Motorcycle Crash Patterns for Riders aged 17-25 in NSW

Christie, R., RCSC Services Pty Ltd, & Harrison, W., Eastern Professional Services Pty Ltd

Abstract
The Motor Accidents Authority of NSW (MAA) funded the authors to investigate motorcycle crash patterns for riders and pillion passengers aged 17-25 in NSW using Roads & Traffic Authority (NSW) crash data and MAA compulsory third party (CTP) insurance claims data for the period 1989-2000 inclusive. This paper summarises the findings of the study reported to MAA in early 2002. The majority of crash-involved motorcycle riders were male with a similar proportion across all age groups and motorcycle types. By contrast, the majority of crash involved pillion passengers were female, with a higher proportion in the over 25 year old group. In general, the study found that riders aged above 25 years were at greater risk of crash involvement and more severe injury than those aged below 25 - except for underage and/or unlicensed riders. Mean total claims cost was higher for riders and pillions aged over 25 years - claims cost was related to injury severity and vice versa. Unlicensed use was more common among crash involved riders aged below 25 years – about three times the rate for those aged over 25 years. Analysis of MAA claims data showed sports type motorcycles to present a high crash and injury risk to all age groups of riders - particularly riders aged below 25 years. Sports type motorcycles also presented a particular risk for both male and female pillion passengers. Conclusions regarding the study findings are presented together with countermeasure recommendations.

Introduction

The Motor Accidents Authority of NSW (MAA) funded the authors to investigate motorcycle crash patterns for riders and pillion passengers aged 17-25 in NSW using Roads & Traffic Authority (NSW) crash data and MAA compulsory third party (CTP) insurance claims data for the period 1989-2000 inclusive.

This project was completed in two stages. The first stage investigated and summarised motorcycle crash patterns for NSW riders aged from 17-25 years (including pillion passengers) using Roads and Traffic Authority (RTA) accident data for the period 1991-2000 inclusive and NSW Compulsory Third Party (CTP) Insurance Scheme claims register data for the period 1990-2000 (see Christie & Harrison, 2002). Patterns for these younger riders were compared with those for those aged over 25 years. NSW data were supplemented by Australian motorcycle fatality data from the Australian Transport Safety Board (ATSB) and vehicle use survey data from the Australian Bureau of Statistics (ABS) for similar time periods to provide a national perspective. A brief review of the international literature related to motorcycle accidents, fatalities and injuries was also conducted to provide a perspective on motorcycle crash patterns in comparable overseas jurisdictions (eg USA, Canada and United Kingdom). Patterns that emerged from the analysis were compared with those identified in other jurisdictions within Australia (eg Victoria and SA) and overseas to determine where commonalties and differences may lie. Descriptive and inferential multivariate data analyses based on RTA and MAA data were completed where possible and appropriate.

The second stage of the project used the results from the first stage to identify targets for countermeasures and the approaches or initiative recommended for application to these target areas. A rationale for the suggested approaches was also provided, together with an indication of the agencies likely to be involved in implementation.

As a supplement to the original investigation, MAA funded the matching of MAA motorcycle claims data for the period 1989-1999 inclusive with make, model and type information and analysis of the resulting file to determine claim patterns for riders (and pillions) aged 17-25 years, compared with that for those aged over 25 years (see Christie, 2002). The unique vehicle identification number (VIN) details for the 2,871 motorcycles in the merged file of MAA (CTP) motorcycle related claims 1990-1999 inclusive created in the course of the original study for MAA were matched against details held on the Australian national vehicle database. This matching process allowed 2,818 of the 2,871 motorcycles to be assigned a model - a 98% match rate.

Motorcycle type rather than model was used in the study as some 650 models, and variants, were identified across 28 makes via the matching process. As this number of models was unworkable for analysis purposes, it was decided that type of motorcycle would be a more useful classification system for use in this report. Motorcycles were classified against 10 basic types based on structure, configuration and intended use that appeared in National Highway Traffic Safety Administration/ Motorcycle Safety Foundation (NHTSA/MSF) (2000) and are commonly used within the motorcycle industry (eg traditional/naked, sports, tourer, trail/dual-purpose)

As this paper provides only a brief overview, without explanatory tables and figures, the authors refer the reader to the full reports for more a more comprehensive treatment (ie Christie & Harrison, 2002 and Christie, 2002).

Summary of Patterns of Motorcyclist Casualty Crash Risk/Involvement from the International, National and NSW Literature

Australian and international crash data, and reports in the literature, show that motorcycle riders carry a far greater risk of casualty crash involvement than the occupants of passenger cars (Christie & Newland, 2001; Christie & Harrison, 2002). Based on NSW and Victorian data, the risk of casualty per distance travelled for Australian motorcycle riders is of the order of 16-18 times that of passenger car occupants (VicRoads, 2000; RTA, 2001).

