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Motorcycling in South Australia: Knowledge gaps for research

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ABSTRACT

The aim of this report is to provide an overview of knowledge regarding motorcycling that can be applied to South Australia. To this end, recent relevant literature published prior to 2010 was reviewed. Areas of interest include: the number of motorcyclists, the motorcycles they ride, riding exposure, motorcycle crashes, motorcycling injuries, attitudes, training and countermeasures. The report is not an exhaustive examination of these issues but a general overview allowing for identification of knowledge gaps in South Australia that would be suitable for research. An analysis of the costs of motorcycle crashes in South Australia is provided in an appendix.

KEYWORDS

Motorcycle, Review, Accident, Injury, Training, Countermeasures, Attitudes, Accident Costs

Summary

The aim of this report is to provide an overview of the state of knowledge regarding motorcyclists in South Australia, so that knowledge gaps can be identified to guide future research in the area. To this end, recent relevant literature published prior to 2010 was reviewed. A broad overview is given of issues related to motorcyclists themselves, the motorcycles they ride and the nature of motorcycle crashes. Issues explored include trends and characteristics of motorcyclists, registered motorcycles, riding exposure, motorcycle crashes, and motorcyclist injuries. There are also brief sections concerned with the complex topics of rider training, rider attitudes and crash countermeasures.

Future possibilities for research include examination of:

- The age and gender of motorcycle owners, by motorcycle type
- Riding exposure – not just how much but by whom, on what motorcycle, where and when
- The nature of crashes – the main contributing factors and the characteristics amenable to countermeasures
- Who is at fault in multiple vehicle crashes
- Fatigue and riding – extent of the problem, whether it is more sleepiness or task-related fatigue, and whether it is cognitive or physical
- Motorcyclist injuries as they relate to characteristics of the rider, motorcycle and crash
- How well South Australian training and licensing practices compare with best practice
- Rider attitudes, particularly related to perceived risk of detection for riding offences and attitudes or practices related to protective clothing
- The effectiveness of current traffic law enforcement practices
- The possibility of promoting greater use of conspicuous clothing with evaluation of effectiveness
- The likely effectiveness of various new technologies to reduce South Australian motorcycle crashes
- Examination of the possibility of ‘slow motorcycling’ in shared paths with bicycles and pedestrians
- The most useful road infrastructure treatments for preventing motorcyclist crashes or injuries

A number of data sets are potentially useful for future research by CASR into motorcycle safety in South Australia. These are described in the report. Some data linkage is also possible, with considerable linkage having already been accomplished between hospital case notes, TARS data, licensing data and Forensic Science Centre of SA data. The information on around 200 motorcycle crashes available in this linked database could be a good starting point for future research.

Contents

1 Introduction

The aim of this report is to provide an overview of the state of knowledge regarding motorcyclists in South Australia, so that knowledge gaps can be identified to guide future research in the area. A broad overview is given of issues related to motorcyclists themselves, the motorcycles they ride and the nature of motorcycle crashes. Issues explored include trends and characteristics of motorcyclists, registered motorcycles, riding exposure, motorcycle crashes, and motorcyclist injuries. There are also brief sections concerned with the complex topics of rider training, rider attitudes and crash countermeasures.

The gaps in knowledge are chiefly identified through a review of recent relevant literature published prior to 2010. Care is taken to examine the extent to which literature from other jurisdictions, including overseas, can be applied to the South Australian context. In Section 10, possible data sources available in South Australia are identified that could be used in future research to fill the knowledge gaps. An analysis of motorcycle crash costs in South Australia is provided in Appendix A.

2 Motorcyclist numbers

2.1 Recent research findings

One of the factors driving recent Australian research interest in motorcycles is the increase in the number of motorcyclists in recent years. Christie (2001) argues that the best indicator of the number of motorcyclists on the road is not the number of motorcycle licences but the number or registered motorcycles. Data for Victoria presented in Andrea (2006) provide firm support for this position. On the basis of registered motorcycles, motorcycling has been increasing in recent years in South Australia, in Australia and throughout the industrial world.

The Australian Bureau of Statistics regularly publishes a Motor Vehicle Census and the most recent one (ABS, 2009) reports that the proportion of registered vehicles in Australia that are motorcycles has increased from 2.5 percent in 2004 to 4 percent in 2009. The average annual increase nationally in motorcycle registrations from 2004 to 2009 was 9.5 percent, well ahead of all other vehicle types (ABS, 2009).

Increases in motorcycle registrations in South Australia have been consistent with national trends. There were just under 30,000 motorcycles in SA in 2004 and nearly 45,000 in 2009. Rates of motorcycle ownership in South Australia are very similar to those in Australia as a whole. Interestingly, the average age of South Australian motorcycles was reported as being somewhat lower than the national average but the ABS indicated that the age of manufacture of motorcycles was not well reported in South Australia (ABS, 2009).

The most recent general analysis of registration trends in South Australia (Colmar Brunton Social Research, 2009) revealed that motorcycle registrations have increased since 2004 in all motorcycle categories. The increases have been 230 percent for motorcycles with engine capacities up to 50cc, 10 percent for motorcycles between 51 and 250cc, 100 percent for motorcycles between 251 and 600cc, and 50 percent for motorcycles with capacities above 600cc. These increases are all sizeable but it is clear that the most substantial growth in recent years has been in the lowest capacity engine category. These motorcycles would mainly be scooters (Colmar Brunton Social Research, 2009).

Haworth and Nielson (2008, 2009) looked at the issue of increasing use of mopeds and scooters. From 2001 to 2005, registrations of these vehicles increased by 20 percent across Australia, the biggest increase of any vehicle type. According to the Federal Chamber of Automotive Industries, from January to September 2007, a quarter of all new motorcycle sales were scooters. Scooters are marketed as a low cost means of commuting and their growth may lead to a reversal in the previous trends for motorcycles to be largely a form of recreational transport. The authors argued that “while moped safety could be effectively ignored a decade ago, the trend suggests that this issue will become increasingly important” (Haworth & Nielson, 2009, p73).

Haworth and Nielson (2008) also noted the recent trend for older riders in Australia. A similar trend has been noted in Europe (European Transport Safety Council, 2008) and in the United States (Bureau of Transportation Statistics, 2009). According to the latter report, the median age of motorcycle owners in the USA in 1985 was 27. In 2003, it was 41. Across this time period, the proportion of registered motorcycle owners aged in their 40s increased from 13 to 28 percent and the proportion in their 50s increased from 8 to 25 percent. Data in the same report indicate that from 1997 to 2006 in the United States there was a 75 percent increase in motorcycle registrations, with particularly large increases for motorcycles with engine capacities greater than 750cc. This reflects an increase in popularity of supersports motorcycles: machines featuring a high power to weight ratio and capability of high speed and acceleration. These motorcycles were found to be more popular among younger riders (Bureau of Transportation Statistics, 2009). Interestingly, a review in the Netherlands into the effects of motorcycle power on safety (Ruijs & Berkhour, 1997) found that many factors influence crash risk (age, experience, exposure, road conditions, road user attitudes) but there was no evidence that a powerful motorcycle was less safe than a less powerful one. This conclusion may not be generalisable to the even more powerful supersports motorcycles.

2.2 South Australian needs

South Australian data are published that indicate trends in increasing registration of motorcycles similar to national trends, with respect to total numbers. Additionally, published data provide an indication of trends for motorcycle type, as defined at least by engine capacity. However, it would be useful to analyse trends in motorcycle registrations by age and gender of owner. Such data should be readily available but could usefully be augmented with other data as specified in following sections. Unfortunately, we do not currently have access to a simple means of interpreting VINs for motorcycles. The organisation that interprets VINs for us, Polk, does not offer this service for motorcycles. When a means of analysis of motorcycle VINs is available, very detailed analysis of registration trends for motorcycles would be possible.

3 Riding exposure

3.1 Recent research

A key measure needed to understand the motorcycling situation in any jurisdiction, and to provide an interpretative basis for levels of crash involvement, is exposure. Measures of riding exposure ideally include distances ridden and locations of riding, broken down by rider demographics and motorcycle type.

Johnston, Brooks and Savage (2008) reported on Australia as a whole and noted that the distance travelled per year by motorcycles had increased every year since 2002, with an average annual increase in this time of 5.7 percent. This increase exceeded that for other passenger vehicles.

Data reported by the Australian Bureau of Statistics (2008) indicate that the increase above has been due largely to increases in the number of motorcycles. Rates of distance driven per motorcycle have not increased appreciably between 2003 and 2007. In South Australia, there were 106 million kilometres of motorcycle riding in 2007, with an average of 2900 km per motorcycle. This average distance per motorcycle was lower than the national average but by a similar extent as for other vehicle types (ABS, 2008).

Although some data sources do exist, one regularly reported complaint in the literature regarding motorcycle use is the lack of adequate exposure data (Andrea, 2006; Christie, 2001; Motorcycle Safety Consultative Committee, 2008). Andrea reported that motorcycles accounted for approximately one percent of travel (in terms of distance) in Victoria but lamented the scarcity of information useful for determining the patterns of motorcycle use and how these are changing. Christie (2001) similarly called for surveys of motorcycle use, in terms of where riding is done, when it is done and by whom.

3.2 South Australian needs

The lack of adequate exposure data for Australia is reflected in the lack of such data in South Australia. An appropriate survey of motorcycle use would not be confined to distance ridden but would include information about the rider, the type of motorcycle, the locations where riding is done, and the times when riding is done. The nature of the purpose being served by the exposure survey should guide the choice of survey method and the prioritisation of variables measured.

The broad issue of exposure in road safety research has recently been reviewed by Wundersitz and Hutchinson (2008) and Hutchinson et al. (2009). Hutchinson et al. note that there are conceptual and practical problems with the idea of exposure, and many studies for which exposure data would in principle be useful would actually be difficult if they were attempted. Road safety practitioners and researchers make only limited use of exposure data --- there is probably good reason for this. But the difficulties with exposure should not be over-stated. Firstly, in many contexts the task that the concept of exposure is being asked to perform is quite a crude one. The differences in numbers of crashes between different groups of drivers seem to be large, and the differences in types of crashes between different models of car seem to be large --- in both cases, it seems likely that differences in exposure are unlikely to be large enough to be responsible (and hence that there is a genuine difference in rate), and quite a rough estimate of exposure should be sufficient to confirm this. Secondly, practical difficulties can often be overcome by survey design targeted at the specific issue and by spending money --- take a sufficiently random sample, take a sufficiently large sample, employ modern technology.

