk per kilometre was considerably smaller than the corresponding risks found for Melbourne and rural towns.

3.3 SERIOUS CASUALTY CRASH RISKS

Motorcycle riders involved in crashes resulting in a death or a serious injury were selected to determine the risk of serious casualty crash involvement on Melbourne arterial roads, in Victorian rural towns and on rural highways. The motorcycle serious casualty crash risks were compared with the corresponding driver risks for the three locations.

3.3.1 Serious Casualty Crash Risks on Melbourne Arterial Roads

The serious casualty crash risks for motorcycle riders and car drivers travelling on Melbourne arterial roads during 1994 are given in Table 3.3. Per million kilometres of travel, motorcycle riders had an estimated risk of almost 6 serious casualty crashes. This risk estimate was 31 times as large as the serious casualty crash risk for car drivers on Melbourne arterial roads.

Table 3.3: SERIOUS CASUALTY Crash Risks for Motorcycle Riders and Car Drivers on MELBOURNE Arterial Roads during 1994

ROAD USER	ESTIMATE	
Motorcycle Rider	Serious Casualty Crash Involvement	866
	Exposure Estimate (million km)	146.6
	Serious Casualty Crash Risk	**5.91**
Car Driver	Serious Casualty Crash Involvement	9,207
	Exposure Estimate (million km)	47,780.9
	Serious Casualty Crash Risk	**0.19**

3.3.2 Serious Casualty Crash Risks for Rural Towns

Serious casualty crash risks for motorcycle riders and car drivers travelling in Victorian rural towns during 1994 are given in Table 3.4.

The risk of serious casualty crash involvement for motorcycle riders in Victorian rural towns was greater than the corresponding risk on Melbourne arterial roads; 8.4 serious casualty crashes were estimated to occur per million kilometres (for Melbourne the corresponding risk was 5.9). Further, the serious casualty crash risk for motorcycle riders in rural towns was 30 times as large as the corresponding risk estimate for car drivers.

Table 3.4: SERIOUS CASUALTY Crash Risks for Motorcycle Riders and Car Drivers in VICTORIAN RURAL TOWNS during 1994

ROAD USER	ESTIMATE	
Motorcycle Rider	Serious Casualty Crash Involvement	154
	Exposure Estimate (million km)	18.3
	Serious Casualty Crash Risk	**8.40**
Car Driver	Serious Casualty Crash Involvement	1,026
	Exposure Estimate (million km)	3,661.9
	Serious Casualty Crash Risk	**0.28**

3.3.3 Serious Casualty Crash Risks for Rural Highways

As had occurred for all casualty crashes, motorcycle riders travelling on Victorian rural highways had a considerably smaller serious casualty crash risk (estimated risk of 0.23 crashes per million kilometres) than riders in rural towns or on Melbourne arterial roads (Table 3.5). This risk was 1.4 times larger than the serious casualty crash risk for drivers on rural highways. In comparison, car driver risks in Melbourne and in Victorian rural towns were approximately 30 times larger than the corresponding motorcycle rider risks.

Table 3.5: SERIOUS CASUALTY Crash Risks for Motorcycle Riders and Car Drivers on VICTORIAN RURAL HIGHWAYS during 1994

ROAD USER	ESTIMATE	
Motorcycle Rider	Serious Casualty Crash Involvement	56
	Exposure Estimate (million km)	245.3
	Serious Casualty Crash Risk	**0.23**
Car Driver	Serious Casualty Crash Involvement	639
	Exposure Estimate (million km)	3,916.2
	Serious Casualty Crash Risk	**0.16**

3.4 FATAL CRASH RISKS

The risks of motorcyclists being involved in a fatal crash in Melbourne, in Victorian rural towns and on Victorian rural highways are presented in the following sections. Fatal crash risks for car drivers are also presented as a comparison.

3.4.1 Fatal Crash Risks on Melbourne Arterial Roads

On Melbourne arterial roads during 1994, motorcycle riders were estimated to have 0.273 fatal crashes per million kilometres travelled (Table 3.6). The motorcycle fatal crash risk was 33 times larger than the fatal crash risk for car drivers.

Comparing the risks for casualty, serious casualty and fatal crashes on Melbourne arterial roads, it was found that as the severity of the crash increased, the relative risk for motorcycle riders also increased in relation to car driver risks.

