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THE RISK OF DRIVER CRASH INVOLVEMENT AS A FUNCTION OF DRIVER AGE

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The Risk of Driver Crash Involvement as a Function of Driver Age

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Abstract:

This short report has presented an analysis of risk of crash involvement estimates for 1988 in Metropolitan Melbourne. By necessity, the analysis was age based, in contrast to the original work which was primarily experience based. It was noted that factors other than the ambient level may have affected the incidence of **reported** crashes, perhaps reducing the direct comparability of the two sets of results. Nevertheless, the same general patterns of results have been obtained, namely the increased risk of crash involvement for younger drivers, the approximate equivalence of risk as a function of driver gender and the elevated risk of night-time driving, particularly after midnight, and for 19 year old drivers.

Key Words:

crash, exposure, risk, young driver.

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1.0 INTRODUCTION

The Victorian Expert Working Group on Young and/or Inexperienced Driver Safety recognised the need for the collection of high quality exposure data to supplement mass crash data and support the estimation of casualty crash involvement risk as a function of driving experience (Drummond & Torpey, 1984).

On the assumption that high risk driving is the most legitimate young driver exposure reduction target, this process could be considered essential to the development of young driver crash countermeasures. Exposure reduction continues to be the only effective method of reducing the frequency of young driver crashes; the MUARC (Monash University Accident Research Centre) research program on young driver performance aims to develop risk reduction measures through fundamental analyses of driving performance differences.

The initial crash risk analysis outcomes have been reported in a number of places, with Drummond & Healy (1986) providing both an overview of crash risk outcomes and a description of the unique method by which objective measures of exposure (i.e. distance driven) are generated. This short report provides an update of this work.

2.0 EXPOSURE, CRASHES, AND RISK

2.1 Background

Exposure is often defined as "the opportunity to have a crash". In Victoria, this has been operationally defined as the distance of travel. Work in New Zealand has indicated that duration of travel is also an acceptable measure of exposure, although distance and duration are both preferable to a count of the **number of trips** (White, 1979).

Within any given unit of exposure (e.g. total driving on weekdays, driving in non-metropolitan areas, total statewide driving), a certain number of crashes will occur. The actual number of crashes depends on a range of factors but has been demonstrated to vary as a function of vehicle type, road type, age of driver, time of day, etc. The mathematical relationship between risk, crashes, and exposure is:

$$\text{RISK} = \frac{\text{CRASHES}}{\text{EXPOSURE}}$$

Thus, estimates of the risk of crash involvement can vary over time as a result of differential changes in the incidence of crashes and/or the aggregate amount of exposure (if both crashes and exposure increase/decrease **in proportion**, risk estimates remain the same). However, over time, there are a range of factors in the crash frequency domain other than the ambient level of safety which will affect the apparent number of crashes and, by extension, the estimates of crash involvement risk. Thus, the question of comparability of this update is an issue requiring resolution. There are three elements to this question:

- apparent changes in exposure patterns
- apparent changes in crash frequencies
- absolute versus relative crash risk

These three elements are addressed in the next section. The original work and this "update" used/use the following datasets:

Table 2.0.1: Datasets used to calculate risk estimates

	Original	Update
Crashes	1981-83	1988
Exposure	1984	1988

It should be noted that, at the definitional level, these data sets are directly comparable both **within** and **between** time periods. That is, the data related to the same time (non-holiday period of year) and space (the same Local Government Areas of the Melbourne Statistical Division). These times and locations are presented in Appendix A.

2.2 Exposure Pattern

Table 2.1.1 shows that the estimate of aggregate exposure calculated on the basis of survey data has increased by 40% between 1984 and 1988 and that there does not appear to be any differential change in exposure as a function of driver age.

Table 2.1.1: Exposure data collected from 37 LGAs during the non-holiday period

Year	18-25 year old exposure (millions)	% change	26-98 year old exposure (millions)	% change	Total driver exposure (millions)	% change
1984	1264.1		4796.3		6060.4	
1988	1790.5	42%	6702.0	40%	8492.5	40%

There are no directly comparable data to provide a measure of external validation for these measured increase in exposure (neither have confidence limits for these point estimates been calculated - these would give upper and lower bounds for the change in exposure, i.e., 95% sure that the change is between say, 30-50%) and whether this change is significant.

Nevertheless, in the period 1984-1988, there has been a 10% increase in the number of vehicles registered in Victoria and it is estimated that there has been a 20% increase in kilometres travelled statewide (this estimate is derived from fuel sales data). It would appear that the survey data reported in Table 2.1.1 are not inconsistent with these other data.

2.3 Crash Patterns

Table 2.3.1 presents a time series of crash frequency data for young, older, and all drivers for the period 1981-1988. Crash frequencies relate to the whole year as defined non-holidays periods were only available for 1981-83 and 1988.

Table 2.3.1: Crash data collected from 37 LGAs for the whole year

Year	18-25 years	% change	26-98 years	% change	Total	% change
1981-82*	2483		4642		7125	
1983*	2472	-0.4%	4546	-2%	7017	-2%
1984	3799	54%	6716	48%	10515	50%
1985	4222	11%	7013	4%	11235	7%
1986	4017	-5%	7182	2%	11199	-0.3%
1987	4416	10%	8050	12%	12466	11%
1988	5347	21%	9711	21%	15058	21%

* 1981-82 and 1983 crash data for the whole year have been scaled from non-holiday crash frequencies, using scaling factors derived from the 1988 data. The scaling factors for the 18-25 age group, 26-98 age group, and total were 1.348, 1.307, and 1.321 respectively.

Table 2.3.1 shows two dysjunctions in the series, the large apparent increase between 1983 and 1984, and the large jump in 1988. It is not possible to provide definitive explanations for these jumps (nor is it necessary, given the greater emphasis on relative risk estimates). However, the following points should be noted;

- Crash data extraction relies upon the variable ANS_TYPE to identify those crashes on the arterial network. While virtually all metropolitan crashes are now classified by ANS_TYPE (and earlier years have been classified retrospectively), in the early 1980's, a proportion of metropolitan crashes were unclassified. This would have made the original analysis, restricted as it was to known arterial road crashes, conservative in an absolute sense: it is likely that classification/lack of classification was a random process with respect to driver age and therefore relative risk estimates would have been largely unaffected.

- The large jump in 1988, and to a lesser extent 1987, reflect both a worsening serious crash situation in Victoria (Drummond, Sullivan, & Vulcan, 1991) and changes in crash reporting requirements. The relative contribution of each factor to the overall result is not known.

This crash time series pattern reduces the direct comparability of crash risk outcomes over time and emphasises the need to focus on general patterns over time (**within** a time period, more detailed analysis and interpretation can be undertaken).

2.4 Absolute versus Relative Crash Involvement Risks

There may be a range of reasons why the estimates of **absolute** risk of casualty crash involvement may not be directly comparable **over time**. Absolute risk means the number of crash involvements per million kilometres travelled for any particular unit of analysis (e.g. inexperienced drivers on weekday nights, etc). However, the computation of two or more absolute risk estimates allows the calculation of a relative risk estimate which may go some way to controlling the effect of other factors and improve comparability of estimates in different time periods (relative risks are calculated by setting the relative risk of the chosen reference group, e.g. experienced drivers) to unity (by dividing that group's absolute risk by itself) and establishing the relativities of other groups by dividing their absolute risk by the risk estimate for the comparison group. The following hypothetical example both illustrates the process and the different interpretations flowing from the use of absolute and relative risk estimates.

Table 2.4.1: Absolute risk estimates
(Crash Involvement per million kilometres travelled)

	Young Drivers	Older Drivers
1980	2.0	1.0
1990	4.0	2.0

One interpretation of this table is that, per unit distance, it was, on average, twice as risky to drive during 1990 as it was during 1980 as absolute risk estimates have doubled (crash involvement frequencies may not have doubled as this depends on the actual amount of exposure). The relative risk of young driver crash involvement (relative to older drivers) has remained constant at 2:1 and this could be interpreted as indicating a degree of stability in ambient levels of safety (i.e. increases in absolute risk reflect changes in factors other than safety, e.g. crash reporting rates).

