ROAD ACCIDENT PREVENTION RESEARCH UNIT

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Drink-driving Arrests and Alcohol-related Crashes:

Results from the Linkage of Western Australian Arrest and Crash Records (1987-1995)

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Abstract

Records of all reported road crashes occurring in Western Australia between 1987 and 1995 were linked with records of all drink-driving arrests in the same period. All drink-driving arrests and all road crashes experienced by each driver over the period were identified. An 'alcohol-related' crash was defined as being one that resulted in a drink-driving arrest. About 7% of all drink-driving arrests were made as a result of a crash. Those drivers arrested for drink-driving, who were subsequently involved in a road crash, were identified and compared with similar drivers not involved in crashes. Drivers who had already been involved in one alcohol-related crash, or who were involved in alcohol-related crashes at younger ages, were significantly more likely to drink, drive and crash again.

Keywords

Drink-driving, road crashes, arrests

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

EXECUTIVE SUMMARY

Introduction

In 1997, about 25% of drivers in fatal crashes in Western Australia (WA) had a blood alcohol concentration (BAC) exceeding 0.05%, (Cercarelli et al, 1998). However, the BAC of drivers in less serious crashes is not always reliably recorded. An international examination of drink-driving using results from roadside surveys and fatality studies showed that while Australia (and some Scandinavian countries) had relatively low drink-driving rates in roadside surveys, there were nevertheless high levels of illegal BACs in driver fatalities. This may reflect the existence of a small group of extremely dangerous drink-drivers who may be alcohol dependent and who are resistant to control policies (Ross, 1993).

Objectives

The objectives of this study were to determine the characteristics of crash-involved drink-drivers compared to other drink-drivers and to identify the drink-drivers most likely to re-offend in a criminal and traffic context.

Data Sources

Records of all drink-driving arrests for the period 1987 to 1995 were extracted from the offender database maintained by the Crime Research Centre at the University of Western Australia. Records of crash-involved drivers were extracted from the Western Australian Road Injury Database for the same period.

For each driver, each drink-driving offence record was matched to a corresponding road crash record, if one existed. Records were linked (or matched) if an arrest record related to the same person (driver's licence number) and event (time, date, location) as a road crash record. In this way, crash-related drink-driving arrests were separated from arrests arising from other police enforcement activity.

Results

All drink-driving offences

There were 85,563 drivers arrested for a drink-driving offence in WA between 1987 and 1995. Of these, 53,166 were arrested for the first time. In fact, 75% of the

drivers arrested had only one drink-driving arrest in the nine-year period, although there were about 700 individuals who were arrested five or more times. In all, 117,428 charges for drink-driving were laid between 1987 and 1995. Of these, 60% were for 'excess 0.08%' and 37% were for 'driving under the influence of alcohol and/ or drugs' (DUI).

All road crashes

Over the nine-year period 1987 to 1995, 337,996 road crashes were reported to the police. These crashes involved 596,964 drivers of motor vehicles (cars, trucks and motor cycles). Police officers attended 77,774 road crashes (23%) involving 121,766 drivers (20%) and they arrested and charged 6,727 (1.1%) drivers for drink-driving as a result of the crash.

Drivers in drink-driving or alcohol-related crashes were more often male, aged 18 to 25 years and were more likely to be involved in single vehicle crashes in the country areas of Western Australia.

Drink-driving and road crashes

From the linked drink-driving and road crash records, it was possible to distinguish between the drink-driving arrests made during routine police enforcement (stationary and mobile testing) and those resulting from the driver being involved in a road crash while over the legal limit. There were 104,104 drink-driving arrests, of which 6,883 (6.6%) arose from a road crash.

The most significant factors in crash-related arrests compared to non-crash arrests were the age group, as well as the type of the offence and the number of previous arrests of the driver. Younger (18-35) and older drink-drivers (65+) were more likely to be detected through road crashes than through enforcement. Aboriginal drink-drivers, on the other hand, were more likely to be detected as a result of police enforcement activities. A drink-driver arrested for refusing a breath test had twice the odds (odds ratio = 2.089) of being detected through a crash compared to a similar driver with an 'excess 0.08%' alcohol level.

Drink-driving careers

Of the 53,166 drink-drivers *first arrested* between 1987 and 1995, 8,091 (15.2%) were found to have been subsequently involved in a road crash. Of the drivers who were subsequently involved in a crash, 827 (10.2%) incurred a drink-driving charge as a result of their next crash and 893 (11.0%) incurred a drink-driving charge at the next or a later crash.

Male drink-drivers aged between 18 and 25 years, who were initially charged with DUI, were more likely to be involved in a subsequent road crash. Those ultimately involved in a crash were also likely to have had other drink-driving arrests between their initial arrest and the crash. Those ultimately involved in *alcohol-related* crashes were more likely to have had *more* drink-driving arrests between their initial arrest and the crash *and* to have had the crash *sooner*.

Discussion

Although 70% of first time drink-drivers did not offend again, those that did re-offend had a substantially increased risk of an alcohol-related crash with each subsequent drink-driving charge.

This study has also shown that young people have elevated risks of drink-driving detection through road crashes, due in part to generally high road crash risks and alcohol consumption patterns but perhaps also due to selective policing practices. Similarly, this study has shown that Aboriginal people had elevated risks of detection through police routine enforcement actions rather than through road crashes. There is no doubt that the enforcement activities of police play a large part in the detection and identification of drink-drivers, yet there is little research which examines these practices in detail. Further research may help unravel the extent to which the arrested drink-driving population is a function of selective police enforcement practices.

Conclusion

The identification of 'high-risk' groups would enable countermeasures to be more effectively constructed and more efficiently targeted. Chronic or 'repeat' drink-drivers and drivers with prior criminal records were identified as having greater

subsequent crash risks than other drivers. Similarly, drivers who had already been involved in one alcohol-related crash, or who were involved in alcohol-related crashes at younger ages, were significantly more likely to drink, drive and crash again. Early detection of individuals from these groups would facilitate targeted intervention programs aimed at reducing crime and improving road safety.

ACKNOWLEDGEMENTS

The authors wish to acknowledge the assistance of the WA Police Service and Main Roads WA in providing access to the data files needed for this study. We also thank Ms Alexia Stoney who performed the linkage between the arrest and crash records. Tony Ryan, Nick de Klerk, Max Bulsara and Rina Cercarelli also assisted with helpful suggestions throughout the project.

1. INTRODUCTION

In 1997, about 25% of drivers in fatal crashes in Western Australia (WA) had a blood alcohol concentration (BAC) exceeding 0.05%, (Cercarelli et al, 1998). However, the BAC of drivers in less serious crashes is not always reliably recorded. An international examination of drink-driving using results from roadside surveys and fatality studies showed that while Australia (and some Scandinavian countries) had relatively low drink-driving rates in roadside surveys, there were nevertheless high levels of illegal BACs in driver fatalities. This may reflect the existence of a small group of extremely dangerous drink-drivers who may be alcohol dependent and who are resistant to control policies (Ross, 1993).

In the United States, Brewer et al (1994) demonstrated a link between previous drink-driving arrests and serious, alcohol-related road crashes. They showed that drivers who died in a motor vehicle crash with a BAC of 0.2 % or more were up to 11 times more likely than drivers who died with a lower BAC reading to have been arrested for driving while impaired in the previous five years.

Patterns of drink-driving arrests and characteristics of repeat drink-drivers were investigated by the Road Accident Prevention Research Unit and the Crime Research Centre (CRC) at the University of Western Australia, using the arrest records from the INOIS offender tracking database (Ryan et al, 1996). This report gave a thorough overview of the drink-driving problem in Western Australia. The probability of re-arrest for drink-driving offenders was shown to depend on gender, race, age, occupation and previous criminal history. It was not possible, however, to establish the extent to which these drink-driving offenders were involved in road crashes.

In the present study, it has been possible to examine the relationship between crash involvement and drink-driving arrests both retrospectively and prospectively by linking road crash records with arrest records.

1.1 Objectives

The objectives of this study were:

- to identify the drink-driving arrests resulting from routine enforcement activity and those resulting from a road crash and to determine the characteristics of crash-involved drink-drivers compared to other drink-drivers.

- to characterise the drink-drivers who would be most likely to re-offend in a criminal and traffic context.

2. METHODS

Records of all drink-driving arrests for the period 1987 to 1995 were extracted from the INOIS (*Integrated Numerical Offender Identification System)* offender database maintained by the Crime Research Centre at the University of Western Australia. Over the nine-year period there were 104,104 drink-driving arrests for 85,563 individual drivers. Information about the offender (sex, age, race, occupation and previous criminal history) as well as the time, place and severity of each offence was available for each arrest. It was possible to identify each drink-driving offender by a unique INOIS number. Using this INOIS number and the Western Australian Police Service identification index file, the corresponding driver's licence number was extracted and appended to the record for each offender.

Records of crash-involved drivers were extracted from the WA Road Injury Database. This database contains records of all reported road crashes between 1987 and 1997. These records are extracted periodically from the Traffic Accident System (TAS) maintained by Main Roads WA. Over the nine-year period of the present study (1987-1995) 337,996 road crashes were reported to the police. These crashes involved 596,964 drivers of motor vehicles (cars, trucks and motor cycles).

Most reports of crashes involving a motor vehicle contained the driver's licence number. Of the 596,964 records of drivers involved in road crashes, 73% had a valid driver's licence number, varying from 83% of drivers in crashes attended by the police to 70% of drivers in crashes not attended by a police officer. In addition, 89% of drivers in fatal crashes had a valid licence number, while only 70% of drivers in crashes

without injury (property damage only) had a valid entry in this field. This number, together with event details such as time and place, enabled links between all crash and arrest records for the same driver to be made.

