ANALYSIS OF INVOLVEMENT OF SCOOTERS IN CRASHES AND THEIR COMMON CRASH CHARACTERISTICS

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Road Safety & Network Access Division

by

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EXECUTIVE SUMMARY

Background

Motor scooters (registered as motorcycles) are becoming an increasingly popular mode of transport, with an increasing number of scooters available on the Australian market over the last few years. For example, in 2007, motor scooters accounted for about 24% of all road registrable motorcycle sales and more than10% of all motorcycles (including ATVs, off-road and on road categories) (FCAI, 2008). This contrasts with the pattern for the 1980's and early 1990's when very few scooters were sold in Australia.

Recent reports suggest that those buying and riding scooters may be different to those buying motorcycles in that they do not seem to progress to conventional motorcycle use. They are typically urban dwellers in large cities such as Melbourne, Sydney and Brisbane, use the scooter for short distance, local travel, which may include some commuting, and tend to be aged 25-35 years with a greater representation of women. The scooter is often identified as a "fun" alternative to car or conventional motorcycle use.

For the purposes of this report it is accepted that a motor scooter generally refers to the step-through design whereby the rider does not place a leg either side of the engine. Characteristics of most, but not all, scooters include a moulded metal/plastic body, automatic transmission and much smaller wheels than motorcycles. While Victoria has no separate moped registration category, mopeds are generally considered to be low-powered and speed limited (usually to no more than 50km/h) scooters with an engine capacity not exceeding 50cc. Mopeds and scooters as referred to in this report do not include power assisted bicycles (including electric bicycles) which do not require vehicle registration or a driver/rider licence to operate on road. This report deals only with motor scooters and mopeds registered as motorcycles for road use in Victoria and which require a motorcycle licence or learner permit to operate on road.

Given that little was known about the involvement of motor scooters in crashes in Victoria, VicRoads' Road Safety and Network Access Department commissioned Dr Ron Christie of RCSC Services Pty Ltd in mid 2007 to investigate the trauma profile of motor scooter crashes in Victoria, to identify the extent of involvement of motor scooters in crashes and to examine their common crash types. The project involved using the VicRoads vehicle registration database to identify scooters and assess scooter numbers and analysis of the crash database held by VicRoads to identify their common crash characteristics. It was considered that this would improve the level of understanding and knowledge about scooter-involved crashes and assist with future safety initiatives directed at improving scooter safety.

The objectives of the project were to:

- Review the published literature on scooter crash involvement nationally within Australia and in comparable countries;
- Estimate the number of registered scooters in Victoria for all scooters and by meaningful scooter categories;
- Identify the extent of the involvement of scooters in crashes (including the number and rate of scooter crashes, proportion of scooter crashes compared to motorcycle crashes, and any trends in the number and rate of scooter crashes occurring over time);
- Analyse the common crash types for crashes involving scooters; and
- Prepare a report which discusses the findings and their significance in relation to the safety of scooter riders.

Estimated Number of Registered Scooters

As at August 2007, it was estimated that were 8,632 scooters (including mopeds) in Victoria. This accounted for about 6.4% of all registered motorcycles in Victoria.

Characteristics of Registered Scooters

Analysis of scooter registration data in Victoria showed that:

- Five vehicle makes accounted for about 73% of all registered scooters in Victoria. - Bolwell represented the single most common make with 21.5% of all scooter registrations. However, if all the makes under the Piaggio brand were combined (ie Piaggio, Vespa, Gilera, Derbi, and Aprilia), the Piaggio group accounted for the largest proportion of registered scooters (ie about 34%).
- Mopeds (ie engine size not exceeding 50cc) accounted for almost 24% of all Victorian registered scooters.
- Conventional scooters with an engine size between 51cc and 250cc accounted for the majority of registered machines (ie about 73%).
- Large scooters with engine sizes in excess of 250cc (termed maxi–scooters) accounted for only about 3% of all registered scooters.
- Ten local government areas (LGAs) accounted for about 46% of all registered scooters in Victoria.
    - With the exception of the City of Greater Geelong, all of these LGAs
        - are located within the Melbourne Metropolitan area with most being inner urban, more densely populated municipalities.
        - are relatively affluent areas in which median wage and salary levels exceed the medians for Victoria and Australia.
        - are in the top 25% of municipalities in Australia in terms of personal income with three (Port Phillip, Boroondara and Stonnington) being in the top 10%.
        - the City of Port Phillip accounted for 7.5% of all scooter registrations.
    - While the remaining 54% of scooter registrations was spread across the remaining 69 municipalities in Victoria, the distribution was denser in urban LGAs
        - about 79% of scooters were located within metropolitan Melbourne.
        - 9% were located in rural cities/centres.
        - 13% were spread across other rural areas.
- About 79% of all registered scooters were manufactured after 2000
    - 46% between 2001-2005.
    - 33% after 2005.
- Compared to registered motorcycles, scooters were:
    - newer (ie 79% of scooters were manufactured after 2000, compared to only 47% of motorcycles).
    - more likely to be found in urban municipalities (eg 79% of scooters were located in the Melbourne Statistical Division (MSD), compared to only 60% of motorcycles).
    - more likely to be found in more affluent municipalities (eg nine of the top-10 scooter LGA were in the most affluent 25% of all Australian LGAs, compared to only one for motorcycles).

Matching of Registration and Crash Data for Victorian Registered Scooters

Matching of all Victorian motorcycle involved crashes in the VicRoads crash database for the period 1995 to 2006 inclusive with the file of Victorian registered scooters (including mopeds) as at August 2007 produced a match rate of less than 3% (ie 224 of the registered scooters appeared in the crash dataset). Of this 224 that appeared in the crash dataset, only 102 (i.e. about 45%) were actually classified as mopeds or scooters, 85 as motorcycles (38%) with the balance 37 (17%) being misclassified as cars.

This low match rate necessitated the searching of Victorian registration archives and written-off vehicle databases to identify crash involved motorcycles for the period 1995 to 2006 that were scooters/mopeds. Searching these archives was completed on a record-by-record basis.

A search of the registration archives back to 1999 (inclusive) identified a further 175 scooters/mopeds, that may have been involved in crashes however, not all of these records contained any additional useful information – a further 26 records could not be found. A decision not to search the archives before 1999 was made by VicRoads as almost no crash involved scooters were found for that year and the cost of further searching could not be justified. After the removal of records which contained no additional useful information or were anomalous, a total of 399 known crash involved scooter/moped records for the period 1995-2006 inclusive resulted from the combination of August 2007 registered and archival registration data. A total of 10 possible scooters from the pool of 175 could not be identified in the archival records for the period 1995-2006.

Following consultation with VicRoads, it was agreed that only crashes for the six year period 2001-2006 inclusive (n=337) should be included in the analysis as elimination of the period 1995-2000 accounted for only about a 15% loss of data but allowed analysis to focus on the years in which scooter sales in Victoria were increasing markedly. It was considered that the inclusion of the small number of identified scooter crashes for the six year period 1995-2000 inclusive (ie 62 cases) may distort the overall analysis.

Variables Explored in Crash Analysis

Where possible, the contractors analysed the scooter crash data for 2001-2006 by a range of variables including year of scooter manufacture, age of rider, licence status of rider, crash severity, speed zone, type of crash (using VicRoads Definition Classifying Accident (DCA) coding system) and where the crash occurred (eg rural/urban) and by local government area (LGA).

Crash patterns for scooters were also compared with those for all Victorian motorcycles (ie non-scooters) for the same six year period to look for differences and similarities in patterns/rates. Comparisons were also made where possible and appropriate, to interstate and overseas patterns for scooters/mopeds to provide a broader context. Motorcycle and scooter crash patterns were also compared with general patterns for Victorian passenger cars (ie cars, station wagons and derivatives) for the 2001-2006 period.

The relatively small number of scooter crashes limited the depth to which analysis could proceed before cell sizes became too small and unreliable. It also limited, to some extent, year-to-year comparisons. This made cross-tabulation and analysis by variables such as engine size, age/gender of rider, crash type and region difficult at times. It also limited the separate analysis of moped crashes.

Crash Patterns of Registered Scooters in Victoria 2001-2006

The analysis of identified scooter crashes which occurred in Victoria in the period 2001-2006 was based on a relatively small number of cases (n=337). In view of this, the results presented should be viewed as indicative of scooter crash patterns rather than definitive. Notwithstanding this caveat, analysis of scooter crashes showed that:

- The number of scooter crashes increased between 2001 and 2006 with almost half occurring between 2005 and 2006 inclusive.
- Almost 60% of scooter crashes involved a collision with another vehicle while 35% involved the scooter alone (the balance was recorded as *Unknown* in the VicRoads database)
- In almost all cases (96%) the crash involved scooter rider was riding solo.
- The majority of crash involved scooters, almost 85%, had an engine size greater than 50cc.
- Most crash involved scooters (about 62%) were manufactured after 2000.
- About 38% of crash involved scooters sustained only minor damage (as assessed by police) with only about 22% being towed away.
- While the majority of crash involved scooter riders were male (about 66%), females accounted for almost 34%.
- The mean age of crash involved scooter riders was 38 years (median 35) with most being aged between 21 and 30 years (32%).
- Crash involved female scooter riders tended to be younger than males.
- Almost all (93%) of crash involved scooter riders were Victorian licensed – about 55% held full licences, 27% learner permits and about 6% probationary licences.
- Most scooter crashes occurred in autumn (about 28%) and least in summer (21%) – October was the highest month for scooter crashes (about 10% of all crashes) and September the lowest (about 5%).
- Almost 75% of scooter crashes occurred between 6am and 6pm – most (about 21%) between 3pm and 6pm.
- Most scooter crashes (about 77%) occurred on weekdays – highest proportion of scooter crashes on Thursdays (19%) and lowest on Sundays (about 10%).
- The largest single scooter crash DCA grouping was *Off path on straight* (34%)- a single vehicle crash type.
- While almost all crash involved scooter riders were injured, 60% resulted in other injury levels, 39% in serious injury and less than 1% in fatality.
- The vast majority of scooter crashes occurred in the MSD (about 91%).
- Most scooter crashes occurred in inner/middle band municipalities of the MSD – five LGAs (Melbourne, Yarra, Boroondara, Port Phillip & Stonnington) accounted for 50% of scooter crashes.
- Most scooter crashes occurred in postcode areas close to the postcode of the scooter owner – mean distance about 11 kilometres, median about four kilometres.
- The majority of scooter crashes occurred at an intersection of some type (about 62%).
- About 82% of scooter crashes occurred in speed zones not exceeding 60km/h – about 58% occurred in 60km/h zones.
- Most scooter crashes (about 68%) occurred in daylight – 20% in darkness and about 9% dawn/dusk.
- Almost all scooter crashes (96%) occurred on paved roads.

Comparison of Scooter Crash Patterns with those for Motorcycles and Cars In Victoria 2001 to 2006

The comparison of identified scooter crashes which occurred in Victoria in the period 2001-2006 with those involving motorcycles and cars for the same period was based on a relatively small number of scooter crashes (n=337), compared with much larger datasets for motorcycle and car crash datasets (ie n=11,219 and n=134,747 respectively). In view of this, the results presented should be viewed as indicative of scooter crash patterns relative to motorcycle and car crash patterns rather than definitive. Notwithstanding this comment, comparison of scooter crash patterns with those for motorcycles and cars suggests that:

- Relative to motorcycle and car crashes, those involving scooters rose in Victoria at a faster rate between 2001 and 2006.
- Crash involved scooters riders were older than riders involved in motorcycle crashes or drivers involved in car crashes.
- Scooters and motorcycles sustained lower levels of vehicle damage (as assessed by attending police) relative to cars.
- The proportion of female riders was higher among crash involved scooters than for motorcycles (about seven times higher).
- The mean and median age of crash involved scooter riders were both higher (38 and 35 years respectively) than for motorcycles riders (34 and 34 years respectively) and car drivers (37 and 34 years respectively).
- Relative to car and motorcycle crashes, a lesser proportion of scooter riders held full motorcycle licences and a greater proportion learner permits.
- Known helmet wearing for crash involved riders was about the same (about 68%) for both scooter and motorcycles.
- Preliminary breath test rates were lower for crash involved scooter riders relative to motorcycle riders and car drivers.
- The majority of crash involved scooter and motorcycle riders were riding solo (no more than six percent carried a pillion).
- The hit/run rate was about the same for scooter, motorcycle and car crashes (less than five percent).
- The seasonal pattern for scooter and car crashes was similar with both differing from that for motorcycles – scooter and car crashes peaked in autumn and were lowest in summer, the difference was more marked for scooters. Motorcycle crashes were equally high in spring and autumn and lowest in winter.
- The scooter crash pattern by day of week was different to that for both motorcycles and cars – scooter crashes rose to a mid-week peak while motorcycles peaked on weekends and cars rose to a peak on Fridays.
- While most scooter, motorcycle and car crashes occurred on weekdays, the ratio of weekday/weekend crashes was similar for scooter and car crashes (ie 3:1), which was twice that for motorcycles (1.5:1).
- Crashes involving scooters, motorcycles and cars peaked between 3pm and 6pm, however, scooter crashes were relatively higher in the periods 6am-9am and 6pm-9pm.
- About 70% of scooter crashes occurred in just 10 LGAs – this was more than twice the proportion for motorcycle or car crashes.
- Scooter crashes occurred closer to the registered owner's postcode than did motorcycle or car crashes – mean distance between owner and crash postcode was lowest for scooters (12 kilometres), intermediate for cars (about 17 kilometres) and greatest for motorcycles (about 33 kilometres).
- Most scooter crashes (about 90%) occurred in the MSD compared to 78% for cars and 60% for motorcycles.

- Relative to motorcycles and car crashes, scooters experienced a greater proportion of crashes at intersections.
- Most scooter, motorcycles and car crashes occurred in daylight (69%, 74% and 68% respectively).
- For scooters, motorcycles and cars, most collisions were with another vehicle (59%, 43%, 80% respectively), however, the highest proportion was for cars and the lowest for motorcycles.
- The level of injury in motorcycle crashes was higher relative to scooters with the lowest proportion being for car crashes – both motorcycle and scooter crashes had higher levels of injury relative to car crashes.
- While most scooter, motorcycles and car crashes occurred on paved roads (98%, 96% and 80% respectively), the lowest proportion was for motorcycles.
- While police attended about 75% of reported car crashes, the proportion was lower for scooter and motorcycle crashes (about 60% for each).

Implications of these Crash Patterns and Relativities

Taken together, these findings suggest that scooters and motorcycles cannot be viewed as being the same in terms of crash involvement patterns and/or in respect of safety program development and management. For example, strategies to reduce scooter crashes should have a greater urban focus than those for motorcycles and acknowledge that scooters appear to be used more on weekdays than weekends and accommodate female, older and less experienced riders to a greater degree. Rider training and licensing approaches for scooter riders may need to be better tailored to suit the scooter riding demographic so as to better prepare them for the challenges and risks of predominantly urban riding. However, implied exposure/usage patterns and relativities with motorcycles would need to be confirmed by accurate motorcycle exposure data. Such exposure data will also be required to determine if Victorian scooters and their riders have a higher, lower or equivalent crash risk per distance travelled relative to motorcycles.

Conclusions

Notwithstanding the acknowledged data limitations and the indicative rather than definitive nature of the results, the analysis of scooter crash patterns in Victoria for the period 2001-2006 inclusive suggest the following key conclusions:

1. Scooter crashes increased between 2001 and 2006 at a rate higher than that for motorcycles or cars.
2. This increase is most probably due to the commensurate increase in scooter sales during the same period - accurate exposure data may help establish if this is the case.
3. Exposure data is required to determine the relative risk per distance travelled for scooters and motorcycles.
4. Scooter crashes were predominantly urban occurring mainly in the Melbourne metropolitan area and relatively close to the postcode of the registered owner (ie crashes occurred close to home).
5. Scooter crashes differed in pattern, though not necessarily at statistically significant levels, to those for motorcycles in terms of key factors such as where/when they occurred, distance from home postcode, severity of injury and type of crash ie – scooter crashes were less severe, more urban, occurred more often at intersections, more often in lower speed zones, more often involved collisions with another vehicle, involved more female riders, involved riders with a higher mean age and occurred more often on weekdays compared to weekends - however, not all differences were able to be compared at an inferential level.

6. Scooter crashes shared some commonalities with motorcycles in that both involved higher levels of injury than for cars and involved mainly solo riders
7. Scooter crashes shared some commonalities with cars in that seasonal crash patterns were similar and most car and scooter crashes occurred on weekdays.
8. Where necessary, the safety and countermeasure needs of scooters and their riders should be considered separately from motorcycles within overall motorcycle strategy.

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1. INTRODUCTION

1.1 Background and Objectives

Motor scooters are becoming an increasingly popular mode of transport, with an increasing number of scooters available on the Australian market over the last few years. For example, in 2007, motor scooters accounted for about 24% of all road registrable motorcycle sales and more than 10% of all motorcycles (including ATVs, off-road and on road categories) (FCAI, 2008). This contrasts with the pattern for the 1980's and early 1990's when very few scooters were sold in Australia (FCAI, 2006)

A recent report noted that those buying and riding scooters appear to be different to those buying motorcycles in that they do not seem to progress to conventional motorcycle use (Christie & Newland, 2006). They are typically urban dwellers in large cities such as Melbourne, Sydney and Brisbane, use the scooter for short distance, local travel, which may include some commuting, and tend to be aged 25-35 years with a greater representation of women (Christie & Newland, 2006). The scooter is often identified as a "fun" alternative to car or conventional motorcycle use (Coxon, 2002; Christie & Newland, 2006). They are also identified as cheap commuter transport for low-income people such as university students (Student Services, University of Melbourne, 2006). The European motorcycle industry promote motorcycles, particularly scooters and mopeds, as "Smart Wheels for City Streets" (ACEM, 2006).

At present, little is known about the involvement of scooters in crashes in Victoria. To help address this deficiency, VicRoads' Road Safety and Network Access Division commissioned Dr Ron Christie of RCSC Services Pty Ltd in mid-2007 to investigate the profile of scooter crashes in Victoria, to identify the extent of involvement of scooters in crashes and to examine their common crash types. The project involved using the VicRoads vehicle registration database to identify scooters and assess scooter numbers and analysis of the crash database held by VicRoads to identify their common crash characteristics. It is considered that this will improve the level of understanding and knowledge about scooter-involved crashes and assist with future safety initiatives directed at improving scooter safety.

The objectives of the project were to:

- Review the published literature on scooter crash involvement nationally within Australia and in comparable countries;
- Estimate the number of registered scooters in Victoria for all scooters and by meaningful scooter categories;
- Identify the extent of the involvement of scooters in crashes (including the number and rate of scooter crashes, proportion of scooter crashes compared to motorcycle crashes, and any trends in the number and rate of scooter crashes occurring over time);
- Analyse the common crash types for crashes involving scooters; and
- Prepare a report which discusses the findings and their significance in relation to the safety of scooter riders.

1.2 Definition of a Scooter

For the purposes of this report it is accepted that a motor scooter generally refers to the step-through design whereby the rider does not place a leg either side of the engine. Characteristics of most, but not all, scooters include a moulded metal/plastic body, automatic transmission and much smaller wheels than motorcycles. While Victoria has no separate moped registration category, mopeds are generally considered to be low-powered and speed limited (usually to no more than 50km/h) scooters with an engine capacity not exceeding 50cc. Mopeds and scooters do not include power assisted bicycles (including electric bicycles) which do not require vehicle registration or a driver/rider licence to operate on road. Non-motorised scooters and

motorcycles also fall outside the definition of a motor scooter. However, for vehicle registration purposes in Victoria, all motor scooters fall within the motorcycle category. These definitions were used in conducting analyses and compiling this report. This report dealt only with motor scooters and mopeds registered as motorcycles for road use in Victoria and which required a motorcycle licence or learner permit to operate on road.

The Australian Scooter Federation website defines a motor scooter as follows:

> *A scooter is a fully automatic two wheel vehicle with a step floor however, there are some variations. As scooters have evolved some have moved to a sportier look that are closer in appearance to a motorcycle whilst others have maintained their origins and keep their manual gear boxes. Scooters vary from 50cc "about-towners" through to 650cc highway cruising machines with enough performance to keep any rider happy. The style we all know, with a step floor (to protect us from the road's surface and wet weather) and twist and go automatic transmission, are available in all shapes and colours* (Australian Scooter Federation, 2008).

This is generally consistent with the working definition set out in the previous paragraph.

The following extract from a US National Highway Traffic Safety Administration (NHTSA)/ Motorcycle Safety Foundation (MSF) document is also useful in conceptualizing/defining a scooter:

> *These two-wheeled vehicles are small, mostly low-power designs with small-diameter wheels suitable primarily for use at low and medium speeds on surface streets in urban environments. Their appearance differs significantly from motorcycles 'because of their bodywork and the "step-through" frame design. Most are not suitable or legal for use on high-speed or controlled-access roadways, though some do have sufficient power and other capabilities to allow such use (*NHTSA/MSF, 2000, p40).

While Victoria has no separate moped registration category (ie a sub-category of low-powered, speed limited (usually to no more than 60km/h) scooters with an engine capacity not exceeding 50cc), the European Union (EU) and some other Australian jurisdictions (eg Queensland and Western Australia) do. VicRoads wished to include mopeds in the scooter category for the purposes of this project as these vehicles are treated as motorcycles in Victoria for registration and licensing purposes. However, where possible, mopeds were identified as a distinct sub-category in respect of registration numbers and crash patterns. The following extract from a US National Highway Traffic Safety Administration (NHTSA)/ Motorcycle Safety Foundation (MSF) document is useful in defining/conceptualising a moped:

> *Lightweight, very low-power two-wheelers designed for cheap urban transportation. Their bicycle-like design, slow acceleration, and limited top speed (30 miles per hour) [up to about 60km/hour] make them unsuitable for use on high-speed roadways and create unique traffic issues for their users ((*NHTSA/MSF, 2000, p40).

At a local level, the Australian motorcycle industry classifies scooters into three general groups by engine size:

- mopeds (not exceeding 50cc) – typical model shown (source Haworth, 2006).

- scooters (>50cc and up to 250cc inclusive) - typical 125cc model shown (source Haworth, 2006)

- maxi-scooters (>250cc) - typical 500cc model shown (source Haworth, 2006)

Under the Motor Vehicle Standard Act (MVSA 1989) administered by the Federal Department of Transport and Regional Services, (DoTARS) mopeds fall under the LA vehicle category for import and safety compliance purposes (ie Australian Design Rules (ADRs)). Under the LA category mopeds must:

- have an engine size not exceeding 50cc ;
- not be capable of exceeding 50km/h (achieved by way of a tamperproof speed limiting device fitted to the engine).

It is of note that tampering with speed-limited mopeds and scooters is common in Europe with after-market retuning to derestrict mopeds that would fall within the Australian LA category (Schoon, 2004). This often lifts their maximum speed to 70km/h making them perform like slightly larger capacity scooters and helps blur the distinction between mopeds and low-capacity scooters. The techniques for derestriction are well known and even appear on the Internet (see Wikipedia, 2007).

2. SCOOTER CRASH INVOLVEMENT: A REVIEW OF THE LITERATURE

2.1 General

This chapter provides a summary and overview of the published literature relating to scooter (including moped) crash involvement in Australia and comparable overseas counties/jurisdictions. As a prelude to this, a brief summary of recent scooter/moped sales patterns in Australia is provided together with estimates of the number of scooters/mopeds in overseas jurisdictions. This provides some context for the reader.

2.2 Recent Patterns of Scooter Sales in Australia and Victoria

Sales of new scooters (including mopeds) in Australia have increased markedly in recent years. For example, in 2006, about 14,000 scooters/mopeds were sold in Australia with about the same number being sold in 2007 (FCAI, 2008). These numbers are about three times higher than 2003 sales (Netrider, 2007). About 2,000 scooters/mopeds were sold in Victoria in 2006 and more than 2,500 in 2007 (FCAI, 2008). The upward trend in new scooter and combined scooter/ moped sales in Victoria is evident in Figure 1. However, moped sales fell in 2007.