Hutchinson et al. listed the following six reasons why the future usefulness of exposure (and risk, calculated from exposure) may be greater than in the past.

- Availability of technology for tracking people and vehicles.
- Availability of technology for visual recognition (e.g., of vehicle type or number plate).
- Increasing practicability of linking different datasets (e.g., the crash, vehicle registration, and driver licence datasets).
- Random sampling: if a sample is truly random, it does not need to be very big in order to give a good estimate of the population mean. The traffic and transport world has not really embraced the ideas of deciding what exactly is the population of interest and then taking a random sample. The traffic and transport world could choose to change, and use random sampling more widely.
- Growing awareness of the importance of compatibility between transport and crash datasets.
- The coordinated exploration of crash and exposure datasets with the ideas behind induced exposure kept in mind, without premature calculation of risk as the ratio of crashes to exposure, might throw up credible interpretations of why certain crash and exposure numbers co-vary while others do not.

These apply to the motorcycling context just as much as to road safety more broadly.

4 Motorcycle crashes

4.1 Recent research

4.1.1 Crash numbers and rates

Driven by the increases in recent years in the rates of registration of motorcycles (see Section 2), there have been recent increases in crash numbers both in Australia and internationally. Rates of motorcycle crashes, in terms of distance travelled, have consistently been calculated to be well in excess of crash rates for other vehicle types.

Australia

Johnson, Brooks and Savage (2008) recently analysed ten years of Australian road crash data. Motorcycles comprised 4.5 percent of registered vehicles and 0.9 percent of vehicle miles travelled but motorcyclists comprised 15 percent of road deaths and a greater proportion of seriously injured road users. Per distance driven, motorcyclists were found to have 30 times the fatality rate and 41 times the serious injury rate of car occupants. From 2002 to 2007, motorcycle fatalities increased at a rate of 3.6 percent per year, compared to just 0.4 percent per year for drivers of cars. Data for 1998 to 2007 showed that annual fatalities in South Australia ranged between 13 and 22, except for a low of eight deaths in 2007, and generally accounted for between 7 and 10 percent of the national motorcycle road toll. Numbers for serious injuries nationwide from 2000 to 2004 showed increases for car drivers and cyclists (both 3.1 percent per annum) but a larger increase for motorcyclists (4.4%; 4.2% for males and 6.9% for females). The increases in motorcyclist deaths have been smaller than the increases in registered motorcycle numbers, however, indicating a reduced rate in deaths per registered vehicle. The rate of motorcyclist deaths per registered motorcycle in South Australia is slightly below the national average (Johnson et al., 2008).

Berry and Harrison (2008) analysed one year of hospital separations data (2005-06) from across Australia, looking at serious injury due to land transport accidents. There were 50,401 land transport serious injury cases in Australia in this year, 12,455 of which were motorcyclists. The figures for South Australia only were 3,629 serious injury cases, of which 866 were motorcyclists. The authors also analysed road traffic serious injuries (i.e. off-road accidents excluded), and found that 20.8 percent of seriously injured persons had been riding motorcycles. For males, motorcycle riders were more numerous than drivers of cars (28.7 versus 27.1%). In contrast, female riders of motorcycles accounted for only 5.4 percent of seriously injured females involved in road crashes. In South Australia, male motorcycle riders comprised 389 out of the 1,560 seriously injured road users while the proportion for female motorcycle riders was 44 out of 787. Berry and Harrison also calculated serious injury rates using registration and ABS motor vehicle use survey data. The rates for motorcyclists were ten times that for car drivers based on vehicle registrations and nearly forty times that for car drivers based on distance travelled. The highest seriously injured motorcyclist rate per distance travelled was in Queensland, with South Australia the second highest (436 per 100 million km travelled). Looking at trends from 1999 to 2006, the rate of serious injuries among motorcyclists per head of population had increased by 36 percent (Berry & Harrison, 2008).

A specific study on mopeds and scooters was carried out by Haworth and Nielson (2008, 2009) using merged Queensland registration and crash data. Moped crashes in Queensland increased from 25 in 2001 to 97 in 2005. The 260 percent increase in the moped crash rate easily surpassed the substantial 71 percent crash rate increase for other motorcycles.

International

Figures reported in international reports reflect problems being seen in Australia. In Europe, declines in the fatality rate for motorcycles are not matching the declines for cars (European Transport Safety Council, 2008). In Great Britain, motorcyclists have been reported to have 28 times the risk of a serious injury crash as drivers of cars (Clarke, Ward, Bartle & Truman, 2004).

In the USA, motorcyclist deaths have been increasing every year since 1997, contrasting with decreases in overall road deaths. In 2007, for example, road deaths decreased by four percent while motorcyclist deaths increased by 6.6 percent. Motorcyclists in the USA are 35 times more likely to die in a crash than the occupant of a car (National Safety Council, 2009). Increases in the USA since 1997 in motorcyclist fatalities (144% increase to 2007) and injuries (94% increase to 2007) have outstripped the increases in motorcycle registrations and vehicle miles travelled (Bureau of Transportation Statistics, 2009; Motorcycle Safety Consultative Committee, 2008). One factor involved in these increases is likely to be the repealing of helmet laws in some states.

International comparisons reveal that Australian motorcyclist deaths per registration are higher than the OECD median. The rate is similar to the UK and Canada, lower than the USA, but higher than Germany and Sweden (Johnston et al., 2008).

Mopeds and scooters have been a focus of research in Europe for some time, due to the popularity among Europeans of these forms of transport. In Sweden, Great Britain and Holland, injury crash rates for scooter riders far exceed those of motorcyclists. Haworth and Nielson (2008) pointed out that these European studies are of limited relevance to Australia because of the young age (14 or 15) of moped riders in many countries, in addition to the lack of mandatory helmets for certain types of mopeds.

4.1.2 Crash types and contributing factors

Australia

One major Australian study that considered a broad range of factors involved in motorcycle crashes was that conducted by Johnston, Brooks and Savage (2008) using ten years of fatality and serious injury crash data. Key findings included that the rate of single vehicle motorcyclist fatalities is increasing faster than the rate of multiple vehicle motorcyclist fatalities, that riders over the age of 44 are contributing most to the increase in motorcyclist deaths, that the largest proportion of motorcycle crashes occur on weekends (suggestive of recreational rather than commuter riding), that 20 percent of fatally injured riders are unlicensed, that 10 percent of cases were without a helmet, and that 20 percent of cases were wearing an incorrectly fitted helmet. Other findings included:

- The most common type of serious injury crash (one year of data) was a non-collision crash (i.e. rider came off motorcycle, 32%), followed by a collision with another vehicle (26%), and collision with a fixed object (9%).
- Among single vehicle fatalities from 1999 to 2003, speed was a contributor in 70 percent of cases and alcohol or drug impairment in 46 percent. For multiple vehicle fatalities, motorcycle speed was a factor in 41 percent of crashes and alcohol or drugs a factor in 21 percent.
- The rider failed to see the other vehicle in five percent of multiple vehicle fatal crashes, while the other vehicle did not see the motorcycle in 19 percent. For the driver of the other vehicle, alcohol or drugs were involved in three percent of crashes and speed in two percent. The motorcyclist was adjudged by police to be solely responsible for the multiple vehicle fatal crash in 55 percent of cases, compared to 29 percent of other drivers, with both being responsible in

13 percent (3% unknown). The most common types of fatal multiple vehicle crashes were head-on (28%), right turn opposite (23%) right turn perpendicular (7%) and right angle (6%).

- Fatal single motorcycle crashes were common on bends, these locations accounting for 57 percent of cases (34% off a right bend and 23% off a left bend) compared to 39 percent for other vehicles. The fixed objects most often struck by motorcycles in fatal single vehicle crashes were trees (24%), fences (10%) and street lights or traffic poles (9%).

Andrea (2006) summarised some of the issues relevant to motorcycle crashes in Victoria. In terms of riders, Andrea identified higher risks for young, new and returning riders. Older riders returning to riding after a break have a higher crash risk than those who continued riding without a break. Over half of Victorian serious injury motorcycle crashes are precipitated by loss of control, while 26 percent are intersection crashes in which the motorcyclist usually has right of way. In 10 percent of cases, the crash results from a car turning across the path of a motorcycle. This problem of car drivers failing to give way to motorcycles could be due to motorcycles not being in the schema of hazards that drivers have learnt to look for prior to executing manoeuvres. Andrea also suggested that the separate front and rear brakes of motorcycles make it harder for riders to brake effectively, and that road factors implicated in motorcycle crashes include obstructions to vision, loose material on the road surface, poor road condition, poor road markings, and horizontal curvature.

Berry and Harrison's study of road transport-related serious injuries (2008) demonstrated the major role played by motorcycling in injuries of high severity. It was found that the second most common serious injury crash type overall was a non-collision involving a motorcycle. The third and fourth most common crash types, respectively, were other/unspecified motorcycle crashes and collisions between motorcycles and cars.

Haworth and Nielson (2008) were able to compare motorcycle and moped crashes in Queensland and found a number of notable differences. Moped crashes were more likely to occur in daylight, on low speed roads and on weekdays. Moped riders involved in single vehicle crashes were more likely than motorcycle riders to lose control on a straight section of road rather than a curve. There was a far greater representation of females among moped crashes (38% versus 7%). There was also a greater representation of younger riders (38% versus 24%), those with interstate licences (11% versus 1%) and those with overseas licences (8% versus 1%). Of interest was the finding that there was no difference between moped and motorcycle crashes in terms of injury severity, despite moped crashes occurring more in low speed zones. The authors acknowledge the possibility that this surprising finding, counter to that of an earlier study by the Western Australian Office of Road Safety, could have been due to the coarseness of police ratings of injury severity.