The respective contributions of ambient safety and other factors to changes in the absolute risk of crash involvement can only be partially resolved through reference to relative risk estimates. Other measures of safety which are less affected by non-safety factors such as fatality rates may assist but these may not be directly comparable (or equally affected given the severity difference) to crash risk estimates. Such issues should be kept in mind when the results section is read.

3.0 PREVIOUS STUDY

The original work was all done on the basis that driving experience was the most acceptable method for discriminating between driver groups. Experience-based countermeasures (rather than age-based) were considered most equitable and were consistent with the road safety focus on the target group as new drivers rather than young people. However, it is not possible to duplicate this work as the crash database algorithm used to assign duration of driving experience to crash involved drivers on the basis of driver age and licence numbers is no longer appropriate. When applied to 1988 crash data, the method only achieves a 62% success rate in deriving driving experience from driver information. As shown in Figure 3.0.1, this is a particular and obvious problem for the least experienced driver group.

Figure 3.0.1: Absolute Risk Estimates by Driver Experience

Thus, the only available method for comparing 1984 and 1988 risk estimation outcomes is on the basis of driver age groups. Two points should therefore be kept in mind:

- the 1984 results are slightly different to those previously reported as the risk estimates are now age-based.
- the 1984 to 1988 comparisons need to be made with the information presented in Section 2 in mind.

Table 3.0.1 presents 1984 and 1988 risk estimates as a function of driver age group to allow direct comparisons to be made. It should be noted that Table 3.0.1 demonstrates the greater stability of **relative** risk estimates: for example, whereas the absolute risk estimate for 18 years has increased some 73%, the relative risk estimate has only increased by some 16%. This outcome is generally applicable across the various age groups.

Table 3.0.1: Absolute/relative risk estimates by driver age group (1984 and 1988)

Absolute Risk

	18 yrs	19 yrs	20 yrs	21-25	26-29	30-59	60+
1984	2.37	2.40	1.78	1.13	0.76	0.70	0.93
1988	4.10	3.10	3.24	1.79	1.36	1.04	1.28

Relative Risk

	18 yrs	19 yrs	20 yrs	21-25	26-29	30-59	60+
1984	3.39	3.43	2.57	1.57	1.14	1.00	1.29
1988	3.94	2.98	3.12	1.72	1.31	1.00	1.23

4.0 UPDATED RISK ESTIMATES

4.1 Introduction

This section presents the results of the updating exercise. Both absolute and relative estimates of the risk of crash involvement are provided, primarily in graphical form. The criterion on which all relative risk estimates are calculated is the overall absolute risk of crash involvement for drivers aged 30-59 years. As can be seen in Table 4.2.1, this driver group has the lowest level of absolute risk (1.0 casualty crashes per million kilometres travelled), making them an appropriate baseline comparison group. All data used in the estimation of crash risk outcomes are presented in Appendix B.

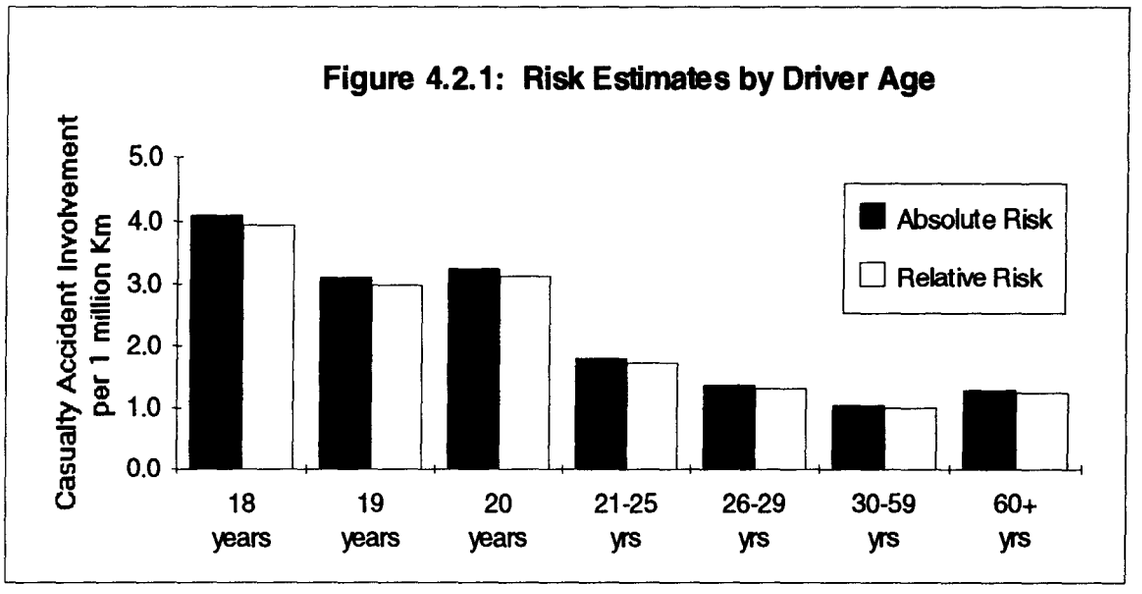
4.2 Results

Table 4.2.1 presents overall crash frequencies, aggregate exposure estimates and absolute and relative risk estimates as a function of driver age.

Table 4.2.1: Risk estimates by driver age

Age	Crash Involvement	Exposure Estimate (millions)	Absolute Risk	Relative Risk
18 years	423	103.3	4.10	3.94
19 years	610	196.7	3.10	2.98
20 years	595	183.4	3.24	3.12
21-25 yrs	2338	1307.2	1.79	1.72
26-29 yrs	1332	978.8	1.36	1.31
30-59 yrs	5241	5053.0	1.04	1.00
60+ years	858	670.2	1.28	1.23

These risk estimates are presented in graphical form in Figure 4.2.1. It shows the same general pattern of a skewed U-shaped curve, with younger drivers having significantly elevated crash involvement risks and the oldest driver group demonstrating a modest increase in crash involvement risk.



One of the outcomes of the original work was the finding that on a per distance travelled basis, there were no substantial differences in crash risk as a function of driver gender (previously the young driver problem had been portrayed primarily as a young **male** driver problem). This substantive equivalency of crash risk remains when age-based risks are examined as a function of driver gender, although for most age groups, females tend to have slightly higher crash involvement risks (see Figure 4.2.2a & b).