Table 3.6: FATAL Crash Risks for Motorcycle Riders and Car Drivers on MELBOURNE Arterial Roads during 1994

ROAD USER	ESTIMATE	
Motorcycle Rider	Fatal Crash Involvement	40
	Exposure Estimate (million km)	146.6
	Fatal Crash Risk	**0.273**
Car Driver	Fatal Crash Involvement	400
	Exposure Estimate (million km)	47,780.9
	Fatal Crash Risk	**0.0084**

3.4.2 Fatal Crash Risks for Rural Towns

Table 3.7 gives the fatal crash risks for motorcycle riders and car drivers travelling on major roads in Victorian rural towns during 1994. Motorcycle riders were estimated to have a fatal crash risk of 0.71 fatalities per million kilometres travelled. This estimate was two and a half times larger than the motorcycle fatal crash risk for travel on Melbourne arterial roads, and was 34 times larger than the fatal crash risk for drivers travelling in rural towns.

Similar to Melbourne, as the severity of the crash increased on major roads in Victorian rural towns, the relative risk for motorcycle riders also increased in relation to the car driver risk.

Table 3.7: FATAL Crash Risks for Motorcycle Riders and Car Drivers in VICTORIAN RURAL TOWNS during 1994

ROAD USER	ESTIMATE	
Motorcycle Rider	Fatal Crash Involvement	13
	Exposure Estimate (million km)	18.3
	Fatal Crash Risk	**0.709**
Car Driver	Fatal Crash Involvement	75
	Exposure Estimate (million km)	3,661.9
	Fatal Crash Risk	**0.021**

3.4.3 Fatal Crash Risks for Rural Highways

On Victorian rural highways, motorcycle riders had a much smaller fatal crash risk (0.037 fatal crashes per million kilometres) than riders in either rural towns or on Melbourne arterial roads during 1994 (Table 3.8). The fatal crash risk on rural highways was one-nineteenth of that in rural towns, and one-seventh of that on Melbourne arterial roads. Further, the motorcycle fatal crash risk was only 1.3 times larger than the corresponding driver risk on rural highways, whereas for the Melbourne and rural towns samples, the motorcycle risks were, respectively, 33 and 34 times larger than the car driver fatal crash risks.

Unlike the other two environments, as the severity of the crash increased on Victorian rural highways, the relative risk for motorcycle riders in relation to the risk for car drivers ***did not increase*** monotonically.

Table 3.8: FATAL Crash Risks for Motorcycle Riders and Car Drivers on VICTORIAN RURAL HIGHWAYS during 1994

ROAD USER	ESTIMATE	
Motorcycle Rider	Fatal Crash Involvement	9
	Exposure Estimate (million km)	245.3
	Fatal Crash Risk	**0.037**
Car Driver	Fatal Crash Involvement	117
	Exposure Estimate (million km)	3,916.2
	Fatal Crash Risk	**0.028**

4. SUMMARY

This report presented the results of an analysis of two different data sets which were provided to MUARC. The first of these was data collected during an exposure survey conducted by Arup Transportation Planning during 1994 on behalf of VicRoads. It was presumed by MUARC that the data were collected as described in the consultant's report and that survey measured what it purported to measure. The second data set was a file of accident report data, originally collected by the Victoria Police during 1990-94, and subsequently enhanced by VicRoads.

Because the MUARC analysis made use of data prepared by others, it should be emphasised that the results depend on the validity of the original data collections. They also depend on a range of assumptions made in the analysis, which include the assumption that accident patterns during the years 1990-94 were relatively stable and hence could be compared with 1994 exposure estimates to measure casualty accident risks during that year.

During 1994, motorcycles comprised a larger proportion of total vehicle travel on Victorian rural highways (5.9%) than on either Melbourne arterial roads (0.3%) or in rural towns (0.5%). However, the risk of casualty crash involvement per kilometre ridden was lowest on Victorian rural highways.

Motorcycle riders in Victorian rural towns had the highest risk of casualty crash involvement amongst all three locations, 20 casualty crashes per million kilometres travelled. For the respective Melbourne and rural towns samples, motorcycle riders were 18 and 16.5 times more likely to be involved in a casualty crash than car drivers, but for rural highways the motorcycle and car risks were similar and relatively low (0.5 casualty crashes per million kilometres).

Serious casualty and fatal crash risks for motorcyclists in rural towns were also higher than on Melbourne arterial roads or on rural highways.