Blackman, Veitch and Steinhardt (2008) conducted a study into serious injury motorcycle crashes in rural and remote areas of Queensland, based on police reported crashes and interviews with a sample of injured riders. It was found that over half of the motorcycles involved were off-road or dual purpose motorcycles, with 17 percent being cruisers. Unlicensed riders (12%) and unregistered motorcycles (15%) were common, especially in off-road recreational crashes. The most common time of day for crashes was late morning or early afternoon, while over half of those involved were riding for recreation. Young riders were common (28% aged 16 to 24), while 94 percent of riders were male. The most common crash type was a single vehicle crash (73%). These were under-represented among crashes for which there was a police report (45%).

Haworth and Rowden (2006) looked at the issue of fatigue and motorcycling, noting that motorcycling differs from other modes of transport in terms of the temporal patterns of travel, the trip purpose, environmental influences, and the greater physical and cognitive demands of riding. Crash rates by exposure by time of day for motorcyclists in Australia reflect the circadian increase in crash risk between 2 and 4pm only on weekends but not on weekdays. Fatigue is likely to be a problem for riders but little research has examined it. The main suggested countermeasure for drivers of cars once fatigue has developed is to pull over and have a nap. This is not possible with a motorcycle. Some countermeasures which may be applied to the motorcycle fatigue problem (in terms of the fatigue that results from the effects of long rides) include throttle assist; suspension, steering and seat modifications to reduce vibration; fairings and screens to block the wind; warm clothes; clean visors to avoid eye strain, and earplugs to block noise.

International

One major recent study of motorcycle crashes in Europe was MAIDS: the Motorcycle Accident In Depth Study, summarised in a report by the European Transport Safety Council (2008). MAIDS was a case control study of 921 crashes with 923 controls and 2000 variables. The data were collected in Germany, Netherlands, Italy, Spain and France. The primary crash causes were found to be rider error in 37 percent of cases and an error by another driver in 50 percent of cases. The remaining 13 percent consisted of problems with road design, maintenance, weather or technical malfunctions. The errors of other drivers involved a failure to detect the motorcycle in 70 percent of cases. Drivers who also had a motorcycle licence were less likely to make this error. A majority (71%) attempted collision avoidance and 31 percent lost control. Nine percent of helmets came off in the crash. Unlicensed riders were found to be at greater risk of a crash than those with a valid licence (ETSC, 2008).

The ETSC (2008) report also summarised a number of other findings in European research. It was determined that the two main crash types for motorcycles are those involving running off the road on a curve and right of way violations. Hurt Jr, Ouellet and Thom (1981) found that other vehicles were at fault in 60 percent of multiple vehicle crashes involving motorcycles, similar to the more recent MAIDS finding. Sexton, Fletcher and Hamilton (2004) and Sporner and Kramlich (2000) both found that motorists were mainly at fault for turns or U-turns in front of motorcycles. Stefan et al. summarised the most dangerous riding situations for motorcyclists as: test riding a motorcycle without protective clothing, overtaking a car that is turning right, overtaking on a left curve, failing to detect traffic hidden behind another vehicle, and group rides in which less experienced riders attempt to keep up with more experienced ones. It was also noted in the ETSC (2008) report that there is an increasing trend for female riders to be involved in crashes, although MAIDS did not find an over-representation of females compared to exposure. In the early 1990s, the crash problem was concentrated among the young but, increasingly, older riders are figuring more prominently in the crash statistics. It is thought that this may be partly related to the greater use of Graduated Driver Licensing systems that restrict riding among the young (ETSC, 2008).

In the UK, Pai, Hwang and Saleh (2009) looked at right of way violations in which other vehicles struck motorcycles at priority T-junctions, using British statistics from 1991 to 2005. Such violations occurred more often on non-built up roads and in low light. Older and female motorists were over-represented in gap-acceptance crashes. The authors argued that there are a number of reasons why motorists adopt smaller safety margins when pulling out in front of motorcycles compared to cars. These include the lower conspicuity of motorcycles, visual failures during turning moves, smaller objects seeming further away than they are and smaller vehicles appearing to be less threatening than larger ones. They also claimed that in a large proportion of cases, other vehicles or other visual obstructions could easily hide motorcycles (Pai et al., 2009).

Also in the UK, Clarke, Ward, Bartle and Truman (2004) reviewed 1000 in-depth crashes that occurred in the Midlands from 1997 to 2002. The authors identified three main crash types: right of way accidents, loss of control on bends, and crashes with motorcycles using overtaking and passing opportunities that only motorcycles have. In terms of rider types, the authors identified the groups requiring specific interventions as young, inexperienced riders on small machines such as scooters, and older riders on large capacity motorcycles, particularly those returning to riding after a break.

In the USA, the National Safety Council (2009) reported that motorcycle crashes are more prevalent among new and older riders, with alcohol, excessive speed, night time, larger engines and the lack of helmet use particular risk factors for fatal crashes. A representative from NHTSA reported to the Motorcycle Safety Consultative Committee (2008) that, whilst young riders were the largest group of fatally injured riders, the most growth in recent years in fatalities has come in the older rider age group (over 40). In addition, it was reported that 27 percent of fatally injured riders had a blood alcohol concentration above .08 g/100ml, 25 percent did not have a valid licence, and half were not wearing a helmet. The 51 percent helmet wearing rate was lower than the 71 percent rate in 2000, most likely due to relaxation of mandatory helmet laws. As already noted in Section 2.1, The Bureau of Transportation Statistics (2009) reported on the increasing popularity of supersports motorcycles with high power to weight ratios capable of high speed and acceleration. The Insurance Institute for Highway Safety reported that the fatality rate for these motorcycles is four times higher than for other motorcycles. The average fatality age for these motorcycles is also younger than for other motorcycle types (27 years old) (Bureau of Transportation Statistics, 2009).

An earlier report in the USA (NHTSA, 2006) focused on 2004 fatal crash data. It stated that half of fatal motorcycle crashes were multi-vehicle collisions, with 78 percent of these involving a frontal impact for the motorcycle. In 39 percent of multi-vehicle crashes, the vehicle turned left in front of a motorcycle that was travelling straight ahead. Both vehicles were travelling straight ahead in 26 percent of multi-vehicle crashes. Impacts with fixed objects were more common for motorcycles than any other form of vehicle (26% compared with 18% for cars, the next highest). Additionally, 36 percent of motorcycles were speeding, twice the rate for cars. The alcohol involvement rate of 31 percent was also higher than the rate for car drivers. Over 40 percent of motorcycle single vehicle fatalities were associated with a BAC above .08 g/100ml, with this figure increasing to 60 percent on weekend nights. A quarter of riders were without a valid licence (NHTSA, 2006).

4.2 South Australian needs

The literature briefly summarised above points to a number of factors that contribute to motorcycle crashes. These include: young, new or returning riders, unlicensed riders, unregistered motorcycles, run off road crashes on curves, right of way violations involving drivers of other vehicles failing to detect motorcycles or misjudging the gap, alcohol impairment and excessive speed, and motorcycle type. Fatigue may also be an unrecognised problem.

In South Australia, detailed crash analysis is necessary for multiple vehicle crashes to ascertain the extent to which motorcycle speed and errors by drivers of other vehicles are contributing to these crashes. The prevalence of unlicensed riders or unregistered motorcycles in crashes is also unknown. Also, the crash involvement and crash characteristics of mopeds and scooters in South Australia are unknown. The issue of fatigue could also be investigated – whether fatigue contributes to motorcycle crashes in South Australia, whether it is physical or cognitive fatigue is the bigger problem, and what rider and trip factors are most implicated in fatigue crashes.

5 Motorcyclist injuries

5.1 Recent research

There have been two recent Australian reports providing information on the relationship between motorcycling and injuries.

Berry and Harrison (2008) studied road traffic serious injuries from 2005 to 2006 and found that the male motorcycle serious injury rate peaked in the 20 to 24 year old age group, with a rate of 131 per 100,000 population. Just under 30 percent of all serious injury cases involved a high threat to life, with the rate for motorcycle serious injuries being 29 percent. The mean length of stay in hospital was 8.4 days for pedestrians, 5.4 days for motorcyclists and 5.0 days for car occupants. The length of stay tended to increase for older age groups. For both pedestrians and car occupants, head injuries were the most common but for motorcyclists, shoulder and upper limb injuries (35%) and lower limb injuries (29%) were most common. The lower limb injuries resulted in the most days in hospital for motorcyclists. Looking at trends from 1999 to 2006, the rate of high threat to life injuries increased from a rate per 100,000 population of 6.9 to 9.2 for motorcyclists (12.6 to 16.8 for males) (Berry & Harrison, 2008).

The other recent Australian report containing data pertaining to the nature of motorcyclist injuries is that by Johnston, Brooks and Savage (2008). Looking at fatally injured riders, the body part sustaining the fatal injury was the head in 30 percent, multiple body regions in 21 percent, the thorax in 12 percent and the neck in two percent. It was unknown in 30 percent of cases. When helmets were worn, the fatal injury was still due to a head injury in 32 percent of crashes, although the figure was higher for cases in which the helmet came off (36%) and in which a helmet was not worn (45%). The rate was 20 percent in cases for which helmet use was unknown (Johnston et al., 2008).

The European Transport Safety Council (2008) reported on findings from Europe with regard to motorcyclist injuries. Analysis of the MAIDS database revealed that 55 percent of motorcyclist injuries were of the upper and lower extremities. Collisions with roadside barriers were associated with serious lower extremity and spinal injuries, as well as serious head injuries. Another study referred to by the Council report indicated that 80 percent of injured riders had sustained leg injuries, 56 percent had injured arms and 46 percent had sustained head injuries. Average Abbreviated Injury Scores were 2.4 for the head, 1.9 for legs, and 1.5 for arms. Thoracic and pelvic injuries were rare but severe. A study based on German data (Otte et al., 1998, in ETSC, 2008) reported that 70 percent of injured riders had sustained leg injuries but that 80 percent of riders with an AIS score greater than three had head injuries, and that the cause of death was usually a head injury.