Figure 4.2.2a: Absolute Risk - Sex by Age Group

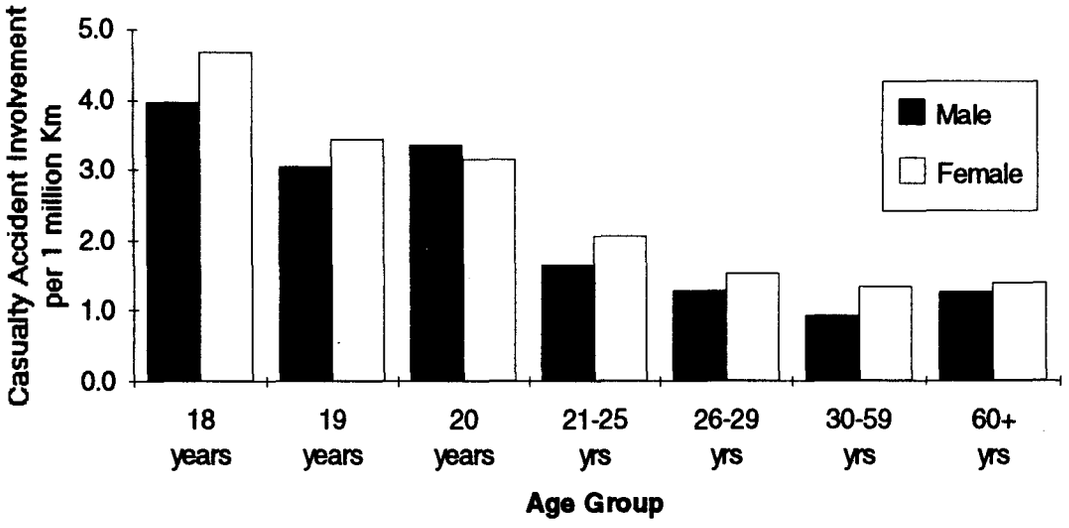
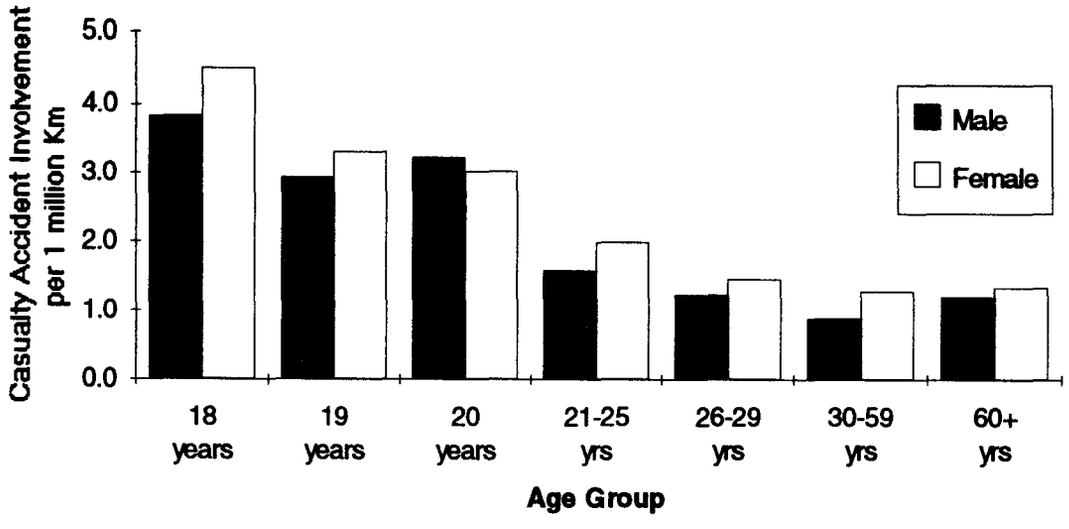


Figure 4.2.2b: Relative Risk - Sex by Age Group



It had been demonstrated that night-time driving, defined at a **general level**, was associated with higher levels of risk of crash involvement for all drivers, but posed a particular problem for the least experienced driver group. On a driver age basis, this general finding remains for the youngest drivers (18-19 year olds) and, for drivers aged 60 years or more (see Figure 4.2.3a & b).

Figure 4.2.3a: Absolute Risk - Day vs. Night by Age Group

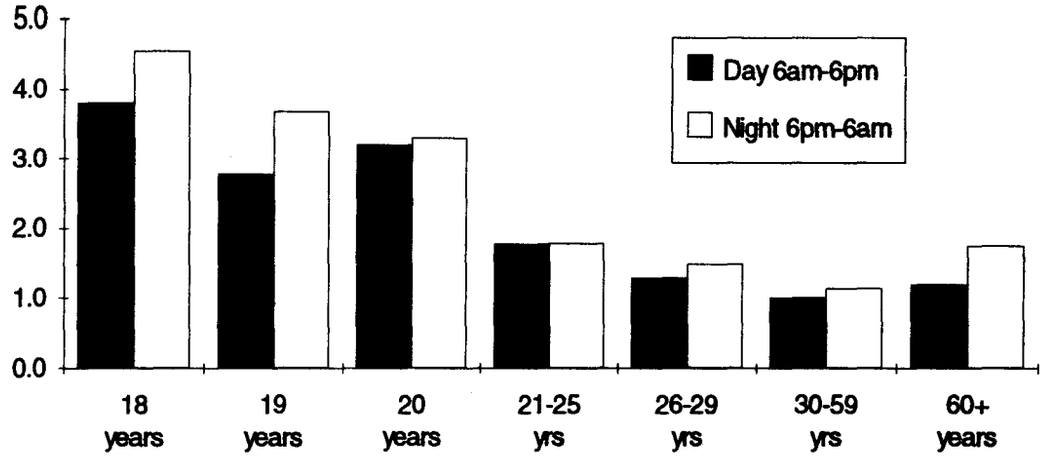
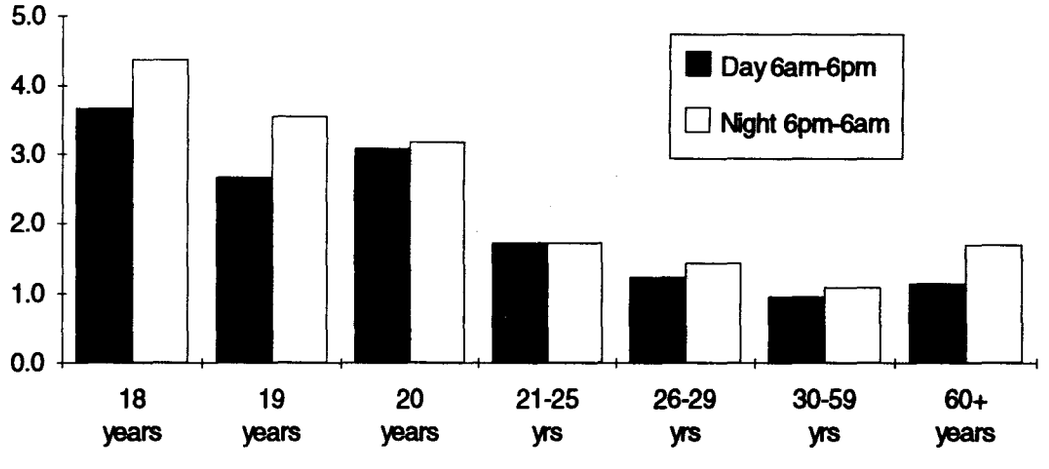


Figure 4.2.3b: Relative Risk - Day vs. Night by Age Group



Figures 4.2.4a and 4.2.4b examine time of day controlling for time of week and presents crash risk estimates with four basic time blocks. The graphs show that weekend night-time driving for 18-20 year old drivers is a particular problem, with risk in the other three time blocks being roughly similar. The relatively high risk associated with weekday daytime driving is perhaps surprising: this may be a reflection of the possibility that reporting of crashes in this time block showed the greatest increase as a result of the new reporting requirements.