2.1 The INOIS Offender Database

Records of all persons apprehended by the WA Police Service between 1 January 1984 and 31 December 1995 are stored in an offender database maintained by the Crime Research Centre, University of Western Australia. Offenders are identified by a unique INOIS number, which tracks individuals from one criminal justice agency to another and over time (Ferrante, 1993).

Police apprehension data are derived from the P18 form which contains demographic details about the alleged offender, charge information (including date, place and nature of the offence) and details of the arrest process (that is, date and place of arrest, custody or bail arrangements). Demographic details are limited to gender, Aboriginality, date of birth, place of birth and occupation. Note that a police apprehension record can arise from either an arrest or a summons.

2.2 The Traffic Accident System

In Western Australia, all road crashes that result in injury or property damage over $1,000 must be reported to the police. When a police officer attends a crash a P72 form is completed and the information is entered into the computerised Traffic Accident System maintained by Main Roads WA. Otherwise, those involved are required to complete a MR72 form with similar details. Overall, police attend about one in four reported road crashes.

2.3 Linkage Methods

All drink-driving apprehension records were extracted from the INOIS offender database for the period 1987 to 1995. All road crash records for motor vehicle drivers were extracted from the Road Injury Database for the same period. Each drink-driving offence record for each driver was matched to a corresponding road crash record, if one existed. Records were linked (or matched) if an arrest record related to the same person (driver's licence number) and event (time, date, location) as a road crash record. The driver's licence number and the date, time and location of the offence were used in the

matching process. This process resulted in 6,883 matched drink-driving arrest and road crash records representing 6.6% of all drink-driving arrests. The remaining 93.4% of drink-driving arrests arose from routine police enforcement activity (eg random breath testing (RBT) and mobile testing).

2.4 Analysis

Available information about the characteristics of the drivers, their drink-driving offences and road crashes was examined. Firstly, all road crashes were examined and compared according to whether a police officer attended and whether a drink-driving charge was issued. Secondly, all drink-driving arrests resulting from routine enforcement were compared with those resulting from road crashes. Finally, factors associated with subsequent road crash outcomes were identified for drink-drivers arrested for the first time in the study period. Both multiple logistic regression and survival analysis techniques were used to examine the independent association of each factor with the likelihood of experiencing a road crash. Repeat drink-driving offences were considered along with all other factors in the multi-variate models.

2.4.1 Logistic Regression

Logistic regression is a method of analysis used when the factors of interest include numbers and categories and the outcome has only two values. This method makes no assumption about the distribution of the various factors and the regression coefficients for each factor can be readily interpreted as the odds of achieving the outcome of interest compared to a baseline level. This method was therefore ideal for determining the risk of re-offending or crashing for particular sub-groups of the drink-driving population.

2.4.2 Survival Analysis

Most methods of analysis of individual survival data are based on the hazard rate. The hazard rate is the instantaneous risk of failure. The risk or probability of death or failure after a certain time period is then calculated from the hazard rate. We have used the Cox proportional hazard model that assumes individual hazard rates are proportional to a baseline hazard rate.

For this study, being involved in a road crash can be interpreted as a 'failure'. The 'survival' time or 'time to failure' is the time between an initial drink-driving arrest and another arrest or crash. This method differs from logistic regression in that the time between events is taken into account.

3. RESULTS

3.1 All Drink-driving Offences

There were 85,563 drivers arrested for a drink-driving offence in WA between 1987 and 1995. Of these, 53,166 drivers were arrested for the first time. In fact, 75% of the drivers arrested had only one drink-driving arrest in the nine-year period, although there were about 700 individuals who were arrested five or more times[1].

Table 3.1 Drink-driving Arrests by Age and Gender, Western Australia 1987-1995

	Male		Female		Total	
Driver age	n	(%)	n	(%)	n	(%)
0-17 years	2,207	2.5	263	1.8	2,470	2.4
18-25 years	38,465	43.0	6,622	46.1	45,087	43.4
26-35 years	28,348	31.7	4,770	33.2	33,118	31.9
36-65 years	20,126	22.5	2,694	18.7	22,820	22.0
65+ years	372	0.4	26	0.2	398	0.4
Total	89,518	100.0	14,375	100.0	103,893	100.0

There were 13,625 female drivers arrested for 14,375 drink-driving incidents compared to 71,763 male drivers arrested for 89,518 incidents. There were also 7,621 drink-drivers who were Aboriginal. Of the drivers arrested, 70% lived in the metropolitan area of Perth, while only 64% of the drink-driving arrests occurred in the metropolitan area. About 6% of the drink-driving arrests[2] arose from a road crash, varying from 5.7% in 1987 to 7.8% in 1990.

[1] It should be noted that the follow-up time for offenders varied from less than twelve months to nine years.

[2] Arrests included in the database could have arisen from an apprehension or a summons.

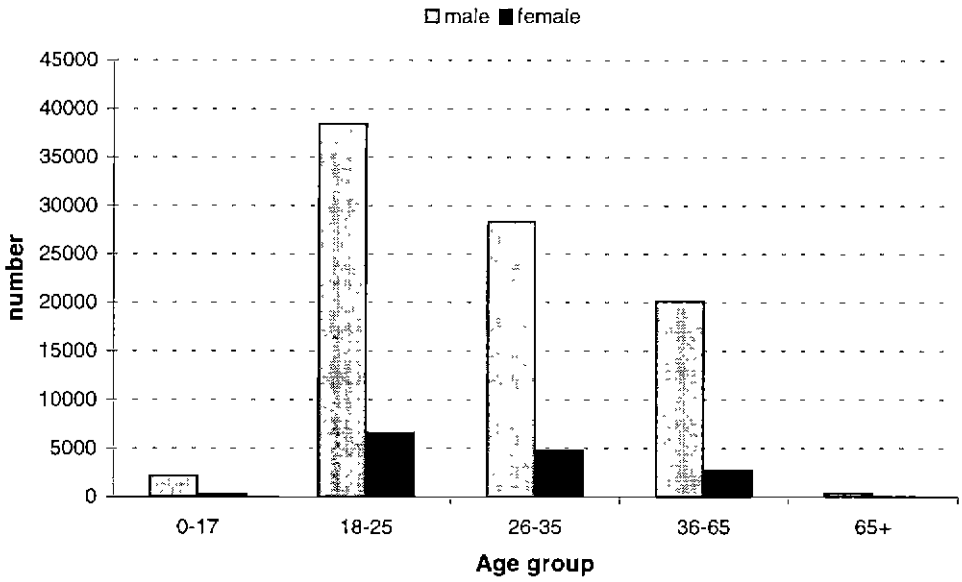

Figure 3.1 Drink-driving Arrests by Age and Gender, Western Australia 1987-1995.

In all, 117,428 charges for drink-driving were laid between 1987 and 1995. Of these, 60% were for 'excess .08%' and 37% were for 'driving under the influence of alcohol (DUI) and/ or drugs[3,4].

3.2 All Road Crashes

Over the nine-year period from 1987 to 1995, there were 337,996 road crashes reported to the police. These crashes involved 596,964 drivers of motor vehicles (cars, trucks and motor cycles). Police officers attended 77,774 road crashes (23%) involving 121,766 drivers (20%).

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[3] It should be noted that drivers charged with an 'excess 0.05%' or 'excess 0.02%' offence alone would not be apprehended and are therefore omitted from the INOIS offender database. These lesser charges would be recorded in the traffic infringement system, except when made concurrently with a more serious driving or criminal offence.

[4] For this study, all charges made within 12 hours were assumed to belong to the same arrest. In fact, of all drink-driving charges made within 48 hours, 42.5% occurred within 2 hours, 66% within 6 hours and 70% within 12 hours. A further 15% of charges for the same person occurred within 12 to 24 hours and 15% within 24 to 48 hours.

Although the blood alcohol level of a driver involved in a crash is often measured if alcohol impairment is suspected, much of this information is missing from crash report records. It is therefore difficult to accurately identify 'alcohol-related' crashes from the routine data recorded for each road crash. However, driver details and the location, time and circumstances of each crash are recorded.

Table 3.2 displays the age distribution of male and female drivers involved in crashes over the nine-year study period.

Table 3.2 Drivers in Reported Crashes by Age and Gender, Western Australia 1987-1995

	Male		Female		Total	
Driver age	n	(%)	n	(%)	n	%
0-17 years	15,336	4.4	7,815	3.8	23,151	4.2
18-25 years	86,447	24.9	54,430	26.5	140,787	25.5
26-35 years	60,535	17.5	39,841	19.4	100,376	18.2
36-65 years	91,777	26.5	59,470	29.0	151,247	27.4
65+ years	14,398	4.2	6,410	3.1	20,808	3.8
missing	78,221	22.6	37,205	18.1	115,426	20.9
Total	346,714	100.0	205,171	100.0	551,885	100.0

Overall, 63% of drivers of motor vehicles involved in crashes in Western Australia from 1987 to 1995 were male. The age distributions of male and female drivers were similar. About 25% of drivers were aged between 18 and 25 years and a further 4% were aged 17 years or under. The extent to which alcohol consumption was associated with this excess of young drivers in crashes will be explored in the analyses that follow.