5.2 South Australian needs

Research to obtain a better picture of the injuries sustained by motorcyclists on South Australian roads would be a valuable addition to our knowledge base. In addition to body region and severity, it would be useful to combine this information with information about the rider, the motorcycle and crash type and location. Collection of information for the crashes pertaining to the use of protective clothing would also be important. Ideally, such studies would use a random sample and/or an in-depth study to identify points of contact that could be linked to the injuries.

Some authors have argued that consideration should be given to the possibility of ‘slow motorcycling’ (i.e. riding motorcycles at low speed) in a shared path with pedestrians and cyclists (e.g. Hutchinson & Lindsay, 2009). A future in which slow motorcycles could share spaces with pedestrians would require a thorough knowledge of the speeds at which motorcycle and pedestrian collisions cause injuries, so that an appropriate speed limit could be set. Collisions of motorcycles with pedestrians have been rather neglected in the research literature. In particular, tabulations that showed the injury severity of the motorcyclist separately for each level of injury severity of the pedestrian would be novel and of special value. There would be expected to be a positive correlation between the injury severities of the two people: high speed would tend to make both injuries severe, low speed would tend to make both injuries minor. As an example of how analysis might proceed, consider the severity of injury of the pedestrian. This will be related to the age of the pedestrian and the speed of the motorcycle (and other factors also). The severity of injury to the motorcyclist will be related to the speed of the motorcycle and other factors, but presumably not to the age of the pedestrian. Consequently, it may be possible to draw some conclusions about the relative sizes of the effects of variation in pedestrian age and variation in motorcycle speed, even though the speeds in individual accidents are unknown. Before conducting so sophisticated an analysis, it would be necessary to get a general understanding of collisions of pedestrian-motorcycle collisions by tabulating the basic characteristics of these accidents and by finding what factors affect the severities of injury of the motorcyclist and pedestrian separately. A similar analysis of injuries in collisions of motorcycles with pedal cycles would also be desirable.

6 Rider training

6.1 Recent research

6.1.1 Australia

A substantial amount of research has been conducted in the area of rider training in recent years in Australia. A best practice review of rider licensing was undertaken by Haworth and Mulvihill (2005), with comparisons between Australian systems and a proposed optimal model. The authors expressed disquiet with the lack of scientific evaluation of different licensing and training schemes but they did argue that an optimal model would involve measures designed to reduce exposure in early years of riding, as "…any safety benefits of motorcycle licensing and training probably result more from reductions in the total amount of riding than from reductions in crash risk per kilometre travelled" (piii). As part of this model, the authors proposed increasing the minimum age for riding, increasing the provisional licence period, and greater time duration of training. They also proposed that all learner riders be faced with the same initial licence restrictions, regardless of whether or not they hold a car driver's licence. In this way, obtaining a motorcycle licence "… should be seen as a higher step in licensing than … a car licence, in the same way that a heavy vehicle licence is considered a more advanced form of licence than a car licence" (piii). It was also suggested that more cognitive factors should be included in the training (e.g. hazard perception).

A more recent appraisal of Australian graduated licensing systems for motorcyclists was conducted by Mitsopoulos-Rubens, Rudin-Brown and Lenne (2009). The authors repeated the earlier study's claim that there has been a paucity of research into motorcycle graduated licensing systems compared to those for cars. The justification for a number of the components of these systems has involved extrapolation from car driver systems and knowledge of the skills deficits in novice car drivers. In terms of the minimum learner riding age, there has been little research into the relationship between licensing age and motorcycle crash risk. Research into car driving indicates decreasing crash risk with a higher initial licensing age. There is also the question of whether car driving skills transfer to the process of learning to ride. There is some evidence that hazard perception does (Liu et al. 2008). Mitsopoulos-Rubens et al. identify the minimum time period for holding a learner permit as a big issue for motorcycle riding. A related issue is whether to reduce the necessary time for older riders as some jurisdictions do for car drivers. This is of particular importance for motorcycle riding as many riders begin at an older age. There is also the question of whether the low crash risk of the learner period for car driving, which is due to the presence of a supervisor or instructor in the vehicle, translates to motorcyclists. Currently, Western Australia and Queensland are the only Australasian jurisdictions requiring a supervising rider during the learner period. The lack of this requirement in other states reflects the impracticality of a rider supervisor. A pillion or sidecar supervisor would affect the balance and co-ordination of the learner rider, while a supervisor in a following vehicle or on a nearby motorcycle is not able to directly communicate with the novice while riding. Technology facilitating this is an option. Finally, many jurisdictions (not South Australia) require riders to begin with a motorcycle with an automatic transmission. This is problematic for Learner Approved Motorcycle Schemes (LAMS) that restrict motorcycle engine capacity and power-to-weight ratios for novice riders, as most motorcycles with automatic transmissions are larger than those permitted in LAMS. There is a lack of empirical evidence that manual transmissions pose a particular risk for novice riders (Mitsopoulos-Rubens et al., 2009).

In response to the changing demographics of riders and crash-involved riders specifically, Haworth, Mulvihill and Rowden (2006) looked at the effects on crashes of training for older motorcyclists, using an internet survey of riders in Victoria aged over 25. Training was not found to have any effect on crashes in total or single vehicle crashes but, if a rider undertook training after 1996, there was an increase in the likelihood of involvement in a multiple vehicle crash. Exposure was the chief determinant of crash involvement with those riding over 300 km per week involved in 66 percent more crashes and 58 percent more multiple vehicle crashes. For each year of age, there was a 1.5 percent decrease in crash involvement, and a 3.8 percent decrease in multiple vehicle crashes specifically. The authors acknowledged that their study could not determine whether there are short term effects of training on safety, whether there are different effects according to different training content, or if there are any effects of training on riding exposure (e.g. training may discourage people from riding), which could then affect crash rates. Nonetheless, the main conclusion was that distance ridden and rider age have a far stronger effect on crash risk than training.

Another recent Australian study was that by Rowden and Watson (2008) looking into how a voluntary pre-licence training program affected self-perception of rider skill. An analysis of rider confidence pre- and post-training for a sample of 244 riders revealed that mean scores for self-rated skill increased after training and were above average, suggestive of overconfidence. The authors did suggest that it is reasonable for riders to expect skill to increase after skill-based training and also that riders may have reported higher skill ratings to be consistent with the aims of the training. It was noted that previous research does not indicate any safety effect of skills training.

Liu, Hosking, Bayly, Mulvihill and Lenne (2008) studied the effects of driving and riding experience on hazard perception in urban and rural environments using a simulator. Motorcycle riders rated urban hazards as more dangerous than car drivers and spotted more hazards in total, including a greater likelihood of identifying a road veering over a bend, rail crossings, and surface repair work as hazardous. Riders also identified road user hazards earlier than car drivers. This better hazard perception capability was related not to earlier fixation on the object in question but quicker recognition of the object as a hazard. Greater levels of experience also aided quicker hazard perception. Experienced riders could achieve a lower travelling speed at one second after hazard onset than inexperienced or novice riders, and there was no effect on scanning or visual search of wearing a helmet.

The meeting of the Motorcycle Safety Consultative Committee (2008) resulted in recommendations for national graduated training and licensing systems, as well as the availability of post-licence training especially for returning riders. It was also suggested that incentives should be provided to riders to stay on Learner Approved Motorcycle Scheme motorcycles through lower registration fees and lower compulsory third party insurance premiums.

6.1.2 International

Although much recent research in Australia has addressed issues related to motorcycle training, some recent international reports propose some additional ideas.

The European Transport Safety Council (2008) report included a section concerned with the issue of training of drivers to reduce collisions with motorcycles. Noting that drivers of other vehicles are mostly at fault in collisions with motorcycles, it was argued that car drivers condition themselves to look only for other cars as possible collision dangers and so often fail to detect motorcycles at junctions. It was suggested that the issue of searching for motorcycles should be included in car driver training and that educational campaigns could be useful. One such educational campaign was one run in the UK using the old slogan of “Think Once, Think Twice, Think Bike”.

A study by Elliott, Baughan and Sexton (2007) using a rider behaviour questionnaire found that self-reported crashes were predicted by self-reported tendency to make control errors and traffic errors. This would seem to suggest that an important means of reducing crashes is to counter these errors with a focus on skill-based training, including traffic-related skills such as hazard perception, and control skills such as cornering. However, it was also found that speed violations predicted involvement in at-fault crashes and so interventions aimed at tackling traffic violations are also important. Furthermore, the authors argued that the errors leading to crashes in many cases would have resulted from careless riding and excessive speed, and that a more sedate riding style would eliminate the need for training in high level riding skills. They recommended that "road safety interventions focus on reducing violational behaviour (e.g. speed violations) in addition to improving perceptual and control skills. Certainly, attempting to improve control skills without a concomitant attempt to improve insights into risk and self-limitations may increase rather than decrease crash risk" (Elliott et al., 2007, p499).

6.2 South Australian needs

The most appropriate research to undertake to benefit South Australia, with respect to rider training, is a review of available training programs, including those connected with licensing procedures, with a comparison to best-practice training models. Training for those returning to riding should be included in the review. The review should also be conducted in a manner consistent with recognition of the need for violational interventions as a key means of reducing motorcyclist crash risk. Such a review would not require a great deal of work.

7 Rider and driver attitudes

7.1 Recent research

A recent South Australian study used four focus groups to investigate attitudes relevant to motorcycling (Colmar Brunton Social Research, 2009). The four groups consisted of scooter riders, motorcycle riders with less than two years experience, motorcycle riders with more than two years experience and car drivers. Scooter riders chose to ride them because they are cheap, easy to park and quick in traffic. They report keeping their position in the lane like a car but are able to push through to the head of a traffic queue. They wear less safety gear than other motorcyclists, usually only helmets. Risks on the road as perceived by scooter riders include cars, bad weather and road conditions.

Motorcycle riders participating in focus groups used by Colmar Brunton Social Research (2009) choose to ride for reasons of thrills and freedom. Perceived safety risks were similar to those identified by scooter riders: other drivers, road conditions and weather. There is a speeding and risk taking culture among motorcycle riders but they reported being able to adopt behaviours to lessen their crash risk. They emphasised the importance of being visible, both in terms of road positioning and conspicuous clothing, and the use of comprehensive safety gear. More experienced riders were more likely to ride after consuming alcohol or drugs than were the less experienced riders.