Figure 4.2.4a: Absolute Risk - Time Block by Age Group

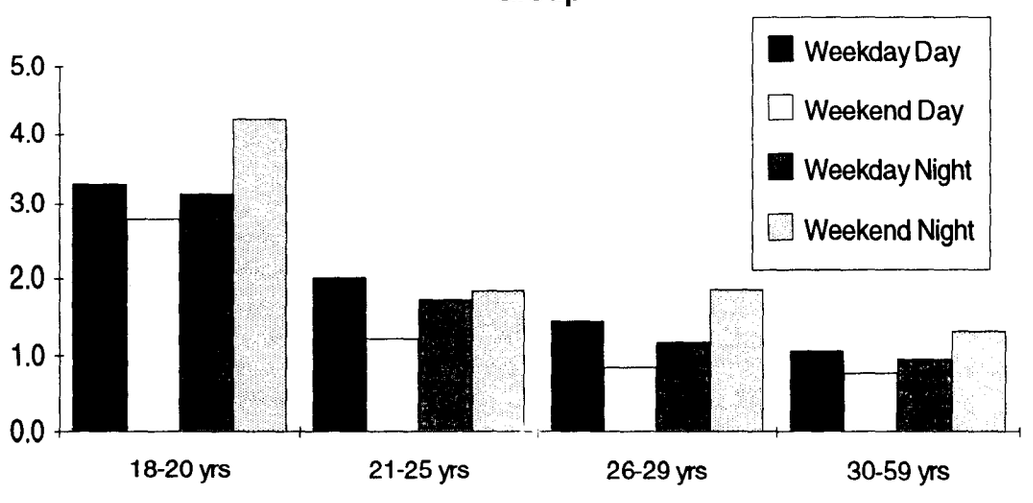


Figure 4.2.4b: Relative Risk - Time Block by Age Group

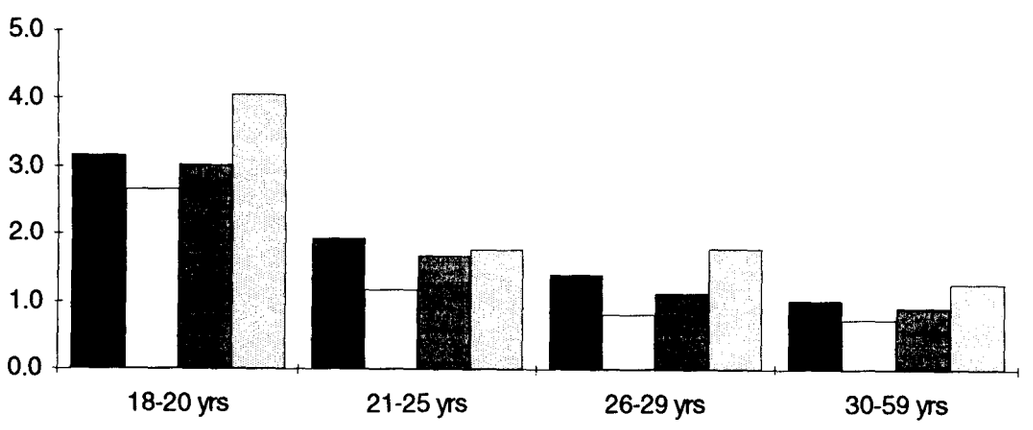
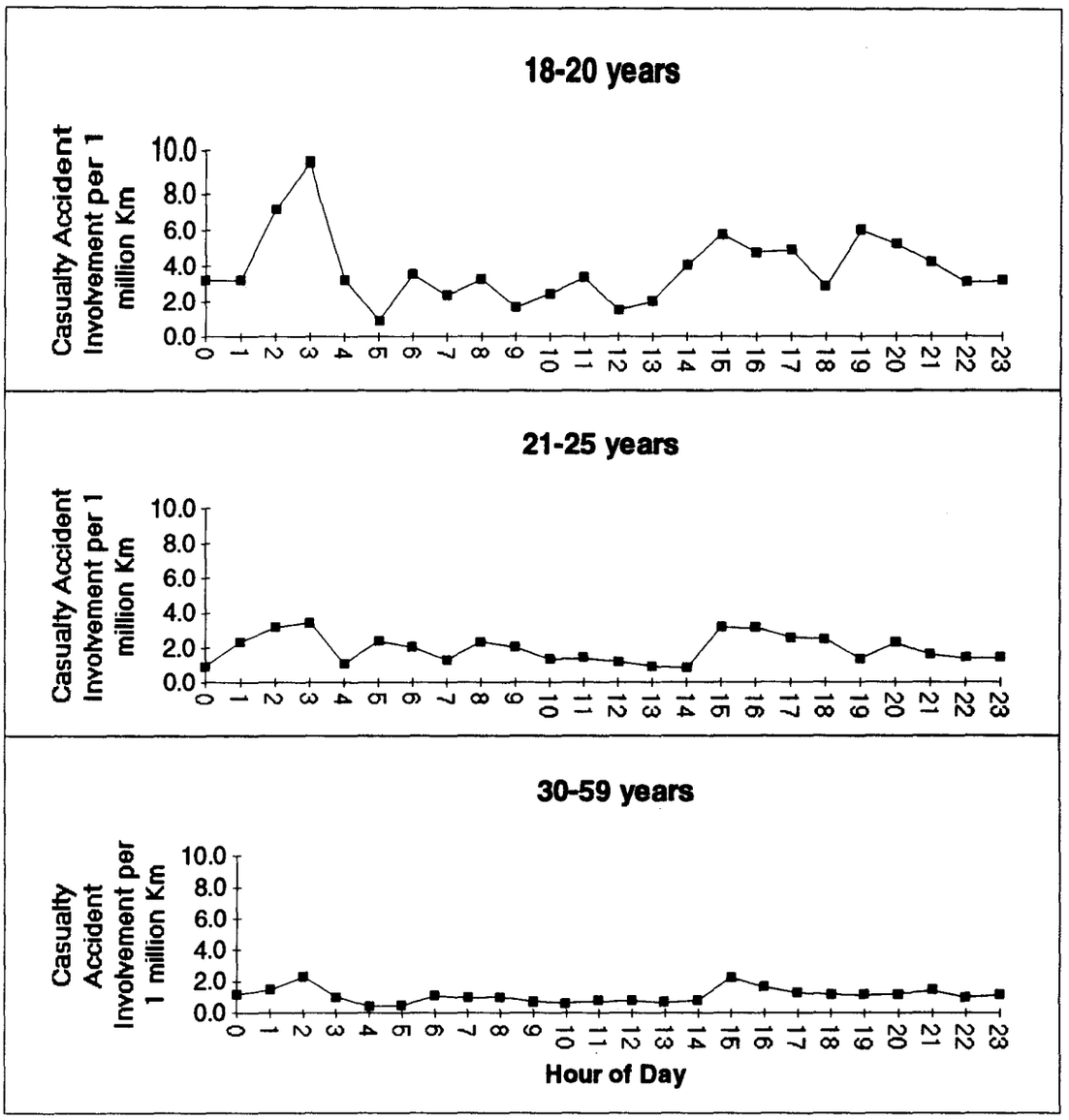


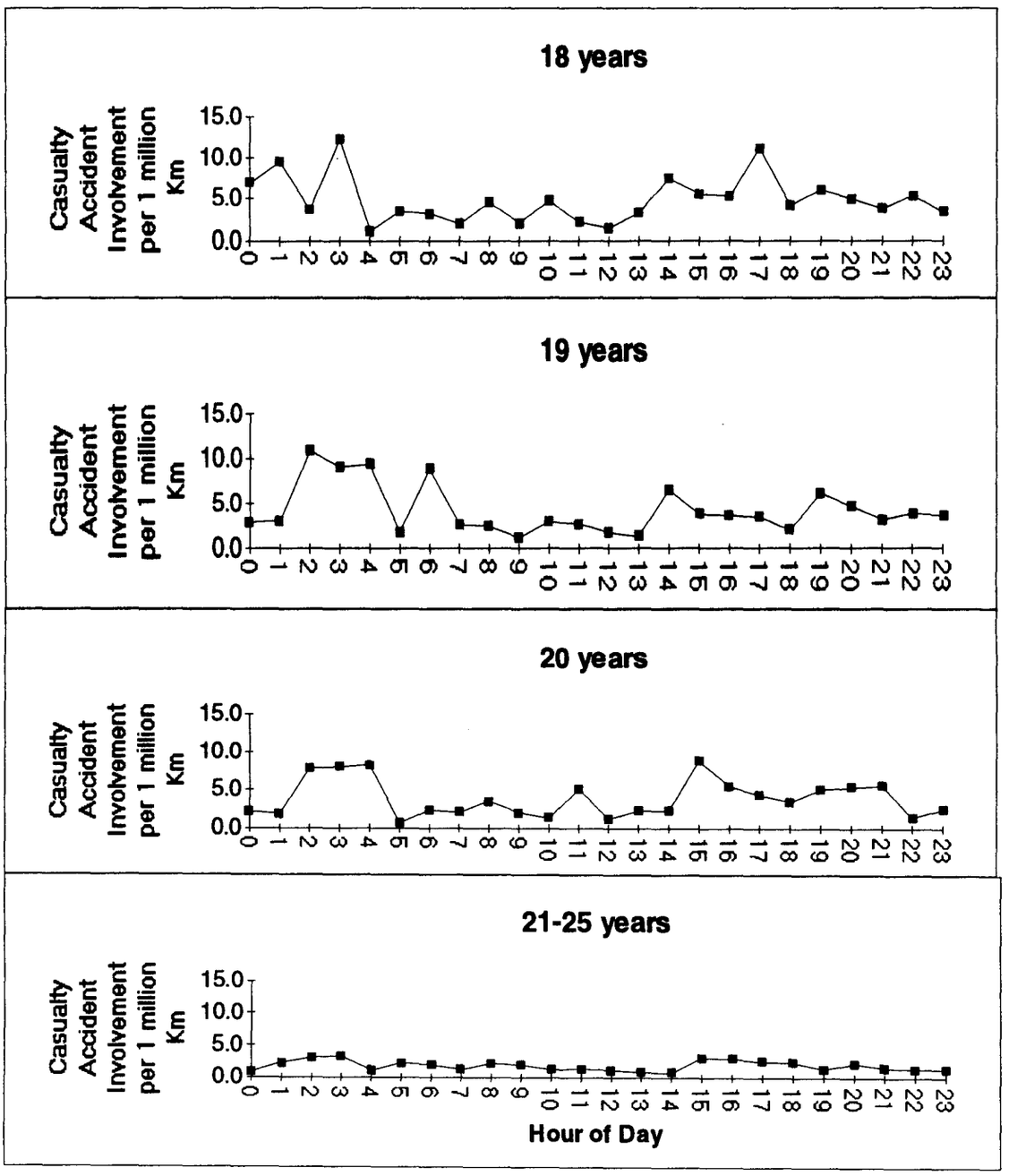
Figure 4.2.5 presents absolute risk estimated for three age groups, viz. 18-20, 21-25, and 30-59 year olds by single hour of day in order to show a more detailed pattern of risk. The early morning (i.e. post midnight) period is generally associated with higher levels of risk than the late night (till midnight) period, while afternoons tend to be associated with higher levels of risk than mornings.