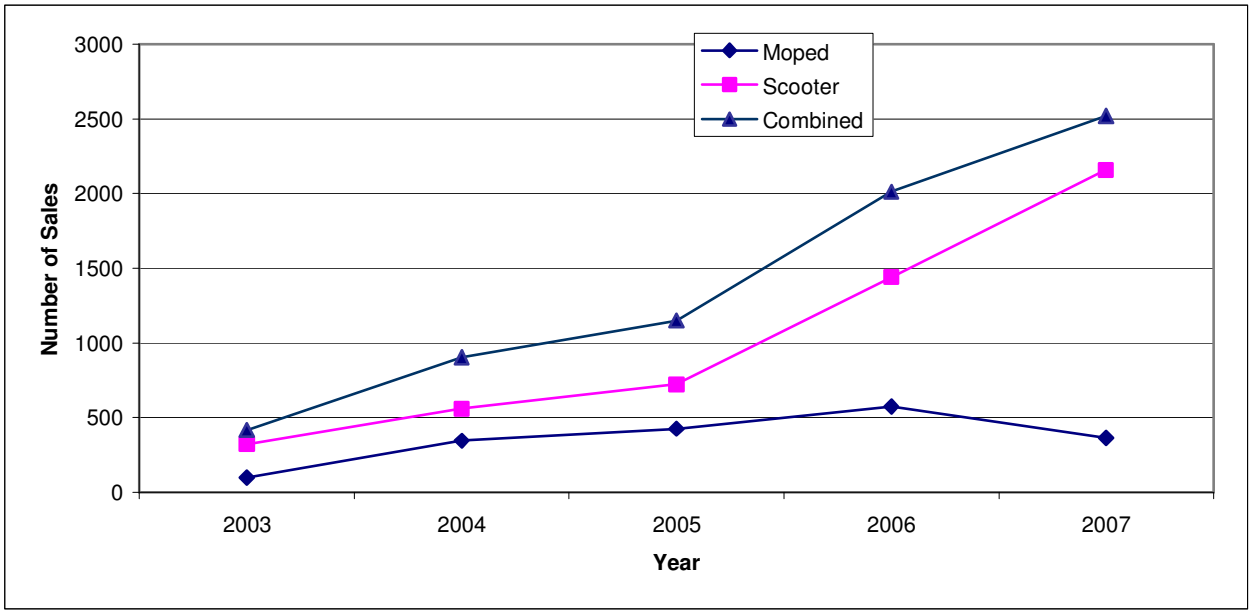

Figure1. New Scooter and Moped Sales, Victoria 2003 -2007 (source: Federal Chamber of Automotive Industries, 2008)

Christie & Newland, (2006) noted that, relative to Queensland (QLD) and New South Wales (NSW), new scooter sales, including moped sales, in Victoria represent a smaller proportion of all road registrable motorcycle sales. This may be due to differences in climate together with registration and rider licensing policy. For example, a moped may be operated on a car licence in QLD, but not in Victoria. Haworth (2007) estimated that about 84% of scooters in Queensland were mopeds.

As will be discussed later in this chapter, this upward trend in scooter/moped sales has occurred in other comparable jurisdictions including New Zealand and parts of Canada and the USA.

2.3 Lack of Data on Scooters in Australia and Victoria

The number of scooters and mopeds in Australia and constituent jurisdictions is difficult to determine as they are subsumed under the motorcycle class in many jurisdictions, including

Victoria. Haworth (2007) noted a general lack of data on scooter numbers and exposure, commenting that little is known about where, when and how they are used. Indeed, one of the objectives of the current project was to estimate how many scooters (and mopeds) were registered in Victoria. Haworth (2007) noted that the Centre for Accident Research and Road Safety - Queensland (CARRS-Q) was undertaking research into scooter/moped crashes under its post-graduate research program.

2.4 Moped Rider Licensing and Registration in Australia

In Queensland, Northern Territory, South Australia and Western Australian road registered mopeds may be operated on a car licence. By contrast, in Victoria, NSW, ACT and Tasmania a motorcycle licence is required for the on-road operation of any moped, scooter or motorcycle irrespective of engine size or ADR category. In these jurisdictions there is no specific concessional moped registration category. However, registration and compulsory third party insurance cover may be lower for mopeds and low powered scooters as these costs are usually linked to engine size.

These differences in the treatment of mopeds makes comparison between Australian jurisdictions in respect of scooters difficult as half of all Australian jurisdictions allow the use of mopeds on a car licence and the other half do not. As mopeds constitute the largest sub-group of scooters in jurisdictions such as Queensland (Haworth, 2007), this makes it difficult to equate exposure and risk across all Australian jurisdictions.

The Royal Automobile Club of Queensland (RACQ) identifies the lack of specific licensing requirements for mopeds to be a road safety and traffic amenity issue:

> *Motor scooters with a capacity of 50cc or less are growing in popularity, particularly for commuters in urban areas. These scooters can travel on high-speed roads but riders do not require motorcycle licences. As riders receive no specific training, other than that required for a normal car driver's licence, this can pose some issues in relation to vehicle handling and control and how they interact in the traffic environment. Some sections of the community may not understand the rights and responsibilities of the riders, e.g., safe and legal scooter riding practices, registration and insurance issues.* (RACQ, 2007)

2.5 Scooters and Moped Crashes in Australia

As in other comparable jurisdictions, it is difficult to determine the crash profile for scooters as they are not usually distinguished from motorcycles in the registration and crash records of most Australian jurisdictions. While some jurisdictions do at least distinguish mopeds from motorcycles in respect of crashes, Haworth (2007) notes that the low numbers of crashes make these data rather unreliable and that it is difficult to determine a crash rate for scooters and/or mopeds. For example, Table 1 shows passenger car, motorcycle and moped crashes for Western Australia (WA) for the period 1995 to 2004. Given that the number of serious crashes involving mopeds did not exceed nine in any of the years shown in the table, comparisons with other vehicle types are difficult. Even though a crash rate for mopeds is shown in the table, this is likely to be unreliable due to the small number of cases on which it is based.

A motorcycle exposure study conducted in NSW in 2003 (Harrison & Christie, 2003) found that 4% of the 794 motorcycles in the sample were scooters (ie about 31 machines). While this was too small for valid and reliable analyses of scooter crashes, the following observations were reported regarding scooter riders - when compared to motorcycle riders, scooter riders:

- Were less likely to wear protective clothing (other than helmet and gloves).
- Were less likely to travel on higher-speed roads.
- Travelled about one-third to half the annual distance of other on-road motorcycles.

- Rode less on weekends and engaged in more working week commuting.
- Were somewhat older.
- Had accumulated less riding experience.

Table 1: Serious Passenger Car, Motorcycle and Moped Crashes, Western Australia, 1995-2004 (source: Office of Road Safety, WA)

Year	Passenger Car Serious Crashes	Passenger Car Crash Rates per 10,000 Registered Vehicles	Motorcycle Serious Crashes	Motorcycle Crash Rate per 10,000 Registered Vehicles	Moped Serious Crashes	Moped Crash Rate per 10,000 Registered Vehicles
1995	3,147	28.0	298	80.3	9	264.9
1996	2,871	24.8	301	80.1	7	219.4
1997	3,226	26.9	301	77.6	5	163.9
1998	3,298	26.3	286	69.5	8	267.6
1999	2,725	21.3	261	61.4	2	52.9
2000	2,402	18.5	254	58.4	3	66.7
2001	2,184	16.5	239	53.2	3	60.2
2002	3,216	23.9	307	66.5	5	94.5
2003	3,306	24.0	303	64.0	4	65.9
2004	3,592	25.3	343	68.6	9	117.8
Ten Year Average	**2996.7**	**23.5**	**289.3**	**67.9**	**5.5**	**137.3**

In a recent paper, Haworth (2007) summarised the moped crash situation in Queensland, noting that, between 2001 and 2005:

- Injury crash numbers quadrupled from 2001 to 2005 (from 24 to 97 police reported).
- Most police reported crashes resulted in hospitalisation and medical treatment.
- 86% of crashes occurred in 60km/h or lower speed zones.
- 80% occurred on week days.
- 50% occurred at intersections.
- 32% were single vehicle crashes.
- Most (38%) crash involved moped riders that were aged 17-24 years.
- Most (76%) held Queensland car licences.

When moped and motorcycles crashes in Queensland were compared, Haworth (2007) noted that:

- There were many more police reported motorcycle crashes (eg 1609 motorcycle vs 97 moped in 2005) – ie less than 6% involved mopeds.
- The severity distribution for mopeds and motorcycles was much the same.
- While the proportion of single vehicle crashes was about the same (ie about 38%), crash types differed.
- Motorcycles were involved in more weekend crashes, particularly in higher speed zones
- More females were involved in moped crashes (38% vs 7%).
- The number of moped crashes involving 17-25 year olds increased fourfold between 2001 and 2005 while the increase for motorcycles was about 20%.

While noting that a crash rate for Australian scooters is not known at present, Haworth (2007) speculates that:

- Scooters may be safer because:

    - mopeds (at least) travel more slowly
    - scooter riders may be less likely to take risks
    - scooters aren't ridden as far.
- Scooters may be less safe because:
    - mopeds travel more slowly (relative to larger scooters and motorcycles)
    - scooter riders are less likely to wear protective clothing
    - scooters have smaller wheels and so are less stable
    - riders may be inexperienced and untrained/unlicensed (particularly in jurisdictions such as Queensland, Northern Territory, South Australia and Western Australian that allow moped operation on a car licence).

Haworth (2007) also noted that as more research information is needed to guide policy in regard to scooters, the CARRS-Q intends to conduct further research in the field and has applied for Australian Research Council (ARC) grant funding to support this.

2.6 Scooter and Moped Crashes in New Zealand

As in Australia, scooter numbers in New Zealand have increased in recent years with the greatest increase occurring in the moped class. New motorcycle registrations increased by 270% between 2001 and 2006 while new moped registrations increased by some 570% (Land Transport New Zealand, 2007). The definitions of mopeds and motorcycles in New Zealand are much the same as in Australia – motor scooters with an engine capacity larger than 50cc are considered to be motorcycles and not separately classified. While mopeds may be operated on a car licence in New Zealand, larger scooters require the rider to hold a motorcycle licence. It should be noted that the minimum licence age for car and motorcycle licences in NZ is 15. This means that young people's access to legal moped use is somewhat similar to that in many EU countries – see Section 2.8.

It is estimated that at June 2006 there were about 14,000 registered mopeds and 45,500 registered motorcycles in New Zealand – ie about 23% of all registered motorcycles were mopeds (Land Transport New Zealand, 2007). The population of New Zealand is about 4.2 million (Statistics New Zealand, 2007).

Those buying mopeds in New Zealand are predominantly urban males in their 20s to mid 30s who want to avoid traffic congestion and reduce fuel/commuting costs (Bone, 2006). However, those buying larger more expensive scooters are described as being affluent older males (ie aged 35-50) who are less concerned about fuel costs, but see scooter use as a means of reducing commuting time and avoiding traffic congestion (Bone, 2006).

While mopeds are a separate vehicle class in NZ, crashes involving mopeds are combined with those of larger motorcycles in crash statistics. There is also no way of partialling out all scooters from the pool of all motorcycle crashes. However, the New Zealand Ministry of Transport did report the percentage of crash involved motorcycles by engine size (Ministry of Transport, 2006). This showed that in the period 2001 to 2005, motorcycles with up to a 50cc engine capacity (most of which would be mopeds) accounted for between about 12% and 18% of all motorcycle involved crashes suggesting that mopeds are under-represented in such crashes relative to larger motorcycles - mopeds represented about 20%-23% of all motorcycles during this period. It was also noted that smaller capacity motorcycles and scooters were involved in less severe crashes (ie relatively fewer fatalities) due perhaps to their being used predominantly in urban areas and at lower travel speeds (Ministry of Transport, 2006).

In 2006, motorcyclists (including scooter and moped riders) in New Zealand accounted for 10% of all fatalities and 7% of all injuries.

2.7 Scooter and Moped Crashes in British Columbia

Situated on the Pacific coast, British Columbia (BC) has a population of about four million (BCStats, 2007) and is the Canadian province with the mildest climate making it more conducive to motorcycle, scooter and moped operation. Unlike most other Canadian jurisdictions, BC collects data separately for mopeds and motorcycles in respect of registrations and crash involvement. While mopeds are a separate vehicle category, larger scooters are included under the general motorcycle category. The definition of mopeds and motorcycles in BC is the same as in Australia. While mopeds may be operated on a car licence in BC, larger scooters require the rider to hold a motorcycle licence.

In 2005, BC had about 68,000 road registered motorcycles and about 5,000 registered mopeds – ie about 7% of all registered motorcycles were mopeds (MMIC, 2006). Between 2001 and 2005 registered moped numbers in BC increased by 500% while registrations of motorcycles increased by only about 12% - national increases for Canada were 70% and 29% respectively in the same period.

Crash statistics for BC in 2005 showed that 55 mopeds and 975 motorcycles were involved in police attended injury/fatal crashes (Insurance Corporation of British Columbia (ICBC), 2007). This equates to a rate of about 110 injury/fatal crashes per 10,000 vehicles for mopeds and about 143 for motorcycles other than mopeds for BC in 2005. The injury/fatal crashes per 10,000 vehicles for passenger cars in BC in 2005 was about 61. This suggests that the crash risk for mopeds in BC is lower than that for larger motorcycles, but higher than that for passenger cars.

2.8 Motorcycles, Scooters and Mopeds in the European Union

In 2001, Western Europe (predominantly the EU) had an estimated 13-14 million mopeds and about 10 million motorcyles of all sizes (including scooters larger than mopeds) (Noordzij, Forke, Brendicke, & Chinn, 2001). It would appear that moped numbers are steady to decreasing while motorcycle numbers (including scooters) are increasing (Wegman et al, 2005). The number of mopeds and motorcycles per 1,000 population is two to three times higher in southern Europe (eg Italy) when compared to northern Europe (eg Denmark). Noordzij et al, (2001) estimate that there are 50 mopeds and 30-40 motorcycles per 1,000 population in southern Europe, but only 20 mopeds and 10 motorcycles per 1,000 population in northern Europe. The majority of mopeds (85%) are concentrated in four EU countries (France, Spain, Germany and Italy) (Noordzij et al, 2001). While new motorcycle sales have continued to increase by about 8% per annum in Europe – following a dip in 2002 – moped sales have been declining at about the same rate since 2000 (ACEM, 2006). It would appear that larger scooters and motorcycles are becoming relatively more popular. However, this may be due to a progressive tightening of moped/light powered two–wheeler (PTW) licensing and registration requirements in the EU, particularly since 2001.

Noordzij et al, (2001) reported that mopeds accounted for about 8-9% of all EU road casualties (ie where death/injury occurred) – about the same proportion as for motorcycles – with 80% occurring in urban areas. However, most moped fatalities occurred in rural areas where there was the greatest differential between moped speed and the speed of other vehicles. The most common moped casualty crash type was where the moped was struck from behind by the faster moving vehicle, usually a passenger car (Noordzij et al, 2001).

The high crash risk associated with mopeds and the popularity among persons aged below 18 years has been established in studies conducted for the European Commission. For example, Schoon (2003) showed that 14-18 year old moped riders accounted for between about 30% and 50% of all moped fatalities in EU countries between 1995 and 2002. The impact of moped deaths and injuries may actually be greater than this in the EU as loose licensing and

registration requirements for mopeds across the EU probably leads to under-reporting of crashes and injuries (Masurel, 2003). It is of note that the Institute for Road Safety Research (SWOV) in the Netherlands suggests that raising the minimum age for moped use to 18 would be the most effective way of reducing moped deaths and injuries – the crash risk for under 18 year olds on mopeds is about four times higher than for older operators in the Netherlands (SWOV, 2006). This is recommendation was also made by Schoon (2004) in respect of the whole EU.

However, SWOV (2007) notes that, in October 2006, the Council of EU Ministers of Transport agreed to a new European guideline regarding the minimum age for immediate access to motorcycle licence categories in the EU. While this raises the age for access to larger, heavier motorcycles from 21 to 24 years, it reduces the age for access to light motorcycles, defined as up to 125cc, to 16 years. Thus the new guidelines which are to come into effect in 2012 provide for a three tier motorcycle/PTW licence system, ie

- A1: up to 125cc
- A2: up to 35 kW engine power and 0.2 kW/kg
- A: all others.

EU member states have only limited freedom to determine their own policy on motorcycle/PTW licensing (SWOV, 2007). However, the guidelines require that there be a 2 year difference between the minimum age for access to the various motorcycle licence categories. For example, this means that if access to A1 is provided at age 16, then access to A2 is at 18

- If A1 is 16, then A2 is 18, and A is 20
- If A1 is 17, then A2 is 19, and A is 21
- If A1 is 18, then A2 is 20, and A is 22.

As the revised A1 category will include mopeds and many scooters, SWOV considers that this may increase the crash risk/involvement of particularly young males on mopeds, scooters and light motorcycles if access at age 16 goes ahead.

The varied and often loose regulation of mopeds in the EU and the over-representation of particularly young males of below Australian minimum driver licensing age in moped deaths/injuries makes direct comparison between the EU and Australian jurisdictions difficult. Haworth (2007) suggests that this limits the relevance and applicability of European and perhaps other overseas moped/scooter research to the Australian traffic environment. The likely changes to EU licensing policy, which will allow access to up to 125cc motorcycles for 16 year olds in 2012 will accentuate these differences and make comparison even more difficult.

Difficulties also exist within the EU in comparing PTW usage and crash involvement between member countries. For example, Masurel (2003) noted that it was also difficult to compare PTW (ie motorcycle, scooter and moped) exposure and crash involvement across the EU because of a lack of exposure data and variation in rider licensing and PTW registration requirements across Europe. However, ETSC (2003) estimated that, per kilometre travelled, the fatality risk for PTWs, including motorcycles, scooters and mopeds, was the highest of all modes of transport within the EU, being on average 20 times higher than for car occupants.

2.9 Scooters and Moped Crashes in Specific European Jurisdictions

This section briefly summarises the findings of studies reporting moped/scooter crashes in some specific European countries. It is based on available/accessible reports and papers appearing in the published literature and is not intended to provide comprehensive or exhaustive coverage. As the amount of information in respect of scooter and moped crashes in respect of each jurisdiction mentioned varies, some summaries are more extensive than others.

2.9.1 Austria

Schoon (2004) reported that Austria had more than 360,000 mopeds and that these vehicles could be operated on a car licence or via a moped permit from age 15. The operation of larger scooters requires the rider to hold a motorcycle licence. The definition of mopeds and motorcycles in Austria is similar to that in Australia. The population of Austria was about 8.2 million in 2005 – about 8.1 million in 2003. While mopeds are a separate vehicle category, larger scooters are included under the general motorcycle category.

Gwehenberger (2007) noted in a study on the crash risk of light vehicles in Austria that, in 2003/2004, the rate of moped fatality was 1.5 per 10,000 vehicles. This was higher than the rate for passenger cars of 1.1 per 10,000 vehicles. However, when injuries per 10,000 vehicles were considered for the same year, the rate for mopeds was lower than for cars (ie 11 and 11.7 per 10,000 vehicles respectively).

In 2003 mopeds accounted for about 5% of all Austrian road fatalities and about 9% of all road crash injuries. This compared to 12% and 7% respectively for larger motorcycles including scooters. The ratio of fatalities to injuries was 1 to 100 for mopeds and 3 to 100 for larger motorcycles/scooters suggesting that severity levels were higher for motorcycles (Austrian Safety & Prevention Board, 2004). This is consistent with other European moped and scooter data/studies and may be due to the lower travel speeds associated with mopeds relative to larger motorcycles.

The majority of Austrian moped fatalities in 2003 (about 55%) occurred outside of urban areas, while the majority of injuries (about 73%) occurred in urban areas (Austrian Safety & Prevention Board, 2004). This pattern compared to about 83% of larger motorcycle/ scooter fatalities and about 50% of injuries occurring outside of urban areas. Again, this pattern is consistent with other European moped and scooter crash studies and may reflect the confinement of mopeds to mainly urban areas and their vulnerability to crash involvement on higher speed, rural roads due to speed differentials (Noordzij et al, (2001).

The majority (about 70%) of killed/injured moped riders in Austria in 2003 were aged 15-19 years and predominantly male (Austrian Safety & Prevention Board, 2004). In respect of motorcycle deaths/injuries, the age spread was broader with most deaths/injuries (about 15%) occurring for males aged 30-34 year.

2.9.2 Denmark

Denmark has about 119,000 motorcycles and about 65,000 mopeds (Statistics Denmark, 2007). In the period 2002-2007, motorcycle registrations increased by more than 50% while moped numbers decreased by about 4%. Denmark has a population of about 5.5 million (Statistics Denmark, 2007). ETSC (2003) noted that the rate of fatalities per million vehicles for mopeds in Denmark was about twice that for motorcycles/scooters. This pattern of higher relative risk for mopeds has persisted with Statistics Denmark (2007) reporting 856 deaths/serious injuries for moped riders in 2006 compared to 515 for motorcycles/scooters. The rate of death/injury per registered vehicle was about 2.6 times higher for mopeds than for motorcycles. This is consistent with earlier reports of over-representation in respect of injuries among moped riders in Denmark relative to motorcycle riders (Barsi, Faergman & Larsen, 2002). While Barsi et al (2002) reported that injury severity for moped and motorcycle riders was similar on the six-point Abbreviated Injury Scale (AIS), they noted that head and facial injuries were more common among moped riders. They also noted that the majority of moped injuries resulted from single-vehicle crashes rather than collisions with other vehicles.

The higher involvement of mopeds in fatal and injury crashes in Denmark relative to other EU countries has been noted in earlier studies (ETSC, 2003). Schoon (2004) reported that this

higher crash involvement was difficult to explain given that the minimum age for moped licensing in Denmark was 16, that both a practical and theoretical test was required and that helmet wearing was compulsory. These features should assist in lowering rather than increasing moped crash risk.

2.9.3 France

France has a population of about 63.2 million (French National Institute for Statistics and Economic Studies (INSEE), 2007). Like other Western, developed countries it has experienced an increase in motorcycle numbers in recent years - in the period 2003-2005 registrations increased by about 7% pa. Scooters accounted for about 32 percent of motorcycle sales with almost 90 percent of these being below 125cc in engine size. Scooter registrations rose by 14% in 2005, making this the fastest growing segment of the French motorcycle market (Penecole, 2006). About 44% of 2002-2005 sales were of sub-125 cc machines, with 60% of these being mopeds or scooters (Penecole, 2006). Yamaha was the market leader in the scooter sector with models such as the XMax, Majesty and YBR being popular.

While Penecole (2006) notes that a growing number of those buying scooters are drivers frustrated by increasing traffic congestion in French cities, younger riders still constitute the majority of the scooter and sub-125 cc market.

Schoon (2004) estimates that France has about 1.5 million mopeds. Schoon (2004) notes that France is still among the top EU countries for mopeds - the numbers dropped from about 4 million in 1985 to about 2 million in 1996. However, as noted by Penecole (2006), moped numbers may be rising again. As noted above in section 2.5, the liberalisation of motorcycle rider licensing allowing access at age 16 to motorcycles and scooters in the A1 class (ie <125cc) may be contributing to this.

Schoon (2004) reported that the rate of moped fatality in France was about 28.5 per 100,000 vehicles. Unfortunately, no comparison rate was reported for motorcycles or larger scooters by Schoon. ETSC (2003) reported that the fatality rate per million vehicles was about 325 for mopeds and about 810 for motorcycles/scooters, implying that the rate for mopeds was less than half of that for motorcycles/scooters. Helmet wearing is compulsory for both moped and motorcycle riders in France with an estimated 89% of moped riders and 96% of motorcycle riders complying with the requirement (Noordzij et al, 2001).

In 2003, crashes involving mopeds in France rose by about 2% while those involving motorcycles fell by about 16% (FIA Foundation, 2003). In 2005, moped deaths in built up areas increased by about 4% which was greater than that for motorcycles (1.3%) (Securite Routiere, 2005)

Moskal, Martin, Lenguerrand & Laumon, (2007) reported that for crash involved French motorcycle riders, chest, abdominal, spinal and upper extremity injuries more likely than in moped riders. However, facial injury was reported as being more likely for moped riders relative to motorcycle riders. They also reported that hospital treatment/admission was more likely for riders of motorcycles relative to moped riders.

2.9.4 Netherlands

Schoon (2004) reported that the Netherlands had some 530,000 mopeds and that these vehicles could be operated from age 16 without a licence. While mopeds are a separate vehicle category, larger scooters are included under the general motorcycle category. As of October of 2006, a special moped driving licence (*brommerrijbewijs*) became a requirement for everyone not already in possession of a drivers licence for a car or motorcycle (A or B licence) – minimum age 16 years. The operation of larger scooters requires the rider to hold a motorcycle licence. The definitions of mopeds and motorcycles in the Netherlands are similar to that in

Australia. The population of the Netherlands was estimated to be about 16.5 million in 2007 – was about 16.3 million in 2004. It has one of the highest population and traffic densities in the world (Statistics Netherlands (CBS), 2007).

