Driving Around Melbourne and the Risks of Crashing

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Abstract

Driving around Melbourne is estimated from an "exposure survey" conducted in Autumn 2001. The risk of crashing per distance travelled is calculated using corresponding crash frequencies during the 3-year period: 2000-2002.

To develop and evaluate road safety initiatives, it is important to assess the circumstances with "high crash risk" as well as the circumstances with 'high crash frequency". Distance travelled depends on the type of vehicle, the occupants, the place, the time, etc. and hence the risk of crashing can be relatively higher or relatively lower than expected from the number of crashes. Knowledge of both measures provides more accurate benefit/cost estimations than estimations based on crash frequencies alone.

This project produces thousands of risk measures: number of crashes per distance travelled corresponding to (a) the chosen interest group (type of vehicle or occupancy of vehicle), (b) the type of risk (driver involvement or driver injury) and (c) the type of crash. For example, absolute risk values can be calculated for casualty crash involvement for young drivers at night, or the risk of serious injury to the driver in rear end crashes.

The results of this study are available on a CD and consist of three published reports and an interactive tool for displaying the chosen risk estimates. The three reports, summarised in this conference paper are:

- **Steer Davis Gleave (2002) Melbourne On-Road Exposure Survey 2001: MORES-01 Reports 1-6 (Ref:1)**
- **Drummond, A. (2003) Driving Around Melbourne (Ref:2)**
- **Drummond, A (2004) The Risks of Crashing While Driving Around Melbourne (Ref:3)**

Introduction

This paper is based on two projects funded under the VicRoads Research and Development Program:

1) **A survey to collect distance driven by various groups of drivers (No.723 2000/01)**
2) **Analysis linking distance driven with corresponding crash data to estimate risks of crashing. (No.828 2002/03)**

The aim was to provide evidence for driver licence changes which could reduce the number of crashes for both young and older drivers. The project identifies high risk drivers in particular circumstances. It also quantifies the size of the problem: the number of drivers injured or involved in such circumstances. Altering the circumstances in the case of a frequent crash occurrence and a high crash risk can yield the biggest reduction in crashes. By taking account of the differing levels of distance travelled, the expected number of crashes can be compared with the actual number of crashes and hence the potential saving in road trauma estimated.

This paper describes a survey to produce measures of distance travelled that are person based rather than vehicle based. Comparisons are made between various groups of drivers on a crash rate per million kilometres driven.

Method - To collect distance driven by various groups of drivers

The intercept method allows a "snapshot" of travel to be captured, from which distance travelled on arterial roads in the Melbourne Statistical Division can be derived over a "typical 24-hour, 7-day week" during the survey period. Drivers of light passenger vehicles (excluding taxis) were interviewed from the median strip at signalised intersections on arterial roads from late March to early June 2001 (excluding holidays). The survey is not intended to provide annual estimates of travel. The driver was not asked about the length of the trip intercepted at the survey site.

Teams of 2 people conducted 366 3-hour sessions over 64 signalised intersections. Two sites were selected from each of 32 Local Government Areas (LGAs) by choosing one site at the 1/3rd position and another site at the 2/3rd position on 32 lists of sites ranked by daily traffic volume. The survey staff activated the pedestrian signal and information was recorded by observation and driver interview. A manual count of passenger vehicles (excluding taxis) was recorded. The hours with little traffic were over-sampled to increase the sample size at these times and then the results reduced accordingly.

The distance was derived using expansion factors, using the length of arterial road in each LGA to convert vehicle frequency to distance travelled. The final expansion weight is the product of four weighting factors.

1. **Vehicle flow weights:** the ratio of manual vehicle counts to the number of vehicles surveyed.

2. **Time weights:** 42 time blocks representing one week (six 4-hr periods/day).

3. **Site selection weights:** the ratio of the average daily traffic volume from all possible sites in the LGA to the average daily traffic volume at that site.

4. **Distance weights:** the ratio of the length of arterial roads in the Melbourne Statistical Division (MSD comprising 32 LGAs) to the length of arterial road in each LGA where the survey site was located. Road lengths on the boundary of one or more LGAs were proportioned.