Figure 4.2.5: Absolute Risk Estimates by Hour of Day



The next set of graphs (Figure 4.2.6) extend the above information by presenting the relative risks by single hour of day for the youngest drivers by single year of age (with 21-25 year olds presented for reference). The pattern for the three youngest age groups is similar, with afternoon and night-time elevations. When presented on the same scale, the risk pattern for 21-25 year old drivers is relatively flat.

Figure 4.2.6: Relative Risk Estimates by Hour of Day



The final set of tables in this section (Table 4.2.2) presents information on exposure, absolute and relative risk and crashes within a range of potential night-time driving restriction period. In contrast to earlier data which showed a consistent increase in risk of crash involvement as the restriction started later at night, the age-based risks appear relatively stable across these periods. It should be noted that absolute exposure is higher for 19 year olds than for 18 year olds in all restricted periods, except for the 1am-5am period in which the amount of exposure affected is the same for the two age groups. A table of crash data by time of day for the whole State to support estimates of statewide benefits from exposure reduction can be found in Appendix C.

Table 4.2.2: Risk estimates of young drivers during restricted period

18 years	% Exposure	Absolute Risk	Relative Risk	% Night-time Crashes	% Total Crashes
8pm-5am	25.6%	4.4	4.2	67.4%	27.4%
9pm-5am	21.0%	4.2	4.1	53.5%	21.7%
10pm-5am	16.5%	4.3	4.2	43.0%	17.5%
11pm-5am	13.0%	4.0	3.9	31.4%	12.8%
12am-5am	9.1%	4.3	4.1	23.3%	9.5%
1am-5am	7.0%	3.4	3.3	14.5%	5.9%

19 years	% Exposure	Absolute Risk	Relative Risk	% Night-time Crashes	% Total Crashes
8pm-5am	18.6%	4.3	4.1	60.5%	25.6%
9pm-5am	16.0%	4.2	4.0	50.8%	21.5%
10pm-5am	11.8%	4.4	4.3	39.9%	16.9%
11pm-5am	8.4%	4.6	4.4	29.5%	12.5%
12am-5am	5.9%	5.0	4.8	22.1%	9.3%
1am-5am	3.5%	6.3	6.1	16.7%	7.0%

Figures 4.2.7a and 4.2.7b present absolute and relative risk estimates for the four youngest age groups within each of the potentially restricted time periods.

Figure 4.2.7a: Absolute Risk Estimates During Restricted Period

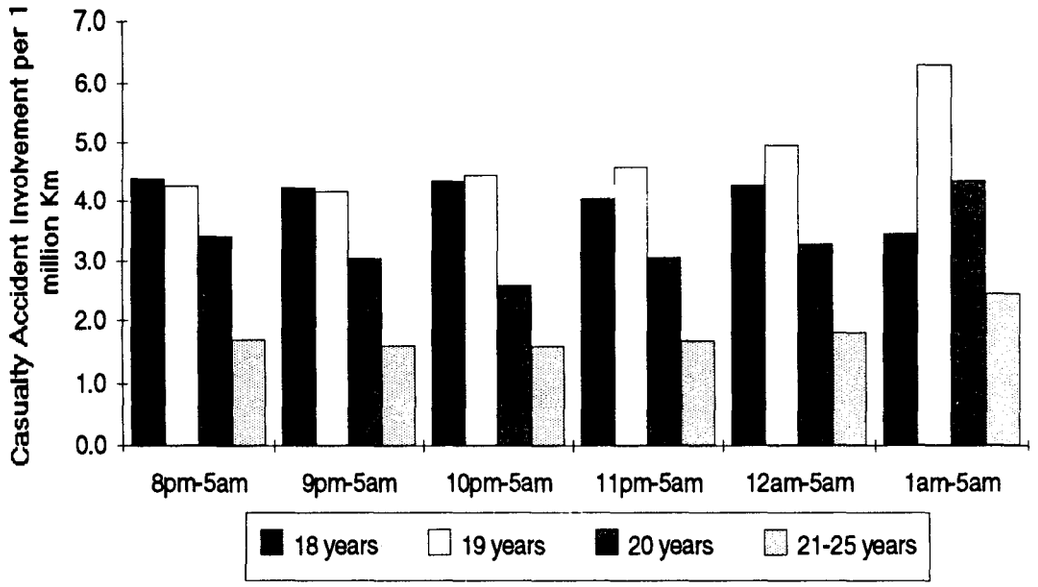
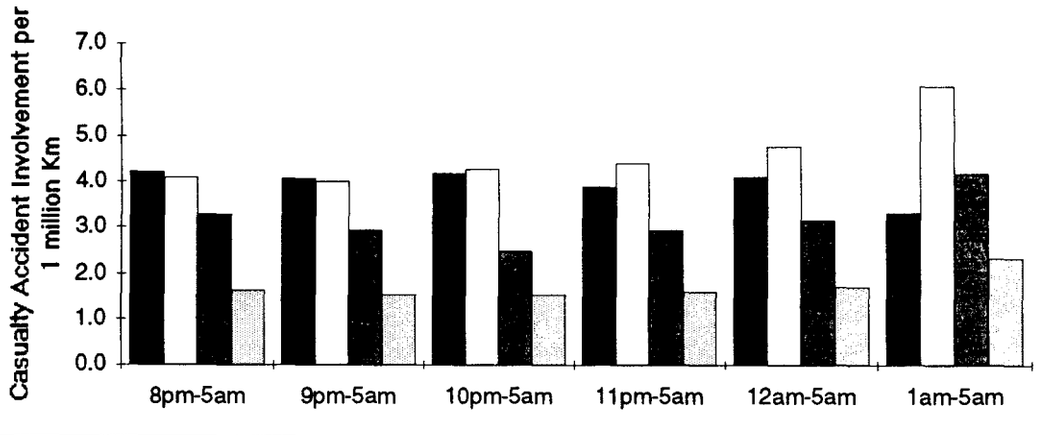
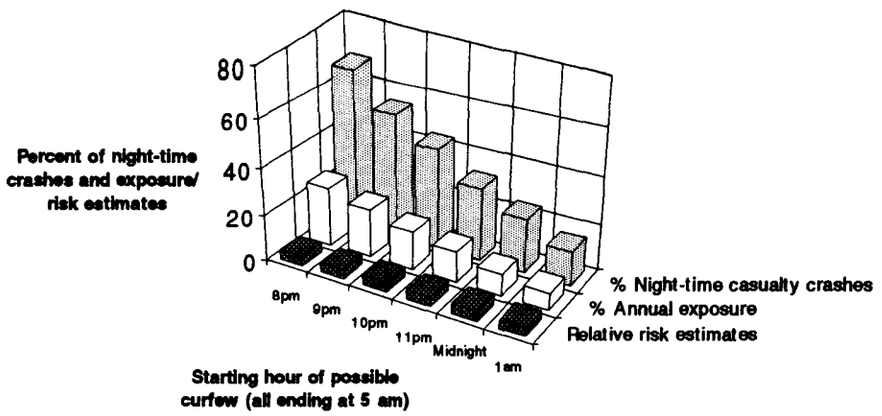