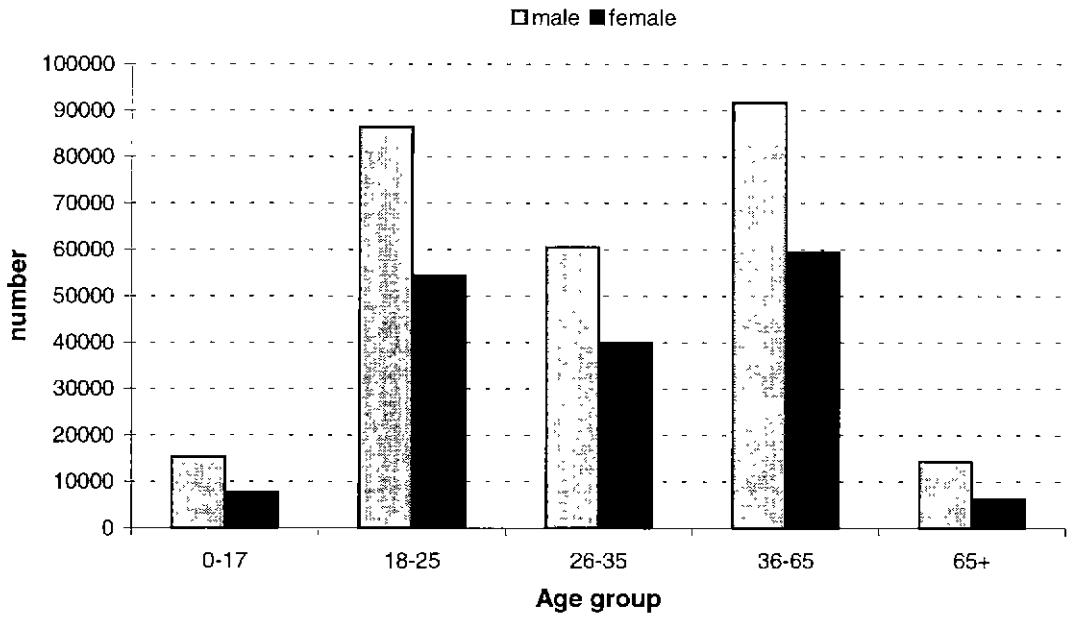

Figure 3.2 Drivers in Reported Crashes by Age and Gender, Western Australia 1987-1995.

3.2.1 Alcohol Involvement

To determine the extent to which a driver involved in a crash was affected by alcohol, crash records that coincided with an arrest for drink-driving were analysed. In fact, 6,727 (1.1%) crash-involved drivers were arrested for drink-driving as a result of the crash. These drivers were involved in 6,690 distinct crashes (that is, there were crashes in which more than one driver was charged with drink-driving offences).

In the past, surrogate measures have been used to estimate the extent of alcohol involvement in road crashes. Certain times of the day for each day of the week were defined by Gantzer (1995) as 'high alcohol hours' to distinguish times of high alcohol consumption from other times. Different times were specified for country and urban areas.

In 1995, 64% of police RBT enforcement activity was concentrated at these 'high alcohol' times (Hendrie et al, 1997). The proportions of drink-driving arrests, crashes and drink-driving crashes that occurred during 'high alcohol hours' are displayed in Figure 3 for each day of the week. About 80% of drink-driving arrests and drink-

driving crashes each day occurred during times of high alcohol consumption, while only about 12% of all crashes occurred at these times.

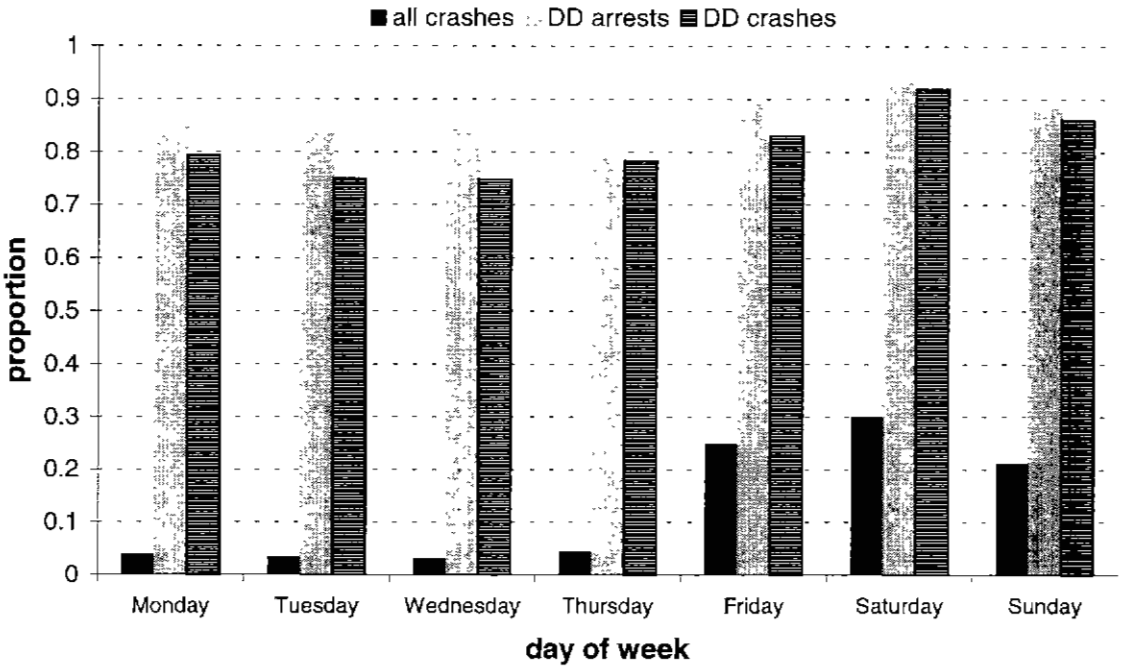

Figure 3.3 Crashes and Drink-driving Arrests in High Alcohol Consumption Periods

Overall, the drink-driving crashes were more severe than those not involving alcohol, resulting in about 50% more casualties in both single and multi-vehicle crashes. For single vehicle crashes, there were 0.61 casualties per drink-driving crash compared to 0.41 casualties per crash where the driver was not charged with drink-driving. In multi-vehicle crashes, vehicles driven by a driver charged with a drink-driving offence had an average of 0.27 casualties, whereas the other vehicle had 0.19 casualties.

Table 3.3 and Table 3.4 show the characteristics of crashes where a driver was charged with drink-driving (DD) compared with the characteristics of other police attended crashes and those that were self-reported. The characteristics of the drivers in these crashes are displayed in Table 3.5 and Table 3.6.

Table 3.3 Police Attendance and Drink-driving Arrests by Crash Region, Western Australia 1987-1995

	Self reported		Police attended				Total	
			no DD arrest		DD arrest			
Region	n	(%)	n	(%)	n	(%)	n	(%)
metro	222,997	79.6	52,683	18.8	4,367	1.6	280,047	100.0
country	38,586	65.1	18,910	31.9	1,752	2.9	59,248	100.0
unknown	330	23.4	509	36.1	571	40.5	1,410	100.0
Total	261,913	76.8	72,102	21.2	6,690	2.0	340,687	100.0

As seen in Table 3.3, about 35% of crashes in country areas and 20% in the metropolitan area were attended by police officers. About 9% of country crashes attended by the police resulted in an arrest for drink-driving with slightly fewer metropolitan police attended crashes (7.6%) generating a drink-driving arrest.

Table 3.4 Police Attendance and Drink-driving Arrests by Crash Type, Western Australia 1987-1995

	Self reported		Police attended					
Crash type			no DD arrest		DD arrest		Total	
	n	(%)	n	(%)	n	(%)	n	(%)
Same direction	123,781	88.4	14,983	10.7	1,308	0.9	140,072	100.0
Opp. direction	12,434	75.3	3,651	22.1	431	2.6	16,516	100.0
Right angle	66,310	73.4	23,136	25.6	898	1.0	90,344	100.0
Pedestrian	2,392	37.3	3,924	37.3	96	1.5	6,412	100.0
Hit animal /object	20,372	52.1	15,862	40.5	2,894	7.4	39,128	100.0
Non-collision	7,932	50.7	6,889	44.0	819	5.2	15,640	100.0
Unknown	28,602	90.8	2,642	8.4	244	0.8	31,488	100.0
Total	261,823	77.1	71,087	20.9	6,690	2.0	339,600	100.0

Same direction crashes (rear-end or side-swipe-same-direction) were the most common crash types reported to the police by drivers. Right angle crashes were the most common crashes attended by police officers. However, most crash-related drink-driving

arrests resulted from the 'hit animal or object' crashes. Charges for drink-driving were laid in 7.5% of these single vehicle crashes compared to 1-2% of multi-vehicle crashes.

Table 3.5 Police Attendance at Crashes and Drink-driving Arrests by Driver Gender, Western Australia 1987-1995

	Self reported		Police attended					
Driver gender			no DD arrest		DD arrest		Total	
	n	(%)	n	(%)	n	(%)	n	%
male	265,729	77.7	70,401	20.6	5,795	1.7	341,925	100.0
female	168,278	82.6	34,593	17.0	925	0.4	203,796	100.0
Total	434,007	79.5	104,994	19.3	6,720	1.2	545,721	100.0

Proportionately more male drivers than female drivers were involved in police-attended crashes. Among the male drivers involved in crashes, 20.6% were attended by the police without incurring a drink-driving charge, while an additional 1.7% were charged with a drink-driving offence (Table 3.5).

Table 3.6 Police Attendance at Crashes and Drink-driving Arrests by Driver Age, Western Australia 1987-1995

	Self reported		Police attended					
Driver age			no DD arrest		DD arrest		Total	
	n	(%)	n	(%)	n	(%)	n	%
0-17 years	16,392	69.5	6,815	28.9	369	1.6	23,576	100.0
18-25 years	105,070	73.3	34,950	24.4	3,304	2.3	143,324	100.0
26-35 years	76,636	74.8	24,001	23.4	1,759	1.7	102,396	100.0
36-65 years	121,295	78.0	33,122	21.3	1,129	0.7	155,546	100.0
65+ years	16,051	73.4	5,769	26.4	55	0.2	21,875	100.0
unknown	139,754	93.0	10,382	6.9	111	0.1	150,247	100.0
Total	475,198	79.6	115,039	19.3	6,727	1.1	596,964	100.0

Relatively more drivers aged between 18 and 25 years were involved in alcohol-related crashes. Overall, about 1% of crash-involved drivers were arrested for drink-driving, whereas 2.1% of those aged 18 to 25 years; 1.6% of those aged under 17 years and 1.7% of those aged 26 to 35 years incurred drink-driving charges arising from the crash (Table 3.6).