Between 1993 and 2003, the proportion of road fatalities resulting from moped crashes increased in the Netherlands by about 24%, while the proportion resulting from motorcycle and car/truck crashes rose by about 9% and 2% respectively. In 2003, the proportion of fatalities resulting from moped or motorcycle crashes was the same, about 9% for each (Wegman et al (2006). The proportion of fatalities resulting from moped crashes is higher in the Netherlands relative to other EU countries while the reverse is generally due in respect of motorcycles (Wegman et al (2006).

SWOV (2006) report that mopeds are over-represented in crashes in the Netherlands as they account for only 1% of vehicle kilometres travelled but about 16% of all road related deaths and injuries. The majority of those killed/injured on mopeds in the Netherlands are males aged 16-17 years - they account for 30% of all moped deaths and 37% of all moped injuries in the Netherlands.

An in-depth report on moped crashes in the Netherlands (de Vries, Margaritis & Mooi, 2003) also reported that young males were the largest group. This report also noted that a prior record of traffic offences was associated with higher crash involvement. The injury levels were relatively low on the six-point AIS with 70% being at AIS 1 (Minor) or 2 (Moderate). Moped injuries rated at AIS 3 or above tended to involve head and lower limb injury. Most injuries resulted from striking the road or road furniture. A statistically significant relationship was found between the injury level and impact speed.

The three most common moped collisions involving other vehicles were:

- where the moped was crossing the path of a vehicle (usually a car) approaching from the right at an intersection
- where another vehicle (usually a car) was turning across the path of an oncoming moped
- where the moped collided head-on with another vehicle often when negotiating a bend – the moped was often on the wrong side of the road (de Vries, Margaritis & Mooi, 2003).

In moped collisions with other vehicles, the driver often failed to see the moped (estimated at 48% of cases) (de Vries, Margaritis & Mooi, 2003).

An earlier study of moped and motorcycle riders in the Netherlands reported that the most common crash type was where another vehicle turned left or right in front of them at an intersection (about 25% and 26% respectively of all crashes) (Mooi & Gallioano, 2001). Proportions were also similar for mopeds and motorcycles in respect of collisions at intersections where both vehicles were proceeding straight through (about 16% and 17% respectively of all crashes). However, mopeds and motorcycles differed in respect of head on collisions with this crash type accounting for about 17% of moped crashes but only about 4% of motorcycle crashes. They also differed in respect of crashes where the rider fell onto the road in an effort to avoid collision with another vehicle (about 2% for mopeds and 21% for motorcycles) (Mooi & Gallioano, 2001). There is some similarity between the findings of de Vries, Margaritis & Mooi (2003) and Mooi & Gallioano (2001), particularly in respect of head-on collisions for mopeds.

2.9.5 Spain

There were about 275,000 motorcycles (excluding mopeds) in Spain in 2006 with the number of motorcycles increasing by almost 25% from the previous year (Spanish Institute of Statistics, 2007). Based on estimates circa 2000, Spain has at least 800,000 mopeds (European

Conference of Ministers of Transport (ECMT), 2000). However, Schoon (2003) estimated that there may be more than 2 million. Spain has a population of about 40.4 million (Spanish Institute of Statistics, 2007).

While scooters and motorcycles are not differentiated in crash data for Spain, moped crashes are reported separately. Mopeds crashes account for about 8% of road fatalities in Spain (Wegman et al, 2005) compared to about 7% for motorcycles. This finding is similar to that of an earlier study which showed a slightly higher crash risk for mopeds compared to motorcycles in urban Barcelona (OR 1.61 and 1.50 respectively) (Cirera, Plasencia, Ferrando, Segui-Gomez, 2001).

Between 1993 and 2003, moped fatalities rose by 28% while motorcycle deaths fell by 26%. Between 2005 and 2006 motorcycle and moped fatalities increased by 2% and 4% respectively (International Road Traffic and Accident Database (IRTAD), 2007). The higher rate for Spanish moped riders is considered to be due to early access (at age 14), the lack of a specific moped rider skill test and lower helmet wearing among moped riders relative to motorcyclists (Wegman et al, 2005). It was also noted by Wegman et al (2005) that, contrary to the pattern for most other EU counties, moped numbers were increasing in Spain. The Spanish authorities have introduced measures to help reduce moped deaths/injuries, including the enforcement of helmet wearing (IRTAD, 2007).

2.9.6 Sweden

As at the first quarter of 2007, there were about 253,000 registered motorcycles in Sweden and about 85,000 registered mopeds (Statistics Sweden, 2007). Sweden has a population of about 9.1 million (Statistics Sweden, 2007a). Motorcycle numbers (excluding mopeds) have increased in Sweden since 2000 by about 50%. (Statistics Sweden, 2007). While mopeds are a separate vehicle category, larger scooters are included under the general motorcycle category.

In 2003, Swedish moped riders had a risk of injury 42 times greater than car drivers per distance travelled while motorcyclists had a 20 times greater risk. However, the relative risk of fatality per distance travelled was higher for motorcycle riders (19 times greater than for car driver) than for moped riders (12 times greater) (Statistics Sweden, 2003). In 2003, about 62% of all killed/injured moped riders were aged 15-17 years. By contrast, the largest group of all killed/injured motorcycle riders (51%) were aged 25-44 years.

Aare & von Holst (2003), in a study of Swedish moped and motorcycle crashes, estimated that, relative to passenger car occupants, the risk of fatality per kilometre travelled was 20 times higher for mopeds and 10 times higher for motorcycles. Most killed/injured riders were under 25 years with limb fractures and head injury common despite compulsory helmet laws. Injury levels were generally less severe on the AIS for moped riders, resulting in lower hospital treatment days for moped compared to motorcycle riders. For example, for under 25 year olds (the largest age group) the average hospital stay was 6.5 days for moped riders and 8.7 for motorcycle riders. It was suggested that this may have been due to lower travel/collision speeds for mopeds relative to motorcycles.

2.9.7 United Kingdom

In 2006, there were over 1.2 million registered motorcycles in the UK with about 154,000 (or 13%) of these being mopeds (Department for Transport, 2007). Between 2002 and 2006, the number of registered motorcycles (excluding mopeds) increased by about 18%, while the number of mopeds fell by about 8% (Department for Transport, 2007). This reduction in moped numbers, which occurred after 2004, is consistent with the down turn noted for the EU by ACEM (2006). In 2005, about 31% of new UK motorcycle registrations were for scooters, including mopeds – this was the largest sales category with the next largest being for sports machines (28%) (Department for Transport, 2007).

Schoon (2004) notes that the minimum age for moped licensing in the UK was 16, that both a practical and theoretical test was required and that helmet wearing was compulsory. Access to 125cc motorcycles /scooters is available from age 17 in the UK (Schoon, 2004). Schoon also notes that, relative to other EU countries, the UK has fewer mopeds with larger motorcycles being more popular. This means that the number of moped crashes is small.

Relative to car drivers, UK motorcycle riders (including moped riders) have about a 36 times greater chance of fatality crash involvement based on 2004 crash data (Department for Transport, 2007a). The population of the UK is about 61 million (National Statistics (UK), 2007).

If one compares the number of killed/seriously injured moped riders with those for larger motorcycles for the UK in 2004, mopeds appear to have a lower crash rate on a per registered vehicle basis relative to larger machines (ie 46 per 10,000 registered vehicles for mopeds and 58 per 10,000 registered vehicles for larger motorcycles) (Department for Transport, 2007a). A similar result was reported in an in-depth study of motorcycle crashes in the UK for the period 1997-2002 where Clarke, Ward, Bartle & Truman (2004) found mopeds and scooters combined to be under-represented in crashes relative to larger motorcycles on a per registered vehicle basis. However, they suggest that this may be anomalous:

> *Mopeds and scooters appear (somewhat surprisingly) under-represented. However, it is possible that this seemingly anomalous result in the scooter/moped figures is accounted for by the large increase in the sales of scooters during 2003 (up 16%), which means that they have only become a large category relatively recently, compared to the earlier years that this study was carried out over. They may also do many less miles than machines of other types. There is also some confusion in our sample as some scooters are legally mopeds (i.e. under 50cc) while some are not, which may lead to errors in categorising them correctly. Without the correct recording of exact model designations on some accident reports, it proved difficult to be precise on this point, and many scooters may have been categorised as mopeds by their engine capacity alone as a result. When machines recorded as "moped" are separated from 'scooters' in the sample, it is found that mopeds in general are over-represented in accidents relative to their sales figures.* (p26)

In terms of crash types Clarke et al (2004) found a shunt from behind was a common crash type for scooters/mopeds relative to other motorcycle types (ie 40% for scooter/moped, and 17% other types). They also reported that mopeds/scooters were under-represented in curve/bend and over-taking crashes. While scooter/moped riders overall were found more likely to be at fault in a crash, responsibility reduced with the increasing age of the riders. Clark et al (2004) suggested that this pattern may be due to the involvement of young male moped riders in crashes.

2.10 Concluding/Summary Comment

In Victoria, and in other comparable jurisdictions in Australia and overseas, registration and crash statistics for scooters are often combined with those for all motorcycles. However, mopeds are more often partialled out in both registration and crash records. The lack of specific data on scooter numbers and crash involvement makes it difficult to compare the crash risk of scooters relative to larger motorcycles in Victoria and elsewhere. While some comment can be made on the crash risk/involvement of mopeds relative to larger machines in respect of some Australian and overseas jurisdictions, little can be said in respect of larger scooters that fall outside the moped class.

Differences in regulations relating to minimum rider licensing age and registration categories for mopeds, scooters and motorcycles in various jurisdictions also make direct comparison difficult. For example, while the definition of a moped is reasonably consistent in Australia and

comparable overseas jurisdictions, minimum licence age for access to such machines can vary from age 14 to 18 years. Notwithstanding these limitations, the following general observations regarding mopeds and scooters can be made:

- Scooter/moped numbers are increasing in most jurisdictions comparable to Victoria – scooter numbers may be increasing at the expense of mopeds in some jurisdictions.
- Some jurisdictions in Australia and overseas allow moped operation on a car licence (eg Queensland, Northern Territory, South Australia and Western Australian).
- New scooter/moped sales in Australian and comparable overseas jurisdictions accounted for between about 20% and 30% of new motorcycle sales in the last five years.
- Mopeds/scooters may account for between 4% and 7% of registered motorcycles in Australian jurisdictions.
- Mopeds/scooters are more common in EU jurisdictions relative to Australia, New Zealand, UK and Canada – there are proportionally more mopeds/scooters in southern EU countries relative to northern Europe or the UK where mopeds numbers can exceed those for larger motorcycles.
- As the number of moped/scooter crashes in Australian jurisdictions is small, and mopeds/scooters are not always identified in crashes, it is difficult to establish the crash risk of scooters/mopeds relative to other motorcycles.
- In New Zealand and British Columbia moped crash risk (per registered vehicle) appears to be less than that for larger motorcycles.
- Crash risk for mopeds across the EU may be about the same as for motorcycles, however, while studies in individual counties have reported both higher and lower levels of crash involvement relative to larger motorcycles, most have reported a higher crash/fatality risk for mopeds relative to motorcycles.
- Fatality risk for all motorcyclists in the EU appears to be between about 10 and 36 times higher than that for a passenger car driver.
- Injury patterns for the EU suggests that moped riders may suffer less severe injuries than the riders of larger motorcycles, but may suffer higher levels of facial and head injury.
- Crash-involved moped riders overseas tend to be younger males – in the EU 14-18 year old moped riders accounted for between about 30% and 50% of all moped fatalities between 1995 and 2002.
- A common moped crash type in the UK/EU was where the moped was struck from behind by a faster moving vehicle, usually a passenger car – sometimes referred to as a “shunt” collision.
- Other moped crash types reported for the EU are similar to those for all motorcycles, though mopeds may be less involved in curve and overtaking crashes.
- Moped crashes tend to be more urban than rural in the EU – while most injury crashes occur in urban areas, fatalities are generally higher in rural areas.
- Further research is needed to reliably establish the crash risk of mopeds and scooters relative to larger motorcycles.

3. ESTIMATING THE NUMBER OF REGISTERED SCOOTERS IN VICTORIA

3.1 Process Used to Estimate the Number of Registered Scooters in Victoria

As noted earlier in this report, identifying scooters in the registration and crash databases may be difficult as motor scooters are not uniquely identified and are subsumed by the motorcycle category. However, the definition set out in Section1.2 of this report *(ie Definition of a Scooter*) was used. The general approach applied by the contractors in respect of the registration data base was to use the variables known to be in the mandatory registration database fields (eg engine size/cubic capacity, Vehicle Identification Number (VIN) and make) to filter/distil the respective datasets to smaller data pools of:

- Motorcycles known from descriptors to be scooters.
- Motorcycles known from descriptors not to be scooters.
- Scooters known to be mopeds.
- Motorcycles that may be scooters.

A data file of all Victorian registered motorcycles as at August 2007 (n= 134,938) was supplied by VicRoads for the purposes of this project. This was a stripped file that did not include the personal identifiers of the registered owners such as name and address. However it did include the following key variables:

- Year of manufacture of the registered motorcycle.
- VIN.
- Engine number.
- Registration class.
- Make/model of motorcycle.
- Cubic capacity of motorcycle (engine size) and power units/kW (where available) moped category machines would be of particular interest.
- Residential postcode of registered owner- this allowed Australian Bureau of Statistics (ABS) demographic/socio-economic patterns to be derived from this based on the most recent census and surveys.
- Registration number.

Registration number was of particular importance as this was required for subsequent cross-referencing to scooters appearing in crash data. This matching process will be discussed in more detail below.

The motorcycle registration dataset was interrogated using packages such as Microsoft Excel, Microsoft Access and/or SPSS to identify scooters by make/engine size/VIN. In general terms, this detected most scooters as some manufacturers only make scooters (eg Bug and Piaggio/Vespa) and most scooters have a relatively small engine (most <250 cc in engine size). However, some such as the Suzuki Burgman have up to 650 cc engines, but these maxi-scooters are the exception rather than the rule. In addition, about 70% of scooters sold nationally since 2001 were in the not exceeding 50cc moped class (Christie & Newland, 2006). While some manufacturers make motorcycles, scooters and/or cars, the engine size provided a useful clue (eg a 100cc Peugeot is likely to be a scooter). Some major manufacturers such as Kawasaki do not make scooters which helped narrow the field.

This process also identified motorcycles that may be scooters, but could not be confirmed as such by this means. The details of these motorcycles were then examined in more detail to determine their status using VIN and engine number to distinguish between scooters and motorcycles of the same engine size – the assistance of industry experts was enlisted to assist in this regard. This process helped reduce the number of unknowns in the dataset. However,

there were some motorcycles (n=78) that could not be conclusively classified as scooters and were omitted from the analysis. Most of these had missing or incomplete VIN and/or engine number entries and related to machines manufactured in the 1980s. Given that the 78 motorcycles in question accounted for less than 1% of the file of known registered scooters, the loss of these data was not considered problematic. This was particularly so as none of these unidentified motorcycles/scooters appeared in the crash files for the period 1995-2006.

Adoption of this process led to the compilation of a dataset known to contain only scooters and provided the best estimate of the number of registered scooters in Victoria. This dataset was then stratified and explored descriptively by make, engine size, age and metropolitan/rural location. It was considered particularly important to identify the number/proportion of moped category scooters as a preliminary to comparison with other jurisdictions in terms of proportions and crash involvement patterns. The number/proportions were also cross-referenced against other datasets such as scooter sales in recent years by variables such as make and engine size as a cross-validation.

3.2 Estimated Number of Registered Scooters in Victoria

Using the techniques outlined above, the file of all 134,938 registered motorcycles in Victoria as at August 2007 supplied by VicRoads was distilled/reduced to a sub-file of 8,632 machines known to be currently registered scooters. This implies that as at August 2007, scooters accounted for about 6.4% of all registered motorcycles in Victoria. It is of note that this proportion was similar to the 6% estimated by the author based on sample data supplied by VicRoads during the tendering process. This proportion is also similar to the estimates derived from motorcycle exposure studies conducted in NSW in 2002/2003 and in QLD in 2005/ 2006 (Harrison & Christie, 2003; 2007 respectively).

3.3 Registered Scooters in Victoria by Make

Table 2 shows the distribution of registered scooters by make for the 10 most frequent makes. Inspection of Table 2 shows that Bolwell represents the most common make with 21.5% of all scooter registrations. However, if all the makes under the Piaggio brand are combined (ie Piaggio, Vespa, Gilera, Derbi, and Aprilia), the Piaggio group accounts for the largest proportion of registered scooters (ie 34.2% of registered scooters).

The top five makes account for about 73% of all registered scooters in Victoria. In combination, the makes outside the top 10 shown in Table 2 account for only 10.4% of all registered scooters (ie 888 registered scooters).

Table 2. Number and Proportion of Victorian Registered Scooters by Make as at August 2007

Make	Number of Scooters	% of All Registered Scooters
Bolwell	1,858	21.5
Vespa	1,348	15.6
Honda	1,156	13.4
Yamaha	1,006	11.7
Piaggio	926	10.7
Aprilia	481	5.6
VMoto	434	5.0
Suzuki	262	3.0
Ital	142	1.6
TGB	131	1.5
Totals	**7,744**	**89.6**

3.4 Registered Scooters in Victoria by Type/Engine Size

As shown in Table 3, vehicles categorised as mopeds (based on engine size not exceeding 50cc) accounted for almost 24% of all Victorian registered scooters. However, conventional scooters with an engine size between 51cc and 250cc accounted for the majority of registered machines (ie about 73%). Maxi scooters with engine sizes in excess of 250cc accounted for only about 3% of all registered scooters.

Table 3. Proportion of Victorian Registered Scooters by Type as at August 2007

Type/Engine size	Number of Scooters	% of All Registered Scooters
Moped (to 50cc)	2,056	23.8
Scooter (51-250cc)	6,297	72.9
Maxi Scooter (>250cc)	279	3.2
Totals	**8,632**	**100**

3.5 Registered Scooters in Victoria by Local Government Area (LGA)

Table 4 shows the distribution of registered scooters for the top 10 LGAs in Victoria. The top 10 LGAs account for about 46% of all registered scooters in Victoria. It is of note that, with the exception of the City of Greater Geelong, all of these LGAs are located within the Melbourne Metropolitan area with most being inner urban, more densely populated municipalities. With the exception of the City of Greater Geelong, these are relatively affluent areas in which median wage and salary levels exceed the medians for Victoria and Australia (ie $34,215 and $34,149 respectively in 2003/2004) (ABS, 2007). These nine LGAs are in the top 25% of municipalities in Australia in terms of personal income with three (Port Phillip, Boroondara and Stonnington) being in the top 10% (ABS, 2007).

Table 4. Number and Proportion of Victorian Registered Scooters in top 10 LGAs as at August 2007

LGA	Number of Scooters	% of All Registered Scooters
City of Port Phillip	649	7.5
City of Yarra	518	6.0
City of Melbourne	422	4.9
City of Boroondara	404	4.7
City of Stonnington	390	4.5
City of Greater Geelong	335	3.9
City of Moreland	330	3.8
City of Moonee Valley	324	3.8
City of Darebin	316	3.7
City of Glen Eira	285	3.3
Totals	**3,973**	**46.1**

The distribution pattern for the top 10 LGAs for registered motorcycles (other than scooters) in Victoria differs from that for scooters. As can be seen in Table 5, the top 10 LGAs account for only about 34% of all registered motorcycles, a lesser proportion than for scooters. While most of these 10 LGAs are in the Melbourne metropolitan area they are located in the outer fringe areas. Three of the top ten LGAs are rural cities/regional centres. There is only one common LGA in the top 10 listings for both scooters and motorcycles, the City of Greater Geelong. These are not particularly affluent areas with only four exceeding the Victorian median for wages/salaries and then only by small margins (ABS,2007). Only one of these LGAs (City of Wyndham) is in the top 25% of municipalities in Australia in terms of personal income (ABS, 2007).

Table 5. Number and Proportion of Victorian Registered Motorcycles (Excluding Scooters) in top 10 LGAs as at August 2007

LGA	Number of Motorcycles	% of All Registered Motorcycles
Shire of Yarra Ranges	5,888	4.7
City of Casey	5,626	4.5
City of Wyndham	4,973	4.0
City of Greater Geelong	4,833	3.8
Morning Peninsula Shire	4,229	3.4
City of Knox	4,187	3.3
City of Hume	3,265	2.6
City of Latrobe	3,201	2.5
City of Greater Bendigo	3,100	2.5
City of Frankston	2,892	2.3
Totals	**42,194**	**33.6**

Table 6. Number and Proportion of Victorian Registered Scooters by Geographic Area as at August 2007

Geographic Area	Number of Scooters	% of All Registered Scooters
MSD	6,794	78.7
Rural/Regional City	756	8.8
Rural Shire	1,082	12.5
Totals	**8,632**	**100**

While the remaining 54% of scooter registrations is spread across the remaining 69 municipalities in Victoria, the distribution is denser in urban LGAs. The urban nature of scooter distribution is further illustrated by Table 6 which shows the distribution of scooters across the Melbourne Statistical Division (MSD) (ie the Greater Melbourne area), rural cities/regional centres and rural shires. The majority of all registered scooters (about 79%) are located within the Melbourne metropolitan area with a further 9% being located in rural cities/centres and only about 13% being spread across other rural areas.

The distribution for Victorian registered motorcycles follows the same pattern of urban bias, but is less pronounced than the pattern for scooters. As shown in Table 7, about 60% of registered motorcycles other than scooters are found in the MSD, with about 14% being found in rural cities and regional centres and about 26% in rural shires.

Table 7. Number and Proportion of Victorian Registered Motorcycles (Excluding Scooters) by Geographic Area as at August 2007

Geographic Area	Number of Motorcycles	% of All Registered Motorcycles
MSD	75,110	59.7
Rural/Regional City	18,171	14.4
Rural Shire	32,540	25.9
Totals	**125,821**	**100**

3.6 Registered Scooters in Victoria by Year of Manufacture

As shown in Table 8, almost 79% of Victorian registered scooters were manufactured in or after 2001. Almost a third of all registered scooters (32.8%) were manufactured in 2006 or 2007.

Table 8. Number and Proportion of Victorian Registered Scooters by Year of Manufacture as at August 2007

Year of Manufacture	Number of Scooters	% of All Registered Scooters
After 2005	2,831	32.8
2001-2005	3,951	45.8
1996-2000	826	9.6
1991-1995	181	2.1
1986-1990	241	2.8
Pre 1986	601	7.0
Totals	**8,631**	**100**

Table 9. Number and Proportion of Victorian Registered Motorcycles (excluding scooters) by Year of Manufacture as at August 2007

Year of Manufacture	Number of Motorcycles	% of All Registered Motorcycles
After 2005	16,1213	12.8
2001-2005	42,977	34.0
1996-2000	28,587	22.6
1991-1995	13,957	11.1
1986-1990	9,396	7.4
Pre 1986	15,266	12.1
Totals	**126,306**	**100**

The fleet of registered scooters is relatively younger than the registered motorcycle fleet (excluding scooters) in Victoria. Inspection of Table 9 shows that only about 47% of registered motorcycles were manufactured after 2000 and only about 13% in 2006 or 2007.

3.7 Concluding/Summary Comment

Analysis of the fleet of Victorian registered scooters suggests that the majority of scooters were made by a small number of overseas manufacturers, are between 51 and 250cc in engine size, were manufactured in the last seven years and are concentrated in urban, predominantly inner urban areas, of metropolitan Melbourne with higher personal income levels. The scooter fleet is relatively younger than the motorcycle fleet and more urbanised.

4. ESTIMATING THE CRASH INVOLVEMENT OF REGISTERED SCOOTERS IN VICTORIA

4.1 Process Used to Identify Crash Involved Scooters

VicRoads supplied a file of all crashes for the most recent and complete 12 year period (ie from 1995 to 2006 inclusive) where a motorcycle was indicated to be involved – this file included both vehicle and person based data. This was then electronically matched to the file of scooters described in the previous chapter that was identified/derived from the motorcycle registration file supplied by VicRoads. The matched file was then analysed to build a profile of Victorian scooter crashes.