Figure 4.2.7b: Relative Risk Estimates During Restricted Period



While the general stability of risk across these periods has been noted, the elevated risk of 18 and 19 year old drivers in each period is marked (except for 18 year old drivers in the 1am-5am period). Figure 4.2.8 shows graphically how exposure, risk, and crashes vary as a function of possible commencement time of a night-time driving restriction.

Figure 4.2.8: Crash, exposure, and relative risk as a function of possible commencement time of a night-time driving restriction (18 year olds)



5.0 CONCLUSION

This short report has presented an analysis of risk of crash involvement estimates for 1988 in Metropolitan Melbourne. By necessity, the analysis was age based, in contrast to the original work which was primarily experience based. It was noted that factors other than the ambient level may have affected the incidence of **reported** crashes, perhaps reducing the direct comparability of the two sets of results. Nevertheless, the same general patterns of results have been obtained, namely the increased risk of crash involvement for younger drivers, the approximate equivalence of risk as a function of driver gender and the elevated risk of night-time driving, particularly after midnight, and for 19 year old drivers.

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APPENDIX A

Holiday period (marked X) in 1988:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	X			X			X		X	X	X	
2	X			X			X		X	X		
3	X			X			X		X			
4	X			X			X		X			
5	X			X			X		X			
6	X			X			X		X			
7	X			X			X		X			
8	X			X			X		X			
9	X			X			X		X			
10	X			X			X		X			
11	X					X			X			X
12	X		X			X			X			X
13	X		X			X			X			X
14	X		X						X			X
15	X								X			X
16	X											X
17	X											X
18	X											X
19	X											X
20	X											X
21	X											X
22	X											X
23	X											X
24	X											X
25	X					X						X
26	X					X						X
27	X					X						X
28	X					X						X
29	X					X				X		X
30	X					X				X		X
31	X									X		X

Local Government Areas (LGAs):

Central: Collingwood, Fitzroy, Melbourne, Port Melbourne, Prahran, Richmond, South Melbourne.

Eastern: Box Hill, Camberwell, Croydon, Doncaster/Templestowe, Hawthorn, Kew, Knox, Malvern, Nunawading, Ringwood, Waverley.

Southern: Brighton, Caulfield, Dandenong, Frankston, Moorabbin, Mordialloc, Oakleigh, St. Kilda, Sandringham, Springvale.

Northern: Brunswick, Broadmeadows, Coburg, Essendon, Footscray, Heidelberg, Northcote, Preston, Williamstown.

APPENDIX B

All data used in the estimation of the 1988 crash risk outcomes are shown in the following tables.

Age Group x Sex

	Crash				Exposure				Exposure x 37/1000000			
	Unknown	Female	Male	Total	Unknown	Female	Male	Total	Unknown	Female	Male	Total
Unknown	8	12	25	45	963076	104493	762730	1830299	35.63	3.87	28.22	67.72
0-17 yrs	.	71	120	191	.	91297	241402	332699	.	3.38	8.93	12.31
18 years	1	141	281	423	62455	816156	1912710	2791321	2.31	30.20	70.77	103.28
19 years	.	235	375	610	134622	1850361	3330865	5315848	4.98	68.46	123.24	196.69
20 years	.	227	368	595	28155	1954530	2972999	4955684	1.04	72.32	110.00	183.36
21-25 yrs	3	986	1349	2338	218345	12917607	22193256	35329208	8.08	477.95	821.15	1307.18
26-29 yrs	3	537	792	1332	83790	9561475	16809178	26454443	3.10	353.77	621.94	978.81
30-59 yrs	7	1977	3257	5241	765939	40249809	95552180	136567928	28.34	1489.24	3535.43	5053.01
60+ yrs	1	227	630	858	52010	4426394	13634489	18112893	1.92	163.78	504.48	670.18
Total	23	4413	7197	11633	2308392	71972122	157409809	231690323	85.41	2662.97	5824.16	8572.54

	Absolute Risk				Relative Risk			
	Unknown	Female	Male	Total	Unknown	Female	Male	Total
Unknown	0.22	3.10	0.89	0.66	0.22	2.98	0.85	0.64
0-17 yrs	.	21.02	13.44	15.52	.	20.21	12.92	14.92
18 years	0.43	4.67	3.97	4.10	0.42	4.49	3.82	3.94
19 years	.	3.43	3.04	3.10	.	3.30	2.93	2.98
20 years	.	3.14	3.35	3.24	.	3.02	3.22	3.12
21-25 yrs	0.37	2.06	1.64	1.79	0.36	1.98	1.58	1.72
26-29 yrs	0.97	1.52	1.27	1.36	0.93	1.46	1.22	1.31
30-59 yrs	0.25	1.33	0.92	1.04	0.24	1.28	0.89	1.00
60+ yrs	0.52	1.39	1.25	1.28	0.50	1.33	1.20	1.23
Total	0.27	1.66	1.24	1.36	0.26	1.59	1.19	1.30

Age Group x Time Block

	Crash						Exposure					Exposure x 37/1000000				
	Unknown	WD-D	WE-D	WD-N	WE-N	Total	WD-D	WE-D	WD-N	WE-N	Total	WD-D	WE-D	WD-N	WE-N	Total
Unknown	1	25	3	8	8	45	699163	285186	450471	395477	1830297	25.87	10.55	16.67	14.63	67.72
0-17 yrs	1	117	23	16	34	191	183830	67517	63209	18144	332700	6.80	2.50	2.34	0.67	12.31
18 years	2	196	53	63	109	423	1171252	597883	458453	563733	2791321	43.34	22.12	16.96	20.86	103.28
19 years	.	279	73	90	168	610	2645554	777417	1048073	844805	5315849	97.89	28.76	38.78	31.26	196.69
20 years	1	268	92	109	125	595	2288751	748815	748432	1169686	4955684	84.68	27.71	27.69	43.28	183.36
21-25 yrs	4	1170	280	384	500	2338	15805803	6167265	5984287	7371853	35329208	584.81	228.19	221.42	272.76	1307.18
26-29 yrs	4	718	148	189	273	1332	13396639	4705050	4352619	4000135	26454443	495.68	174.09	161.05	148.00	978.81
30-59 yrs	14	3120	659	604	844	5241	79317880	22848298	17052015	17349736	136567929	2934.76	845.39	630.92	641.94	5053.01
60+ yrs	3	552	139	85	79	858	11853297	3734755	1380185	1144657	18112894	438.57	138.19	51.07	42.35	670.18
Total	30	6445	1470	1548	2140	11633	127362169	39932188	31537744	32858226	231690325	4712.40	1477.49	1166.90	1215.75	8572.54