Drivers of cars participating in the research by Colmar Brunton Social Research (2009) perceived motorcycle riders to be vulnerable and to appear ‘out of nowhere’. The drivers reported that scooters tend to be frustratingly slow and their riders to be dangerously under-protected by safety clothing. Drivers indicated that motorcyclists and scooter riders both need to keep visible and stay with the flow of traffic, while acknowledging the importance of drivers indicating appropriately and checking blind spots.

Another recent study in Australia featuring measurement of rider attitudes was one by Friswell, Williamson, Allsopp, Gavin and Bryant (2008) to evaluate the success of a safe cornering mail-out campaign by the Road Traffic Authority in New South Wales. As part of the evaluation, the researchers measured a number of beliefs related to taking corners on a motorcycle. Younger riders admitted often using an inappropriate cornering speed, were less committal about their own cornering competence, and expressed a belief that greater riding experience permits faster cornering.

Another Australian study that measured attitudes and beliefs as part of an evaluation was that by Rowden, Watson, Wishart and Schonfeld (2009). This study evaluated a rider training program designed to address risk taking behaviour as an adjunct to normal skill-based training. The program focused on risks associated with ‘bending’ road rules, ‘pushing limits’, and extreme speeds and stunts, as well as psychosocial factors in risk taking, such as personality and peer influence. It was found that new riders embraced concepts included in the course while those riders who were more experienced tended to report the concepts as being ‘common sense’ yet also report riding behaviours contrary to the messages of the course. The authors concluded that the course may have successfully raised awareness of risk factors but may not have challenged beliefs about risk taking sufficiently to change behaviour among more experienced riders. Some riders only considered some of the issues raised in the program after being involved in an on-road incident.

A study from the United Kingdom by Crundall, Bibby, Clarke, Ward and Bartle (2008) assessed car drivers’ attitudes to motorcyclists. The researchers were particularly interested in comparing the attitudes and beliefs of drivers with different levels of experience and drivers with a motorcycle licence. Previous studies had found that drivers with a motorcycle licence and even those with friends or family members with a motorcycle licence are less likely to be involved in collisions with motorcycles when driving a car. The study by Crundall et al. found that drivers of cars, except for those also with a motorcycle licence, had negative attitudes to motorcyclists. These negative attitudes tended to decline with age. The authors suggested that drivers would benefit from a training package incorporating footage filmed from a rider's perspective to show the hazards caused by unobservant drivers. It was also found that drivers with the most traffic violations perceived themselves to be most like motorcyclists and to think they would like riding a motorcycle. The authors described this as representing a 'biased attitude' about motorcycling. Those who had both a motorcycle and car licence claimed that identifying the presence of a motorcycle against a cluttered background was not difficult.

7.2 South Australian needs

There is a vast array of attitudes, beliefs and self-reported behaviours that could be measured in questionnaires of South Australian motorcycle riders. Currently, CASR is undertaking a study of Victorian motorcyclists in which an internet survey is being used to ask questions concerned with rider demographics, motorcycle characteristics, riding history, offence history, crash history, exposure to enforcement, perceived likelihood of detection, road infrastructure issues, and self-reported on-road behaviour. An advantage of such surveys is that they can also be used to examine other areas of interest discussed in previous sections, such as rider training and riding exposure.

8 Countermeasures

8.1 Recent research

Countermeasures for motorcycle crashes can be grouped into three categories: those pertaining to the rider, to the motorcycle and to the road environment. These will be discussed separately.

8.1.1 The rider

There are a variety of rider safety measures available to mitigate the risk of crashes and injuries related to motorcycling. Measures aimed at reducing crashes include rider training, rider licensing, law enforcement and road safety advertising, while injury mitigation centres on the use of helmets and other types of protective clothing. Rider training and licensing have already been discussed in an earlier section (Section 6) so will not be discussed further here.

There has been a surprising lack of recent research explicitly examining law enforcement programs and motorcyclists. It is especially surprising given that a number of authors have pointed to the risk taking propensity and speeding culture among subgroups of motorcyclists. The European Transport Safety Council (2008) report included a section on enforcement countermeasures in which it was claimed that European Union countries were conducting insufficient amounts of traffic law enforcement. The chief recommendation of the report regarding enforcement was that enforcement activities should focus on helmet use, numberplate visibility and improved accuracy of speed detection. These should be combined where appropriate with education and rehabilitation. The authors also argued that speed enforcement should be based on data (time, place) for speed-related crashes (ETSC, 2008).

The Motorcycle Safety Consultative Committee (2008) made a number of recommendations regarding enforcement of traffic laws to aid motorcycle safety. One was the implementation of community policing campaigns that combine education and enforcement, and which are aimed at educating other road users to be mindful of motorcyclists and for motorcyclists to be responsible for their own safety. Such a campaign is currently running in Victoria. Enforcement needs to be targeted at high risk behaviour, including but not restricted to speeding. A combination of overt and covert enforcement would be ideal. Aiding the recognition of motorcycle registrations from the front would also be useful to help with enforcement. One possibility is the use of radio frequency identification devices. It was argued that these could be fitted to all vehicles and linked to registration databases, allowing for instant detection of unregistered vehicles (Motorcycle Safety Consultative Committee, 2008).

There has been surprisingly little research evaluating motorcycle safety advertising campaigns, probably reflecting the lack of specific advertising directed at this group in recent years. One campaign that has been running for some time in the UK in recent years is the THINK! Campaign, which includes advertising concerned with the need for drivers to look out for motorcyclists. A marketing evaluation by BMRB Social Research, which utilised an omnibus survey of around 2000 people in the UK, found that 88 percent of respondents could recall the TV campaign and 28 percent had heard the radio commercial. Sixty three percent claimed the TV advertisement would stick in their mind and 42 percent reported that it made them think that they should take longer to look for motorcyclists on the road. When prompted, the majority of respondents were able to identify car drivers pulling out in front of motorcycles at junctions as one of the main causes of motorcycle crashes. Two out of three thought that car drivers and motorcycle riders were equally responsible for reducing crashes involving motorcycles (BMRB Social Research, 2009).

In Malaysia, a media campaign was run that targeted rider conspicuity, proper use of helmets, the high injury risk in crashes, the effects of speeding and the dangers of weaving in traffic. There were nine television advertisements, as well as radio advertisements, billboards, newspaper advertisements and leaflets. An evaluation found that 87 percent of riders were aware of the campaign, 78 percent recalled the slogan, 97 percent agreed with the message and 90 percent claimed to heed the advice of the message. Observations indicated an increase in the proper use of helmets from 44 to 66 percent and a significant increase in the use of light coloured clothing (Radin Umar, Billyamin & Ibrahim, 2004). Note that the low levels of helmet use suggest the restricted applicability of this program to South Australia.

The South Australian Motorcycling Road Safety Strategy 2005-2010 included recommended strategies for the use of advertising in the interests of motorcycle safety. High priority areas for action included:

- Addressing the high risk factors associated with motorcycle crashes through linked public education and enforcement that target drink driving, excessive speed, helmet use, repeat offender behaviour, and
- Promoting a motorcycle awareness campaign focusing on motorcycle safety and especially driver awareness of motorcyclists.

The use of protective clothing to reduce injuries in the event of a crash is a countermeasure that has received a reasonable amount of attention in recent literature. Helmets have long been recognised as an important safety item for reducing motorcyclist injuries, with Andrea (2006) claiming that compulsory helmet wearing was the sole countermeasure clearly shown to improve rider safety. Literature relevant to the USA, where policies in many jurisdictions do not require mandatory helmet wearing, continues to be published demonstrating that helmets mitigate injuries (Houston & Richardson, 2008; Mayrose, 2008). A recent Cochrane Review of helmet use by motorcyclists found that helmets reduced head injury risk by around 69 percent and death by around 42 percent, and that evidence was suggestive of prevention of facial injury and no negative side effect on neck injury (Liu, Ivers, Norton, Boufous, Blows & Lo, 2008).

In Australia, recent research has looked more at other aspects of rider protective clothing. Encompassing gloves, boots, jackets, pants or full suits or body armour, protective clothing is known to reduce the frequency and extent of abrasions and lacerations of skin, and soft tissue injuries in motorcycle crashes. It also provides protection from the elements, thus reducing dehydration and physiological stress (Haworth, de Rome, Varnsverry & Rowden, 2007). The European Transport Safety Council did note, however, that many forces involved in motorcycle collisions are well beyond the protective capability provided by clothing (ETSC, 2008).

At the meeting of the Motorcycle Safety Consultative Committee (2008), the following recommendations were made regarding rider protection: that a star rating system for protective clothing based on the European Union Standard be tested and disseminated, that riders be provided with better access to information, that a GST exemption be made for protective clothing that can be classified as safety gear, and that assessments should be made of whether particular design features of motorcycles are systematically associated with particular types of injury.

The suggestion regarding a star rating for protective clothing was the subject of the paper by Haworth et al. (2007). The authors noted that in Europe there are mandatory standards for protective clothing but no enforcement to support it. They suggested that in Australia a star system like that used by ANCAP for cars could be used for clothing, incorporating ratings for safety, weather protection and ergonomic performance. It would have to be an independent rating system, and not one requiring only voluntary participation. Merely utilising Australian Standards does not provide manufacturers with incentives to produce goods that exceed the standard or allow the public to choose the best performing products (Haworth et al., 2007).

The other safety advantage that can be provided by appropriate clothing is greater conspicuity (ETSC, 2008; Haworth et al., 2007). The most recent study especially devoted to rider conspicuity was conducted in New Zealand by Wells et al. (2004). This was a case control study utilising 463 motorcycle casualty crashes and 1,223 controls recruited from roadside survey sites. Comparisons were made between the two groups in terms of the use of reflective or fluorescent clothing, headlight operation, colour of helmet, colour of clothing and colour of motorcycle. Lower crash risk was associated with the use of reflective or fluorescent clothing, a white or light coloured helmet and use of a daytime headlight. Colour of clothing or motorcycle had no effect (Wells et al., 2004).