While casualty risk is still high relative to passenger cars, patterns of motorcycle use, fatality and injury have changed over the last 10-15 years with exposure-to-risk (ie average estimated distance travelled per annum for motorcycles fell by about 50% between 1985 and 1999 – ie from about 6,500 kilometres per annum to about 3,100 kilometres per annum (Christie & Harrison, 2002; Australian Transport Safety Bureau (ATSB) web site: www.atsb.gov.au). However, the average distance travelled by passenger cars fell only slightly in the same period from about 15,500 to 14,400 kilometres per annum. This marked reduction in exposure may have been the major contributor to the approximately 44% reduction in motorcycle fatalities per registered motorcycle reported by ATSB for the period 1987-1997 (ATSB, 2000). However, it is of note that, at a national level, total motorcycle fatalities per distance travelled increased in 1998 and 1999 and the number of fatalities in 2000 exceeded those for each of 1997 to 1999 inclusive (see Australian Transport Safety Bureau (ATSB) web site: www.atsb.gov.au).

At a national level, motorcycle riders aged less than 25 years appear to have markedly reduced their involvement in fatalities and hospitalisations over the last 10 years (Christie & Newland, 2001). The number of fatalities involving riders aged less than 25 years across Australia in 2000 was less than half of that for 1990 (ie 52 and 116 fatalities respectively). While this reduction could be due to the direct effects of more stringent rider training and licensing programs introduced around Australia from the mid 1980's, it could also be the product of reduced exposure to risk as riders aged under 25 years reduced the average annual distance they travelled by about 45% between 1991 and 1999 - ie from about 6,300 kilometres per annum to about 3,400 per annum (Christie & Newland, 2001). However, the average distance travelled by riders aged 25-54 years fell less dramatically in the same period from about 5,400 kilometres per annum to 4,300 kilometres per annum

Driver licensing data from NSW shows that the number of motorcycle licence holders aged under 30 years also fell by about 42% between 1990 and 2000, suggesting that there may have been fewer younger riders riding fewer annual kilometres over the last decade (RTA, 2001). An indirect effect of more stringent rider training and licensing programs introduced around Australia from the mid 1980's may have been to discourage motorcycle licensing among younger people leading to a consequential reduction in exposure and a reduction in fatality/injury involvement for younger motorcyclists (Christie & Newland, 2001).

While there is some evidence of a shift in crash risk towards older riders and good evidence that the crash risk for younger riders has declined, they continue to be substantially over-represented in crash statistics (RTA, 2001). The limited literature makes it difficult to make any firm predictions about factors associated with crash involvement in younger riders compared to older riders.

Summary of Patterns of Motorcycle Crash Risk/Involvement in RTA Accident Data 1991-2000

Analysis of RTA accident data suggests that riders aged above 25 years are at greater risk of crash involvement than those aged below 25, except for underage and/or unlicensed riders. This is consistent with findings in respect of motorcycle crashes at a national level and in the published literature.

Across all motorcycle-involved accidents, underage and unlicensed (ie unlicensed, expired, cancelled or disqualified) riders had higher rates of crash involvement and greater levels of injury severity than legitimately operating riders. However, unlicensed use was more common among riders aged below 26 years – about three times the rate for those aged over 25 years. These findings are consistent with the Australian and international literature whereby "unriders" pose an elevated crash risk to themselves and others, including pillions.

Illegal riders and their pillions were more likely to be killed or severely injured than legitimately operating riders. Underage riders were more likely to collide with pedestrians and to have been riding on footpaths or the wrong side of the road. Illegal riders were less likely to have been riding with headlamps on and more likely than legal riders to be the operator of the key vehicle involved in the accident.

Overall, analysis suggests that there were few age-related differences in motorcycle crash patterns other than those noted above. Across all age groups, most motorcycle crashes in NSW occurred in daylight, on sealed roads and in fine weather in 60km/hour or 100km/hour speed zones. They occurred mainly in urban road environments in the Sydney Statistical Division (SSD) and/or in the urban areas of country towns and regional centres. Most motorcycle crashes occurred within 10 kilometres of the rider's home – this pattern is similar to that reported for the drivers of cars and other vehicles in NSW and elsewhere – with only the rider on the motorcycle (ie no pillion). Fatigue, rider

distraction, or equipment failure was rarely reported as being factors present in motorcycle crashes. While most riders and pillions wore helmets, non-wearing rates were higher for younger riders/pillions and illegal riders (and their pillions). Most collisions were with one other vehicle, usually a car. Single motorcycle crashes where the machine ran off the road on a straight or curve constituted the largest road user movement (RUM) code group (about one third of all motorcycle accidents).

Summary of Patterns in MAA Motorcycle Accident Claims and Vehicle Data 1990-2000

Analysis of CTP claims register data showed a similar pattern to that for the RTA accident data in that injury severity (Maximum Abbreviated Injury Scale (MAIS)) and mean total claim cost were generally higher for riders aged above 25 years. However, multiple regression analysis failed to find a strong/significant relationship between claims cost and rider age, accident location, motorcycle engine capacity and/or motorcycle age. The key finding of multiple regression analysis was that claims cost was related to injury severity and vice versa – no other relationships achieved statistical significance. This suggests that severity reduction should be a primary MAA countermeasure target in the motorcycle accident area.