In summary, males and those aged 18 to 25 years were more likely to be involved in alcohol-related crashes. The crashes were also more likely to involve one vehicle and to occur in the country areas of Western Australia.

3.3 Methods of Detecting Drink-driving

From the linked data, it was possible to distinguish between the drink-driving offences detected through routine police enforcement (RBT and mobile testing) and those resulting from a road crash in which a driver was found to be over the legal blood alcohol limit. In all, there were 104,104 drink-driving arrests, of which 6,883 (6.6%) arose from a road crash. Thus about 93% of drink-driving arrests resulted from routine police enforcement activities. The 6,883 crash-related arrest records were associated with 6,727 different drivers.

Table 3.7 to Table 3.15 show the numbers of drivers in the crash-related and non-crash-related arrest categories for each available driver and arrest characteristic. The total number of breath tests and crash tests may differ in each table due to missing information for a particular factor.

Table 3.7 Detection Method by Region, Drink-driving Arrests, Western Australia 1987-1995

Region	Breath test		Crash		Total	
	n	(%)	n	(%)	n	%
metropolitan	56,739	92.7	4,500	7.3	61,239	100.0
country	33,000	94.8	1,800	5.2	34,800	100.0
Total	89,739	93.4	6,300	6.6	96,039	100.0

A significantly greater proportion of metropolitan drink-driving offences were detected through crashes (7.3%) compared to the proportion in country areas (5.2%) ($p < 0.001$).

The 4,500 metropolitan crash-related arrests accounted for 71% of all drink-driving arrests (about 63% of routine apprehensions occurred in the metropolitan area).

Table 3.8 Detection Method by Month, Drink-driving Arrests, Western Australia 1987-1995

Month of offence	Breath test		Crash		Total	
	n	(%)	n	(%)	n	%
January	8,040	94.3	488	5.7	8,528	100.0
February	7,595	93.9	492	6.1	8,087	100.0
March	8,307	93.5	577	6.5	8,884	100.0
April	7,882	94.3	476	5.7	8,358	100.0
May	8,044	93.3	574	6.7	8,618	100.0
June	8,112	93.1	601	6.9	8,713	100.0
July	8,439	92.1	722	7.9	9,161	100.0
August	9,289	93.1	686	6.9	9,975	100.0
September	8,396	93.1	624	6.9	9,020	100.0
October	7,861	93.3	561	6.7	8,422	100.0
November	7,502	93.0	567	7.0	8,069	100.0
December	7,754	93.8	515	6.2	8,269	100.0
Total	97,221	93.4	6,883	6.6	104,104	100.0

Slightly more crash-related arrests than expected occurred in the month of July. Conversely, slightly more routine arrests were made in the holiday months of December, January (Christmas) and April (Easter). With regard to all crashes during the study period, 9.4% of all crashes occurred in July, 7.7% in December, 7.0% in January and 7.8% in April.

Table 3.9 Detection Method by Day of Week, Drink-driving Arrests, Western Australia 1987-1995

Day of Offence	Breath test		Crash		Total	
	n	(%)	n	(%)	n	%
Monday	5,652	92.6	450	7.4	6,102	100.0
Tuesday	6,240	93.6	428	6.4	6,668	100.0
Wednesday	8,453	93.6	576	6.4	9,029	100.0
Thursday	11,762	93.6	808	6.4	12,570	100.0
Friday	21,883	93.7	1,472	6.3	23,355	100.0
Saturday	25,543	93.8	1,696	6.2	27,239	100.0
Sunday	17,688	92.4	1,453	7.6	19,141	100.0
Total	97,221	93.4	6,883	6.6	104,104	100.0

Two-thirds of all arrests for drink-driving occurred on Friday, Saturday and Sunday. Similarly, most crash-related arrests occurred on the weekend. There were, however, proportionately more crash arrests on Sunday (7.6%) and Monday (7.4%) compared to other days of the week. During the study period, 42% of crashes occurred on Friday, Saturday and Sunday, and the day on which crashes were the most frequent was Friday (18%).

Table 3.10 Detection Method by Time of Day, Drink-driving Arrests, Western Australia 1987-1995

Time of Offence	Breath test		Crash		Total	
	n	(%)	n	(%)	n	%
12:00am- 5:59am	32,674	93.4	2,301	6.6	34,975	100.0
6:00am-11:59am	3,261	90.0	363	10.0	3,624	100.0
12:00pm- 5:59pm	8,486	90.2	921	9.8	9,407	100.0
6:00pm-11:59pm	52,799	94.1	3,298	5.9	56,097	100.0
Total	97,220	93.4	6,883	6.6	104,103	100.0

About 80% of drink-driving arrests occurred at night between 6pm and 6am. However, during daylight hours, the risk of detection through a road crash rather than routine

enforcement was slightly higher (Table 3.10). This reflects the fact that crashes were more common during the day when more vehicles were on the roads - 74% of all crashes in the study period occurred during daylight hours. In addition, police operations and alcohol testing policies would be concentrated to maximise their effect during hours of high alcohol consumption.

Table 3.11 Detection Method by Driver Gender, Drink-driving Arrests, Western Australia 1987-1995

Driver gender	Breath test		Crash		Total	
	n	(%)	n	(%)	n	%
male	83,622	93.4	5,940	6.6	89,562	100.0
female	13,441	93.5	936	6.5	14,377	100.0
Total	97,063	93.4	6,876	6.6	103,939	100.0

There was no difference between the proportion of male and female drink-drivers detected through road crashes.

Table 3.12 Detection Method by Driver Age, Drink-driving Arrests, Western Australia 1987-1995

Driver age	Breath test		Crash		Total	
	n	(%)	n	(%)	n	%
0-17 years	2,284	92.4	187	7.6	2,471	100.0
18-25 years	41,610	92.2	3,516	7.8	45,126	100.0
26-35 years	31,276	94.3	1,906	5.7	33,182	100.0
36-65 years	21,654	94.6	1,227	5.4	22,881	100.0
65+ years	353	88.7	45	11.3	398	100.0
Total	97,177	93.4	6,881	6.6	104,058	100.0

About 25% of drivers in crashes were aged between 18 and 25 years. Table 3.12 shows the distribution of drink-drivers according to the detection method and age group of the driver. Drivers aged between 18 and 25 years at the time of the crash comprised about

half of crash-related drink-driving arrests. This is significantly greater than the proportion (43%) of non-crash drink-drivers in this age group (p<0.001). It is also evident that detection through a road crash was more likely for younger and older drink-drivers than for middle-aged drink-drivers.

Table 3.13 Detection Method by Aboriginality, Drink-driving Arrests, Western Australia 1987-1995

Aboriginality	Breath test		Crash		Total	
	n	(%)	n	(%)	n	%
non Aboriginal	84,420	93.0	6,357	7.0	90,777	100.0
Aboriginal	12,462	96.2	494	3.8	12,956	100.0
Total	96,882	93.4	6,851	6.6	103,733	100.0

Table 3.13 shows that more Aboriginal drivers were among those arrested for drink-driving as a result of police enforcement activities than those arrested as a result of a road crash (p<0.001). About 7% of non-Aboriginal and 4% of Aboriginal drink-drivers were arrested as a result of a crash.

Table 3.14 Detection Method by Driver Arrest Status, Drink-driving Arrests, Western Australia 1987-1995.

Previous DD arrests	Breath test		Crash		Total	
	n	(%)	n	(%)	n	%
no	64,401	93.4	4,571	6.6	68,972	100.0
yes	32,820	93.4	2,312	6.6	35,132	100.0
Total	97,221	93.4	6,883	6.6	104,104	100.0

Novices, or those with no previous drink-driving arrests, accounted for 66% of drink-driving arrests during the study period. There was no difference in detection method between those with or without previous drink-driving arrests (Table 3.14).

Table 3.15 Detection Method by Most Serious Offence, Drink-driving Arrests, Western Australia 1987-1995

Most serious offence	Breath test		Crash		Total	
	n	(%)	n	(%)	n	%
excess 0.08%	55,051	94.6	3,139	5.4	58,190	100.0
DUI	37,196	91.8	3,303	8.2	40,499	100.0
refusing or failing to comply	4,974	91.9	441	8.1	5,415	100.0
Total	97,221	93.4	6,883	6.6	104,104	100.0

As shown in Table 3.15, charges for DUI and for 'refusing to be tested' were more likely to be crash-related than charges for 'excess 0.08'.

To summarise, crash arrests for drink-driving were more likely to occur in the winter months, during the day, or on Sunday or Monday. Drink-drivers detected through crashes were more likely to be under 25 years, non-Aboriginal or more seriously alcohol impaired (DUI charges) than drink-drivers detected through routine enforcement activities.

3.4 Environment and Driver Factors Associated with Drink-driving Detection Method

In order to measure the independent effect of environmental and driver factors, two separate multi-variate logistic regression analyses were performed. The outcome of interest was whether a drink-driving arrest had arisen from a road crash or from routine police breath testing and RBT activities. The first analysis concentrated on environmental factors that might distinguish between an apprehension arising from a crash and an apprehension arising from routine enforcement activities (see Table 3.7 to Table 3.10).

In the multi-variate logistic regression model described in Table 3.16, the odds ratios are the odds of an arrest arising from a crash rather than from routine detection. Values for each variable are compared to a baseline value. For instance, crash-related arrests in the country were compared to crash-related arrests in the metropolitan area. Crash-

related arrests occurring in spring, summer and autumn were compared to those in winter. Wednesday was arbitrarily chosen as the baseline for the day of the week.

For each variable the odds ratios were those calculated after controlling for all the other factors. Only the odds ratios that were significantly different from 1.0 (ie the p-value was < 0.01) are displayed in the table below.