8.1.2 The motorcycle

Increasing research is being conducted into the possibilities of reducing crash involvement or injuries through motorcycle-based countermeasures, similar to those that have proved successful with cars. These include both primary (e.g. ABS, other ITS applications) and secondary (e.g. airbags, protective cages) safety measures.

The European Transport Safety Council (2008) report gives a summary of vehicle-based countermeasures worth considering for motorcycles. Primary safety measures include braking systems, conspicuity (discussed above) and speed limiters. Braking has received the most attention. The average rider only uses around 56 percent of the available braking capacity in an emergency (Ecker & Wassermann, 2001), particularly under-utilising the front brake. The average motorcycle deceleration in an emergency is only 6 m/s^2, which is less than achieved by a typical 40 tonne truck. Problems with braking include: difficulty in controlling the two systems (front and back) at once, low deceleration to avoid wheel lock and tumbling over, the survival reflex resulting in wheel lock, poor initial braking, not properly re-applying brakes after wheel lock, and lack of knowledge about optimal brake handling. One solution to the inadequate braking often seen in motorcycle crashes is the use of combined brake systems that activate both brakes at once. This could be especially helpful for young riders who tend to over use the rear brakes. Anti-lock brakes, which prevent wheel lock in crashes and are associated with a quicker build-up of brake pressure, were initially rejected by motorcyclists but acceptance is growing. Riders on an unfamiliar ABS-fitted motorcycle brake more effectively than on their own (Winkelbauer & Vavryn, 2004). Other braking systems noted by the ETSC (2008) include rear wheel lift-off protection, automatic brake force distribution and integral braking systems that combine elements of all of the above. The authors of the report recommended ABS but also argued that training should be given to riders to learn to use the system appropriately (ETSC, 2008).

Rizzi, Strandroth and Tingvall (2009) conducted a study using four years of in-depth fatal crash data from Sweden to estimate the effectiveness of ABS in reducing severe and fatal motorcycle crashes. The advantages of ABS, argued Rizzi et al., are that wheel rotation is maintained under heavy braking and so the rider has more stability, and the prevention of wheel lock-up means riders will be more confident braking up to the limit of friction, thus producing greater deceleration. The authors' analysis of braking in various crash types led to estimates of a 38 percent reduction in injury crashes and 48 percent reduction in severe/fatal crashes. ABS was estimated to have the largest effect on intersection crashes and the smallest effect on head-on collisions (Rizzi et al., 2009).

Cairney & Ritzinger (2008) interviewed motorcycle safety experts and conducted focus group interviews with Australian motorcycle riders to determine the acceptability of various ITS technologies. With regard to ABS, experts were enthusiastic about the usefulness of the system but riders were more sceptical. Riders were concerned that the availability of ABS would undermine the development of rider braking skills and that it may operate in an unexpected manner, disrupting riders' braking routines. The authors of the paper argued that few riders would be able to brake as effectively as ABS and that very few riders have any practical experience with advanced braking. Cairney and Ritzinger advised that the cost of ABS would make it only good value on expensive motorcycles, not the cheap ones or scooters used by learners (Cairney & Ritzinger, 2008).

Another ITS technology suggested by the European Transport Safety Council (2008) and reviewed by Cairney and Ritzinger (2008) is Intelligent Speed Adaptation (ISA). ISA research has been conducted almost exclusively on cars but needs to apply to all vehicles for an optimal system. There are, however, problems with applying deceleration inappropriately to a motorcycle and there would also need to be a minitiarisation of current systems to fit on a motorcycle (ETSC, 2008). The experts interviewed by Cairney and Ritzinger (2008) were concerned about the potential for adverse outcomes if the ISA involved active control of speed. They also raised concerns about difficulty and expense of implementation. If the ISA system displayed information to riders, there were concerns about distraction of the rider. Additionally, there were concerns about accuracy, especially if a national database was attempted, and given the use of variable speed limits in many locations (Cairney & Ritzinger, 2008).

A final type of ITS reviewed by Cairney and Ritzinger (2008) was automatic crash notification (ACN), which alerts emergency services automatically in the event of a crash. Riders approved of these systems, viewing them as especially useful for solo riders in rural areas. They liked the idea of a voice link with the emergency centre but noted the need for an override function for false alarms. It was stated that they would need to work in hilly areas where mobile telephone coverage can be unreliable. The system, it was claimed, could also be used as a tracking device in the event of motorcycle theft. There was disquiet, however, when it was suggested that the system may require an ongoing subscription fee to pay for the call centre (Cairney & Ritzinger, 2008).

Research into adjustments to the motorcycle to protect the rider in the event of a crash has been of limited success. Positive results have been obtained in airbag studies but this technology has failed to make a commercial break through. Leg protectors have been difficult to design without potentially having negative effects on other parts of the body. Full protective cages on motorcycles have proved a commercial failure, likely to be due to the marked effects they have on the handling of the motorcycle (ETSC, 2008). Recent research in France has produced promising results for airbags located within the motorcyclist's jacket. Computer simulations of pendulum tests conducted on a finite element (HUMOS) model have shown that the inflation of the airbag was associated with a reduction in both the maximum applied load and chest deflection resulting from the pendulum impact. These effects would be likely to be related to reductions in serious injuries to the thorax at the higher speeds tested (Thollon, Godio, Bidal & Brunet, 2008).

8.1.3 The road environment

It is difficult to design a road environment that protects motorcyclists adequately but there are some components of road design and road/roadside infrastructure that can be used to reduce motorcyclist crash or injury risk. The European Traffic Safety Council report (2008) included a substantial section on road infrastructure measures to aid motorcycle safety.

The high crash risk for motorcyclists on curves can be addressed in part by road engineering measures. These include predictability of road geometry such that there is a wide and constant radius, good visibility through the curve achieved through the elimination of vegetation and other objects, adequate speed signage, avoidance of obstacles in the outer curve (sign posts, lighting poles, guard rails if possible), and a maximum distance from the edge of the road to any guard rails that are present (ETSC, 2008).

The importance of collisions at intersections, with poor visibility a major factor, suggests that signs, barriers and vegetation near intersections that may obscure a motorcycle should be removed. Entry angles should be 30 to 40 degrees (ETSC, 2008).

The ETSC (2008) report also examined the issue of roadside hazards. It was noted that in the MAIDS database, a fixed object was the fourth most likely obstacle struck by a motorcycle in a crash, yet roadside infrastructure standards are determined on the basis of the characteristics of car impacts. Design principles suggested in the report include: minimising the presence of obstacles on high speed bends, eliminating jagged or sharp edges on supports, avoidance of road safety barriers if alternative measures are sufficient, keeping a clear zone for the first few metres beyond the road edge, and motorcycle friendly barriers in places of risk. Additionally, consideration should be given to the needs of motorcyclists when designing speed humps and locating drainage covers (ETSC, 2008).

In the USA, NHTSA (2006) also reported that the propensity for motorcycles to hit fixed roadside objects was an important consideration for road infrastructure treatments. Suggested countermeasures include flattening curves, installing rumble strips, installing retroreflective signs, ensuring forgiving roadsides, and using skid resistant pavements and all weather pavement markings.

Other road infrastructure issues of note, according to ETSC (2008), include the need for good, constant surface grip on the road, especially through bends; the preference for tramlines to be embedded in the roadway; the importance of road maintenance; that road markings often have different skid resistance to the rest of the road and so are best not to have on bends or roundabouts; and that road safety audits need to consider the needs of motorcyclists, specifically grip, curvature, obstacles and barriers (ETSC, 2008).

The Motorcycle Safety Consultative Committee (2008) report included a small number of recommendations on road infrastructure and motorcycling. These were maintaining an Australian-wide website for reporting road hazards to which people could upload data, photos and treatments; taking account of the needs of motorcyclists in road audits; and continued use of black spot funding. Evidence suggests that there is no strong economic justification for black spot investment solely for motorcyclists but that investment in proven treatment types within an overall program benefits all road users (Andrea, 2006; MSCC, 2008).

A study is currently being conducted in Australia into road safety barriers and motorcyclists. As part of this study, Grzebieta et al. (2009) reviewed five years of national fatal crash data to assess the extent of the role of barriers in motorcyclist deaths. It was found that over five percent of motorcyclist fatalities involve an impact with a barrier, with 12 percent of cases unknown. Across Australia, there are 13 to 14 such fatalities per year, with three in South Australia. These numbers are low compared with other modes of injury, such as impacts with other fixed objects or collisions with other motor vehicles. The most commonly struck barriers were W-beam guardrails (81%), followed by concrete barriers (10%) and wire rope barriers (4.5%). Determination of exposure to assess the expected levels of involvement for different barrier types is difficult as different barriers are used in different types of location. Wire rope barriers are mainly used on straight roads while W beams are used more on curvy and hilly roads where motorcycling enthusiasts like to ride. Therefore, installed length of barrier is not an appropriate measure of exposure (Grzebieta et al., 2009).

Tan, Tan and Wong (2008) summarised previous research on guardrails and motorcycle crashes. They reported that such crashes tend to be severe as a high proportion of the total impact velocity is perpendicular to the struck surface. The motorcycle and rider tend not to be re-directed by barriers, as the rider tends to be catapulted over the barrier or to slide along the road and hit the barrier posts. Posts are particularly dangerous, being five times more likely to cause a severe injury than a typical motorcycle crash. An ideal barrier system would not allow impacts with posts that cause concentrated loads on the body. Instead, they would have a continuous surface to provide for greater distribution of contact forces over the body area, and would have the capacity to dissipate impact energy through deformation. The authors used simulations to test a barrier system comprised of three polypropylene V-profile beams that combined to produce a 1.39m high barrier (a typical W beam is 0.73m high). It was found to be superior to polypropylene W beams and steel W beams. The advantages of polypropylene, according to the authors, are that it is tough, semi-rigid and requires large plastic deformation before it fails; that it is light, resistant to chemicals and staining, heat resistant and has low moisture absorption; and that it is cheap and easy to manufacture (Tan, Tan & Wong, 2008).