Each driver record is given a 'final weight' which corresponds to the number of kilometres driven by ALL drivers of that type in one week. The sum of all 'final weights' gives the total number of kilometres driven by all drivers on arterial roads in the MSD during a typical non-holiday week in the April/May period.

When total distance driven is required, records with missing values cannot be ignored. The time available to interview the driver, whilst stopped at a red traffic signal, was sometimes too short to begin the interview or to complete the interview. "Hot-deck" imputation and Monte Carlo simulation was used to fill most of the gaps with probable values.

Thus the survey produced an estimate of distance travelled for each driver record.

Method - To link distance with crash data to estimate crash risks

Accident data for a 3-year period 2000-2002 during 114 non-holiday weeks was obtained from the VicRoads Road Crash Information System (RCIS). These accidents happened on arterial roads in the Melbourne Statistical Division (MSD comprising 32 LGAs).

The absolute risk is calculated by dividing the number of incidents by the distance travelled for a matching set of circumstances. For example, the absolute risk for male drivers is the number of male drivers involved in casualty crashes divided by the number of kilometres travelled by male drivers. Missing values in the accident data decrease the absolute risk because the distance driven is estimated for exposure to all accidents.

The relative risk of male drivers compared to female drivers is the absolute risk for male drivers divided by the absolute risk for female drivers. Relative risk estimates per million kilometres travelled are calculated for the following variables, by themselves and in combination:

Driver gender	**Male, Female**
Driver age (1)	**18-25, 26-39, 40-59, 60-74, 75 & above**
Driver age (2)	**18-21, 22-29, 30-39, 40-49, 50-59, 60-69, 70-79, 80 & above**
Licence type	**Standard, Probationary, Learner, Other**
Time of day	**0200-0559, 0600-0959, 1000-1359, 1400-1759, 1800-2159, 2200-0159**
Week segment	**Weekday, Weekend**
Vehicle type	**Utes/vans, Other**
Vehicle occupancy	**Driver only, Driver+1 passenger, Driver+>1 passengers**

Risks are estimated for driver involvement and driver injury – with two levels of crash severity and driver injury:

- **Risk per million kms travelled of being involved in a casualty crash**
- **Risk per million kms travelled of being involved in a serious casualty crash**
- **Risk per million kms travelled of being injured in a crash**
- **Risk per million kms travelled of being seriously injured in a crash**

Five crash types were also identified for calculation of separate risk estimates. It is assumed that the exposure to each type of crash is the same as the exposure to all types of crashes. This assumption, however, is less tenable when applied to crashes involving turning vehicles and may not hold true for crash types at different times of the day.

The five particular crash types are:

1. **Right Near crashes** (DCA code 113) Two vehicles approaching at right angles - one vehicle turns right across the path of the other vehicle
2. **Right Thru crashes** (DCA code 121) Two vehicles approaching from opposite directions - one vehicle turns right across the path of the other vehicle
3. **Rear End crashes** (DCA codes 130 – 132) Two vehicles travelling in the same direction – vehicle collides with the rear of the front vehicle.
4. **Loss of Control crashes** (DCA codes 170 – 189)
5. **Cross Traffic crashes** (DCA code 110)

Results of the On-Road Exposure Survey

The total distance travelled was calculated as 326,955,633 kilometres in light passenger vehicles (excluding taxis) during one week on arterial roads in the Melbourne Statistical Division. There were 12,489 drivers interviewed. The average interview represents about 26,000 kms, ranging from about 4,000 kms to about 100,000 kms.

A selection of results showing comparisons between drivers plus vehicles with different characteristics is listed below:

- **Male drivers account for 61.5% of travel and drivers aged 18-25 account for 15% of travel (males 8.8% and females 6.2%).**

- **Drivers over 60 years of age account for 7.7% of travel (males 5.7% and females 2%).**

- **All drivers drive more during the day, although drivers aged 18-25 and male drivers account for a lower proportion of travel during the day.**

- **Compared to full licence holders, probationary licence holders are more likely to drive during 6pm and 10 pm (1 probationary to every 8.8 full licence holder) and much less likely to drive between 6am and 10am (1 probationary to every 28.6 full licence holders).**