It was considered that 12 years of crash data would be sufficient to detect trends and patterns within motorcycle and scooter crashes and provide sufficient numbers for at least moderate levels of analysis. As noted by Christie & Newland (2006), scooter sales have increased over the last 10 years - particularly in the last five years – and that the demographics of these scooter riders differ from motorcycle riders and perhaps from scooter owners/riders prior to the mid-1990s. In view of this, it seemed prudent to concentrate on the last 10 years rather than attempt to go back further in time.

Crash data for all motorcycles were matched with motorcycle registration data to accurately identify crashes that involved scooters. Unfortunately, only 224 scooters/mopeds known to be registered as at August 2007 appear in the 1995-2006 vehicle crash file - a match rate of less than 3%. Of this 224, only 102 (ie about 45%) were actually classified as mopeds or scooters in the crash database, 85 as motorcycles (38%) with the balance 37 (17%) being misclassified as cars.

This low match rate necessitated the searching of Victorian registration archives and written off vehicle databases to identify crash involved motorcycles for the period 1995 to 2006 that were scooters/mopeds. Searching these archives was completed on a record-by-record basis. This process, though laborious, was necessary to maximise the size of scooter crash data pool and to ensure that all accessible information sources had been explored.

4.2 Crash Involved Scooters Identified and Implications for Data Analysis

A search of the archives back to 1999 (inclusive) identified a further 175 crashed scooters/mopeds, however, not all of these records contained any additional useful information. A decision not to search the archives before 1999 was made by VicRoads as almost no crash involved scooters were found for that year and the cost of further searching could not be justified. The loss of the small number of pre-1999 cases is unlikely to have adversely affected the overall analysis.

After the removal of records which contained no additional useful information or were anomalous, a total of 399 valid crash involved scooter/moped records for the period 1995-2006 inclusive resulted from the combination of August 2007 registered and archival registration data Less than 50% were correctly identified as scooters/mopeds in the crash data base with the balance being listed as motorcycles. However, some of these records contained incomplete information in respect of scooter registration (eg engine size or postcode of owner was missing), but were included to maximise the pool of known crash involved scooters as crash details were known. The distribution of these scooter crashes is shown in Table 10 – the years are shown in descending rather than ascending order to assist interpretation. Inspection of this table shows that identified scooter crashes were greater in more recent years and decreased as one goes backwards to 1995. Indeed, almost 85% of the identified scooter crashes occurred from 2001 onwards.

Following consultation with VicRoads, it was agreed that only crashes for the six year period 2001-2006 inclusive (n=337) should be included in the analysis as elimination of the period 1995-2000 accounted for only about a 15% loss of data but allowed analysis to focus on the years in which scooter sales in Victoria were increasing markedly (see Figure 1 above). It was considered that the inclusion of the small number of identified scooter crashes for the six year period 1995-2000 inclusive (ie n=62) may distort the overall analysis and contribute to misleading conclusions about patterns of scooter crashes.

Table 10. Identified Scooter/Moped Involved Crashes 1995-2006 Inclusive, Victoria

Year	Number	% of All Scooter/Moped Crashes Identified 1995-2006	Descending Cumulative % of All Scooter/Moped Crashes Identified 1995-2006
2006	85	21.3	21.3
2005	78	19.5	40.8
2004	51	12.8	53.6
2003	40	10.0	63.6
2002	45	11.3	74.9
2001	38	9.5	84.4
2000	20	5.0	89.4
1999	17	4.3	93.7
1998	10	2.5	96.2
1997	7	1.8	98.0
1996	3	0.8	98.8
1995	5	1.3	100
Grand Total	399		

Note: Record searches did not include the period before 1999.

Using the August 2007 estimate of the number of registered scooters/mopeds in Victoria and the number of new scooter sales for the period 1999-2007 inclusive, it is possible to create an estimated number of registered scooters for each year by progressively subtracting the annual sales for new scooters (as published by FCAI). The results of this process are shown in Table 11. As the grey import of used scooters is uncommon the annual increases in registered scooter numbers could be assumed to be due predominantly to new scooter sales (personal communication, Ray Newland, Motorcycle Manager, FCAI, 15 January 2008).

Table 11. Estimated Number of registered Scooter/Mopeds 1999-2006 Inclusive, Victoria (based on Australian Scooter Federation sales figures)

Year	Estimated Number of Registered Scooters/Mopeds	New Scooter Sales, Victoria
2007	(As at Aug 2007) ,8633	(to 30 Sep 2007) 1,733
2006	6,900	1,861
2005	5,039	1,025
2004	4,014	770
2003	3,244	372
2002	2,872	334
2001	2,538	549
2000	1,989	425
1999	1,564	239

Inspection of Table 11 suggests that there may have been less than 1,600 registered scooters/mopeds in Victoria which would help account for the seemingly low crash numbers shown in Table 10 for 1999.

It is of interest that the pattern of scooter crash numbers for the period 2001-2006 inclusive correlated highly with the pattern for new scooter sales and estimated scooter/moped numbers for the same period (r=0.87 and r= 0.96 respectively). These correlations are based on only 8 years of data. However, the strong positive correlations suggest that, on a prima facie basis, crash numbers for scooters may have moved in concert with the number of scooters on Victorian roads which would be expected from an exposure-to-risk perspective (ie as the number of registered scooters increased, so too did scooter crash involvement).

4.3 Variables Explored in Analysis of Crash Data

Where possible, the contractors analysed the scooter crash data for 2001-2006 by at least the following variables:

- Year of manufacture of the registered scooter.
- LGA where the crash occurred (postcode was not available for all cases/years).
- Whether the crash occurred in the same LGA in which the scooter was registered.
- Gender of crash involved rider.
- Age (age group) of crash involved rider.
- Licence status/type of rider.
- Scooter size (ie moped, scooter and maxi-scooter).
- LGA of owner/rider (postcode was not available for all cases/years).
- Type of crash (using VicRoads Definitions Classifying Accident (DCA) coding system).
- Time/day of week/month of year when the crash occurred– looking particularly for weekday/weekend patterns and any evidence of seasonality.
- Time of day of crash.
- Level of damage.
- Police attendance.
- Whether vehicles were towed away.
- Whether crash helmets were worn.
- Speed zone where crash occurred.
- Road geometry/characteristics of location where crash occurred (eg intersection).
- Road surface condition (paved/unsealed).
- Where the crash occurred (rural/urban/metro) – Melbourne Statistical Division (MSD) vs Rest of State (ROS), VicRoads Region and Local Government Area (LGA).
- Light conditions at time of crash (eg daylight, night, dawn/dusk).
- Severity of Crash.
- Year of crash.
- Variables relating to drink-driving.
- Number of vehicles involved in crash – including single scooter crashes.

Crash patterns for scooters were also compared with those for all Victorian motorcycles/non-scooters for the same 6 year period to look for differences and similarities in patterns. Motorcycle and scooter crash patterns were also compared with those for all Victorian vehicles for the 2001-2006 period. Given the marked difference in crash involved vehicle numbers for scooters/mopeds when compared to motorcycles and to passenger cars, proportions (percentages) rather than numbers were used in comparisons. Comparison with other road users groups such as pedestrians and pedal cyclists was considered inappropriate as these groups differ considerably from motorised road users. For example, pedal cyclists are not

required to be licensed, their bicycles are not required to be registered and many cyclists (including those involved in crashes) are children.

The relatively small number of scooter crashes limited the depth to which analysis could proceed before cell sizes became too small and unreliable. It also limited, to some extent, year-to-year comparisons. This made cross-tabulation and analysis by variables such as engine size, age/gender of rider, crash type and region difficult at times. It also limited the separate analysis of moped crashes. In addition, the pool of 337 cases contained missing data in respect of some variables which again limited the breadth and depth of analysis. In most cases only descriptive statistics could be presented as inferential analysis was not possible. Unless otherwise stated, reference to differences between specific numbers or proportions (eg crash numbers/proportions by engine size) across this report does not imply statistically significant difference.

The results of these analyses are set out in the chapters that follow.

5. CRASH PATTERNS OF REGISTERED SCOOTERS IN VICTORIA 2001-2006

5.1 General

This chapter outlines the crash patterns of registered scooters in Victoria for the period 2001 to 2006 inclusive. This analysis is largely descriptive presenting tables and graphs as the data set (ie the 337 registered scooters known to be crash involved) did not generally support inferential statistical analysis. Following presentation of scooter crash numbers and proportions for the period 2001-2006, crash pattern information is presented under four broad headings:

1. Vehicle related variables.
2. Person related variables.
3. Temporal related variables.
4. Crash type and characteristics variables.

These are derived from the dataset of police reported crashes supplied by VicRoads for this project. Both frequencies and proportions are variously reported across the chapter. Where missing data were encountered in respect of a variable of interest the quantity/percentage is reported, however, missing frequencies or proportions are not shown in tables or graphs.

5.2 Scooter Crash Numbers 2001-2006

As shown in Figure 2, the number of scooter crashes increased across the period 2001-2006. In this period, they more than doubled in number from 38 to 85. While the dotted line represents the overall trend pattern between 2001 and 2006 inclusive, the most marked increase was after 2004 – about 48% of scooter crashes for the 2001-2006 period occurred between 2005 and 2006 inclusive.

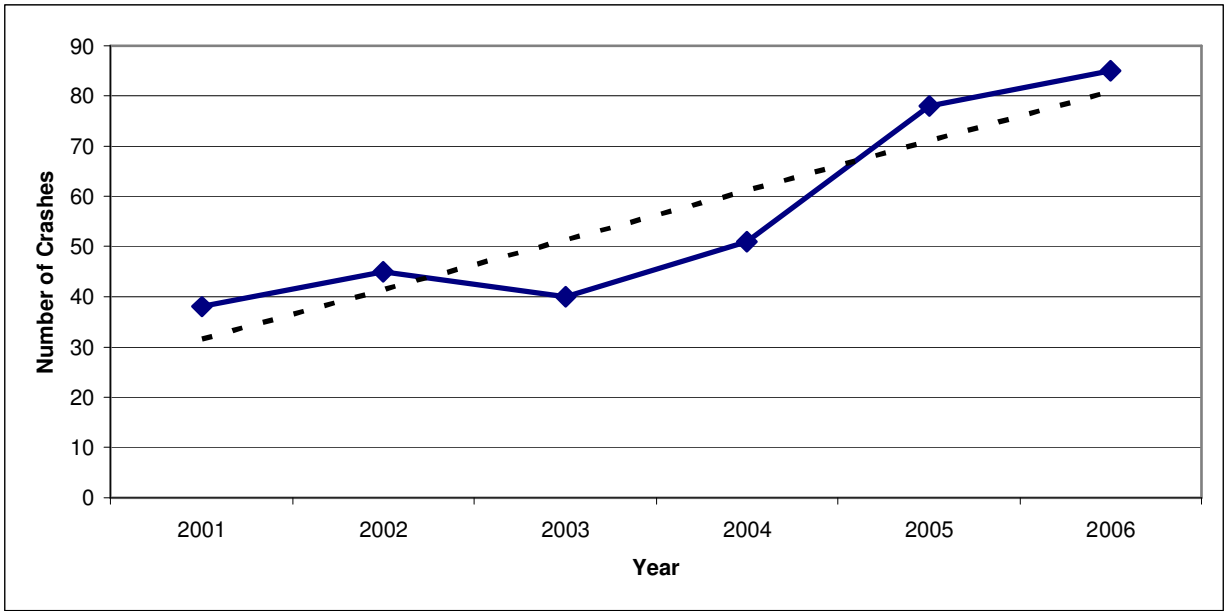

Figure 2: Crash numbers for registered scooters, Victoria, 2001-2006

5.3 Vehicle Related Variables for Scooter Crashes

5.3.1 Number of Vehicles Involved in Crash

As shown in Table 12, the majority of scooter crashes (59.3%) involved two vehicles while 35% involved only the scooter. Scooter crashes involving more than two vehicles were uncommon accounting for less than six percent of scooter crashes.

Table 12. Number of Vehicles Involved in Scooter Crashes, Victoria, 2001-2006

Number of Vehicles	Number of Crashes	Percent
1	118	35.0
2	200	59.3
3	15	4.5
4	3	0.9
5	1	0.3
Total	337	100

5.3.2 Size of Scooter Involved in Crash

The engine size of crash involved scooters ranged from 50cc to 650cc. Most (82.4%) scooters were of conventional size (i.e. >50cc to 250cc) – see Table 13. Mopeds (engine size not exceeding 50cc) accounted for almost 16% of crashes while maxi scooters (ie scooters with an engine size >250cc) accounted for less than two percent. Size/engine size in respect of 75 scooters was missing. The small number of maxi-scooter crashes prevented additional analysis by scooter size while the small number of moped crashes limited analysis in respect of mopeds.

Table 13. Crash involved Scooters by Scooter Size, Victoria, 2001-2006

Number of Vehicles	Number of Scooters	Percent
Moped	41	15.6
Scooter	216	82.4
Maxi-scooter	5	1.9
Total	262	100

Note: Size/engine size in respect of 75 of the 337 crash involved scooters was missing

5.3.3 Year of Manufacture of Scooters Involved in Crash

Inspection of Table 14 shows that most crash involved scooters (62.2%) were manufactured after 2000 and about 26% between 1991 and 2000. Less than 12% were manufactured before 1991. The oldest crash involved scooter was manufactured in 1960. Year of manufacture was missing for only one scooter.

Table 14. Year of Manufacture of Scooter Crashes, Victoria, 2001-2006

Year of Manufacture	Number of Scooters	Percent
After 2000	209	62.2
1991-2000	88	26.2
1981-1990	33	9.8
Before 1981	6	1.8
Total	336	100

5.3.4 Level of Damage to Scooters Involved in Crash

As assessed by attending police, most scooter crashes involved only minor damage to the vehicle (38%) – see Table 15. Less than 5% resulted in damage assessed as extensive unrepairable. Level of damage was missing for only three scooters. Only 22.5% were noted by police as being towed away.

Table 15. Level of Damage to Scooters Involved in Crashes, Victoria, 2001-2006

Level of Damage	Number of Scooters	Percent
Minor	127	37.7
Moderate but driveable	89	26.4
Moderate towed away	49	14.5
Major towed away	24	7.1
Extensive unrepairable	14	4.2
Nil damage	22	6.5
Unknown	9	2.7
Total	334	100

5.4 Person Related Crash Variables

5.4.1 Sex of Scooter Rider

As shown in Table 16, the majority of crash involved scooter riders were male (65.6%). However, more than a third were female. Sex of rider was missing for only three scooter crashes.

Table 16. Sex of Rider: Riders Involved in Scooter Crashes, Victoria, 2001-2006

Sex of Rider	Number	Percent
Female	115	34.4
Male	219	65.6
Total	234	100

5.4.2 Age of Scooter Rider

The age range for crash involved scooter riders was 18-81 years. Inspection of Table 17 shows that the largest group (31.8%) was aged 21-30 years. Less than six percent of riders were aged under 21 years and less than eight percent were aged above 60 years. The average rider age was 38 years and the median 35 years. Age of rider was missing for 16 scooter crashes.

Table 17. Age of Rider Involved in Scooter Crashes, Victoria, 2001-2006

Age (Years)	Number	Percent
<21	17	5.3
21-30	102	31.8
31-40	92	28.7
41-50	46	14.3
51-60	41	12.8
61-70	12	3.7
>70	11	3.4
Total	321	100

5.4.3 Sex by Rider Age Group for Crash Involved Scooter Riders

The pattern of scooter crashes by age group of rider was significantly different for males and females. The peak for females is younger (21-30 years) than for males (male peak, 31-40 years). While these differences in age/gender patterns were statistically significant (Chi square p=.003, df =6), the small number of crashes for females in some age groups suggests that some caution should be applied to the interpretation of this observed difference.

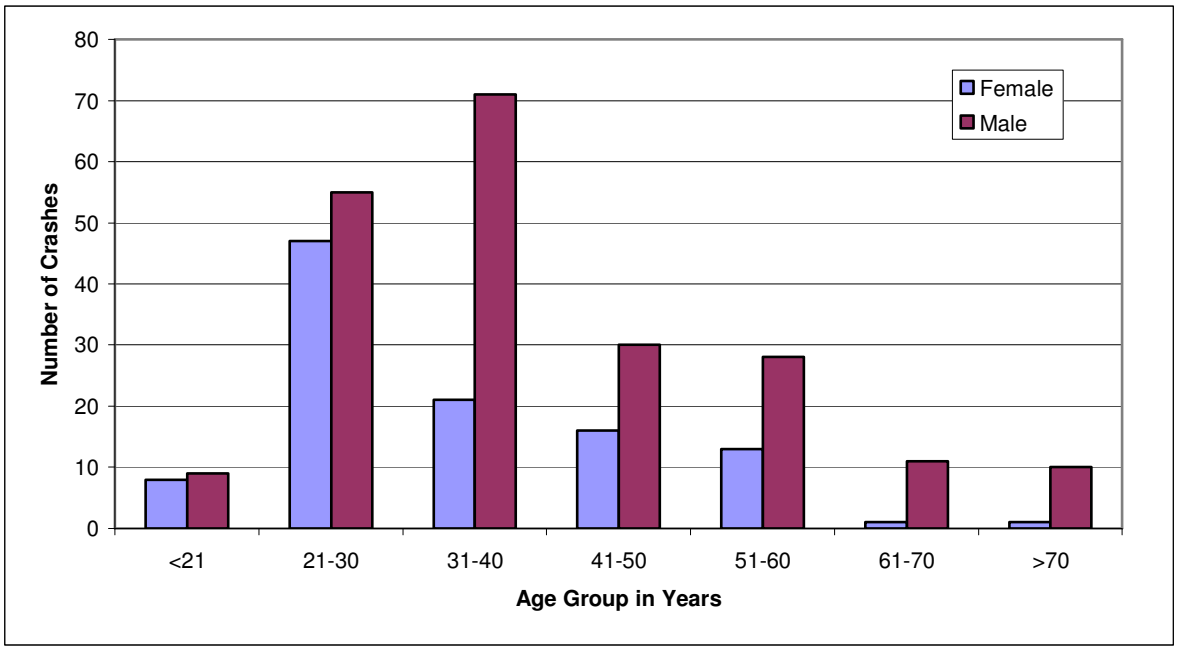

Figure 3: Number of Riders Involved in Scooter Crashes by Sex/Age Group of Rider Victoria, 2001-2006

5.4.4 Licence Status of Scooter Rider

The majority of crash involved scooter riders were legally/validly licensed (88.7%). Less than one percent were known to be suspended/expired/cancelled/disqualified. However, the licence status for 10.4% of crash involved scooter riders was not known.

5.4.5 State of Licensing of Scooter Rider

The majority of crash involved scooter riders were Victorian licensed (93.2%), 5.3% interstate and 1.5% overseas licensed.

5.4.6 Licence Type of Scooter Rider

The majority of crash involved scooter riders held a standard (full) licence (53.4%) while 27.7% held learner permits, and 5.4% probationary licences – see Table 18. About two percent held conditional licences of some type while less than one percent were unlicensed /inappropriately licensed. The licence type of 11% of riders were listed as *Unknown* in VicRoads crash records while details on the remainder (n=16) were missing.

Table 18. Licence Type of Riders Involved in Scooter Crashes, Victoria, 2001-2006

Licence Type	Number	Percent
Learner	91	27.2
Probationary	18	5.4
Probationary conditional	2	0.6
Standard (Full)	180	53.7
Standard conditional	5	1.5
Not Applicable/Unlicensed	2	0.6
Unknown	37	11.0
Total	321	100

5.4.7 Crash Involved Scooter Riders and Pillions

In the majority of scooter crashes (95.8%) the rider was operating solo – in only 4.2% of cases was a pillion passenger being carried.

5.4.8 Crash Helmet Wearing by Crash Involved Scooter Riders

A crash helmet was known to be worn in about 64% of scooter crashes. A helmet was known not to have been worn in less than one percent of cases. However, helmet wearing status was listed as *Unknown* in the crash records for more than one third of cases (35.3%).

5.4.9 Preliminary Breath Testing of Crash Involved Scooter Riders

A preliminary breath test (PBT) was taken in respect of only 35% of scooter crashes and an evidentiary test in less than one percent. These low proportions prevented further analysis of drink-driving related variables for crash involved scooters.

5.5 Temporal Related Crash Variables for Scooter Crashes

5.5.1 Season/Month of Year for Crash Involved Scooters

Most scooter crashes occurred in autumn (28.2%) and least in summer (20.8%). The month with the most crashes was October (10.4%) and the least, September (5.3%). The frequencies and proportions by season are shown in Table 19 and by month in Table 20.

Table 19. Scooter Crashes by Season, Victoria, 2001-2006

Season	Number of Scooters	Percent
Spring	83	24.6
Summer	70	20.8
Autumn	95	28.2
Winter	89	26.4
Total	337	100

Table 20. Scooter Crashes by Month of Crash, Victoria, 2001-2006

Month	Number of Scooters	Percent
January	20	5.9
February	25	7.4
March	30	8.9
April	32	9.5
May	33	9.8
June	26	7.7
July	31	9.2
August	32	9.5
September	18	5.3
October	35	10.4
November	30	8.9
December	25	7.4
Total	337	100

5.5.2 Day of Week for Crash Involved Scooters

Most scooter crashes occurred on weekdays (77.4%) with the highest percentage occurring on Thursdays (18.7%) – see Table 21. Crashes appeared to build to a peak on Wednesday/Thursday then fall through to Sunday before increasing again.

Table 21. Scooter Crashes by Day of Week of Crash, Victoria, 2001-2006

Day of Week	Number of Scooters	Percent
Sunday	34	10.1
Monday	42	12.5
Tuesday	45	13.4
Wednesday	62	18.4
Thursday	63	18.7
Friday	49	14.5
Saturday	42	12.5
Total	337	100

5.5.3 Time of Day of Crash for Crash Involved Scooters

Table 22 shows that most scooter crashes occurred in the time band between 3pm and 6pm (21.3%). The majority of crashes (about 74%) occurred in the 12 hour period between 6am and 6pm. Few crashes occurred between midnight and 6am (3%). Time of day was missing for nine scooter crashes.

Table 22. Scooter Crashes by Time of Day of Crash, Victoria, 2001-2006

Time of Day	Number of Scooters	Percent
Midnight to 6am	10	3.0
6:01am to 9am	52	15.9
9:01am to 12 noon	64	19.5
12:01pm to 3pm	56	17.1
3:01pm to 6pm	70	21.3
6:01pm to 9pm	59	18.0
9:01pm to midnight	17	5.2
Total	328	100

5.5.4 Time of Day of Crash Weekdays/Weekends for Crash Involved Scooters

The pattern by time of day for crash involved scooters varied for weekends and weekdays. As shown in Figure 4, the peak time period for scooter crashes on weekdays was between 3pm and 6pm, but between 9am and noon on weekends. Weekend crashes declined across the day for the period after 9am through to 9pm, a pattern not shown for weekday crashes. While differences in crash pattern for weekends and weekdays were statistically significant (Chi square p=.019, df=6), the small number of crashes on weekends suggests that some caution should be applied to the interpretation of this observed difference.