Since the logistic model calculates the contribution of each factor to the natural logarithm of the odds of a crash arrest, the combined effect is multiplicative.

Table 3.16 Multiple Environmental Factors Associated with a Crash-related Arrest

Factors	Coefficient	Standard error	p-value	Odds ratio
intercept	-2.5757	0.0860	0.0001	
Area				
metro	0.0000	0.0000		
country	-0.2021	0.0472	0.0001	0.817
Season				
winter	0.0000	0.0000		
spring	-0.1044	0.0566	0.0648	
summer	-0.2859	0.0595	0.0001	0.751
autumn	-0.1960	0.0569	0.0006	0.822
Day of week				
Wednesday	0.0000	0.0000		
Thursday	-0.0628	0.1015	0.5358	
Friday	-0.0484	0.0890	0.5865	
Saturday	-0.0892	0.0884	0.3129	
Sunday	0.0484	0.0899	0.5904	
Monday	0.1484	0.1135	0.1911	
Tuesday	-0.1310	0.1232	0.2875	
Time of day				
1800-2359	0.0000	0.0000		
0000-0559	0.1531	0.0481	0.0015	1.165
0600-1159	0.8235	0.0992	0.0001	2.278
1200-1759	0.7097	0.0719	0.0001	2.033

Compared to routine enforcement arrests, crash-related arrests for drink-driving were less likely to occur in the country areas of WA (odds ratio = 0.817) than in the metropolitan area of Perth. Crash arrests were also less likely to occur in summer (odds ratio=0.751) and autumn (odds ratio=0.822) than in winter. Crash-related arrests were

less likely to occur in the evenings than at any other time of the day. The day of the week was the only factor not having a significant independent effect on a crash-related arrest compared to a routine arrest for drink-driving.

The next multi-variate analysis concentrated on driver and offence characteristics. The factors entered into the analysis were analysed separately in Table 3.11 to Table 3.15.

Table 3.17 Multiple Driver Factors Associated with a Crash-related Arrest

Factors	Coefficient	Standard error	p-value	Odds ratio
intercept	-3.1350	0.0342	0.0001	
Age group				
0-17	0.5677	0.0851	0.0001	1.764
18-25	0.4920	0.0352	0.0001	1.636
26-35	0.1091	0.0381	0.0042	1.115
36-65	0.0000	0.0000		
65+	0.8274	0.1619	0.0001	2.287
Gender				
male	0.0000	0.0000		
female	0.0203	0.0371	0.5833	
Aboriginality				
non-Aboriginal	0.0000	0.0000		
Aboriginal	-0.8617	0.0528	0.0001	0.422
Offence type				
excess 0.08	0.0000	0.0000		
DUI	0.5823	0.0266	0.0001	1.790
refuse test	0.7366	0.0813	0.0001	2.089
Prior history				
DD arrests	-0.0052	0.0153	0.7339	
criminal arrests	0.0077	0.0031	0.0146	

In the multi-variate logistic regression model described in Table 3.17, the odds ratios are the odds of a crash-related arrest versus an arrest resulting from routine detection. Female drivers were compared to male drivers; Aboriginal drivers to non-Aboriginal drivers and drivers in each age group were compared to drivers aged between 36 and 65 years. The comparison group for the offence type is the 'excess 0.08' offence. For each variable, the odds ratios are those derived after controlling for all the other factors.

The most significant independent factors in crash-related arrests compared to 'routine' arrests were the age group and Aboriginality of the driver, as well as the type of the offence. Compared to routine enforcement arrests, crash-related arrests were more likely to involve younger (18-35) and older (65+) drink-drivers than middle-aged drivers. Routine enforcement arrests, on the other hand, were more likely to involve a greater proportion of Aboriginal drivers (odds ratio=0.422). A drink-driver arrested for refusing a breath test had twice the odds of being detected through a crash compared to a similar driver with an 'excess 0.08' alcohol level (odds ratio=2.089).

3.5 Novice Drink-drivers and Subsequent Road Crashes

Of the 53,166 drink-drivers *first arrested* between 1987 and 1995, 8.091 (15.2%) were subsequently found to have been involved in a road crash. Of the drivers who were subsequently involved in a crash, 827 (10.2%) incurred a drink-driving charge as a result of their next crash and 893 (11.0%) incurred a drink-driving charge at the next or a later crash. A crash in which a driver incurred a drink-driving (DD) charge has been referred to as a 'DD crash' or an 'alcohol-related crash'.

Of the 53,166 novice drink-drivers 8,828 (16.6%) had been involved in a road crash at least once prior to their first drink-driving arrest. Of these, 7,058 drivers had been involved in one crash; 1,392 in two crashes; 305 in three crashes; 55 in four crashes and 19 in five or more crashes. The time between the first crash and the arrest for drink-driving varied from less than one year to more than five years. Over the nine years of the study, the average number of crashes (excluding the index event if it was a crash) for the 53,166 novice drink-drivers was 0.395.

The following tables examine available information about the drivers and their first arrest for drink-driving. Included in each table are the numbers of drivers in each category who were subsequently involved in a road crash of any kind and those who were charged for drink-driving as a result of the crash (DD crash). Factors examined were the age, gender and Aboriginality of the driver; the number of other drink-driving arrests between the first offence and the crash; and the time between the first offence and the crash.

3.5.1 Characteristics of the Initial Drink-driving Arrest

The characteristics of the initial arrest – the time, place and severity - were investigated to identify factors associated with drivers later involved in a road crash. For each driver, the length of follow-up was the time from the initial arrest to the crash or the end of the study period, if the driver had not experienced a crash. The incidence rates per 1,000 person-years have been calculated from the sum of all the follow-up periods for the drivers in each class. The relative risk of crash involvement for one group compared to another is the ratio of the two incidence rates.

Table 3.18 The Initial Drink-driving Detection Method and Subsequent Crash Involvement, Novice Drink-drivers, Western Australia 1987-1995

	Subsequent crash				
Initial detection method	no DD arrest		DD arrest		Total
	n	I*	n	I*	person-years
routine	6,071	31.2	760	3.9	194,512
crash-related	1,131	92.8	129	10.6	12,183
Total	7,198	34.8	893	4.3	206,695

* incidence rate per 1,000 person years

Drivers whose first drink-driving arrest emanated from a road crash had a subsequent crash incidence of 93 per thousand person-years and were three times as likely as those first arrested through routine detection to experience another crash (relative risk=3.0). They were also three times as likely to be arrested for drink-driving as a result of the crash (relative risk=2.7).

Table 3.19 The Most Serious Initial Offence and Subsequent Crash Involvement, Novice Drink-drivers, Western Australia 1987-1995

	Subsequent crash				
Initial offence	no DD arrest		DD arrest		Total
	n	I*	n	I*	person-years
excess 0.08	4,747	37.4	395	3.1	127,087
DUI	1,880	27.5	449	6.5	69,294
refusing/failing to comply	75	32.6	23	10.0	2,302
Total	6,702	33.7	867	4.4	198,683

*incidence rate per 1,000 person years

Table 3.19 illustrates the crash experience of novice drink-drivers according to the severity of their initial offence. Drivers originally charged with DUI had an incidence rate of 27.5 per thousand person-years of experiencing a subsequent *non-alcohol crash*. As the severity of the initial offence increased the rate of non-alcohol crash involvement decreased from 37.4 to 27.5 per thousand person-years.

Of the 599 drivers refusing to be tested at their first encounter, 23 (3.8%) were later involved in an *alcohol-related crash*. DUI novices and those refusing to be tested were two to three times more likely to be involved in an *alcohol-related crash* than those initially charged with 'excess 0.08'. (Relative risks=2.1 and 3.2 respectively).

3.5.2 Driver Characteristics

The gender, age and race of the group of novice drink-drivers arrested for the first time between 1987 and 1995 are displayed in Tables 3.5.3, 3.5.4 and 3.5.5.

Table 3.20 Driver Gender and Subsequent Crash Involvement, Novice Drink-drivers, Western Australia 1987-1995

	Subsequent crash				
Driver gender	no DD arrest		DD arrest		Total
	n	I*	n	I*	person-years
male	5,887	35.1	810	4.8	167,531
female	1,296	33.3	83	2.1	38,889
Total	7,183	34.8	893	4.3	206,420

*incidence rate per 1,000 person years

Male drivers comprised about 81% of the drink-drivers arrested for the first time between 1987 and 1995. About 2% of the males and about 1% of the females were later involved in an alcohol-related crash. A further 13% of females and 14% males were involved as drivers in road crashes that did not incur an arrest for drink-driving. Thus, male novice drink-drivers had an incidence rate of 35.1 per 1,000 person years for a non alcohol-related crash and 4.8 per 1,000 person years for an alcohol-related crash. The corresponding incidence rates for female novice drink-drivers was 33.3 and 2.1 respectively. Male novice drink-drivers were, therefore, more than twice as likely as female drink-drivers to be involved in an alcohol-related crash (relative risk=2.3).

Table 3.21 Driver Age and Subsequent Crash Involvement, Novice Drink-drivers, Western Australia 1987-1995

	Subsequent crash				
Driver age	no DD arrest		DD arrest		Total
	n	I*	n	I*	person-years
0-17 years	299	64.7	4	0.9	4,621
18-25 years	4,484	43.2	568	5.5	103,849
26-35 years	1,432	24.9	236	4.1	57,438
36-65 years	966	24.2	84	2.1	39,937
65+ years	17	20.8	1	1.2	816
Total	7,198	34.8	893	4.3	206,661

*incidence rate per 1,000 person years

The incidence rate per 1,000 person-years decreased with increasing age at first arrest for both *alcohol* and *non-alcohol-related* crashes. The relative risk of a novice drink-driver under the age of 25 years becoming involved in a *non-alcohol-related* crash was nearly twice that of a novice driver aged between 36 and 65 years (relative risk=2.7 for 0-17 years; 1.8 for 18-25 years). However, drink-drivers who were older (26 to 35 years) when first arrested, were slightly less likely to be involved in a subsequent *alcohol-related* crash than those aged 18 to 25 years (relative risk=0.7).