WD-D = Weekday Day
WE-D = Weekend Day
WD-N = Weekday Night
WE-N = Weekend Night

	Absolute Risk					Relative Risk				
	WD-D	WE-D	WD-N	WE-N	Total	WD-D	WE-D	WD-N	WE-N	Total
Unknown	0.97	0.28	0.48	0.55	0.66	0.93	0.27	0.46	0.53	0.64
0-17 yrs	17.20	9.21	6.84	50.65	15.52	16.54	8.85	6.56	48.70	14.92
18 years	4.52	2.40	3.71	5.23	4.10	4.35	2.30	3.57	5.02	3.94
19 years	2.85	2.54	2.32	5.37	3.10	2.74	2.44	2.23	5.17	2.98
20 years	3.16	3.32	3.94	2.89	3.24	3.04	3.19	3.78	2.78	3.12
21-25 yrs	2.00	1.23	1.73	1.83	1.79	1.92	1.18	1.67	1.76	1.72
26-29 yrs	1.45	0.85	1.17	1.84	1.36	1.39	0.82	1.13	1.77	1.31
30-59 yrs	1.06	0.78	0.96	1.31	1.04	1.02	0.75	0.92	1.26	1.00
60+ yrs	1.26	1.01	1.66	1.67	1.28	1.21	0.97	1.60	1.79	1.23
Total	1.37	0.99	1.33	1.76	1.36	1.32	0.96	1.28	1.69	1.30

Age Group x Time of Day

	Crash									
	Unknown	0-17 yrs	18 years	19 years	20 years	21-25 yrs	26-29 yrs	30-59 yrs	60+ yrs	Total
12-1 am	.	1	15	14	18	40	15	74	5	182
1-2 am	1	4	9	12	9	43	24	39	3	144
2-3 am	.	1	6	13	9	42	16	36	4	127
3-4 am	.	1	5	10	9	31	14	16	1	87
4-5 am	.	1	5	8	6	15	12	15	1	63
5-6 am	1	3	1	3	6	30	7	33	2	86
6-7 am	2	7	8	12	15	65	54	197	16	376
7-8 am	1	18	20	43	34	143	83	334	37	713
8-9 am	2	27	27	39	39	201	94	433	41	903
9-10 am	.	9	12	12	17	82	52	234	35	453
10-11 am	1	4	15	18	14	60	39	219	35	405
11am-12pm	2	9	12	21	30	85	58	248	63	528
12-1 pm	5	8	16	28	11	99	57	271	79	574
1-2 pm	.	11	16	17	23	75	38	236	69	485
2-3 pm	2	3	20	17	23	69	50	228	62	474
3-4 pm	4	8	19	27	34	147	89	447	83	858
4-5 pm	4	20	37	52	58	196	124	471	98	1060
5-6 pm	5	16	47	66	62	228	128	461	73	1086
6-7 pm	5	7	31	50	42	209	118	419	53	934
7-8 pm	3	11	24	49	38	144	84	281	40	674
8-9 pm	2	5	24	25	35	104	44	151	7	397
9-10 pm	.	7	18	28	31	79	38	154	17	372
10-11 pm	1	9	20	27	14	83	38	122	15	329
11pm-12am	3	.	14	19	17	64	52	108	16	293
Unknown	1	1	2	.	1	4	4	14	3	30
Total	45	191	423	610	595	2338	1332	5241	858	11633

Age Group x Time of Day

	Exposure									
	Unknown	0-17 yrs	18 years	19 years	20 years	21-25 yrs	26-29 yrs	30-59 yrs	60+ yrs	Total
12-1 am	20288	7562	57010	126930	216163	1133919	448137	1651423	69033	3730465
1-2 am	103874	633	24648	102364	127609	494542	335054	722314	26712	1937750
2-3 am	13787	.	43824	31175	29945	357806	180048	421952	6518	1085055
3-4 am	.	.	10569	28532	29173	241479	104288	421142	115195	950378
4-5 am	8063	.	117609	22095	18830	363238	138942	948030	67559	1684366
5-6 am	5268	.	7691	43624	232382	343344	366815	1870477	88193	2957794
6-7 am	5751	.	66755	34954	165618	861783	942813	4983660	418214	7479548
7-8 am	3350	.	270738	426258	429939	2937338	1509379	9206360	923555	15706917
8-9 am	21666	2600	156560	422307	289183	2323854	1518178	11712438	1178183	17624969
9-10 am	.	33819	153341	274585	218860	1087624	1738694	8517533	1585951	13610407
10-11 am	395437	3974	83743	160118	279634	1221516	1585016	9133136	1412074	14274648
11am-12pm	215553	26041	148380	205321	153996	1609197	1269863	8840521	1739365	14208237
12-1 pm	.	46420	303928	433303	231106	2200957	1806220	9472687	1239563	15734184
1-2 pm	14195	69403	130502	350016	261257	2168093	1908381	9687576	1783945	16373368
2-3 pm	44805	43779	70120	66852	263803	2263423	1690118	7678248	1630258	13751406
3-4 pm	20398	.	90015	184984	99591	1255267	956272	5346272	1341473	9294272
4-5 pm	17486	15614	185979	375291	274212	1685922	1122551	7787919	986284	12451258
5-6 pm	245709	9697	109075	488983	370367	2358094	2054205	9799824	1349187	16785141
6-7 pm	84736	794	196311	656612	319113	2239942	1952000	9576365	733317	15759190
7-8 pm	34002	24837	103321	204069	194804	2836300	1216474	6679361	360149	11653317
8-9 pm	1788	9559	127558	137326	169792	1230757	973905	3358709	292241	6301635
9-10 pm	38109	29796	126669	225258	144267	1327450	1004055	2920234	317027	6132865
10-11 pm	530045	5454	98946	177760	254737	1575348	844101	3308699	226523	7021613
11pm-12am	5991	2719	108030	137132	181304	1212014	788934	2523045	222374	5181543
Unknown	.	.	.	.	.	.	.	.	.	0
Total	1830301	332701	2791322	5315849	4955685	35329207	26454443	136567925	18112893	231690326

	Exposure x 37/1000000									
	Unknown	0-17 yrs	18 years	19 years	20 years	21-25 yrs	26-29 yrs	30-59 yrs	60+ yrs	Total
12-1 am	0.75	0.28	2.11	4.70	8.00	41.96	16.58	61.10	2.55	138.03
1-2 am	3.84	0.02	0.91	3.79	4.72	18.30	12.40	26.73	0.99	71.70
2-3 am	0.51	.	1.62	1.15	1.11	13.24	6.66	15.61	0.24	40.15
3-4 am	.	.	0.39	1.06	1.08	8.93	3.86	15.58	4.26	35.16
4-5 am	0.30	.	4.35	0.82	0.70	13.44	5.14	35.08	2.50	62.32
5-6 am	0.19	.	0.28	1.61	8.60	12.70	13.57	69.21	3.26	109.44
6-7 am	0.21	.	2.47	1.29	6.13	31.89	34.88	184.40	15.47	276.74
7-8 am	0.12	.	10.02	15.77	15.91	108.68	55.85	340.64	34.17	581.16
8-9 am	0.80	0.10	5.79	15.63	10.70	85.98	56.17	433.36	43.59	652.12
9-10 am	.	1.25	5.67	10.16	8.10	40.24	64.33	315.15	58.68	503.59
10-11 am	14.63	0.15	3.10	5.92	10.35	45.20	58.65	337.93	52.25	528.16
11am-12pm	7.98	0.96	5.49	7.60	5.70	59.54	46.98	327.10	64.36	525.70
12-1 pm	.	1.72	11.25	16.03	8.55	81.44	66.83	350.49	45.86	582.16
1-2 pm	0.53	2.57	4.83	12.95	9.67	80.22	70.61	358.44	66.01	605.81
2-3 pm	1.66	1.62	2.59	2.47	9.76	83.75	62.53	284.10	60.32	508.80
3-4 pm	0.75	.	3.33	6.84	3.68	46.44	35.38	197.81	49.63	343.89
4-5 pm	0.65	0.58	6.88	13.89	10.15	62.38	41.53	288.15	36.49	460.70
5-6 pm	9.09	0.36	4.04	18.09	13.70	87.25	76.01	362.59	49.92	621.05
6-7 pm	3.14	0.03	7.26	24.29	11.81	82.88	72.22	354.33	27.13	583.09
7-8 pm	1.26	0.92	3.82	7.55	7.21	104.94	45.01	247.14	13.33	431.17
8-9 pm	0.07	0.35	4.72	5.08	6.28	45.54	36.03	124.27	10.81	233.16
9-10 pm	1.41	1.10	4.69	8.33	5.34	49.12	37.15	108.05	11.73	226.92
10-11 pm	19.61	0.20	3.66	6.58	9.43	58.29	31.23	122.42	8.38	259.80
11pm-12am	0.22	0.10	4.00	5.07	6.71	44.84	29.19	93.35	8.23	191.72
Unknown	.	.	.	.	.	.	.	.	.	0.00
Total	67.72	12.31	103.28	196.69	183.36	1307.18	978.81	5053.01	670.18	8572.54