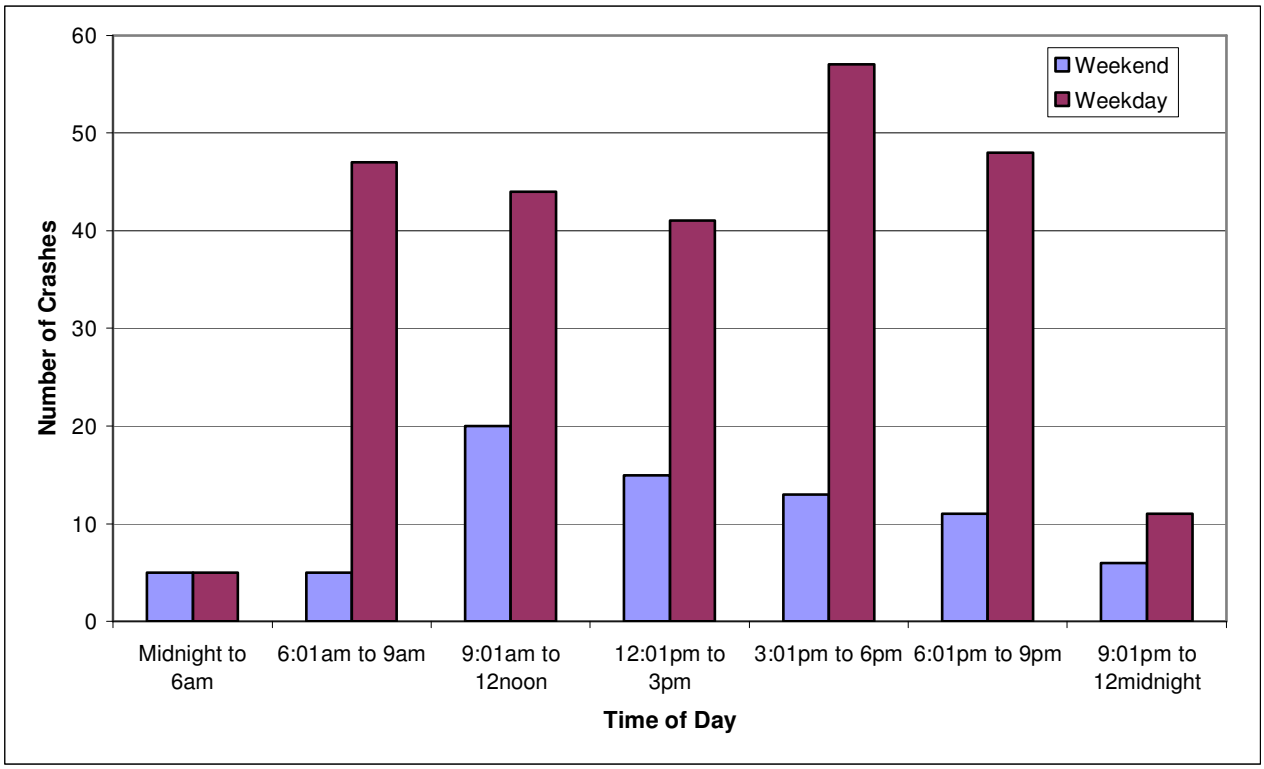

Figure 4: Number of Crash Involved Scooters by Time of Day of Crash, Weekdays/ Weekends, Victoria, 2001-2006

5.6 Crash Type and Classification Variables

5.6.1 Crash Type for Scooter Crashes

As shown in Table 23, the majority of scooter crashes, about 60%, involved a collision with another vehicle. About 31% did not involve collision with vehicles or objects. Collisions with pedestrians were relatively rare (ie less than two percent) as were collisions with animals (less than one per cent). Collisions with fixed or other objects accounted for about six percent of crashes.

Table 23. Scooter Crashes by Crash Type, Victoria, 2001-2006

Crash Type	Number of Crashes	Percent
Collision with other vehicle	197	58.5
Struck pedestrian	6	1.8
Struck animal	2	0.6
Collision with fixed object	16	4.7
Collision with other object	5	1.5
Vehicle overturned (no collision)	28	8.3
Fall from or in moving vehicle	6	1.8
No collision & no object struck	77	22.8
Total	337	100

5.6.2 DCA Grouping for Scooter Crashes

The largest DCA grouping for scooter crashes was *Off path on straight* (33.8%), a single, vehicle category – see Table 24. The second largest grouping was *Vehicles from same direction* (20.8%). Collisions with pedestrians were rare (less than two percent). A summary of DCA codes and groupings may be found at Appendix A.

Table 24. Scooter Crashes by Crash Type, Victoria, 2001-2006

DCA Grouping	Number of Crashes	Percent
Pedestrian	6	1.8
Vehicles from opposing directions (intersection only)	42	12.5
Vehicles from opposing directions	42	12.5
Vehicles from the same direction	70	20.8
Manoeuvring	25	7.4
Overtaking	7	2.1
On path	21	6.2
Off path on straight	114	33.8
Off path on curve	8	2.4
Passenger & miscellaneous	2	0.6
Total	337	100

The five most common individual DCA codes for scooter crashes were:

- DCA 174 Out of control on carriageway (23.7%) – a single vehicle crash type.
- DCA 121 Right through – where Vehicle 1 was turning right across the path of an oncoming vehicle (11.5%) – the scooter was vehicle 1 in about 18% of cases.
- DCA 130 Vehicles in same direction - where Vehicle 1 collided with the rear of another vehicle (7.1%) – the scooter was Vehicle 1 in about 62% of cases (i.e. scooter ran into rear of another vehicle).
- DCA 113 Right rear – collision at intersection where right-turning Vehicle 1 collided with vehicle approaching from right on intersecting road (5%) – the scooter was Vehicle 1 in only 6% of cases.
- DCA 170 Off carriageway to left (4.7%) - a single vehicle crash type.

These five DCA codes accounted for about 52% of scooter crashes.

5.6.3 Injury Level for Scooter Crashes

As shown in Table 25, almost all scooter crashes involved some level of injury with only about one percent involving no injury. The majority (59.6%) of scooter crashes involved less serious injury, while 38.9% involved serious injury and less than one percent fatality (there was one fatality recorded).

Table 25. Injury Level for Scooter Crashes, Victoria, 2001-2006

Injury Level	Number of Crashes	Percent
Fatality	1	0.3
Serious injury	131	38.9
Other injury	201	59.6
No injury	4	1.0
Total	337	100

5.6.4 Police Attendance at Scooter Crashes

Police attended 61.4% of scooter crashes. They did not attend 36.2% of scooter involved crashes. In less than three percent of cases police attendance status was not known.

5.6.5 Hit and Run Scooter Crashes

Most scooter crashes (94.7%) did not involve hit and run.

5.6.6 Number of Persons Involved in Scooter Crashes

The majority of scooter crashes involved two persons (48%) with 33.4% involving only one person (ie the scooter rider). Involvement of multiple persons (ie three or more) was less common, accounting for less than 19% of crashes. Information on the number of persons involved was missing for eight scooter crashes.

5.7 Location and Environmental Conditions Variables

5.7.1 Scooter Crashes by LGA

Scooter crashes were distributed across 49 of the 79 Victorian LGAs. However, the majority of these were urban and in the Melbourne metropolitan area. The majority of scooter crashes did not occur in the same LGA as that of the registered owner (64.4%). However, most crash LGAs were in the Melbourne metropolitan area. The Top-10 scooter crash LGAs – mainly inner/middle band metropolitan areas– accounted for 70.3% - see Table 26 – while the Top-five accounted for 50.7%. The highest concentration of scooter crashes (18.1%) was in the City of Melbourne. Crash LGA was recorded for all 337 identified scooter crashes.

Table 26. Top-10 Scooter Crash LGAs, Victoria, 2001-2006

LGA	Number of Crashes	% of All Scooter Crashes
Melbourne	62	18.1
Yarra	31	9.2
Boroondara	28	8.3
Port Phillip	27	8.0
Stonnington	24	7.1
Moreland	20	5.9
Glen Eira	16	4.7
Moonee Valley	12	3.6
Darebin	10	3.0
Whitehorse	8	2.4
Total for Top 10 LGAs	238	70.3

5.7.2 Scooter Crashes by LGA of Owner

The owners of crash involved scooters were spread across 47 of the 79 Victorian LGAs. However, owner LGAs were predominantly urban and in the Melbourne metropolitan area. The Top-10 owner LGAs were inner to middle band Melbourne metropolitan municipalities. The highest concentration (8.6%) was in the City of Port Phillip. The Top-10 LGAs accounted for 53.4% of all owner LGAs and the Top-5 LGAs 32.8% of all owner LGAs – see Table 27. Owner LGA was recorded for all 337 identified scooter crashes.

Table 27. Scooter Crashes by Top-10 Owner LGAs, Victoria, 2001-2006

LGA	Number of Crashes	% of All Scooter Crashes
Port Phillip	29	8.6
Yarra	23	6.8
Boroondara	22	6.5
Stonnington	19	5.6
Darebin	18	5.3
Moonee Valley	17	5.0
Glen Eira	15	4.5
Moreland	15	4.5
Melbourne	11	3.3
Kingston	11	3.3
Total for Top 10 LGAs	180	53.4

5.7.3 Scooter Crashes by VicRoads' Region

About 91% of scooter crashes occurred in VicRoads' two metropolitan regions, with the greater proportion (55.9%) occurring in the Metropolitan NW region and the lesser (35%) in the Metropolitan SE Region – see Table 28. Less than 10% of scooter crashes occurred in regions outside of the Melbourne metropolitan area. VicRoads' region information was missing for eight scooter crashes. It should be noted that the Metropolitan NW region includes many inner metropolitan LGAs.

Table 28. Scooter Crashes by VicRoads' Region, Victoria, 2001-2006

Region	Number of Crashes	Percent
Eastern	7	2.1
Western	3	0.9
Northeastern	6	1.8
Northern	8	2.4
Metro SE	115	34.1
Southwest	6	1.8
Metro NW	184	55.9
Total	329	100

5.7.4 Distance between Postcode of Scooter Owner and Postcode of Scooter Crash Location

Most scooter crashes occurred in postcode areas close to the postcode of the registered owner. The mean distance between the scooter owner postcode and the scooter crash postcode was 11.6 kilometres and the median four kilometres. The maximum distance between the scooter owner postcode and the scooter crash postcode was 216.5 kilometres. Distance between scooter owner postcode and scooter crash location postcode was missing for 48 scooter crashes.

5.7.5 Scooter Crashes by Road Geometry

About 62% of scooter crashes occurred at an intersection of some type, with cross and T-intersections being equally represented. As shown in Table 29, about 37% did not occur at intersections while less than one percent occurred on private property.

Table 29. Scooter Crashes by Road Geometry, Victoria, 2001-2006

Road Geometry	Number of Crashes	Percent
Cross intersection	100	29.7
T-intersection	100	29.7
Multiple intersection	10	3.0
Not at intersection	124	36.8
Private property	2	0.6
Unknown	1	0.3
Total	337	100

5.7.7 Scooter Crashes by Speed Zone

The majority of scooter crashes occurred in 60km/h speed zones (57.6%) - see Table 31. Almost 82% of scooter crashes occurred in speed zones of 60km/h or less. Less than five percent of scooter crashes occurred in 100km/h zones.

Table 31. Scooter Crashes by Speed Zone, Victoria, 2001-2006

Speed Zone (km/h)	Number of Crashes	Percent
40	7	2.1
50	75	22.3
60	194	57.6
70	18	5.3
80	20	5.9
90	2	0.6
100	15	4.5
Unknown	6	1.8
Total	337	100

5.7.8 Scooter Crashes by Light Condition

As shown in Table 32, the majority of scooter crashes occurred in daylight (68.5%), about 21% in darkness (19.9% under street lighting) and 9.5% at dusk /dawn.

Table 32. Scooter Crashes by Light Condition, Victoria, 2001-2006

Light Condition	Number of Crashes	Percent
Day	231	68.5
Dusk/dawn	32	9.5
Dark (lights on)	67	19.9
Dark (lights off)	2	0.6
Dark (lights unknown)	1	0.3
Unknown	4	1.2
Total	337	100

5.7.9 Scooter Crashes by Road Surface Type

Almost all (95.7%) scooter crashes occurred on paved roads. About two percent occurred on unpaved or gravel roads. Road type information was unknown for seven cases and missing for eight scooter crashes.

5.8 Crash Patterns for Mopeds Relative to Scooters

Of the 337 scooter crashes identified between 2001 and 2006 inclusive, only 41 involved mopeds. This prevented valid and reliable statistical comparisons and rendered even the presentation of descriptive statistics potentially unreliable. In view of this, no separate analysis was conducted for moped crashes. However, Figure 5 shows the pattern of moped and scooter crashes by year for the period 2001-2006 whereby both increased in number across these six years. This graph is presented to provide some indication of moped and scooter crash patterns and should not be considered definitive as in only one year (2006) did identified moped crashes exceed 10 in number.

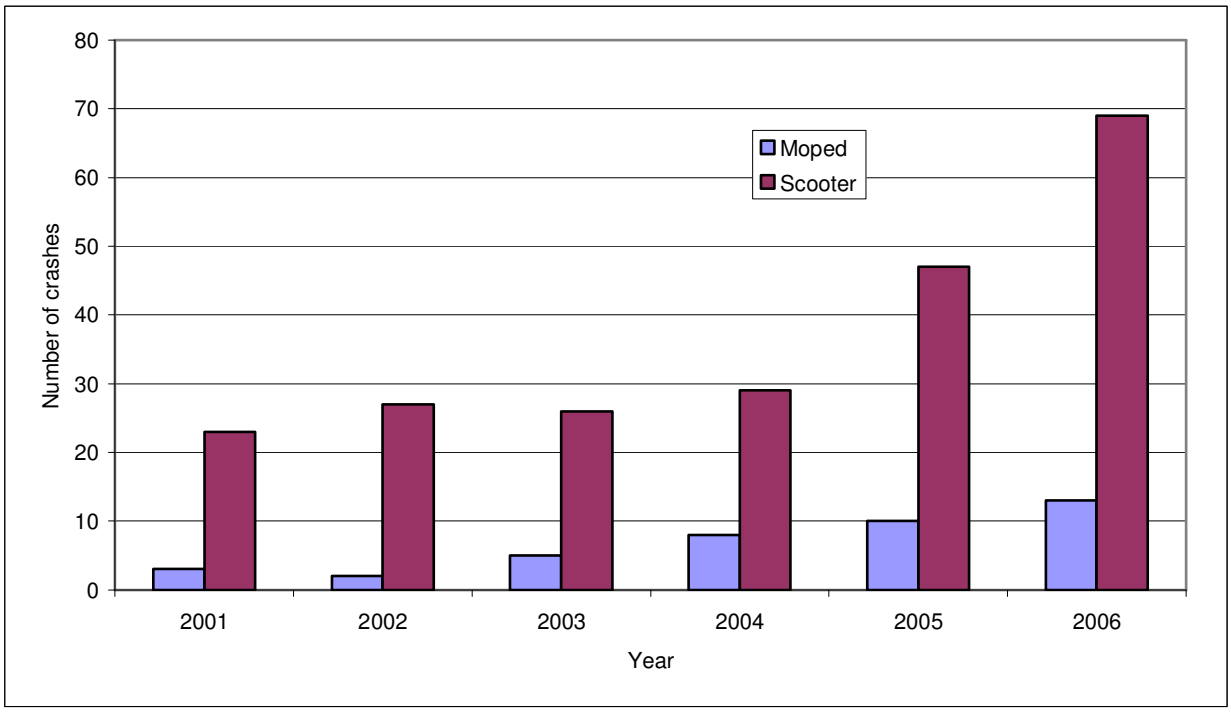

Figure 5. Moped and Scooters Crashes by Year, Victoria, 2001-2006

5.9 Crash Patterns for Scooters: Concluding Comment

The analysis of identified scooter crashes which occurred in Victoria in the period 2001-2006 was based on a relatively small number of cases (n=337). In view of this, the results presented should be viewed as indicative of scooter crash patterns rather than definitive. Notwithstanding this caveat, analysis of scooter crashes showed that:

- The number of scooter crashes increased between 2001 and 2006 with almost half occurring between 2005 and 2006 inclusive.
- Almost 60% of scooter crashes involved a collision with another vehicle while 35% involved the scooter alone – the remainder were listed as unknown.
- In almost all cases (96%) the crash involved scooter rider was riding solo.
- The majority of crash involved scooters, almost 85%, had an engine size greater than 50cc.
- Most crash involved scooters (about 62%) were manufactured after 2000.
- About 38% of crash involved scooters sustained only minor damage (as assessed by police) with only about 22% being towed away.
- While the majority of crash involved scooter riders were male (about 66%), females accounted for almost 34%.

- The mean age of crash involved scooter riders was 38 years (median 35) with most being aged between 21 and 30 years (32%).
- Crash involved female scooter riders tended to be younger than males.
- Almost (93%) of crash involved scooter riders were Victorian licensed.
- About 55% of crash involved scooter riders held full licences, 27% learner permits and about 6% probationary licences while less than one percent were known to be unlicensed – the status of the balance, about 11% was not known.
- Most scooter crashes occurred in autumn (about 28%) and least in summer (21%) – October was the highest month for scooter crashes (about 10% of all crashes) and September the lowest (about 5%)
- Almost 75% of scooter crashes occurred between 6am and 6pm – most (about 21%) between 3pm and 6pm.
- Most scooter crashes (about 77%) occurred on weekdays – highest number of scooter crashes on Thursdays (19%) and lowest number on Sundays (about 10%).
- Almost 60% of scooter crashes involved collision with another vehicle.
- The largest single scooter crash DCA grouping was *Off path on straight* (34%)- a single vehicle crash type.
- While almost all crash involved scooter riders were injured, 60% resulted in other injury levels, 39% in serious injury and less than 1% in fatality.
- The vast majority of scooter crashes occurred in the MSD (about 91%).
- Most scooter crashes occurred in inner/middle band municipalities of the MSD – five LGAs (Melbourne, Yarra, Boroondara, Port Phillip & Stonnington) accounted for 50% of scooter crashes.
- Most scooter crashes occurred in postcode areas close to the postcode of the scooter owner – mean distance about 12 kilometres, median about four kilometres.
- The majority of scooter crashes occurred at an intersection of some type (about 62%).
- About 82% of scooter crashes occurred in speed zones not exceeding 60km/h – about 58% occurred in 60km/h zones.
- Most scooter crashes (about 68%) occurred in daylight – 20% in darkness and about 9% dawn/dusk.
- Almost all scooter crashes (96%) occurred on paved roads.

6. COMPARISON OF SCOOTER CRASH PATTERNS WITH THOSE FOR MOTORCYCLES AND CARS IN VICTORIA 2001 TO 2006

6.1 General

To provide some perspective, identified scooter crashes for the period 2001-2006 inclusive (n=337) were compared with those for motorcycles and cars for the same period using crash data supplied by VicRoads – ie derived from same VicRoads crash database. Comparison was based on the same variables presented for scooter crashes alone in Chapter 5.

To enable this comparison to be undertaken, two additional datasets for the period 2001-2006 inclusive were extracted and provided to the author, one containing only motorcycle crashes (n=11,219) and the other containing only car crashes (n=134,747, including cars, station wagons and derivatives). Only Victorian registered vehicles were retained to correspond with the scooter crash dataset. In addition, unregistered and unknown vehicles were removed to provide datasets known to contain only motorcycle and car crashes respectively. While there was considerable missing data in both of these datasets, which sometimes reduced the number of cases in respect of some crash variables by up to 10%, they were still large enough to provide valid and reliable comparison with scooter crashes. The aim of the comparison was to identify differences and similarities in patterns and proportions, not to compare numbers.

Comparison with motorcycle crash patterns was considered the most relevant as both scooters and motorcycles are powered two wheel vehicles (PTWs in European Union parlance) that require vehicle registration and a drivers licence to operate them legally on-road. The comparison with cars was included to compare and contrast patterns between powered two wheelers and powered passenger carrying vehicles with four wheels and due to cars representing both the largest vehicle category and largest crash group in Victorian data.

It should be noted that proportions were used to make these comparisons as the small frequencies for scooter categories would have been swamped by the much larger crash numbers relating to motorcycles and cars. This approach preserved the relativities between scooter, motorcycle and car crashes allowing data for all three to be presented in common tables and graphs.

Comparison with other road users groups such as pedestrians and pedal cyclists was considered inappropriate as these groups differ considerably from motorised road users. For example, pedal cyclists are not required to be licensed, their bicycles are not required to be registered and many cyclists (including those involved in crashes) are children.

6.2 Scooter, Motorcycle and Car Crashes in Victoria, 2001-2006

As shown in Figure 6, the pattern of crashes in Victoria for the period 2001-2006 differed for scooters, motorcycles and cars. While scooter crashes showed a marked upward trend, particularly after 2004, the overall pattern for motorcycles was fairly flat with a more moderate increase after 2004. The pattern for car crashes differed from both scooters and motorcycles showing a downward trend, particularly after 2003. In short, the majority of scooter crashes occurred in 2005 and 2006 while crashes were more evenly spread for cars and motorcycles across the 2001-2006 period.

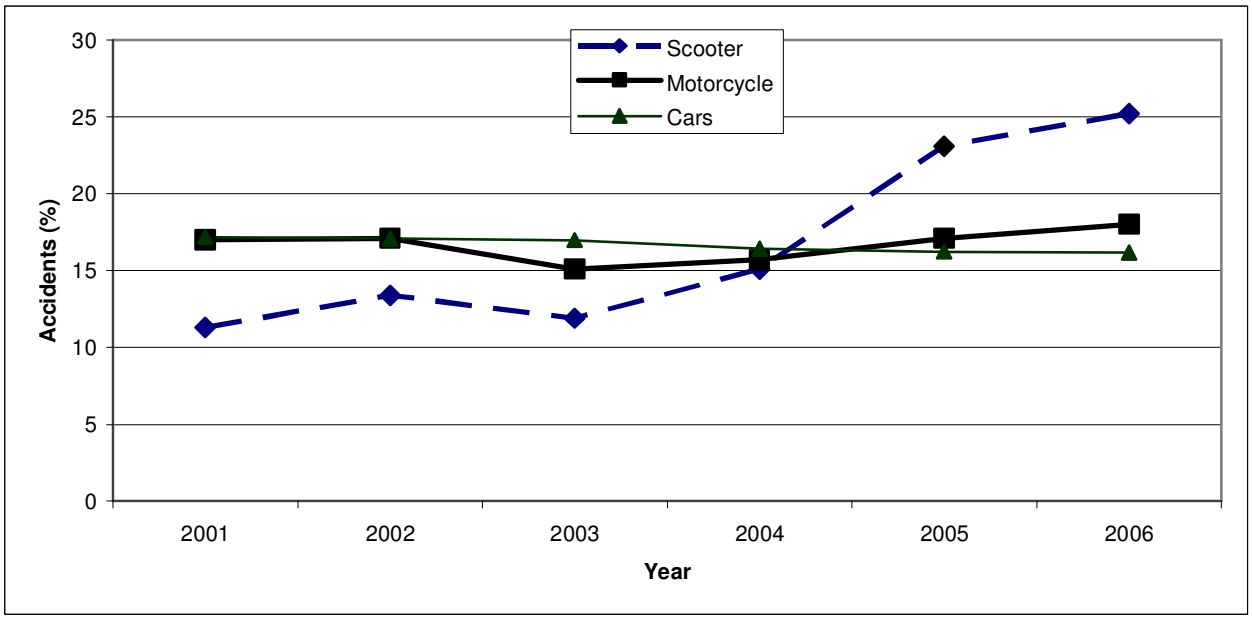

Figure 6. Scooter, Motorcycle & Car Crashes, Victoria 2001-2006 (Proportions of total crashes for the 2001-2006 period by year)

6.3 Vehicle Related Variables for Scooter, Motorcycle and Car Involved Crashes

6.3.1 Number of Vehicles Involved in Scooter, Motorcycle and Car Crashes

Inspection of Figure 7 shows that, for all three vehicle crash groups, the involvement of two vehicles in the crash was the most common – highest for cars and lowest for motorcycles. Single vehicle crashes were most common for motorcycles and least common for cars.

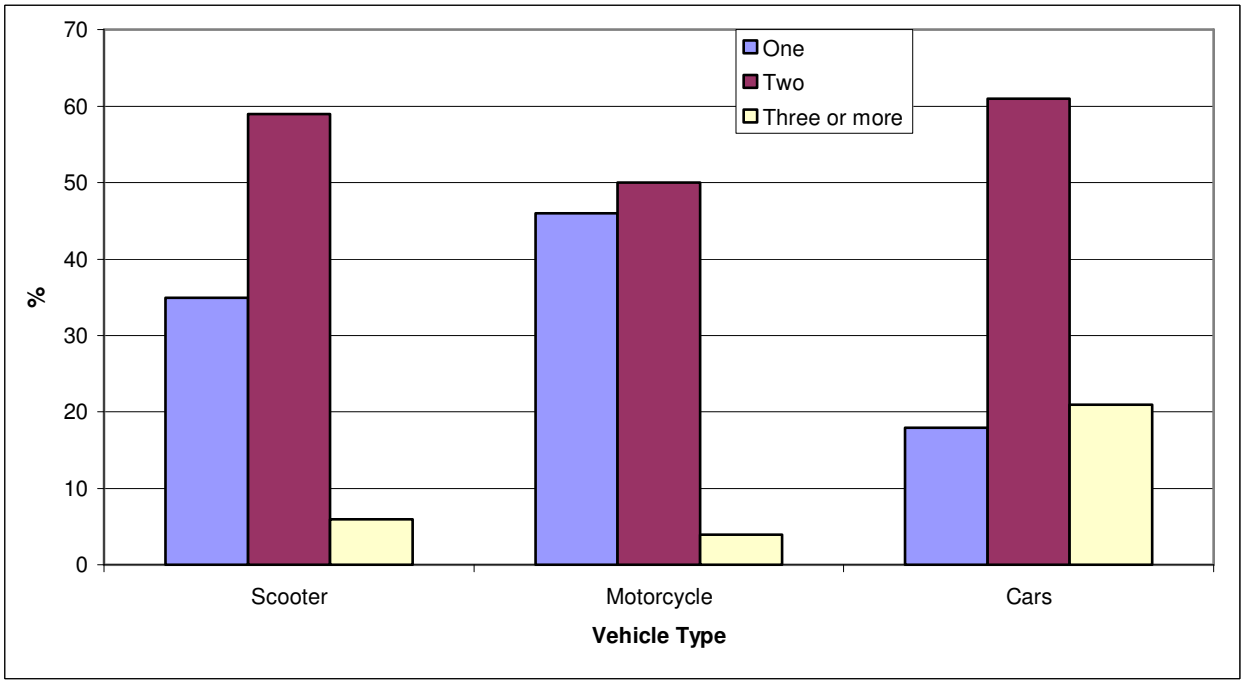

Figure 7. Proportion of Crashes involving One, Two or Three (or more) Vehicles: Scooters, Motorcycles & Cars, Victoria 2001-2006

6.3.2 Year of Manufacture of Scooters, Motorcycles and Cars Involved in Crash

Figure 8 shows that crash involved scooters were proportionally newer than their motorcycle and car counterparts in the period 2001-2006. Crash involved cars were older than scooters or motorcycles.