Table 3.22 Driver Aboriginality and Subsequent Crash Involvement, Novice Drink-drivers, Western Australia 1987-1995

	Subsequent crash				
Aboriginality	no DD arrest		DD arrest		Total
	n	I*	n	I*	person-years
non Aboriginal	7,015	35.8	826	4.2	195,760
Aboriginal	166	16.1	67	6.5	10,291
Total	7,181	34.8	893	4.3	206,051

*incidence rate per 1,000 person years

Non-Aboriginal novice drink-drivers were more likely than those of Aboriginal background to be involved in a subsequent *non-alcohol-related* crash (relative risk=2.2); however, Table 3.22 also indicates that novice Aboriginal drink-drivers were more likely to be involved in a subsequent *alcohol-related* crash (relative risk=1.5).

3.5.3 Interim Events

The sequence of events between the initial arrest for drink-driving and a subsequent road crash may be important in determining a strategy for intervention. Some drink-driving novices accumulated up to 10 drink-driving charges by the end of the study period.[5] Table 3.23 shows the number of drink-driving arrests between the initial arrest and the subsequent crash. The number of person-years for each category (number of interim arrests) has been calculated as being the number of crashes divided by the time

from one arrest to the next for each novice drink-driver, until a crash occurs. Where a driver was not involved in a crash, the end of the sequence was defined as the end of the study (ie 31 December 1995).

Table 3.23 Interim Drink-driving Arrests and Subsequent Crash Involvement, Novice Drink-drivers, Western Australia 1987-1995

	Subsequent crash				
Number of arrests	no DD arrest		DD arrest		Total
	n	I*	n	I*	person-years
0	6,481	36.7	685	3.8	178,754
1	628	26.7	161	6.9	23,480
2	71	19.7	37	10.3	3,608
3 or more	18	21.1	9	10.6	853
Total	7,198	34.8	892	4.3	206,695

*incidence rate per 1,000 person years

Novice drink-drivers, with one or more additional arrests for drink-driving, were no more likely to have a *non-alcohol* crash than those without further arrests. However, those with one additional arrest had twice the risk and those with two or more arrests had three times the risk of becoming involved in an *alcohol-related* crash.

Of the 8,091 novice drink-drivers, who were later involved in a crash, 810 (10%) were arrested for other drink-driving offences prior to their crash. Of the 893 novice drink-drivers known to have been involved in a subsequent alcohol-related crash, 170 (19%) had been arrested for drink-driving again before crashing.

More than 50% of the novice drink-drivers known to have crashed did so within 2 years of the first arrest. Alcohol-related crashes were likely to happen sooner than non alcohol-related crashes.

[5] There was also one driver who had been involved in seven crashes during the period.

In summary, those ultimately involved in a crash were likely to have had other drink-driving arrests between their initial arrest and the crash. Those ultimately involved in *alcohol-related* crashes were more likely to have had *more* drink-driving arrests between their initial arrest and the crash *and* to have had the crash *sooner*.

3.5.4 Factors Associated with Crash Involvement

The independent effects of driver and arrest characteristics were measured using survival analysis. (These characteristics have been separately described in Section 3.5.3.) The outcome of interest was the time between the first drink-driving arrest and the subsequent road crash. One level of each factor was chosen as the 'baseline' and risk ratios were calculated relative to that value for each factor. The following table gives the result of these calculations.

Table 3.24 Multiple Factors Associated with a Subsequent Crash, Novice Drink-drivers, Western Australia 1987-1995

Factors	Coefficient	Standard error	p-value	Risk ratio
Age group				
0-17	0.6493	0.0686	0.0001	1.914
18-25	0.4927	0.0353	0.0001	1.637
26-35	0.1166	0.0397	0.0033	1.124
36-65	0.0000	0.0000		
65+	-0.3207	0.2378	0.1774	
Gender				
male	0.0000	0.0000		
female	-0.1077	0.0300	0.0003	0.898
Aboriginality				
non-Aboriginal	0.0000	0.0000		
Aboriginal	-0.5802	0.0678	0.0001	0.560
First arrest at crash	0.9115	0.0312	0.0001	2.488
First offence				
excess 0.08	0.0000	0.0000		
DUI	-0.0504	0.0297	0.0898	
refuse test	0.1283	0.0255	0.0001	0.880
Any interim DD arrests	-0.3278	0.0879	0.0002	0.721
No. of interim DD arrests	-0.3623	0.0675	0.0001	0.696
Any criminal arrests	0.4047	0.0248	0.0001	1.499

The age at which a driver was first arrested for drink-driving; whether the first arrest resulted from a crash and any criminal arrests were the most important factors in determining the time between a drink-driving arrest and a subsequent crash. Significant increased risk was found for those drivers who were under 25 years when first arrested for drink-driving. For this group, the time between the first arrest and crash was significantly shorter. In fact, the time to crash for drink-drivers in the 0-17 and 18-25 year age groups was more than 60% shorter than that of drink-drivers aged between 36 and 65 years (risk ratio=1.914 and 1.637 respectively). Drivers with interim drink-driving arrests were likely to take longer to crash, possibly because of the effects of penalties that may have suspended drivers' licences and restricted the ability to drive.

3.5.5 Factors Associated with *Alcohol-related* Crash Involvement

As for all crashes, the elapsed time between the initial drink-driving arrest and a subsequent drink-driving crash is important. The results of the survival analysis (Cox regression model of the elapsed time (or 'time to failure')) are given in Table 3.25.

Table 3.25 Multiple Factors Associated with a Subsequent *Alcohol-related* Crash, Novice drink-drivers, Western Australia 1987-1995

Factors	Coefficient	Standard error	p-value	Risk ratio
Age group				
0-17	-1.3206	0.5148	0.0103	
18-25	0.5508	0.1212	0.0001	1.735
26-35	0.5002	0.1283	0.0001	1.649
36-65	0.0000			
65+	-0.3422	1.0061	0.7100	
Gender				
male	0.0000			
female	-0.6077	0.1166	0.0001	0.545
Aboriginality				
non-Aboriginal	0.0000			
Aboriginal	-0.0564	0.1310	0.6666	
First offence				
excess 0.08	0.0000	0.0000		
DUI	0.7685	0.0701	0.0001	2.157
refuse test	1.0035	0.2034	0.0001	2.728
Any interim DD arrests	-0.2935	0.1665	0.0762	
No. of interim DD arrests	-0.2558	0.1113	0.0215	
Any criminal arrests	1.3430	0.0765	0.0001	3.831

Female drivers had a significantly longer delay between their first drink-driving arrest and a subsequent drink-driving crash than male drivers (risk ratio=0.545). Younger drivers (aged 18 to 25 and 26 to 35 years at their first offence) took significantly less time to experience an alcohol-related crash after their first drink-driving charge than older drivers (36 to 65 years).

Drivers who were originally charged with the more serious offences of DUI or refusing to be tested took less time to have an alcohol-related crash than those originally charged with 'excess 0.08'. Those drivers charged with DUI took about half the time (risk ratio=2.157) and those refusing a test took about one third of the time (risk ratio=2.728) to crash. Drivers with a criminal history were also likely to crash sooner (risk ratio=3.831) than those without such history. The indicator for whether or not the initial

arrest occurred at a crash or not was omitted due to small numbers. When the analysis was restricted to novice drivers initially arrested through routine enforcement, the results were only marginally different.

3.6 Drink-driving and Road Crash Careers

During the nine-year period 1987 to 1995, 53,166 drivers were first arrested for drink-driving. About 7% of these novice drink-drivers were arrested as a result of a crash.

All drink-driving and road crash records for these drivers were analysed and it was found that 37,184 (70%) had not incurred any further arrests or crashes by the end of the study (31 December 1995). However, 57 drivers had five or more subsequent drink-driving arrests and 10 had been involved in five or more road crashes. There were also 15 drivers involved in two drink-driving crashes following their initial arrest for drink-driving.

Figure 3.4 summarises the arrest and crash experience of the 53,166 novice drink drivers in this study. As seen previously in Table 3.23, 6,481 drivers were not arrested for drink-driving again, but were involved in at least one *non-alcohol-related* crash. Similarly, 717 novice drink-drivers, who were arrested again for drink-driving offences, were not involved in a road crash before the end of the study. The numbers of drivers experiencing no crashes, a non-alcohol-related (non-DD) crash or an alcohol-related (DD) crash for each number of additional drink-driving arrests are depicted as bars on the figure below. The incidence rates corresponding to each crash type (non-alcohol-related / alcohol-related) and arrest category are depicted as dashed lines.