- **Learners made up 0.3% of travel.**

- **Cars account for 81.8% of vehicle kilometres.**

- **Most travel (20.7%) is done by male drivers driving to or from work (females driving to or from work accounted for 12.2%). Least travel was by males accompanying as chauffer (2.6% – females 3.3%).**

- **Vehicles with no passengers made up 67.6% of distance travelled. Female drivers were more likely to have passengers (1 female driver with passengers to every 1.8 females without passengers, compared to 1 male driver with passengers to every 2.3 without passengers).**

- **Drivers with mobile phones account for 74% of travel. Probationary licence holders are more likely to have a mobile phone (5 out of 6 probationary drivers have a mobile phone compared to 3 out of 4 full licence holders). This rate of 5 out of 6 is also found for drivers driving for work.**

- **Male drivers are far more likely to have the mobile phone switched on (7.1 male drivers with mobile phone on to 1 male driver with mobile phone off compared to 2.9 female drivers with phones switched on to 1 female driver with phone switched off). Drivers aged 18-25 have the highest rate: 7.8 drivers with mobiles switched on to 1 driver with mobile switched off.**

- **Vehicles with bull-bars fitted account for 3.9% of travel.**

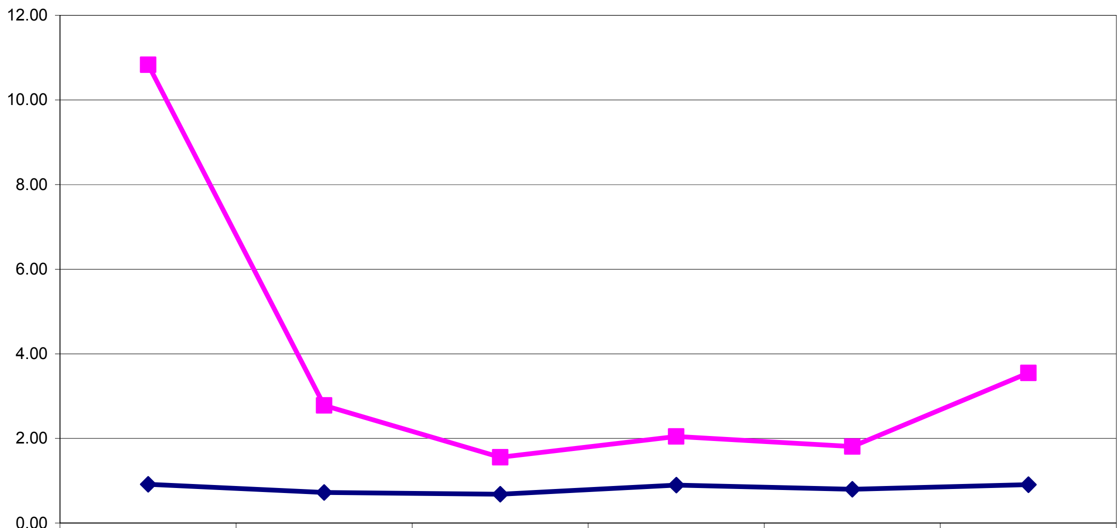
Results of Crash Risk Estimation

There were 34,014 drivers involved in these casualty crashes during 2000-02 with 16,737 drivers injured. These arterial road crashes comprised 54% of driver crash involvements and 57% of driver injuries in the MSD. The remaining crashes happened on local roads, collector roads and freeways.

Figures 1 and 2 illustrate the higher absolute risk for probationary drivers at all times and show the added risk during the night and when driving with more than 1 passenger.