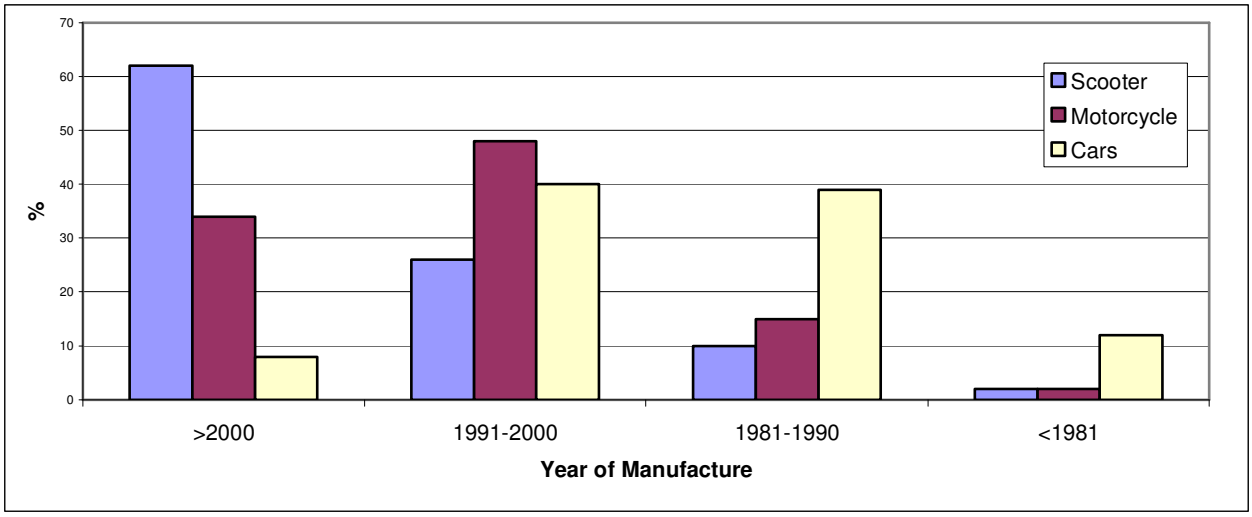

Figure 8. Year of Manufacture by Crash Involved Scooters, Motorcycles & Cars Victoria 2001-2006 (Proportions)

6.3.3 Level of Damage to Scooters, Motorcycles and Crash Involved in Crash

Relative to cars, scooters and motorcycles sustained lower levels of damage and were less likely to have been towed away – see Figure 9. Relative to motorcycles, scooters sustained lower levels of damage in crashes.

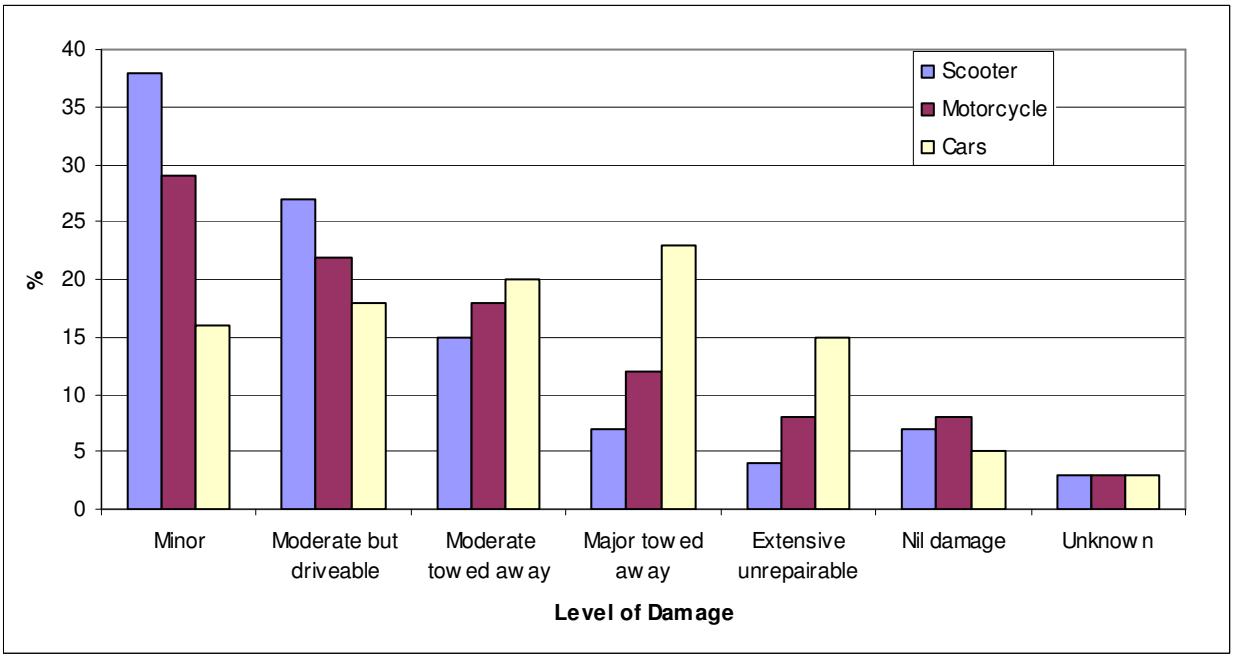

Figure 9. Level of Vehicle Damage by Crash Involved Scooters, Motorcycles and Cars, Victoria 2001-2006 (Proportions)

6.4 Person Related Crash Variables

6.4.1 Sex of Rider/Driver Involved in Crash

Figure 10 shows that car crashes had the highest proportion of female drivers relative to motorcycle and scooter crashes. Relative to motorcycles, scooter crashes involved a much greater proportion of female riders. Motorcycle crashes had the lowest proportion of females.

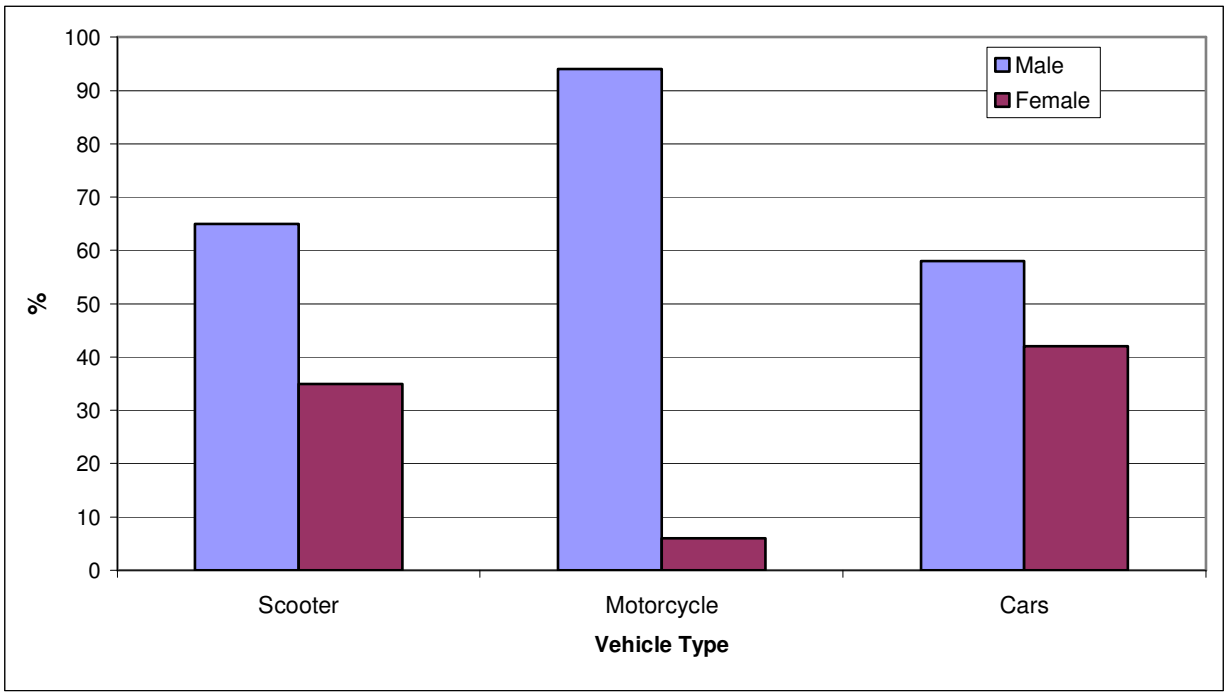

Figure 10. Sex of Rider/Driver by Crash Involved Scooters, Motorcycles and Cars, Victoria 2001-2006 (Proportions)

6.4.2 Age of Crash Involved Rider/Driver

Relative to scooter riders and car drivers, crash involved motorcycle riders were younger in respect of mean and median age – see Figure 11. While crash involved scooter riders had a

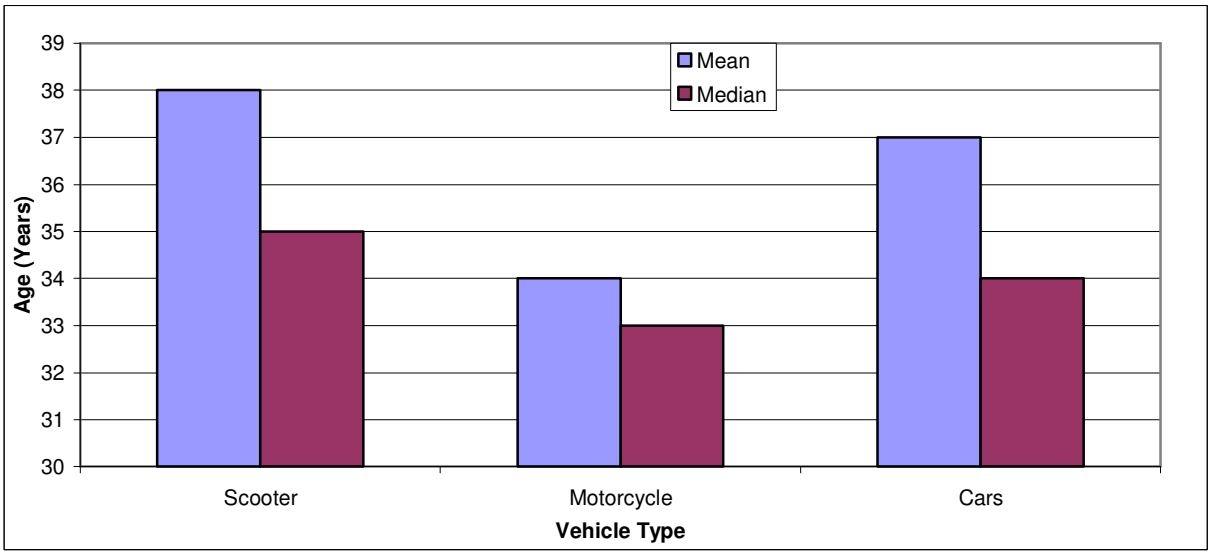

Figure 11. Age of Rider/Driver by Crash Involved Scooters, Motorcycles and Cars, Victoria 2001-2006 (Proportions)

higher mean/median age than either motorcycle riders or car drivers, only the mean age difference between scooter and motorcycle riders was statistically significant (t=4.64, *df*=10,793 $p < .01$).

6.4.3 Licence Type/Status of Crash Involved Scooter, Motorcycle and Car Operators

Figure 12 shows that both crash involved motorcycle and scooter riders had lower levels of full licence holders relative to car drivers. Crash involved scooter riders had the lowest level of full licence tenure, but also the highest level of learner permit holders. While small in size, crash involved motorcycle riders had higher levels of illegal operators (eg unlicensed, inappropriately licensed, cancelled or disqualified) relative to scooter riders and car drivers.

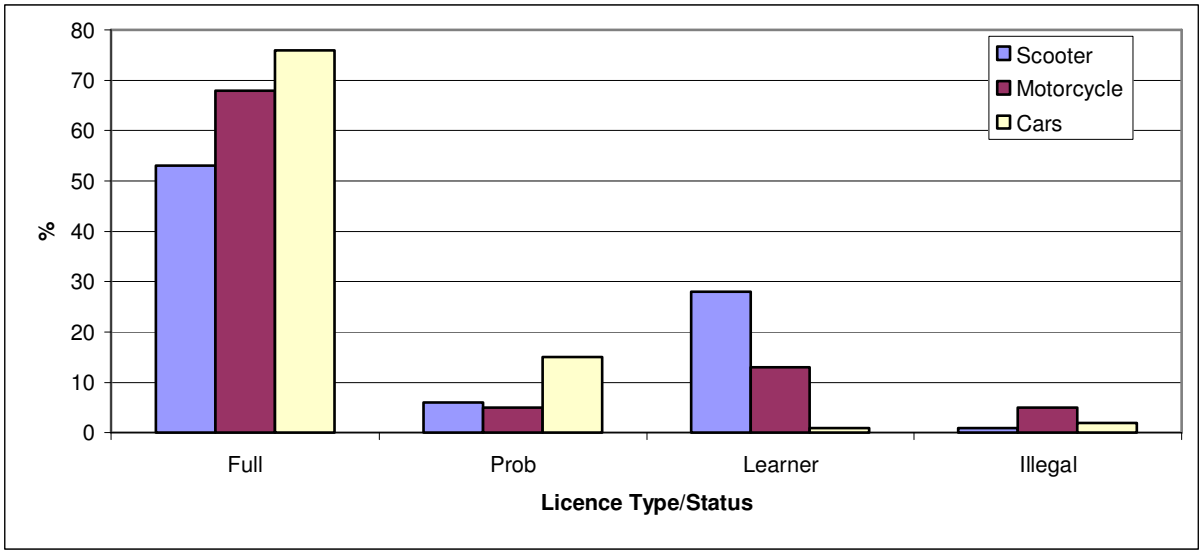

Figure 12. Licence Type/Status of Operator by Crash Involved Scooters, Motorcycles and Cars, Victoria 2001-2006 (Proportions)

6.4.4 Crash Involved Scooter, Motorcycle and Car Operators by Seat Belt/Helmet Wearing

In most car crashes (87%) the driver was known to have been wearing a seatbelt while this was unknown for 11% and about one percent were known not to have been wearing a seatbelt. About 64% of crash involved scooter and motorcycle riders were known to have been wearing a helmet. Less than one percent of scooter riders and about two percent of motorcycle riders were known not to have been wearing a helmet. The helmet wearing status of the balance for both scooter and motorcycle crashes (about one third) was recorded as *Unknown*.

6.4.5 Scooter, Motorcycle and Car Crashes by Number of Occupants

In most car crashes (67.7%) only the driver was in the vehicle. This was considerably lower than that for both scooter and motorcycle crashes where in almost all the riders were operating solo (96% and 94% respectively).

6.4.6 Scooter, Motorcycle and Car Crashes by PBT Taken

Preliminary breath tests were taken in a higher proportion of car crashes (56%) relative to scooter and motorcycle crashes (28% and 35% respectively). Relative to car and motorcycle crashes, scooter crashes had the lowest level of preliminary breath testing. It should be noted, however, that these proportion are based on small numbers of cases and may be unreliable.

6.4.7 Scooter, Motorcycle and Car Crashes by Hit/Run

The proportion of hit/run crashes car, scooter and motorcycle crashes was similar with all recording less than five percent.

6.5 Temporal Related Crash Variables for Scooter, Motorcycle and Car Crashes

6.5.1 Scooter, Motorcycle and Scooter Crashes by Season/Month of Year

As shown in Figure 13, the pattern of crashes by season differed somewhat for scooters, motorcycles and cars. While scooter and car crashes peaked in autumn and were lowest in

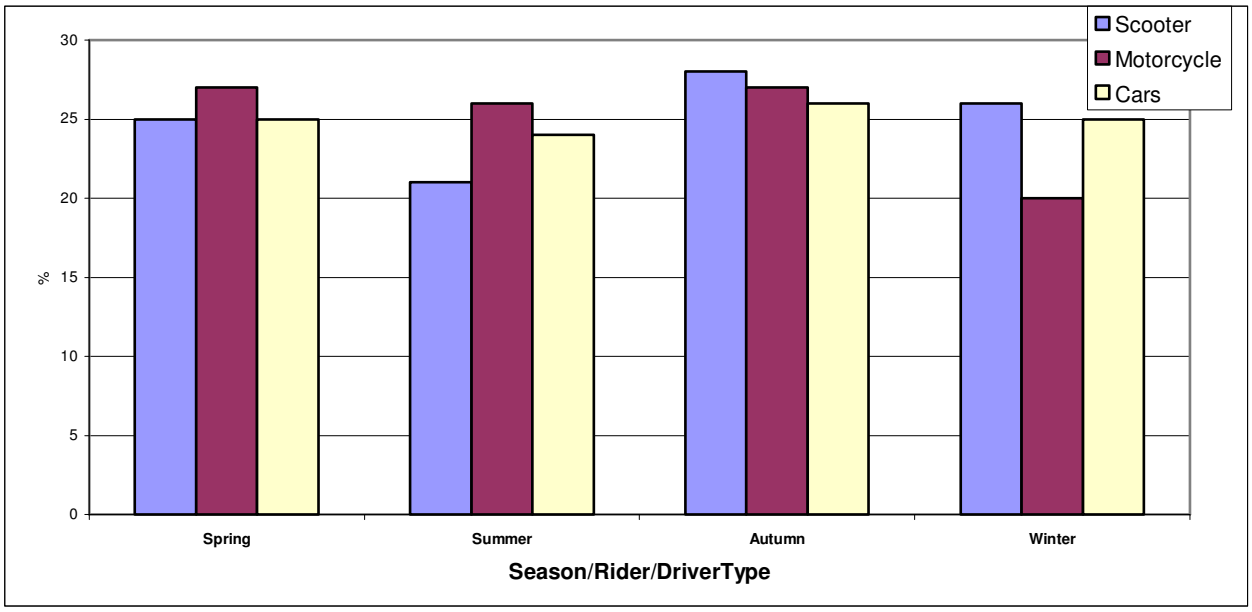

Figure 13. Crash Involved Scooters, Motorcycles and Cars by Season , Victoria 2001-2006 (Proportions)

summer, the difference was more marked for scooters. Motorcycle crashes were equally high in spring and autumn and lowest in winter.

6.5.2 Scooter, Motorcycle and Scooter Crashes by Day of Week

Figure 14 shows that the pattern of crashes by day of week differed for scooters, motorcycles and cars. The proportion of scooter crashes was highest on Thursdays, highest for motorcycles on Sundays and highest for cars on Fridays. The lowest proportion of scooter and car crashes occurred on Sundays which contrasted with Mondays for motorcycles (only marginally lower on Mondays than Tuesdays). Figure 15 shows that the while the ratio of weekday crashes to weekend crashes for scooters and cars was similar (ie about 3:1), the ratio for motorcycles was about half that (ie about 1.5:1).

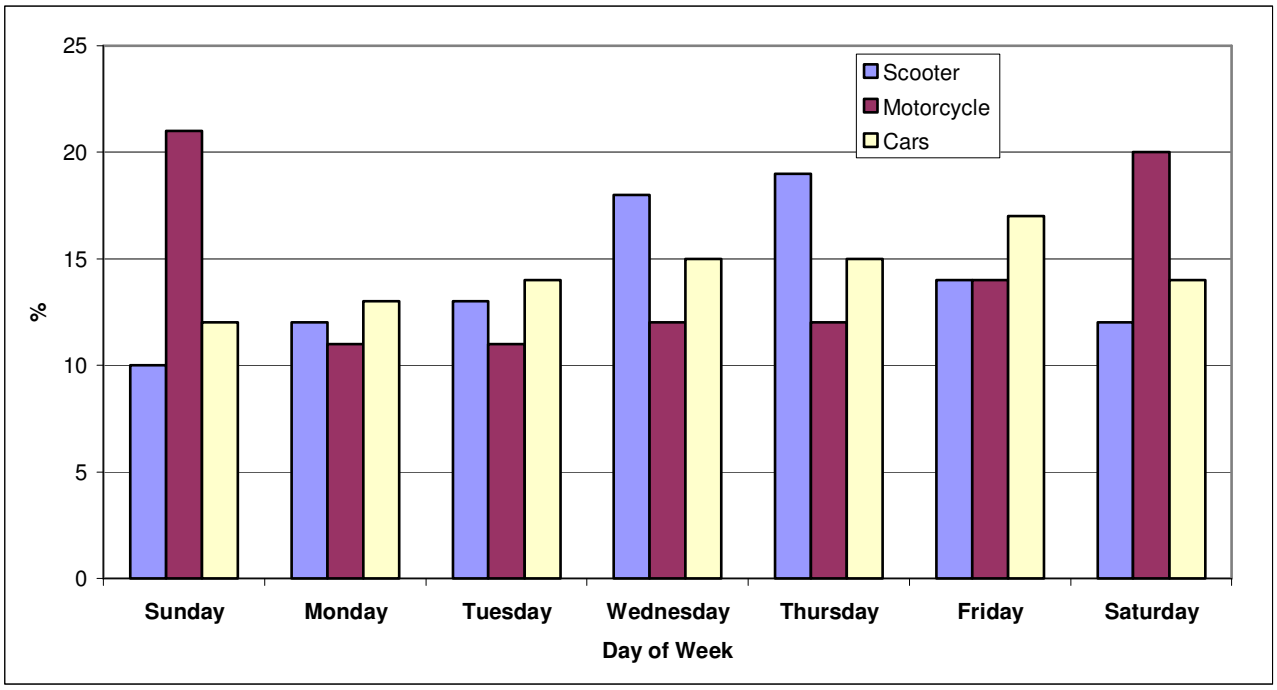

Figure 14. Crash Involved Scooters, Motorcycles and Cars by Day of Week, Victoria 2001-2006 (Proportions)

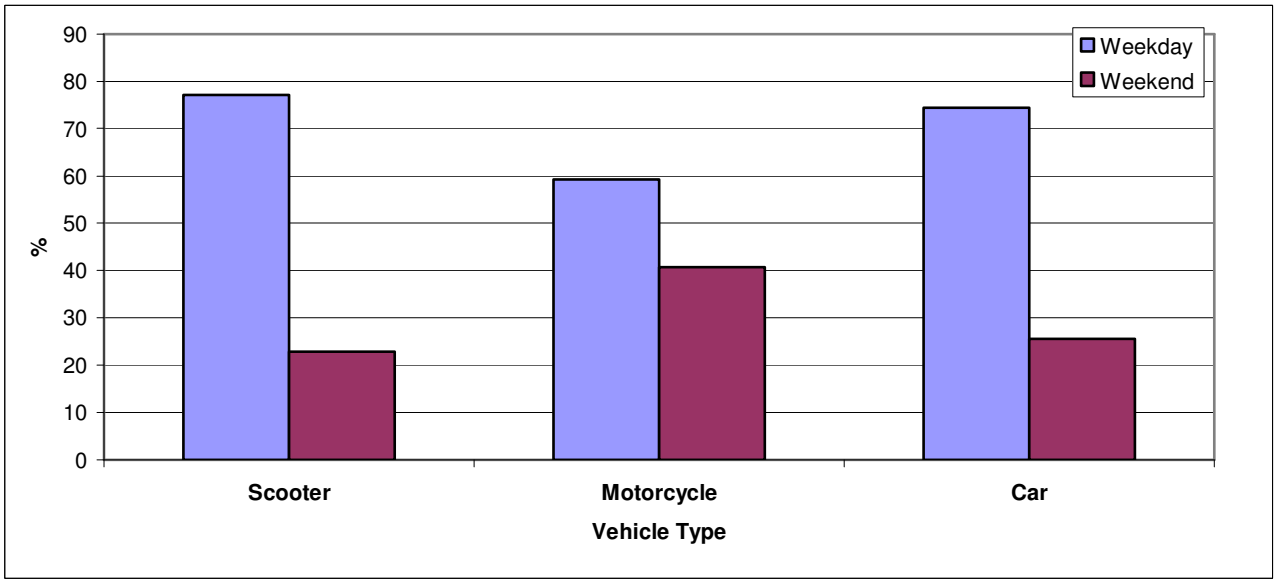

Figure 15. Crash Involved Scooters, Motorcycles and Cars by Weekday/Weekend, Victoria 2001-2006 (Proportions)

6.5.3 Scooter, Motorcycle and Scooter Crashes by Time of Day

Inspection of Figure 16 shows that scooter, motorcycle and car crashes all peaked between 3pm and 6pm. However, scooter crashes were proportionally higher than those for motorcycles and cars between 6am and noon and between 6pm and 9pm.