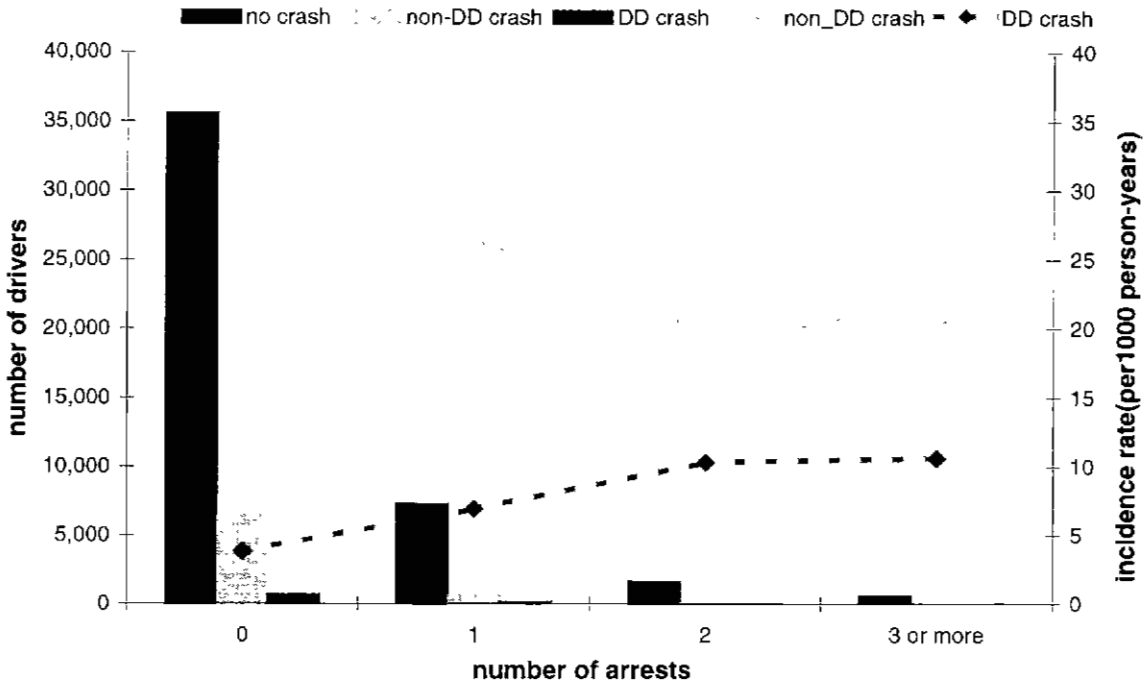

Figure 3.4 Drink-driving and the Risk of Crashing

From Figure 3.4 it can be seen that as the number of further drink-driving arrests increased from zero to three or more, the likelihood that a driver would be involved in a *non-alcohol-related* (non-DD) crash did not increase. The likelihood that a driver would be involved in an *alcohol-related* (DD) crash before 31 December 1995, however, increased from a factor of two after one additional arrest to a factor of three after two or more additional arrests.

3.7 Summary

Table 3.26 below briefly summarises the findings of this study. The over-representation of male drivers and young drivers in alcohol-related crashes compared to all crashes and the over-involvement of Aboriginal drivers in drink-driving arrests are of particular interest. In addition, those drivers initially arrested for more serious drink-driving offences were more likely to be involved in alcohol-related crashes and those with a prior criminal record were more likely to be arrested for drink-driving.

Table 3.26 Summary of Driver and Environmental Factors Associated with Drinking-driving Arrests and Alcohol-related Crashes

Driver/ Environment Characteristic	Percentage of all crashes	Percentage of all "alcohol-related" crashes	Percentage of all drink-driving arrests	Percentage of all "routine" DD-arrests
males	63%	86%	86%	86%
young (18-25 years)	25%	50%	43%	43%
Aboriginal	unknown	7.2%	12.4%	12.9%
prior criminal record	unknown	34%	45%	45%
charged with most serious DUI offence	n/a	48%	39%	38%
country areas	17%	28%	36%	36%
high alcohol consumption hours	27%	84%	89%	89%
winter	28%	29%	27%	26%

With regard to the drink-driving and crash careers of the group of 53,166 novice drink-drivers; those who continued to be arrested for drink-driving had a two to three fold increase in the risk that they would be involved in an alcohol-related crash by the end of the study. The variable time of follow-up for these drivers was included in the calculation of these relative risks.

4. DISCUSSION

All arrests and road crash records for drink-drivers in Western Australia between 1987 and 1995 have been used in this study. The two sets of records were linked so that drink-driving arrests that coincided with a road crash could be identified. These were labelled as 'alcohol-related' crashes.[6]

The data-linkage fulfilled a number of objectives. First, it allowed us to better identify the extent of alcohol involvement in road crashes in Western Australia. Second, it provided evidence of the proportion of drink-driving arrests arising from road crashes (as compared to those detected through routine police enforcement practices). Finally,

[6] However, when compared with other drink-driving apprehensions, these alcohol-related crashes were referred to as 'crash-related' arrests.

it permitted us to track drink-driving and road crash careers to identify those drivers most likely to have on-going problems with drinking, driving and general road safety.

4.1 About Alcohol-related Crashes

Our study found that 'alcohol-related' crashes comprised about 2% of all reported crashes (and 1.1% of crashing drivers) in WA. This is a small but significant proportion because it is represents a minimum or 'base-level' of the *true* level of alcohol involvement in road crashes. Our estimates are likely to *under-estimate* the true level of alcohol involvement in road crashes since they are based on 'reported' crashes only, which account for about 60% of all road crashes (Rosman and Knuiman, 1994), and are a consequence of police attendance at such crashes. Thus, our data is subject to the combined filtering effects of driver reporting practices and the decisions of police to attend crashes, to test suspected drivers and to record offences, if any.

As the summary in Table 3.26 shows, male drivers were over-represented in alcohol-related crashes. While male drivers were involved in 86% of alcohol-related crashes, they accounted for only 63% of total reported crashes. Young drivers (male and female), aged between 18 and 25 years, were also over-represented in alcohol-related crashes, being involved in about half of such crashes but only 25% of total reported crashes.[7] These results accord with existing research identifying sex and age as correlates of alcohol consumption (Abraham et al, 1995; Somerford et al, 1995) and road crashes (Ryan et al, 1998).

Country areas were also over-represented in alcohol-related crashes - comprising more than one-quarter of such crashes yet only 17% of total reported crashes.

Importantly, we found that alcohol-related crashes were more severe than those not involving alcohol, resulting in about 50% more casualties in both single and multi-vehicle crashes. However, the extent to which those casualties suffered more serious injuries could not be determined from the available data.

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[7] Racial differences could not be determined since the Aboriginality of drivers is not routinely recorded in road crash statistics in WA. However, earlier research by Cercarelli (1989) found that, on the basis of hospital based crash data, Aborigines are vastly over-represented in road crashes in WA.

As expected, alcohol-related crashes were much more likely to involve only one vehicle. In fact, of the crashes associated with a drink-driving arrest, 55% were either a vehicle hitting an object or a non-collision crash. In contrast, just 11% of self-reported crashes were 'hit object' or 'non-collision' crashes.

Also as expected, the crashes identified as 'alcohol-related' were more likely to occur during periods of high alcohol consumption. More than 80% of alcohol-related crashes occurred during times of high alcohol consumption, compared with only 26% of total reported crashes.

4.2 About Drink-driving Offences

Criminologists classify drink-driving as a 'discovery' offence, meaning that it is a crime not normally reported by individual community members, but rather, relies on the activities of the police to detect and record such offences (Coleman and Moynihan, 1996). More than other offences, the number and nature of discovered offences are heavily influenced by the operational activities of the police and the policy decisions that underpin them.

For this study, most of the review period (1987-1995) preceded the introduction of bus-based RBT, the 'new' police enforcement strategy implemented in 1995. However, prior to 1995, the level of car-based RBT enforcement had been increasing and there was an increase in the number of drivers charged through car-based RBT, from 2,470 drivers charged in 1987/88 to 7,322 in 1994/95 (Hendrie et al, 1997)

With respect to police attendance at road crashes, this study found that the police attended slightly less than one-quarter (23%) of all reported road crashes and, of these, about 8% led to charges being laid for drink-driving offences. Police attendance was slightly greater at crashes involving male drivers than those involving female drivers. The proportion of male drivers subsequently charged with a drink-driving offence (7.6%) was also greater than the proportion of female drivers charged (2.6%). The latter finding accords with current literature which identifies gender differences (male-dominance) in both alcohol consumption (Abraham et al, 1995; Somerford et al, 1995) and drink-driving patterns (Vingilis et al, 1982; Ryan, et al, 1996)

Only about 7% of all drink-driving arrests arose from road crashes - the vast majority (93%) being detected through routine enforcement activities such as random breath testing. However, this varied somewhat depending on environmental factors and some driver characteristics.

Environmental factors

There was an excess of drink-driving arrests from crashes on Sundays and Mondays, during daylight hours and in the country. This is most likely due to lower levels of routine enforcement on these days, at these times and outside the Perth metropolitan area.

Police enforcement actions have tended to concentrate at times of expected high alcohol consumption (weekends and at night).[8] Recent local research by Hendrie et al (1998) has found that more than 40% of RBT enforcement actions in WA occur on weekends, with a similar proportion occurring in the evenings between 7pm and midnight. Our findings reflect this concentrated enforcement effect: in the nine years between 1987 and 1995, 84% of alcohol-related crashes and 26% of total reported road crashes occurred at high alcohol consumption times (Table 3.26). Overall, 89% of drink-driving arrests were made during times of high alcohol consumption and about 64% of RBT hours were concentrated in these times of expected high alcohol consumption.

Driver characteristics

This study has also found an excess of drink-driving arrests from crashes for younger (under 25 years) and older (65+) drivers, non-Aboriginal drivers and/or more seriously alcohol impaired drink-drivers than those detected through routine enforcement operations.

Previous studies have shown that young people generally face higher risks of road crashes (Ryan et al, 1998) and higher detection risks for drink-driving (Ryan et al, 1996). These factors combined would tend to explain the higher risk of detection through crashes of young drink-drivers as revealed in our study.

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[8] In the absence of more detailed information about the occurrences of alcohol-related crashes, the WA police have tended to rely on alcohol consumption patterns to determine the timing and placement of RBT

However, the lower risk of detection through crashes of Aboriginal drink-drivers appears surprising at first glance. Researchers have found that Aboriginal people are greatly over-represented in road crashes in WA (Cercarelli, 1989), yet they are under-counted in the records of crash-related drink-driving arrests examined in this study. There are a number of plausible explanations for this. First, it is likely that because of the remoteness of many Aboriginal communities, the proportion of road crashes of people from these communities *actually reported* to authorities would be quite low. Second, because of the vast geographical size and the remoteness of many rural areas, the police are likely to be prevented from *both attending* rural road crashes and *detecting* the level of alcohol involved in them.