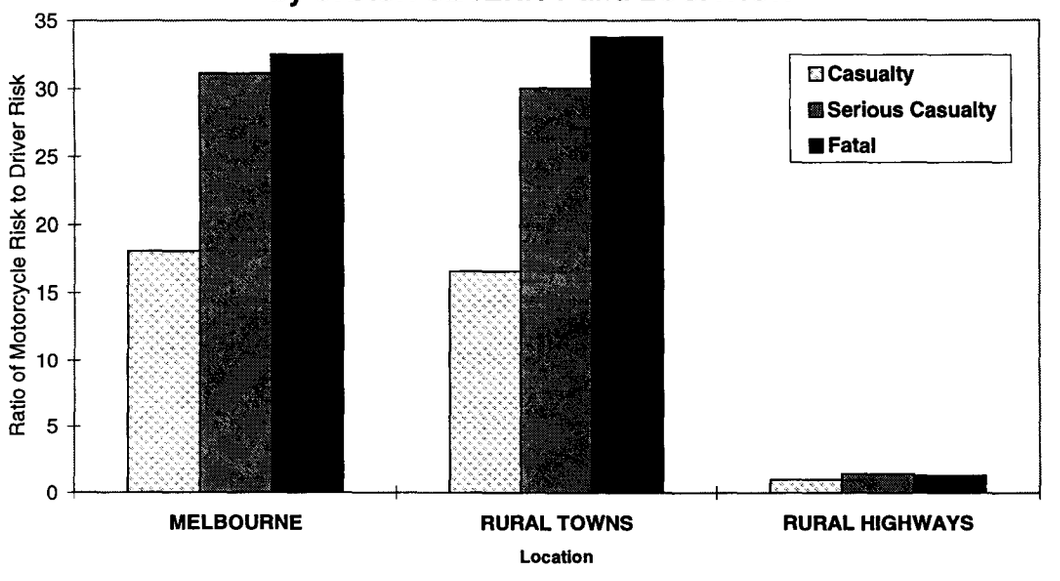
For travel on Melbourne arterial roads and in rural towns it was found that as the severity of the crash increased, the risk for motorcycle riders also increased compared with car drivers as depicted in Table 4.1 and Figure 4.1. On Melbourne arterial roads, motorcycle riders were 18 times more likely to be involved in casualty crashes than car drivers, but for serious casualty and fatal crashes the risks of involvement for motorcyclists were respectively 31 and 33 times greater than the risks for car drivers. Similar relative risks occurred for travel on major roads in Victorian rural towns.

A different pattern emerged for rural highway travel as shown in Figure 4.1. There was little difference between the motorcycle rider risks and car driver risks for each crash severity level. At most, motorcycle riders were 1.4 times as likely to be involved in a serious casualty crash as car drivers, per kilometre travelled.

Table 4.1: Motorcycle and Car Driver Risks by CRASH SEVERITY and LOCATION during 1994

LOCATION	CRASH SEVERITY	CRASH RISK (per million km)		Ratio of Motorcyclist Risk to Driver Risk
		Motorcyclist	Car Driver	
Melbourne	Casualty	14.80	0.82	18.1
	Serious Casualty	5.91	0.19	31.1
	Fatal	0.273	0.0084	32.5
Rural Towns	Casualty	20.02	1.21	16.6
	Serious Casualty	8.40	0.28	30.0
	Fatal	0.709	0.021	33.8
Rural Highways	Casualty	0.47	0.46	1.0
	Serious Casualty	0.23	0.16	1.4
	Fatal	0.037	0.028	1.3

Figure 4.1: Ratio of Motorycle Rider Risk to Car Driver Risk by CRASH SEVERITY and LOCATION



5. REFERENCES

Arup Transportation Planning. (1995). *The 1994 Crash Exposure Survey.* Prepared for VicRoads, Melbourne.

Cameron, M. & Oxley, J. (1995). *Investigation of Improved Exposure Data for the Assessment of Road Safety.* Report No. RIIP-6, Australian Institute of Health and Welfare, National Injury Surveillance Unit, South Australia.

Diamantopoulou, K., Skalova, M., Dyte, D. & Cameron, M. (1996). *Crash Risks of Road User Groups in Victoria.* Report No. 88, Monash University Accident Research Centre, Victoria.