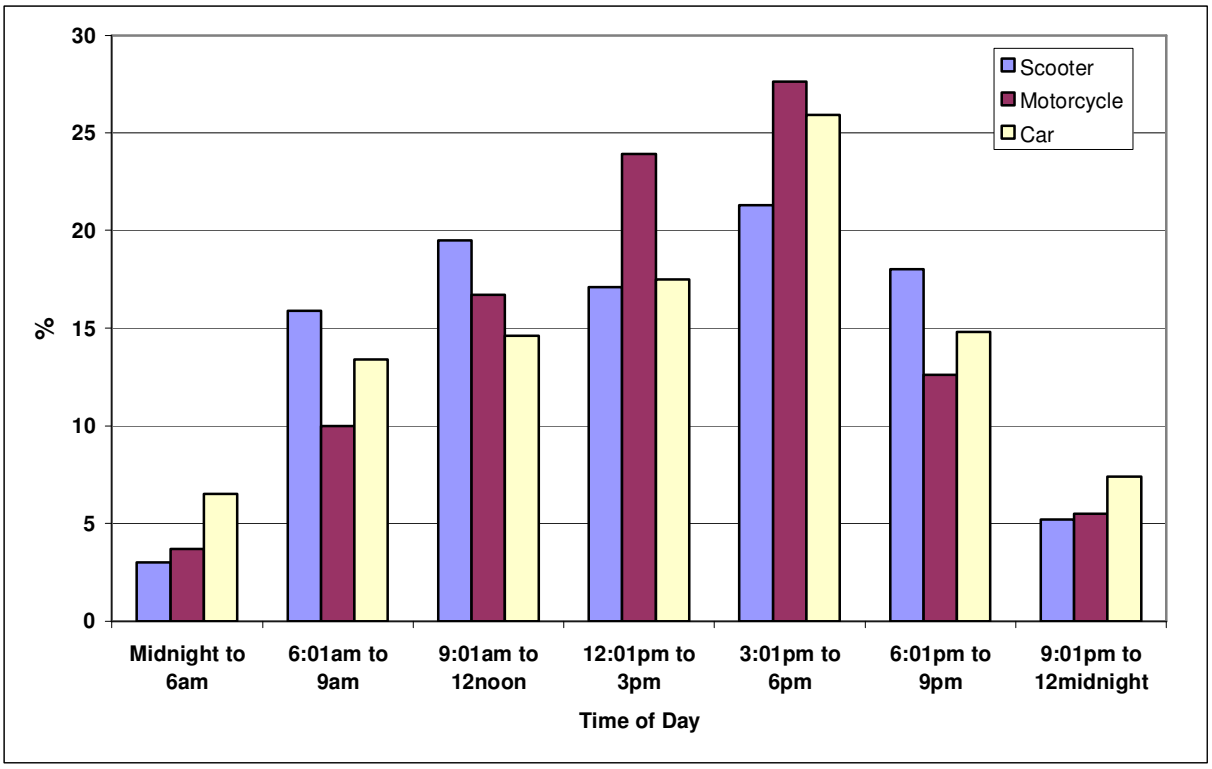

Figure 16. Crash Involved Scooters, Motorcycles and Cars by Time of Day, Victoria 2001-2006 (Proportions)

6.6 Crash Type and Classification Variables for Scooter, Motorcycle and Car Involved Crashes

6.6.1 Scooter, Motorcycle and Car Crashes by Crash LGA

Relative to motorcycles and cars, scooter crashes were concentrated in a smaller number of LGAs. Figure 17 shows that the Top-10 LGAs accounted for about 70% of scooter crashes. By comparison, the Top 10 LGAs for cars accounted for about 35% of car crashes and about 30% of motorcycle crashes.

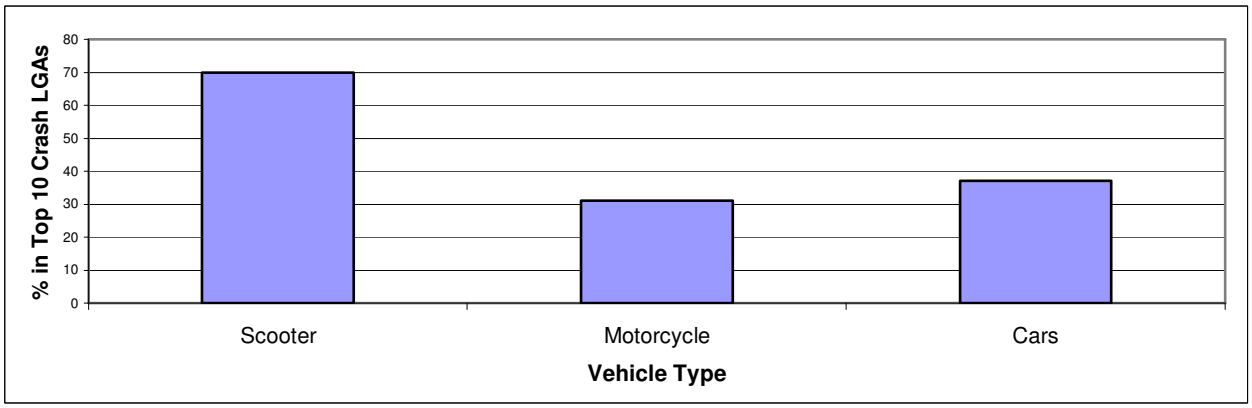

Figure 17. Proportion of Crash Involved Scooters, Motorcycles & Cars Accounted for by Top 10 LGAs of Occurrence, Victoria 2001-2006

6.6.2 Scooter, Motorcycle and Car Crashes by Owner LGA

Compared to motorcycles and cars, the owners of crash involved scooters were concentrated in a smaller number of LGAs. Figure 18 shows that the Top-10 LGAs accounted for over 50% of scooter crashes. By comparison, the Top-10 LGAs for cars accounted for about 35% of crash involved car owners and about 30% of crash involved motorcycle owners.

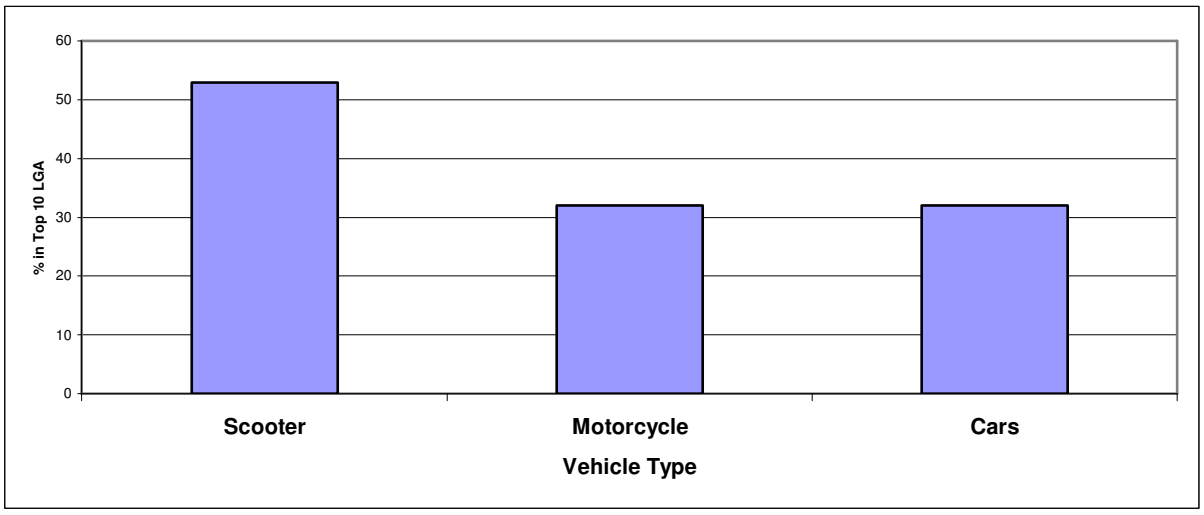

Figure 18. Proportion of Crash Involved Scooters, Motorcycles and Cars Accounted for by Top-10 LGAs of Owner, Victoria 2001-2006

6.6.3 Distance between Postcode of Owner and Postcode of Crash Location for Scooter, Motorcycle and Car Crashes

Most scooter crashes occurred in postcode areas relatively close to the postcode of the registered owner. The mean distance between the scooter owner postcode and the scooter

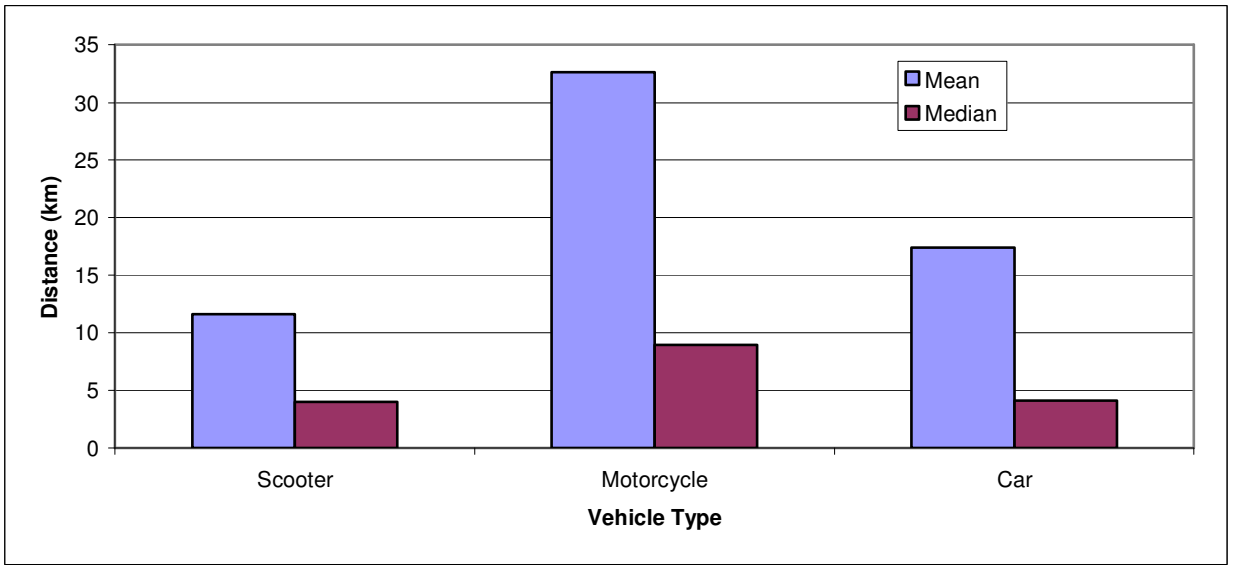

Figure 19. Mean and Median Distance Between Postcode of Owner and Postcode of Crash Location for Scooters, Motorcycles and Cars, Victoria, 2001-2006

crash postcode was 11.6 kilometres and the median 4.0 kilometres. The maximum distance between the scooter owner postcode and the scooter crash postcode was about 216 kilometres. Motorcycle crashes occurred further away from the postcode of the owner – mean

32.6 kilometres and median 8.9 kilometres with a maximum distance of about 585 kilometres. Relative to scooter crashes, car crashes also occurred further away from the owners' postcode (ie mean 17.4 kilometres, median 4.1 kilometres). The maximum distance between owner and crash postcodes for car crashes was higher than for motorcycle crashes (ie 628 kilometres compared to 585 respectively). The respective means/medians for scooter, motorcycle and crashes are shown in Figure 19.

6.6.4 Scooter, Motorcycle and Car Crashes by VicRoads Region

Figure 20 shows that most scooter crashes occurred in VicRoads Metropolitan NW Region while most motorcycle crashes occurred in VicRoads non-MSD regions. Most car crashes occurred in VicRoads Metropolitan SE Region. Over 90% of scooter crashes occurred in the MSD compared to 78% for cars and 60% for motorcycles.

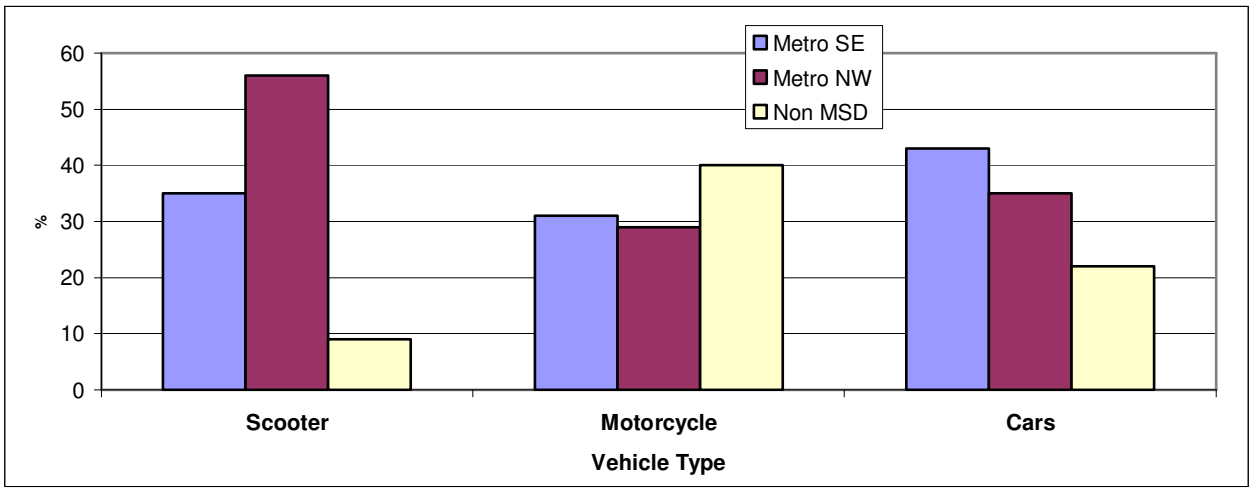

Figure 20 Crash Involved Scooters, Motorcycles and Cars by VicRoads Region, Victoria 2001-2006 (Proportions)

6.6.5 Scooter, Motorcycle and Car Crashes by Road Geometry

While the largest single road geometry category for scooter, motorcycle and car crashes was non-intersection crashes, motorcycles had the highest proportion and scooters the lowest – see

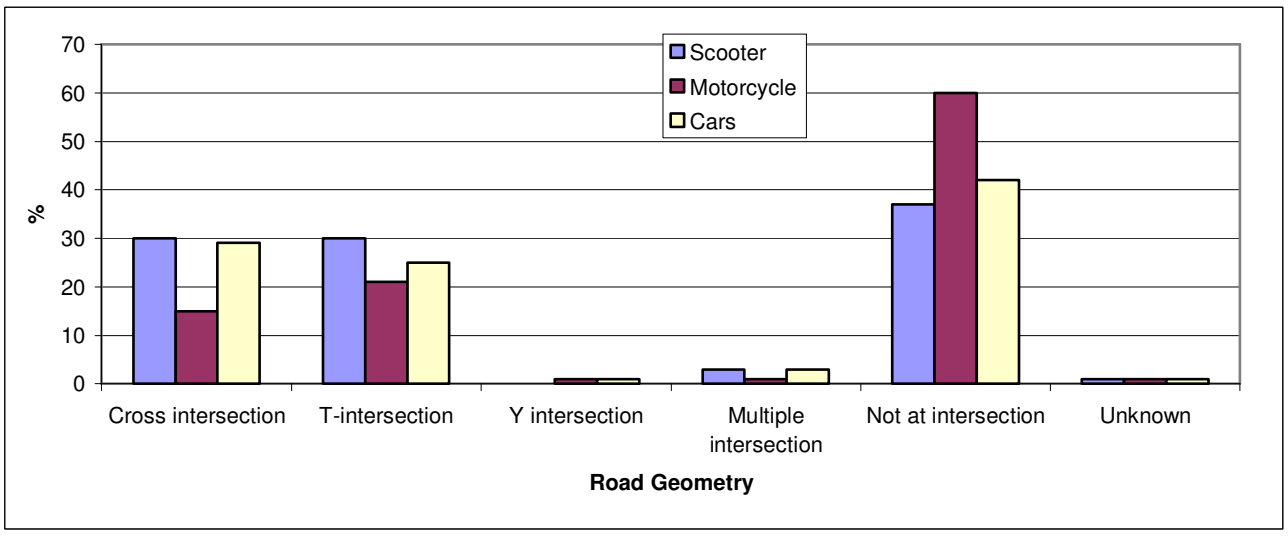

Figure 21 Crash Involved Scooters, Motorcycles and Cars by Road Geometry, Victoria 2001-2006 (Proportions)

Figure 21. Scooters experienced proportionally more crashes at cross and T-intersections than motorcycles or cars.

6.6.6 Scooter, Motorcycle and Car Crashes by Speed Zone

Figure 22 shows that most scooter, motorcycle and car crashes occurred in 60 km/h speed zones. However, relative to motorcycles and cars, more scooter crashes occurred in speed zones not exceeding 60 km/h.

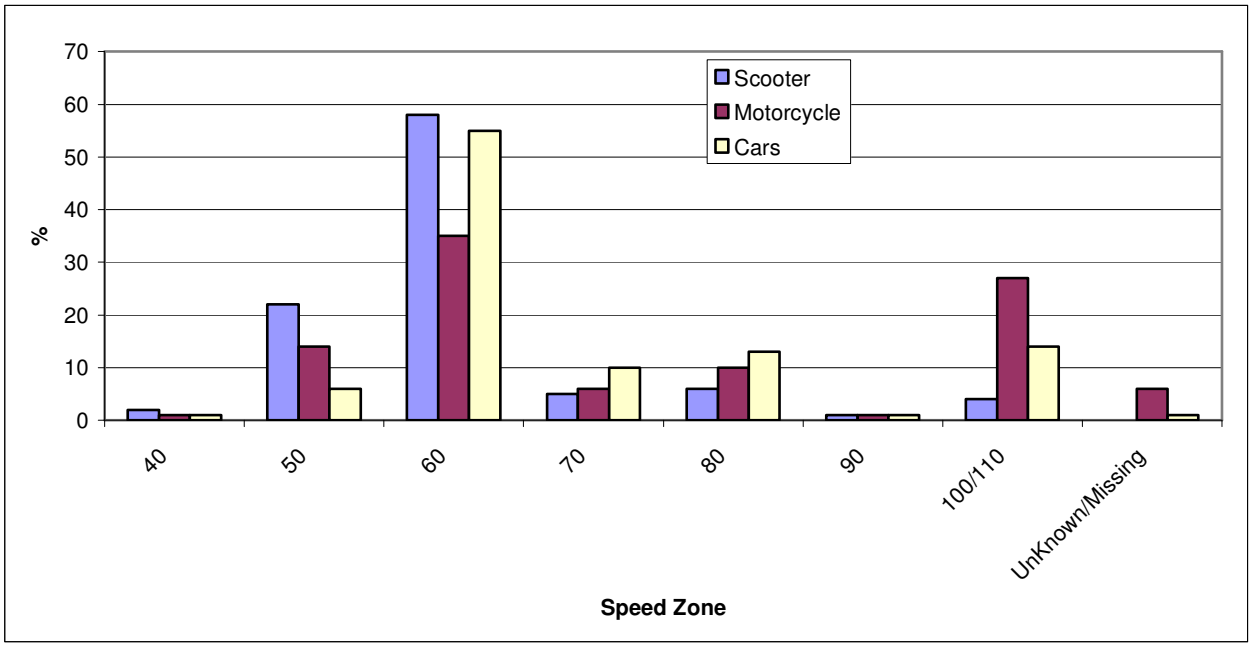

Figure 22. Crash Involved Scooters, Motorcycles and Cars by Speed Zone, Victoria 2001-2006 (Proportions)

6.6.7 Scooter, Motorcycle and Car Crashes by Light Condition

Most scooter, motorcycle and car crashes occurred in daylight, with the highest proportion being for motorcycles and least for cars – see Figure 23. Dawn/dusk crashes were lowest for cars.

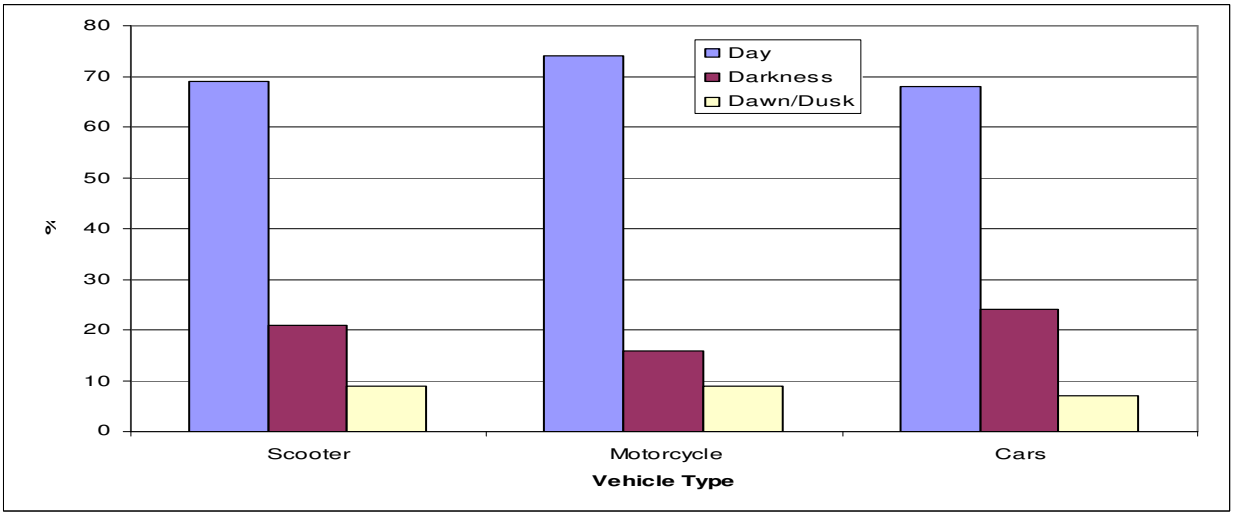

Figure 23. Crash Involved Scooters, Motorcycles and Cars by Light Condition, Victoria 2001-2006 (Proportions)

6.6.8 Scooter, Motorcycle and Car Crashes by Crash Type

Figure 24 shows that most scooter, motorcycle and car crashes involved collision with another vehicle. The lowest proportion was for motorcycles and the highest for cars. Motorcycles and scooters experienced higher levels of crashes involving no collisions (ie where the rider lost control of the motorcycle/scooter without striking another vehicle or object).