In South Australia, a new guardrail treatment for existing W beams is being used by DTEI in a trial on a 2km section of Gorge Road with a marked crash history. The system being used is the BASYC Protection System developed in Spain. This system involves a flexible mesh barrier being fitted to the W beam. The BASYC barrier has the same advantageous properties of the system described by Tan et al. (2008) above. It is also being used in Victoria and Queensland.

Some authors have argued that, given the difficulty of improving motorcycle safety for the current distribution of speeds, it may be that safe motorcycling in the future requires substantial reductions in speed. Such 'slow motorcycling' could be an environmentally friendly (in comparison to cars) means of travel within urban areas. If 'slow motorcycling' is to be encouraged, there would need to be specific road space allocated to it, possibly shared with pedal cycles and pedestrians. Those who have raised this issue include Oxford Systematics (2000, especially p. 52), Haworth (2006), and Hutchinson and Lindsay (2009, Section 10.3). Any consideration of redesigning the road environment to give greater space to environmentally friendly wheeled traffic (pedal cycles, power-assisted bicycles, slow motorcycles, and perhaps other technologies) and pedestrians would have to start from what already exists. This suggests the need for a detailed examination of the practicability of improving facilities everywhere in the Adelaide Metropolitan Area or, more practicably, at a random sample of places. It would be valuable to know at what proportion of places it would be difficult to improve provision for environmentally friendly modes, and at what proportion it would be quite easy and cheap. The types of facilities that might be considered would include the following:

- on-road cycle lane, separated from motor traffic by a painted line;
- cycle lane, separated from motor traffic by a kerb or other physical barrier;
- conversion of footpath to shared use by pedestrians and cyclists;
- priority for cycles on a secondary road parallel to an arterial route, with motor traffic limited to low speed and perhaps one way only;
- off-road cycle path;
- elevated cycle lane above road.

8.2 South Australian needs

South Australia could benefit from a review of traffic enforcement related to motorcycling. The choice of the most appropriate enforcement practices would need to be guided by a detailed understanding of motorcycling crashes. It could be that a community policing project combining enforcement and education similar to that being conducted in Victoria would have benefits here. Such a policing project would involve additional enforcement but also interactions with motorcyclists in which riding skills and protective clothing could be discussed. Any such project should be implemented with an evaluation in mind. It could be useful to undertake roadside observational studies and speed surveys before and after the project. Encouraging riders to wear better protective and more conspicuous clothing could be done separate from police involvement but, again, evaluations would be important.

With regard to motorcycle-based technology, the likely effectiveness of ITS solutions needs to be examined. A thorough understanding of the characteristics of motorcycle crashes would be needed as a basis for determination of the possible harm reduction through greater use of various new technologies on motorcycles. The technologies in question could then be prioritised for promotion or legislation. The effectiveness of new technology on motorcycles also needs to be established in the field. This requires a certain degree of market penetration for the technology and also detailed motorcycle information available in the analysed crash data set. Prior to that, it could be useful to undertake trials of different technology on a sample of motorcycles, with outcomes measured both objectively and through feedback from riders.

With regard to infrastructure, a good deal is known about the available countermeasures for motorcycle crashes. South Australia could benefit from an analysis of crash characteristics and locations to determine the infrastructure treatment types most likely to prevent crashes or reduce injuries in this State.

9 Data sets available in South Australia

In addition to the TARS (Traffic Accident Reporting System) database of police-reported crash data, data sets available in South Australia that could be used to examine some of the research areas discussed in previous sections include:

- CASR in-depth crash database
- Compulsory Third Party (CTP) database
- Hospital case notes from the Royal Adelaide Hospital
- Forensic Science Centre of SA data
- Integrated South Australian Activity Collection (ISAAC) data
- Bent and Buckled Bikers' Brigade (4Bs)
- Licensing data
- Registration data
- Speed survey data

The CASR in-depth crash database contains detailed information pertaining to the road user, vehicle and road environment for a sample of crashes. The database includes 236 rural crashes investigated between 1998 and 2000, 298 metropolitan crashes investigated between 2002 and 2005, and, at the time of writing, 238 crashes investigated since 2006 (a mixture of rural and metropolitan, mostly the former). In total, the databases contain 30 metropolitan area motorcycle crashes and 41 rural area motorcycle crashes.

The Compulsory Third Party database includes information pertaining to claims made to the Motor Accident Commission for third party injury payments. This database contains injury summary data, both for type of injury and coded severity. Cost of treatment is also included, in addition to crash type. It would be possible to link these records with the associated TARS records to examine relationships between TARS crash characteristics and injuries and costs.

CASR is currently collecting hospital case notes, the definitive source of injury and treatment information for crash participants, for drivers, riders and pedestrians treated at or admitted to the Royal Adelaide Hospital from 2008 to 2010. The data collected include:

- Date, time and location of crash
- Injuries sustained in the crash
- Length of hospitalisation as a result of injuries
- Long term health outcomes as a result of involvement in the crash
- Documentation related to pre-existing medical conditions
- Documentation of medication use at the time of the crash
- Results of diagnostic tests

These injury data are being matched to TARS records, and so we are able to examine detailed injury data for its association with TARS-recorded crash factors. Furthermore, the data are being supplemented with licensing information from the Registrar of Motor Vehicles. These data include licence status, any conditions on the licence, periods of licence suspension, and traffic infringements. Forensic Science Centre of SA data pertaining to the results of blood screening for alcohol and drug use are also being collected. Between January 1 2008 and July 31 2009, records were collected for 750 road users, of whom 187 were motorcyclists.

Patients admitted to hospital have the details of their injuries and treatments entered into the Integrated South Australian Activity Collection (ISAAC) maintained by SA Health. The information in ISAAC includes date of birth, sex, postcode, external cause of admission, place of injury, date and length of admission, coding of injuries and coding of treatments. Injury information could thus supplement the routine data on crashes in TARS records by using date, place, age and sex. Concerns over privacy are important and would need attention but it should be possible to satisfy these as patient name is not included and the usefulness of the data lies at the statistical level, not at the individual level. This, again, would enable analysis of the association between injuries and crash factors but for a larger number of cases than available using the RAH case notes. Currently, CASR does not have access to ISAAC but this could be pursued if considered useful.

The Bent and Buckled Bikers' Brigade (4Bs) is a data collection program operated by Motorcycle Riders Association volunteers in South Australia, which involves interviewing injured riders in hospital about their crash. The nature of any sampling biases in the data collection is unclear. CASR has been provided with around 400 cases extending back to the 1980s. Around 100 of these are for the period since 1990. It is hoped that CASR could continue to obtain these data in future. Again, a number of variables could be used to match the records to those in TARS (and again, matters of privacy and confidentiality would need to be strictly controlled). Data recorded by the 4Bs include: sex and age of rider, type of licence held, riding experience in years, whether a pillion was being carried, date and time of crash, location of crash, description of the crash, make and model of the motorcycle, clothing worn, helmet type, speed zone, lighting, road surface, weather, hospital attended, and description of the injuries. Note that the data are all self-reported.

As indicated above, CASR can access Registration and Licensing data kept by DTEI. Licensing data includes offences and licensing history for riders. Registration data would include make, model and engine size, and could be used to compare the distribution of registered motorcycles with the distribution of those involved in crashes. The crash-involved motorcycles in TARS could be matched to the associated registration database entries, again being careful with regard to issues of privacy and confidentiality. CASR also has access to the Polk database of VINs but, as noted earlier in Section 2.2, VINs for motorcycles are not included in their database.

CASR is responsible for managing the yearly collection of speed data for a one week period at each of 130 sites around South Australia. The collection started in 2007 with a subset of sites extending back to 2002. This allows for speeds of vehicles to be tracked systematically over time. It should be possible, using the number of axles and wheelbase variables, to identify motorcycles in the traffic distributions recorded at these sites. This would enable analysis of motorcycle speeds and comparison with the speeds of other vehicles at the same sites.

10 Summary and conclusions

A review of recent literature was undertaken to determine knowledge gaps with regard to motorcycling in South Australia. Topics addressed include: motorcyclist numbers, motorcycle riding exposure, motorcycle crashes (number and type), motorcyclist injuries, rider licensing and training, road user attitudes, and countermeasures.

General findings are the following:

- Increasing numbers of motorcycles, especially scooters
- Increasing older riders
- Increasing riding exposure only due to increased numbers of motorcycles
- Increasing crashes due to increasing exposure, especially for scooters
- A much higher crash risk than other forms of road transport
- A large proportion of crashes are single vehicle, run-off road crashes (especially on curves) and multiple vehicle crashes involving right of way violations by other road users
- A higher risk for returning riders and new riders
- A possible problem related to unlicensed riders and unregistered motorcycles
- A tendency for injuries to shoulders, upper limbs and lower limbs
- A tendency for fatalities to be related to head injuries
- A lack of recent research into traffic law enforcement related to motorcycles
- A reduction in crash risk associated with headlight use, and high conspicuity helmets and clothing
- A likely benefit for more advanced braking systems but some resistance among motorcyclists for ITS solutions
- A good knowledge base regarding possible infrastructure treatments that can reduce crash risk

There are gaps in the knowledge base for all areas but there is a particular need for more detailed knowledge about:

- The age and sex of motorcycle owners, by motorcycle type
- Riding exposure – not just how much but by whom, on what motorcycle, where and when
- The nature of crashes – the main contributing factors and the characteristics amenable to countermeasures
- Who is at fault in multiple vehicle crashes
- Fatigue and riding – extent of the problem, whether it is more sleepiness or task-related fatigue, and whether it is cognitive or physical
- Motorcyclist injuries as they relate to characteristics of the rider, motorcycle and crash
- How well South Australian training and licensing practices compare with best practice
- Rider attitudes, particularly related to perceived risk of detection for riding offences and attitudes or practices related to protective clothing
- The effectiveness of current traffic law enforcement practices
- The possibility of promoting greater use of conspicuous clothing with evaluation of effectiveness

- Examination of the possibility of ‘slow motorcycling’ in shared paths with bicycles and pedestrians
- The likely effectiveness of various new technologies to reduce South Australian motorcycle crashes
- The most useful road infrastructure treatments for preventing motorcyclist crashes or injuries

A number of data sets are potentially useful for future research by CASR into motorcycle safety in South Australia. These include:

- CASR in-depth crash database
- Compulsory Third Party (CTP) database
- Hospital case notes from the Royal Adelaide Hospital
- Forensic Science Centre of SA data
- Integrated South Australian Activity Collection (ISAAC) data
- Bent and Buckled Bikers’ Brigade (4Bs)
- Licensing data
- Registration data
- Speed survey data

Some data linkage is possible, with considerable linkage having already been accomplished between hospital case notes, TARS data, licensing data and Forensic Science Centre of SA data. The information on around 200 motorcycle crashes available in this linked database could be a good starting point for future research.