Figure 1

Risk of Driver Involvement in Casualty Crashes by Time Period

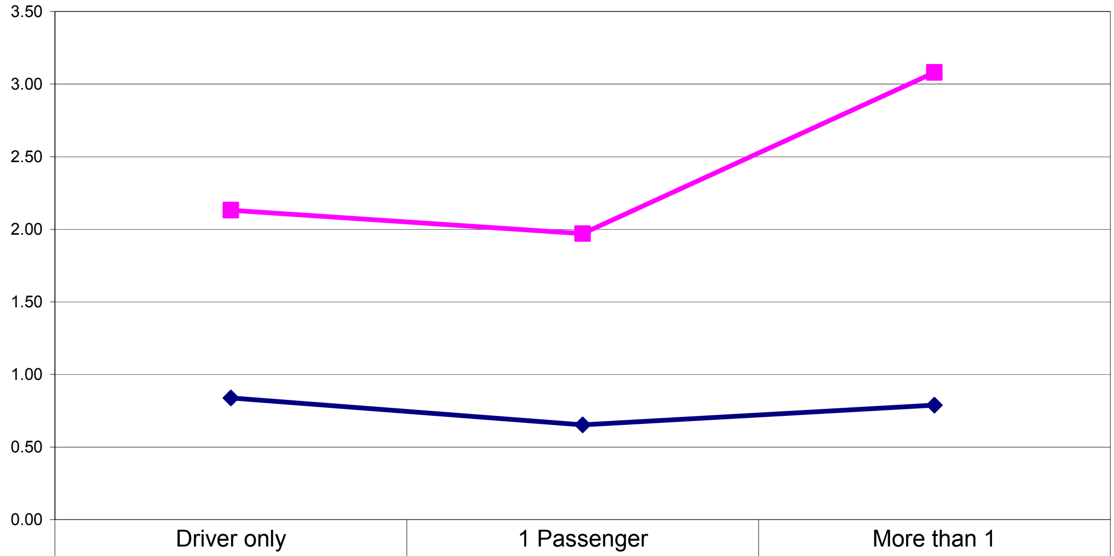


	2am - 6am	6am - 10am	10am - 2pm	2pm - 6pm	6pm - 10pm	10pm - 2am
Full	0.92	0.72	0.68	0.90	0.80	0.91
Prob.	10.83	2.78	1.55	2.05	1.81	3.55

The absolute risk of being involved in a casualty crash is increased for all drivers between 10pm and 6am. The risk for probationary drivers is elevated to a greater extent after 10pm and is much higher during the early hours of the morning: 2am – 6am.

Figure 2

Risk of Driver Involvement in Casualty Crashes by Vehicle Occupancy



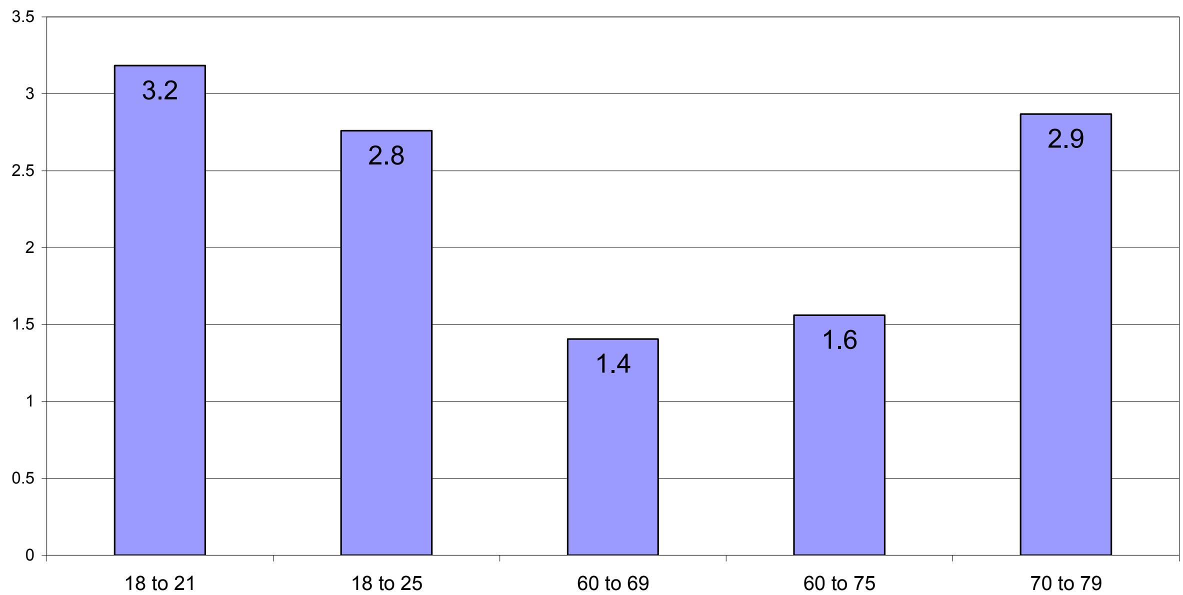
	Driver only	1 Passenger	More than 1
Full	0.84	0.65	0.79
Prob.	2.13	1.97	3.08

All drivers have a lower absolute risk of being involved in a casualty crash when driving with one passenger. Probationary drivers, however, have a higher crash involvement per distance travelled when driving with more than one passenger.