Age Group x Time of Day

	Absolute Risk									
	Unknown	0-17 yrs	18 years	19 years	20 years	21-25 yrs	26-29 yrs	30-59 yrs	60+ yrs	Total
12-1 am	.	3.57	7.11	2.98	2.25	0.95	0.90	1.21	1.96	1.32
1-2 am	0.26	170.79	9.87	3.17	1.91	2.35	1.94	1.46	3.04	2.01
2-3 am	.	.	3.70	11.27	8.12	3.17	2.40	2.31	16.59	3.16
3-4 am	.	.	12.79	9.47	8.34	3.47	3.63	1.03	0.23	2.47
4-5 am	.	.	1.15	9.79	8.61	1.12	2.33	0.43	0.40	1.01
5-6 am	5.13	.	3.51	1.86	0.70	2.36	0.52	0.48	0.61	0.79
6-7 am	9.40	.	3.24	9.28	2.45	2.04	1.55	1.07	1.03	1.36
7-8 am	8.07	.	2.00	2.73	2.14	1.32	1.49	0.98	1.08	1.23
8-9 am	2.49	280.67	4.66	2.50	3.64	2.34	1.67	1.00	0.94	1.38
9-10 am	.	7.19	2.12	1.18	2.10	2.04	0.81	0.74	0.60	0.90
10-11 am	0.07	27.20	4.84	3.04	1.35	1.33	0.67	0.65	0.67	0.77
11am-12pm	0.25	9.34	2.19	2.76	5.27	1.43	1.23	0.76	0.98	1.00
12-1 pm	.	4.66	1.42	1.75	1.29	1.22	0.85	0.77	1.72	0.99
1-2 pm	.	4.28	3.31	1.31	2.38	0.93	0.54	0.66	1.05	0.80
2-3 pm	1.21	1.85	7.71	6.87	2.36	0.82	0.80	0.80	1.03	0.93
3-4 pm	5.30	.	5.70	3.94	9.23	3.17	2.52	2.26	1.67	2.49
4-5 pm	6.18	34.62	5.38	3.74	5.72	3.14	2.99	1.63	2.69	2.30
5-6 pm	0.55	44.59	11.65	3.65	4.52	2.61	1.68	1.27	1.46	1.75
6-7 pm	1.59	238.27	4.27	2.06	3.56	2.52	1.63	1.18	1.95	1.60
7-8 pm	2.38	11.97	6.28	6.49	5.27	1.37	1.87	1.14	3.00	1.56
8-9 pm	30.23	14.14	5.09	4.92	5.57	2.28	1.22	1.22	0.65	1.70
9-10 pm	.	6.35	3.84	3.36	5.81	1.61	1.02	1.43	1.45	1.64
10-11 pm	0.05	44.60	5.46	4.11	1.49	1.42	1.22	1.00	1.79	1.27
11pm-12am	13.53	.	3.50	3.74	2.53	1.43	1.78	1.16	1.94	1.53
Unknown	.	.	.	.	.	.	.	.	.	.
Total	0.66	15.52	4.10	3.10	3.24	1.79	1.36	1.04	1.28	1.36

	Relative Risk									
	Unknown	0-17 yrs	18 years	19 years	20 years	21-25 yrs	26-29 yrs	30-59 yrs	60+ yrs	Total
12-1 am	.	3.44	6.84	2.87	2.16	0.92	0.87	1.16	1.88	1.27
1-2 am	0.25	164.22	9.49	3.05	1.83	2.26	1.86	1.40	2.92	1.93
2-3 am	.	.	3.56	10.84	7.81	3.05	2.31	2.22	15.95	3.04
3-4 am	.	.	12.29	9.11	8.02	3.34	3.49	0.99	0.23	2.38
4-5 am	.	.	1.10	9.41	8.28	1.07	2.24	0.41	0.38	0.97
5-6 am	4.93	.	3.38	1.79	0.67	2.27	0.50	0.46	0.59	0.76
6-7 am	9.04	.	3.11	8.92	2.35	1.96	1.49	1.03	0.99	1.31
7-8 am	7.76	.	1.92	2.62	2.06	1.27	1.43	0.94	1.04	1.18
8-9 am	2.40	269.87	4.48	2.40	3.50	2.25	1.61	0.96	0.90	1.33
9-10 am	.	6.92	2.03	1.14	2.02	1.96	0.78	0.71	0.57	0.86
10-11 am	0.07	26.16	4.65	2.92	1.30	1.28	0.64	0.62	0.64	0.74
11am-12pm	0.24	8.98	2.10	2.66	5.06	1.37	1.19	0.73	0.94	0.97
12-1 pm	.	4.48	1.37	1.68	1.24	1.17	0.82	0.74	1.66	0.95
1-2 pm	.	4.12	3.19	1.26	2.29	0.90	0.52	0.63	1.01	0.77
2-3 pm	1.16	1.78	7.41	6.61	2.27	0.79	0.77	0.77	0.99	0.90
3-4 pm	5.10	.	5.49	3.79	8.87	3.04	2.42	2.17	1.61	2.40
4-5 pm	5.94	33.29	5.17	3.60	5.50	3.02	2.87	1.57	2.58	2.21
5-6 pm	0.53	42.88	11.20	3.51	4.35	2.51	1.62	1.22	1.41	1.68
6-7 pm	1.53	229.11	4.10	1.98	3.42	2.42	1.57	1.14	1.88	1.54
7-8 pm	2.29	11.51	6.04	6.24	5.07	1.32	1.79	1.09	2.89	1.50
8-9 pm	29.07	13.59	4.89	4.73	5.36	2.20	1.17	1.17	0.62	1.64
9-10 pm	.	6.11	3.69	3.23	5.58	1.55	0.98	1.37	1.39	1.58
10-11 pm	0.05	42.88	5.25	3.95	1.43	1.37	1.17	0.96	1.72	1.22
11pm-12am	13.01	.	3.37	3.60	2.44	1.37	1.71	1.11	1.87	1.47
Unknown	.	.	.	.	.	.	.	.	.	.
Total	0.64	14.92	3.94	2.98	3.12	1.72	1.31	1.00	1.23	1.30

APPENDIX C

Victoria: Age Group x Restricted Period

	Crash									
	Unknown	0-17 yrs	18 yrs	19 yrs	20 yrs	21-25 yrs	26-29 yrs	30-59 yrs	60+ yrs	Total
5am-8 pm	2152	130	1250	1387	1313	4951	2975	12355	2616	29129
8-9 pm	52	15	85	100	102	286	159	464	42	1305
9-10 pm	63	11	87	86	79	242	118	422	44	1152
10-11 pm	63	14	97	90	54	234	116	340	35	1043
11pm-12am	16	8	49	61	60	202	111	285	32	824
12-1 am	27	13	48	44	51	138	61	180	12	574
1-5am	65	27	113	131	130	387	175	336	17	1381