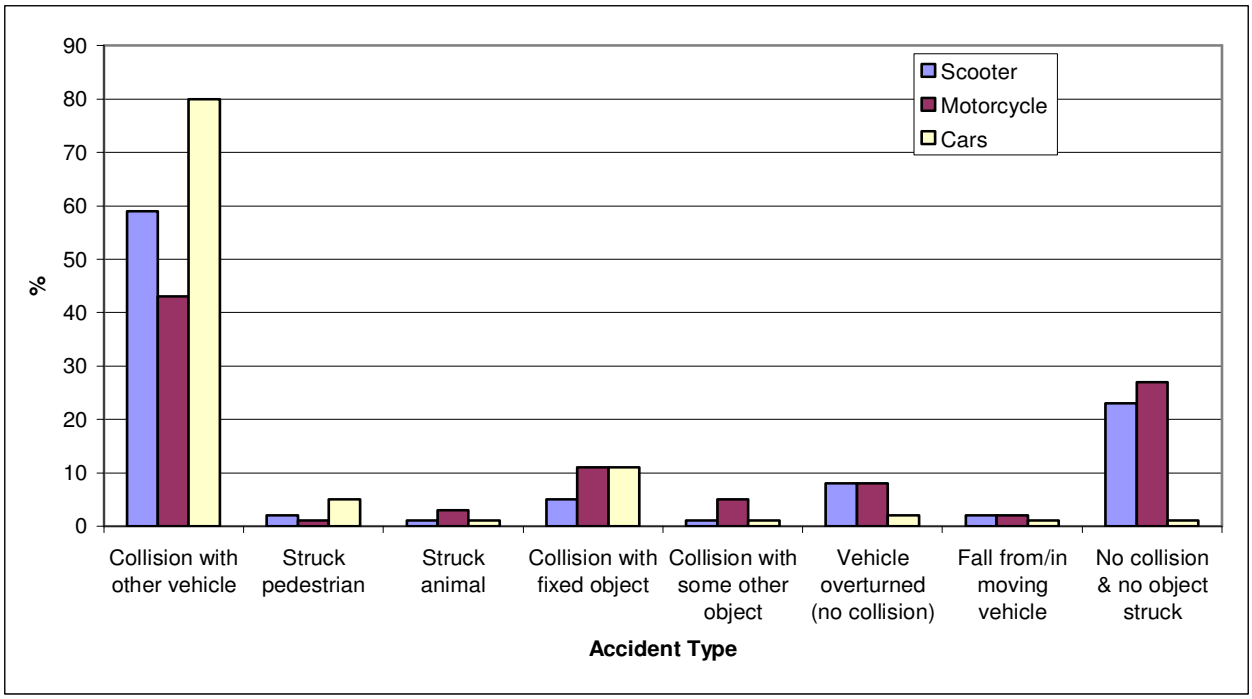

Figure 24 Crash Involved Scooters, Motorcycles and Cars by Crash Type, Victoria 2001-2006 (Proportions)

6.6.9 Scooter, Motorcycle and Car Crashes by Injury Level

As shown in Figure 25, while most car crashes did not result in injury most scooter and motorcycle crashes did. Relative to scooters and cars, motorcycle crashes resulted in higher

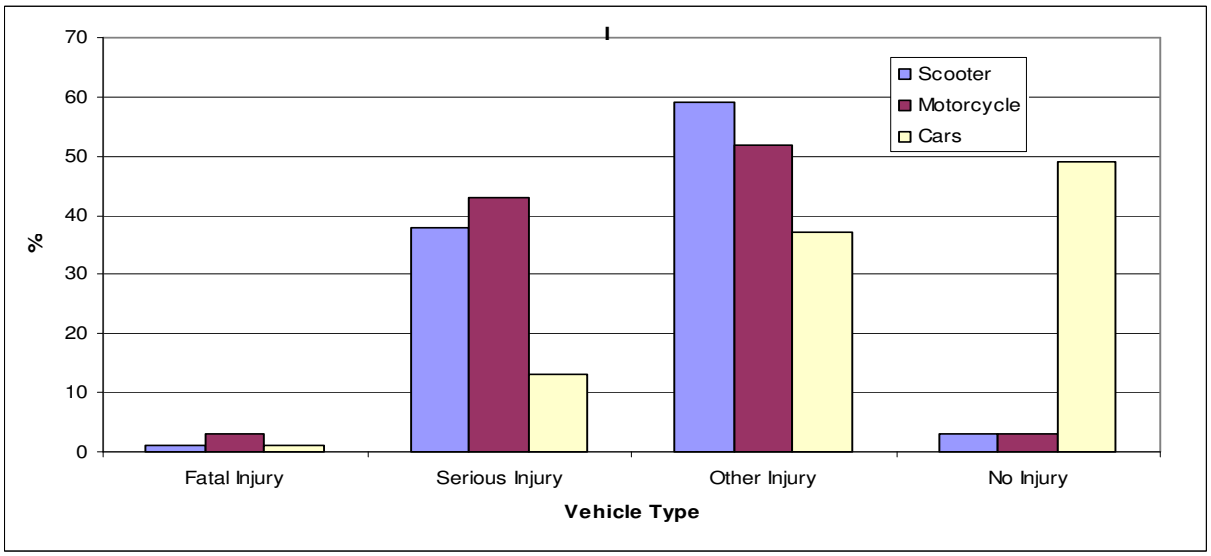

Figure 25. Crash Involved Scooters, Motorcycles and Cars by Injury Level, Victoria 2001-2006 (Proportions)

levels of serious injury and fatality. However, the proportion of scooter crashes resulting in serious injury was very similar to the proportion for motorcycle crashes and was much higher than the proportion of serious injuries resulting from car crashes.

6.6.10 Scooter, Motorcycle and Car Crashes by Road Surface

The majority of scooter, motorcycle and car crashes occurred on paved roads. However, motorcycles had the lowest proportion of paved-road crashes (80%) and scooters the highest (98%) – about 96% of car crashes occurred on paved roads.

6.6.11 Scooter, Motorcycle and Car Crashes by Police Attendance

Police attendance at car crashes (75%) was higher than for attendance at scooter crashes (61%) or motorcycle crashes (60%).

6.7 Crash Patterns for Scooters, Motorcycles and Cars: Concluding Comment

The comparison of identified scooter crashes which occurred in Victoria in the period 2001-2006 with those involving motorcycles and cars for the same period was based on a relatively small number of scooter crashes (n=337), compared with much larger datasets for motorcycle and crash datasets (ie n=11,219 and n=134,747 respectively). In view of this, the results presented should be viewed as indicative of scooter crash patterns relative to motorcycle and car crash patterns rather than definitive. Notwithstanding this caveat, comparison of scooter crash patterns with those for motorcycles and cars suggests that:

- Relative to motorcycle and car crashes, those involving scooters rose in Victoria at a faster rate between 2001 and 2006.
- Most scooter, motorcycle and car crashes involved two vehicles.
- Scooters and motorcycles sustained lower levels of vehicle damage (as assessed by attending police) relative to cars.
- The proportion of female riders was higher among crash involved scooters than for motorcycles (about seven times higher).
- The mean and median age of crash involved scooter riders were both higher (38 and 35 years respectively) than for motorcycles riders (34 and 34 years respectively) and car drivers (37 and 34 years respectively).
- Relative to car and motorcycle crashes, a lesser proportion of scooter riders held full motorcycle licences and a greater proportion learner permits.
- Known helmet wearing for crash involved riders was about the same (about 68%) for both scooters and motorcycles.
- Preliminary breath test rates were lower for crash involved scooter riders relative to motorcycle riders and car drivers.
- The majority of crash involved scooter and motorcycle riders were riding solo (no more than six percent carried a pillion).
- The hit/run rate was about the same for scooter, motorcycle and car crashes (less than five percent).
- The seasonal pattern for scooter and car crashes was similar with both differing from that for motorcycles – scooter and car crashes peaked in autumn and were lowest in summer, the difference was more marked for scooters. Motorcycle crashes were equally high in spring and autumn and lowest in winter.
- The scooter crash pattern by day of week was different to that for both motorcycles and cars – scooter crashes rose to a mid-week peak while motorcycles peaked on weekends and cars rose to a peak on Fridays.
- While most scooter, motorcycle and car crashes occurred on weekdays, the ratio of weekday/weekend crashes was similar for scooters and cars (ie 3:1), which was twice that for motorcycles (1.5:1).

- Crashes involving scooters, motorcycles and cars peaked between 3pm and 6pm, however, scooter crashes were relatively higher than motorcycles and cars in the periods 6am-noon and 6pm-9pm.
- About 70% of scooter crashes occurred in just 10 LGAs – this was more than twice the proportion for motorcycle or car crashes.
- Scooter crashes occurred closer to the registered owner's postcode than did motorcycle or car crashes – mean distance between owner and crash postcode was lowest for scooters (12 kilometres), intermediate for cars (about 17 kilometres) and greatest for motorcycles (about 33 kilometres).
- Most scooter crashes (about 90%) occurred in the MSD compared to 78% for cars and 60% for motorcycles.
- Relative to motorcycles and cars, scooters experienced a greater proportion of crashes at intersections.
- Most scooter, motorcycles and car crashes occurred in daylight (69%, 74% and 68% respectively).
- For scooters, motorcycles and cars, most collisions were with another vehicle (59%, 43% and 80% respectively), however, the highest proportion was for cars and the lowest for motorcycles.
- The level of injury in motorcycle crashes was higher relative to scooters with the lowest proportion being for car crashes - serious injury was much more common for motorcycle and scooter crashes relative to cars, while other injuries were more common for scooter crashes than for motorcycle and car crashes.
- While most scooter, motorcycles and car crashes occurred on paved roads (98%, 96% and 80% respectively), the lowest proportion was for motorcycles.
- While police attended about 75% of reported car crashes, the proportion was lower for scooter and motorcycle crashes (about 60% for each).

7. DISCUSSION OF RESULTS AND THEIR IMPLICATIONS

7.1 Introduction

As at August 2007, it was estimated that were about 8,600 registered scooters (including mopeds) in Victoria which accounted for less than 7% of all registered motorcycles in the state. In the period 2001-2006 less than 340 scooter crashes were identified using VicRoads crash records. The number of scooter crashes increased between 2001 and 2006 with almost half occurring between 2005 and 2006 inclusive.

The results outlined in this report suggest that the crash involvement of registered scooters in Victoria in the period 2001-2006 was different to that for motorcycles and cars. However, as noted above, given the small number of identified scooter crashes for the period in question, some caution needs to be applied to the interpretation of these results. It would be prudent to view the findings as indicative of scooter crash patterns relative to motorcycle and car crash patterns rather than definitive. It should be recalled that most of the information presented was descriptive in nature with little inference being drawn about the significance of any differences reported.

As noted above, the small number of moped crashes and even smaller number of maxi-scooter crashes prevented separate analysis for these scooter types. This restricted analysis to consideration of scooters of all sizes as one single group and comparison of this group with patterns for crash involved motorcycles and cars.

Issues relating to the quantity and quality of data, the lack of exposure information for scooters and difficulties in comparing the results reported with Australian and overseas findings are briefly discussed. This provides an important context and preamble to the discussion of results and their implications.

While this chapter does discuss indicative findings from the analysis of scooter crashes and comparison with patterns for motorcycle and car crash patterns it does so at a macro rather than micro level, discussing general patterns emerging from this analysis rather than detail. Areas of difference were highlighted rather than areas of similarity. Given the cautions noted above in regard to data limitations, such a conservative approach was considered appropriate.

7.2 Registration and Crash Data Issues

The identification of scooters in the VicRoads' registration database was difficult and time consuming. As noted earlier in this report, most scooters and mopeds appear under the general classification of motorcycle. This necessitated electronic and manual interrogation of the registration data file to identify scooters and mopeds and eliminate motorcycles.

Even though the culling and identification process was conducted by contractors with a sound knowledge of scooter and motorcycles makes, and often used engine number and VIN for cross-checking, there is still a chance that some scooters were not detected among the majority listings of motorcycles in active registration files or in the registration archives. This may have led to an underestimation of scooter numbers. In addition, a proportion of the unknown motorcycle files could have been scooters. However, based on the registration analysis reported earlier, the proportion is unlikely to have been large as scooter registrations accounted for less than 7% of all registered motorcycles in 2007.

The crash data supplied by VicRoads, required considerable cleaning and manipulation to arrive at files that could be validly and reliably analysed. Doubtful or potentially unreliable data were not used in the analysis. For example, unless a vehicle was known to be a crash involved scooter it was not used in the analysis. While prudent, this may have reduced the size of the available analysis pool and the number of scooter crashes identified in this report.

This is particularly important as identified scooter crashes were relatively small in number meaning that the loss of only 30 to 40 cases could change the size of the scooter data pool up or down by up to 10%. Given the relatively larger size of the motorcycle and car crash data sets, the loss of even a few hundred cases would have made little difference to motorcycle crash patterns while the loss of several thousand would have had no discernible effect on the crash patterns reported and compared in respect of passenger cars.

When registration and crash data systems have improved, it may be prudent to repeat the current study to ensure that VicRoads and its road safety partners have access to the most reliable results available in respect of registered scooter/moped numbers and their respective involvement in police reported crashes across Victoria.

7.3 Lack of Exposure Data

The methodology employed in this study made it possible to identify registered scooters in the Victorian registration database and to identify scooter involved crashes in VicRoads' crash data sets and to compare crash patterns for scooters with those for motorcycles and cars. While this was useful, this process was limited by the lack of exposure data in respect of scooters and motorcycles. It was not possible, therefore, to determine the rate of scooter crashes per kilometres travelled compared to motorcycles and cars or to draw conclusions about the over/under representation or parity of scooter crashes when compared to motorcycles and cars. While crash patterns imply when and where scooters are used, it is not possible to compare these patterns with those for scooters in general, including those that have not been involved in police-reported crashes.

The results of this study should be considered in the light of exposure patterns identified for Victorian motorcycles, scooters and mopeds. Accurate motorcycle exposure data is required to enable this. Exposure studies completed in NSW and Queensland in respect of motorcycles provided some insight into usage and crash patterns for scooters and mopeds (Harrison & Christie, 2003; 2007).

7.4 Possible Distortions Due to Rapid Rise of Scooter Numbers

As noted earlier in this report, and by Christie & Newland (2006), registered scooter numbers in Victoria and Australia and have grown rapidly in the last five to six years (see Figure 1). The estimated 8,600 registered scooters as at August 2007, is therefore a product of rapid expansion resulting predominantly from new scooter sales - growing from a base of probably less than 1,600 scooters in 1999 (see Table 11). Scooters now have a greater presence, albeit a small one, in the pool of all registered motorcycles. They have gone from an almost invisible vehicle type to visible/emerging in a short space of time. The separate identification of scooters mattered less when there were few of them, but matters more now that they are a growing vehicle type. As noted by Clarke et al (2004), in respect of analysis of motorcycle crashes in the UK, this rise in scooter numbers has not been accompanied by the ability of the authorities to readily identify scooters and mopeds among the mass of motorcycles in either the registration or crash data bases. This, according to Clark et al (2004), leads to the misclassification of mopeds and scooters and the potential underestimation of crashes involving these vehicles and conclusions that scooters/mopeds are under involved in crashes relative to motorcycles and cars. Such distortions are likely to persist unless and until scooters/mopeds can be readily and accurately identified within the registration and crash data bases. It is possible that this type of distortion may be at work in Victoria.

7.5 Difficulties in Comparing Victorian Scooter Crashes to those of Other Jurisdictions

As discussed in Chapter 2, there is little reported crash analysis and discussion about scooter crashes per se. Much of what is published relates to mopeds rather than larger scooters and comes from jurisdictions with very different registration and licensing requirements (eg the EU where mopeds can be accessed at age 16 and are frequently used and crashed by young males of below car or full size motorcycle licensing age). Even within Australia, data and reports from WA and Queensland concentrate on mopeds rather than full sized scooters and cannot be directly compared to the Victorian situation due to this and the differences in rider licensing laws whereby access to mopeds is permissible on a car licence in WA and Queensland, but not in Victoria. These differences were raised in Chapter 1.

Furthermore, as also noted in Chapter 2, few jurisdictions in Australia or overseas partial out scooter registrations and crashes from those of motorcycles generally. On top of licensing differences, this makes comparison of the results from the present study difficult to make with interstate and overseas jurisdictions.

The most valid comparison would be between Victoria and NSW as both jurisdictions require motorcycle licensing for moped and scooter operation. However, NSW has an earlier licensing age (17 years) than Victoria and there is little published information on scooter and moped crashes with the report by Harrison & Christie (2003) being something of an exception.

7.6 Indications from the Scooter Crash Analysis

Notwithstanding the cautions noted above about the small number of scooter crashes in the analysed dataset, some broad indications about scooter crash patterns can be drawn from the results.

7.6.1 Scooter Crashes Increased Between 2001 and 2006

Scooter crashes increased markedly between 2001 and 2006 and at a rate higher than for motorcycles (or cars) in the same period – as illustrated in Figure 6 earlier in this report. In the absence of exposure data it is difficult to determine why this occurred. However, it would seem reasonable to assume at this stage that the increase in exposure is probably related to the rapid increase in scooter numbers - quite simply, more scooters on the road, more scooter crashes. This is the general thesis put forward by Christie & Newland (2006) in respect of the increase in Australian motorcycle fatalities in recent years, ie

> *While increasing sales are not making riders less safe, it would appear that the greater number of motorcycles, particularly larger motorcycles, travelling more collective kilometres per annum are increasing the number of motorcycle deaths in Australia.* (p9)

Better exposure data should assist in determining if this is in fact the case in respect of scooters.

7.6.2 Scooter Crashes are Predominantly Urban

Scooter crashes appear to be more urban in nature and occur in a narrow band of Melbourne metropolitan LGAs. These crashes occur mainly in lower speed zones (ie 60km/h or less) and fairly close to the registered owner's postcode. This pattern is consistent with the heavily urban registration pattern for Victorian registered scooters. In the absence of exposure and usage information, this suggests that scooters are located and used in urban areas and therefore have most of their crashes in urban areas. This pattern is consistent with that reported by Harrison & Christie (2003, 2007) for scooters and motorcycles in NSW and Queensland respectively – albeit based on small numbers. It is also consistent with Haworth's (2007) findings in respect of mopeds in Queensland.

One could assume that given their smaller engine capacity and range, it is to be expected that scooters would be used in predominantly urban areas. This is consistent with recent publications about who is buying and using scooters – ie typically urban dwellers in large cities who use the scooter for short distance, local travel, which may include some commuting, with the scooter representing an alternative to a car or conventional motorcycle (Coxon, 2002; ACEM, 2006; Christie & Newland, 2006). It is also consistent with earlier UK research that showed that the larger the motorcycle engine size, the larger the range/exposure of crash involved machines (Lynam, Broughton, Minton & Tunbridge, 2001). Dutch comparisons of moped and motorcycle crashes (Mooi et al, 2001) and analysis of Australian motorcycle crash data (Harrison & Christie, 2003) also reported similar patterns of more localised crashes for scooters/mopeds.

The greater proportion of scooter crashes that occur at intersections of some kind and involve collision with another vehicle may also reflect their urban usage. One could assume that, per distance travelled, a scooter rider in the inner Melbourne metropolitan area would encounter more intersections and greater potential for collision with other vehicles than a driver/rider operating in outer suburbia and/or in rural areas.

7.6.3 Crash Involved Scooters are Relatively New

Crash involved scooters were proportionally newer than their motorcycle and car counterparts while crash involved cars were older than scooters or motorcycles. Over 60% of crash involved scooters were less than six years old. This is consistent with the rapid rise in scooter numbers noted earlier in this report and by Christie & Newland (2006) and does not imply that newer scooters are somehow less safe than older machines.

7.6.4 Scooter Crashes Patterns are Different to those of Motorcycles

Scooter crash pattern differ to those for motorcycles. Motorcycle crashes are less urban, occur more often in higher speed zones, and occur at greater distances from the postcode of the registered owner, particularly in areas outside of metropolitan Melbourne.

Most scooter crashes occur on weekdays suggesting commuting and general transportation usage in and around urban areas. This contrasts with motorcycle crashes which occur more on weekends and further from home suggesting more recreational/touring use. Again this pattern is consistent with that reported by Harrison & Christie (2003, 2007) for scooters and motorcycles in NSW and Queensland respectively.

Scooter crashes appear to be less severe than motorcycle crashes with scooter riders sustaining lesser injury levels. This may be due to lower travel speeds on the part of scooters given their mainly urban usage and the presumably higher travel speeds of motorcycles on rural roads and highways. However, like motorcycles riders, scooter riders sustained greater injury levels relative to car drivers, especially with respect to serious injuries.

Relative to motorcycles, scooter crashes involved more female riders - about seven times higher than for motorcycles. Even in the absence of sales by gender and exposure data, it would be unreasonable to assume that women are somehow less safe on scooters. A more likely explanation is that proportionally more women are buying, riding and crashing scooters relative to those doing likewise with motorcycles – anecdotal information about sales patterns tends to support this (Christie & Newland, 2006). In short, the higher proportion of crash involved scooter riders is likely to be exposure based (ie more female riders therefore greater female representation in scooter crashes).

The older mean/median age of crash involved scooter riders suggests that those buying and riding scooters may also be older relative to motorcycle riders. In view of general road safety research that suggests that crash risk decreases with age and experience, it is unlikely that age related

factors per se are causing this difference between scooter and motorcycle riders (McKnight & Robinson,1990;Christie, 2004). However, it is also known that crash risk in the first year of motorcycle (and presumably scooter riding) is high for novices of all age groups, but drops to age-peer levels within one to two years for new riders aged over 30 years (McKnight & Robinson, 1990). The proportionally greater crash involvement of learner and probationary scooter riders - despite the older average/median age for crash involved scooter riders - may reflect that the pool of scooter riders is relatively new and inexperienced relative to motorcycle riders. This is a reasonable assumption due to the rapid rise in recent scooter sales and the suggestion in recent reports that those buying scooters have moved across from car use rather than from motorcycle operation (Coxon, 2002; Christie & Newland, 2006).

7.6.5 Scooter Crashes Patterns Share some Commonalities with Motorcycle Crashes

Scooter and motorcycle crashes shared some commonalities. For example, both sustained lower levels of vehicle damage (as assessed by attending police) relative to cars, similar proportions of crash involved scooter/motorcycle riders were riding solo and wearing helmets. For both scooter and motorcycle crashes, the largest single DCA grouping was *Off path on straight*, a single-vehicle, loss of control crash type. This may be a commonality related to both vehicle types being PTWs and less stable than vehicles with four or more wheels should things go wrong. However, on balance there were probably more differences than similarities in respect of key factors such as crash location, rider age, sex of riders and injury severity.

7.6.6 Scooter Crashes Patterns Share some Commonalities with Car Crashes

While scooter crash patterns differed to those for motorcycles, they also shared some similarities with that for cars in that seasonal patterns were similar and most car and scooter crashes occurred on weekdays. This may suggest that where and when scooters are being used has more in common with cars than motorcycles. For example, being used for commuting and general local use rather than for recreational use on weekends – a pattern suggested by earlier NSW data (Harrison & Christie, 2003).

7.7 Implications of these Crash Patterns and Relativities

Taken together, these findings suggest that scooters and motorcycles cannot be viewed as being the same in terms of crash involvement patterns and/or in respect of safety program development and management. For example, strategies to reduce scooter crashes should have a greater urban focus than those for motorcycles and acknowledge that scooters appear to be used more on weekdays than weekends and accommodate female, older and less experienced riders to a greater degree. Rider training and licensing approaches for scooter riders may need to be better tailored to suit the scooter riding demographic so as to better prepare them for the challenges and risks of predominantly urban riding. However, implied exposure/usage patterns and relativities with motorcycles would need to be confirmed by better motorcycle exposure data. Such exposure data will also be required to determine if Victorian scooters and their riders have a higher, lower or equivalent crash risk per distance travelled relative to motorcycles.

8. CONCLUSIONS

Notwithstanding the acknowledged data limitations and the indicative rather than definitive nature of the results, the analysis of scooter crash patterns in Victoria for the period 2001 to 2006 inclusive suggest the following key conclusions:

1. Scooter crashes increased between 2001 and 2006 at a rate higher than that for motorcycles or cars.
2. This increase is most probably due to the commensurate increase in scooter sales during the same period - accurate exposure data may help establish if this is the case.
3. Exposure data is required to determine the relative risk per distance travelled for scooters and motorcycles.
4. Scooter crashes were predominantly urban occurring mainly in the Melbourne metropolitan area and relatively close to the postcode of the registered owner (ie crashes occurred close to home).
5. Scooter crashes differed in pattern to those for motorcycles in terms of key factors such as where/when they occurred, distance from home postcode, severity of injury and type of crash ie – scooter crashes were less severe, more urban, occurred more often at intersections, more often in lower speed zones, more often involved collisions with another vehicle, involved more female riders, involved riders with a higher mean age and occurred more often on weekdays compared to weekends - however, not all differences were able to be compared at an inferential level.
6. Scooter crashes shared some commonalities with motorcycles in that both involved higher levels of injury than for cars and involved mainly solo riders.
7. Scooter crashes shared some commonalities with cars in that seasonal crash patterns were similar and most car and scooter crashes occurred on weekdays.
8. Where necessary, the safety and countermeasure needs of scooters and their riders should be considered separately from motorcycles within the overall motorcycle strategy.

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APPENDIX A: Summary of DCA Groups and Codes