Consideration of the converse, that is, that compared with non-Aborigines, Aboriginal people had *higher* risks of detection for drink-driving *through routine police enforcement* rather than from road crashes, provides yet another explanation. It may be argued that, for Aborigines, it is not so much that the detection from road crashes is low but that the detection risk from routine enforcement is *much higher* than expected. This raises the additional question of whether police enforcement activities regarding drink-driving are somehow selectively targeted towards sub-groups of the population and, perhaps, towards Aboriginal people.

While it is known that police enforcement strategies are targeted at times of high alcohol consumption and located near places of high alcohol consumption (Hendrie et al, 1998), our study provided only a limited assessment of whether such strategies specifically targeted any sub-group(s) of the general population. There was evidence that some groups, such as young drivers were over-represented in crash-related arrests, however, it is difficult to disentangle the effects of differential alcohol-consumption patterns, different driving and crash patterns of sub-groups of the population from the effects of differential or 'targeted' police enforcement actions. Thus, the conclusion could be that any differences measured between crash and non-crash arrests for drink-driving were due simply to exposure effects.

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enforcement actions. Crashes occurring at night and on the weekend were considered more likely to be alcohol-related.

Nevertheless, given the historically high contact rates between Aboriginal people and the police in WA (Harding et al, 1994) and the very nature of that contact which is characterised by a high number of arrests for 'street' or public order offences[9] (Blagg & Ferrante, 1997), speculation about the selective nature of police enforcement strategies remains.

4.3 About Patterns of Drinking, Driving and Crashing

Characteristics of drink-drivers and their patterns of drink-driving and crashing also confirm previous findings. Male drivers less than 25 years were the most likely to be arrested for drink-driving and were the most likely to continue to be re-arrested for drink-driving offences. Although the proportion of drink-drivers who re-offended during the study period was relatively small (about 30%), those that did re-offend had an increased risk of eventually become involved in an alcohol-related crash. Moreover, their relative risk of an alcohol-related crash increased with each subsequent drink-driving charge: the relative risk increasing from two after the second drink-driving arrest to three following three or more arrests when compared to no further arrests.

Other factors also added to the risk of a subsequent alcohol-related crash. Drivers whose first drink-driving arrest resulted from a road crash were not only more likely to be re-arrested for another drink-driving charge but were also more likely to experience another alcohol-related crash. Also, the risk of an alcohol-related crash more than doubled if the first drink-driving arrest was for refusing the test or if it involved the more serious charge of 'driving under the influence of alcohol or drugs'. Further, if drivers had a history of other criminal behaviour, then their risk of a subsequent alcohol-related crash increased nearly four-fold.

These findings support the notion of an overlap between drinking drivers, drink-driver offenders and collision drivers - individuals who, though they may not be identical, have much in common. Like earlier researchers (eg Vingilis, Raymond and others - quoted in Homel 1988 p.15), our findings support the conclusion that drink-driving violations and crashes may be one of the early predictors of 'high risk' drinking drivers. Very little work has been done to identify such groups within an Australian setting.

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[9] Public order offences are also 'discovered' offences and thus highly influenced by policing actions.

The nexus between conventional criminality and drink-driving re-emerges in this study as it has done in previous studies of drink-drivers. Most recently, Ryan et al (1996) found that many *repeat* drink-drinkers in Western Australia had records of criminal offences. As Wilson and Jonah observe, "impaired driving may be just one behaviour which is part of a deviant behavioural syndrome typified by high-risk behaviours" (Wilson and Jonah, quoted in Homel, 1988, p16). Criminal career research also supports the view that anti-social behaviour "covers a multitude of sins" (Farrington, 1997) including reckless driving, heavy drinking, sexual promiscuity, heavy gambling, and employment instability. These acts tend to be interrelated, in the sense that people who commit any one of them have a considerably increased risk of committing any of the others (West and Farrington, 1977).

This study also considered the elapsed time between first drink-driving arrest and subsequent road crash and found that this too was affected by a number of factors. The age at which a driver was first arrested for drink-driving; whether the first arrest resulted from a crash, and having a prior criminal history were the most important variables affecting the time between first arrest and subsequent crash. Each of these factors (that is, an early age of onset, a prior alcohol-related crash and a prior criminal record) predicted that subsequent road crashes would happen sooner.

These findings also agree with the conclusions of criminal career research. Numerous studies have shown that an early age of onset foreshadows a longer and more serious criminal career (Home Office, 1987; Farrington 1992; Loeber and LeBlanc 1990) and that past (offending) behaviour is predictive of similar future (offending) behaviour. Thus, it is not surprising that past alcohol-related crashes predict future alcohol-related crashes, and that prior drink-driving violations predict future violations (and future alcohol-related crashes).

5. CONCLUSION

Clearly, the identification of 'high-risk' groups would enable countermeasures to be more effectively constructed and more efficiently targeted. Chronic or 'repeat' drink-drivers and drivers with prior criminal records were two groups identified as having

greater subsequent crash risks than other drivers. Similarly, drivers who had already been involved in one alcohol-related crash, or who were involved in alcohol-related crashes at younger ages, were significantly more likely to drink, drive and crash again. Early detection of individuals from these groups would facilitate targeted intervention programs aimed at reducing crime and improving public road safety.

On a broader front, our study has shown that young people had elevated risks of drink-driving detection through road crashes, due in part to generally high road crash risks but perhaps also due to selective policing practices. Similarly, our study showed that Aboriginal people had elevated risks of detection through routine police enforcement actions rather than through road crashes.

There is no doubt that the enforcement activities of the police play a large part in the detection and identification of drink-drivers, yet, there is little research which examines these practices in detail. Future research may help determine the extent to which the drink-driving population is a function of selective police practices.

REFERENCES

Abraham B, d'Espaignet E T & Stevenson C (1995). *Australian health trends 1995.* Australian Institute of Health & Welfare. Canberra: AGPS.

Blagg H and Ferrante A (1997) Aborigines *and Justice: Policing, Public Order and Community Management.* Report to the Aboriginal Affairs Department, WA. Crime Research Centre, University of Western Australia.

Brewer R D, Morris P D, Cole T B, Watkins S, Patetta M J, Popkin C (1994) The risk of dying in alcohol-related crashes among habitual drunk drivers. *New England Journal of Medicine* 331; 513-517.

Cercarelli L R (1994) Road crashes involving Aboriginal people in Western Australia. *Accident Analysis and Prevention*; 26 (3), 361-369.

Cercarelli L R, Kirov C, Legge M & Rosman D L (1998) *Road crashes in Western Australia Data for 1997* Road Safety Council of Western Australia (in press).

Coleman C and Moynihan J (1996) *Understanding Crime Data.* Open University Press, Buckingham.

Farrington D (1992) Criminal career research in the United Kingdom, *British Journal of Criminology*, 32: 521-36.

Farrington D (1997) Human development and criminal careers. In Maguire M, Morgan R and Reiner R (Eds) *The Oxford Handbook of Criminology* (2nd edition). Clarendon Press, Oxford.

Ferrante A (1993) Developing an offender-based tracking system: the Western Australian INOIS project. *ANZ Journal of Criminology* 26: 232-250.

Gantzer S (1995) *Update of High Alcohol Times in Victoria.* Research Note. Monash University Accident Research Centre, Melbourne.

Harding R, Broadhurst R, Ferrante A & Loh N (1995) *Aboriginal Contact with the Criminal Justice System and the Impact of the Recommendations of the Royal Commission into Aboriginal Deaths in Custody.* Hawkins Press, Sydney.

Hendrie D `V, Allotey P & Ryan GA (1997) *Review of the Random Breath Testing Program in Western Australia in 1994/95 and 1995/96.* Road Accident Prevention Research Unit RR54.

Hendrie D V, Cooper L, Ryan GA & Kirov C (1998) *Review of the Random Breath Testing Program in Western Australia in 1996/7.* Road Accident Prevention Research Unit (draft).

Home Office (1987) *Criminal Careers of Those Born in 1953: Persistent Offenders and Desistance.* Home Office Statistical Bulletin No. 35/87. Home Office, London.

Homel R (1988) *Policing and Punishing the Drinking Driver: A Study of General and Specific Deterrence.* Springer-Verlag, New York.

Loeber R & le Blanc M (1990) 'Toward a Developmental Criminology'. In Tonry M and Morris N (eds) *Crime and Justice*, Vol 12, 375-473. University of Chicago Press, Chicago.

Menhennett L, Emery L, & Maisey G (1996) *Reported road crashes in Western Australia: Statistics for 1995.* Traffic Board of Western Australia.

Rosman D L & Knuiman, M W (1994) A comparison of hospital and police road injury data. *Accident Analysis and Prevention*; 26 (2): 215-222.

Ross H L (1993) Prevalence of alcohol-impaired driving: An international comparison. *Accident Analysis and Prevention*; 23 (6): 777-779.

Ryan G A, Ferrante A M, Loh N, Cercarelli L R (1996) *Repeat drink-driving offenders in Western Australia, 1984-1994.* Federal Office of Road Safety, CR 168.

Ryan G A, Legge M & Rosman D L (1998) Age-related changes in drivers' crash risk and crash type. *Accident Analysis and Prevention* 30(3): 379-387.

Somerford P, Fitzgerald P, Gattorna, Ridolfo B, Serafino S, Unwin E, Thomson N (1995) *An Overview of the health of residents of the Western Health Authority: 1995.* Health Department of Western Australia, Perth.

Vingilis E, Adlaf E & Chung L (1982) Comparison of age and sex characteristics of police suspected impaired drivers and roadside-surveyed impaired drivers. *Accident Analysis and Prevention;* 14(6): 425-430.

West D and Farrington (1977) *The Delinquent Way of Life.* Heinemann, London.