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Appendix A – Costs of motorcyclist injuries

This Appendix has the following Sections:

A1. How many motorcyclist casualties are there in South Australia?
A2. Should the number of motorcyclist casualties be adjusted?
A3. The cost of motorcyclist casualties, based on Baldock and McLean (2005)
A4. Updating for inflation.
A5. South Australia contrasted with Australia.
A6. Should the costs attributed to slight injuries be adjusted?
A7. Should the costs attributed to fatal injuries be adjusted?
A8. Should the costs attributed to serious injuries be adjusted?
A9. Conclusion.

This note was prepared in a limited time and without searching for relevant research literature. The costing of crashes and their consequences is difficult and controversial, both as regards the principles (e.g. "human capital" versus "willingness to pay" valuations of statistical life) and as regards the practicalities of estimating the various components.

A1. How many motorcyclist casualties are there in South Australia?

Average motorcyclist casualties per year were as follows in 2006-2008:

Fatal	16
Admitted to hospital	183
Treated at hospital	321
Treated by private doctor	89

This suggests it is desirable for the costs for those seriously injured to be expressed with about ten times the precision of those for fatalities, and the costs for those slightly injured (treated by hospital or by private doctor) to be expressed a little more precisely again.

A2. Should the number of motorcyclist casualties be adjusted?

The above figures refer to accidents reported to the police, the data being passed on by them to DTEI (Department for Transport, Energy and Infrastructure) and then to CASR (Centre for Automotive Safety Research, University of Adelaide).

Police accident statistics undercount the true number of casualties. It may be that they do so to a greater extent for motorcyclist casualties than for other categories of road casualty. However, no adjustment will be made for this, as police accident statistics are used much more commonly than hospital in-patient statistics (for example).

A3. The cost of motorcyclist casualties, based on Baldock and McLean (2005)

A3.1 Average costs per casualty

The following figures are based upon Table 5.4 of Baldock and McLean (2005). In turn, that was based on a report by the Bureau of Transport Economics (BTE), updated to account for inflation to 2004 (Bureau of Transport Economics, 2000). The “human capital” approach to the value of a statistical life is used.

(a) Fatalities

	(millions of dollars)
Human --- Lost labour in the workplace	0.6
Human --- Lost labour in the household and community	0.6
Human --- Quality of life	0.4
General --- Travel delays	0.1
Other	0.1

(b) Serious injuries

	(millions of dollars)
Human --- Lost labour in the workplace	0.03
Human --- Lost labour in the household and community	0.03
Human --- Quality of life	0.04
Human --- Hospital in-patient	0.01
Human --- Other medical	0.01
Human --- Long term care	0.11
Human --- Legal	0.03
Human --- Workplace disruption and staff replacement	0.01
Vehicle --- Vehicle repair	0.01
General --- Travel delays	0.05
Other	0.01

(c) Slight injuries

	(millions of dollars)
Human --- Quality of life	0.01
Vehicle --- Vehicle repair	0.01
Other	0.00

In the light of the numbers of motorcyclist casualties of different severities, the above are the main categories of costs that are of concern.

A3.2 Result of multiplying the numbers of casualties by the average cost per casualty

The average costs shown below are based upon Table 5.4 of Baldock and McLean (2005). They are not always the same as the sums of those in Section A3.1 above because of rounding.

	Number	Average cost (million$)	Total cost (million$)
Fatal	16	1.7	28
Serious	183	0.33	61
Minor	410	0.02	7
Total			96

So the initial estimate is that motorcyclist casualties in South Australia cost some 96 million dollars annually. (Baldock and McLean estimated the cost of all crashes in South Australia to be 1176 million dollars.)

A4. Updating for inflation

Baldock and McLean (2005) updated the costs to March 2004. Updating further to December 2008 necessitates an increase of 15.2 per cent.

	Number	Average cost (million$)	Total cost (million$)
Fatal	16	2.0	32
Serious	183	0.38	70
Minor	410	0.02	8
Total			110

Thus updating for inflation leads us to conclude that motorcyclist casualties in South Australia cost some 110 million dollars annually.

The same method leads to an average cost of all casualty crashes in South Australia of 862 million dollars annually: motorcyclist casualties are some 7.4 per cent of the total, but their higher severity means that they account for some 12.8 per cent of costs.

A5. South Australia contrasted with Australia

The cost figures in Bureau of Transport Economics (2000) and hence in Baldock and McLean (2005) refer to Australia rather than South Australia. It is not customary in Australia to cost road casualties differently in different states, and so no adjustment is made for this.

A6. Should the costs attributed to slight injuries be adjusted?

The questions of whether costs for slight and fatal injuries should be adjusted will be dealt with quite briefly in this and the next Section. The question of whether costs for serious injuries should be adjusted is a more difficult one, and will be discussed in Section A8.

Section A3.1 above shows that there are two major categories of costs.

> Human - Quality of life. It is likely that this category of costs will be greater in the case of motorcyclists than for other categories of road casualty: for motorcyclists, those treated at hospital were 78 per cent of the minor casualties, whereas for road casualties as a whole, those treated at hospital were 62 per cent of the minor casualties.
>
> Vehicle - Vehicle repair. It is likely that this category of costs will be less in the case of motorcyclists than for other categories of road casualty.

As one of these components is bigger and the other is smaller for motorcyclists, it is suggested that the same figure for slight injuries be used for motorcyclists as for other road casualties. Slightly injured casualties account for only some 8 per cent of total costs (see Section A3.2); thus imprecision about this component will not have much effect on the total.

A7. Should the costs attributed to fatal injuries be adjusted?

Motorcyclists differ demographically from other categories of road casualty. For example, their ages may be different, there are a greater proportion of males, their incomes may be different. This could be taken to suggest adjustment of the value of a statistical life. However, there is no tradition in Australia of discriminating between categories of road casualty on demographic grounds. Indeed, it is noted in Bureau of Transport Economics (2000, Table 3.1) that the human capital approach to valuing human life would, if simplistically applied, undervalue the very young and old. It is plain from the use of the phrase “if simplistically applied” that adjustment is being rejected as a matter of principle. Consequently, no adjustment is made in the present note.

The principle on which the Bureau of Transport Economics (2000) based their calculation of the cost of a fatality is contentious. Specifically, it uses the “human capital” method. A number of authorities have come to prefer the “willingness to pay” method. In the interests of consistency, no adjustment will be made for this.

A8. Should the costs attributed to serious injuries be adjusted?

A8.1 Data on hospitalisation

For Australia, the average length of stay in hospital is very similar for motorcyclists and car occupants: 4.5 days for male motorcyclists and 5.2 days for male car occupants (Bradley and Harrison, 2008, Figure 3.4). (And for male pedestrians, pedal cyclists, and truck occupants, the average lengths of stay were approximately 8 days, 3 days, and 5 days.)

A8.2 Evidence concerning a range of injury severities

The following figures refer to the whole range of injury severity, from none to fatal.

- Data from the Motor Accidents Authority of N.S.W. shows that average claim costs for motorcycle riders were two to three times higher than for drivers and passengers (Christie and Harrison, 2001, p. 375).
- For South Australia, 2004-2008, an email from Ross McColl to Paul Hutchinson gives average claims figures classified by type of road user. The figure for motorcycle riders is shown as $ 119 000, as compared with an average of $ 48 000 and a figure for drivers of $ 36 000.
- For the United States, it has been reported that motorcycle crashes are 3.9 times as costly as the average crash. (That is the ratio for “comprehensive” costs given in Table 2 of Wang et al., 1999.)

As they refer to the whole range of injury severity, these figures are of limited relevance. The proportion of motorcyclist crashes that involve serious injury is greater than for all crashes. That has been taken account of by discussing slight, serious, and fatal injuries separately.

A8.3 Discussion

Data in the report by Bradley and Harrison (2008) cited in Section A8.1 suggests that motorcyclists are not very different from other road users in respect of length of stay in hospital. Data that covers a range of injury severities cited in Section A8.2 indicates that motorcyclists casualties are much more costly than other road users, to a degree that may not be explicable by the greater proportion of motorcyclist casualties that are killed or seriously injured. There is some discrepancy here.

Motorcyclist casualties in South Australia cost some 110 million dollars annually. The costs from fatal, serious, and slight casualties are respectively 32, 70, and 8 million dollars. The first and third of these seem to be appropriate estimates, but there is a question mark over the second - motorcyclists may differ in the costs of their injuries from other categories of road casualty.

What effect might different injury costs have? The costs relating to lost labour, quality of life, and medical care (the first six items in A3.1(b) above) account for some 69 per cent of the total for seriously-injured motorcyclists. Costs relating to seriously injured motorcyclists are some 63 per cent of the total (= 70 / 110). Thus if, for example, costs relating to lost labour, quality of life, and medical care were really 50 per cent greater than so far estimated, this would imply a 22 per cent increase in the estimate of the cost of motorcyclist casualties in South Australia.

9. Conclusion

The most straightforward way of presenting the conclusions is to distinguish between the conventional measures of crash costs, and the crash costs as seen in claims data.

- In South Australia, motorcyclist casualties are some 7.4 per cent of the total, and cost about 110 million dollars annually, which is 12.8 per cent of the total.
- The South Australian claims data shows that motorcyclists account for 9.8 per cent of claims costs.

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