Figure 3 illustrates the relative risk of a younger or older driver being involved in a casualty crash compared to the risk for a 40-49 year old driver (risk set at 1).

Figure 3

Relative Risk of Young and Old Drivers compared to 40-49 year old Driver Involvement in Casualty Crashes



This shows the effect of broadening the age groups. Adding 22-25 year old drivers to the 18-21 year old drivers, results in a decrease in the relative risk for the group from 3.2 to 2.8.

Similarly when the 70-75 year old drivers are included with the 60-69 year old drivers the relative risk for the group increases from 1.4 to 1.6. The relative risk for the 70-79 year old drivers is 2.9. Such comparisons are used to evaluate the projected outcomes for various road safety interventions.

A selection of further results, showing different types of risk, is shown below:

Risk of Crashing – All Casualty Crashes:

- **Female drivers have a significantly higher risk of crashing, relative to male drivers. (1.16 times or 16% higher).**

- **Most driver age groups have significantly higher risks of crashing, relative to 40-49 year old drivers (the group with the lowest absolute risk of crashing). The various driver age groups were often significantly different to each other, indicating that age and its correlates are powerful determinants of crash risk.**

- **P-platers had a relative risk of crashing 2.74 times (or 174%) higher than standard licence holders**

- **The late night (10pm to 1:59am) and early morning (2am to 5:59am) periods were associated with substantially higher risks for drivers having a casualty crash, relative to the middle of the day (10am to 1:59pm).**

Risk of Driver Injury – All Casualty Crashes:

- **Female drivers have a significantly higher risk of injury, relative to male drivers. The female driver risk of injury is 1.7 times (or 70%) greater.**

- **Drivers up to age 39 years and above 59 years have significantly higher risks of injury, relative to drivers in the 40-49 year age group.**

- **The injury risk for P-plate drivers is almost three times that for standard licence holders.**

- **The late night and early morning periods were associated with much higher risks of injury, relative to the middle of the day.**

Risk of Crashing – Casualty Crash Types:

- **Female drivers have a significantly higher risk of involvement in Right Near (RN), Right Through (RT), and Cross Traffic (CT) crashes as well as Rear End (RE) crashes as the driver of the front vehicle.**

- **Male drivers have a significantly higher risk of involvement in Loss of Control (LC) crashes.**

- **Risk of Right Near crash involvement is substantially higher in the morning and afternoon peak periods;**

- **Risk of Right Through crash involvement is substantially higher in the afternoon, evening and late night periods;**

- **Risk of Rear End crash involvement is substantially higher during the day and early evening;**

- **Risk of Loss of Control and Cross Traffic crash involvement is substantially higher in the late night and early morning periods.**

- **The risk of Right Near and Rear End crash involvement is substantially higher for driver-only vehicles;**

- **Risk of Cross Traffic crash involvement is substantially higher for drivers with two or more passengers in the vehicles.**

Discussion

Not all the information collected in the exposure survey could be used to calculate crash risks. The presence/use of mobile telephones is such a variable because it is not recorded on the police accident forms and therefore casualty crash while using a mobile phone cannot be calculated. The prevalence of mobile phones in vehicles, however, was collected to facilitate further investigation and provide evidence for possibly adding mobile phone use to the Police Accident Report Form.

The above findings are not independent of each other. For example: vehicle occupancy varies with trip purpose, time of day, weekday vs. weekend, as well as the sex and age of the driver. Over-representation of any of these factors will influence the risk associated with any of the other factors.

These risk estimates are presented as a starting point for further in-depth investigation into particular circumstances associated with road trauma. Risk estimates can add another dimension to the prioritisation of road trauma funding.

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