The majority of MAA motorcycle rider claimants were male (>95%) with a similar proportion across all age groups. However, the majority of pillion claimants were female (about 72%), with a higher proportion in the over 25 year old group.

Mean total claim cost (in dollars, unadjusted for inflation) was higher for riders and pillions aged over 25 years – ie about $93,000 for the older group and about $88,000 for the younger. For riders within the younger age group (ie less than 26 year olds), mean total claims cost rose with age. This was also true for pillions, except for under 17 year old pillions where the mean total claim cost was highest (about $118,000).

Mean total claim cost rose uniformly with motorcycle engine size, but with higher costs among the older age group (ie over 25 years old). Injury severity and mean total claim cost were higher for older riders. However, injury severity was higher among younger pillions.

Younger riders incurred higher claim costs in the Hunter Statistical Division and in areas outside of the Sydney Statistical Division (SSD). This was consistent with injury severity patterns. While older riders experienced their highest claim costs in the greater Sydney area, injury severity was generally greater outside of the SSD. Younger pillions also experienced greater claim costs in the SSD. Again this was consistent with injury severity patterns. By contrast older pillions incurred greater claim costs, and greater levels of injury severity, in areas outside of the Hunter or Sydney Statistical Divisions.

Claims by Type and Make of Motorcycle

The highest proportion of claims (about 39%) related to sports type motorcycles followed by traditional type motorcycles (about 24%) and trail (dual-purpose) types (about 16%). These three types accounted for almost 80% of MAA claims. The high proportion of sports type motorcycle claims may reflect the rising popularity of this type of machine among Australian riders.

Comparison of RTA motorcycle registration data for NSW with MAA claims showed that the eight most common makes of motorcycle (ie (BMW, Ducati, Harley Davidson, Honda, Kawasaki, Suzuki, Triumph and Yamaha) accounted for 94% of registrations and 98% of claims. Suzuki and Kawasaki were the only makes over-represented in respect of total claims by make relative to their respective representation among motorcycles on register. While Suzuki accounted for 13.1% of all registered motorcycles in NSW, it accounted for 19.6% of total MAA claims (ie over-represented by a factor of 1.5). Similarly, Kawasaki accounted for 12.1% of all motorcycle on the register, but 17.5% of total MAA claims (over-represented by a factor of 1.45) .For the other six most common makes, their total MAA claims representation was less than their representation in the RTA registration database. As distance travelled per annum data was not available by make, model or type, it was not possible to confirm if this pattern persisted when exposure-to-risk was considered.

Makes such as Ducati, Kawasaki, Suzuki and Yamaha stood out in terms of sports type motorcycle claims, while Harley Davidson predominated in respect of cruiser type motorcycles. When total MAA motorcycle claims were broken down by make and type, Suzuki sports motorcycles stood out as the largest single group within the data set (over 13% of all motorcycle related claims) closely followed by Kawasaki sports machines (11%). Trail bike claims were dominated by Honda and Yamaha.

Sports type machines were represented across all engine capacity groupings of crash-involved motorcycles from the smallest to largest with the 501-750cc grouping accounting for the highest proportion. By contrast, cruisers were concentrated in the largest capacity grouping (1250cc plus) and trail bikes in the smallest (up to 250cc)

class. Thus, sports type machines stand out in terms of claims overall and within most engine capacity groupings.

Based on mean total claim cost, the cruiser type of motorcycle was the most expensive (ie about $105,000), followed closely by the sports (about $100,000), trail (about $92,000) and traditional types (about $91,000), while the touring type was the least expensive (about $63,000). Claim costs in respect of some motorcycle types were therefore higher than for others.

When age of rider was taken into account, riders aged 25 years or more had higher mean total claim cost across all types of motorcycle except the sports machines where the younger age group generated a higher mean total cost. This suggests that riders aged less than 25 years may be having more severe and costly crashes only on sports motorcycles.

MAIS categories 1-3 (ie minor to serious injury) accounted for the majority of injury (80-90%) within each motorcycle type for all riders and for those aged above/below 25 years. For all riders, scooters generated the most severe injuries and trail type motorcycles the least severe. While sports machines accounted for the most severe injuries to younger riders, somewhat surprisingly, touring machines generated the most severe injuries for riders aged 25 years and above. This may be an artefact of the relatively small number of claims involving touring machine riders.

About 95% of riders making claims were male. The proportion of claims for male and female riders was similar for traditional type motorcycles. However, the proportion of claims was relatively higher for females on cruiser type machines and on scooters. For males, proportions were higher on sports and trail machines. This pattern may reflect a preference among females for traditional and cruiser types and for scooters.

The majority of pillion claimants were female (about 72%). Most pillion claims related to sports type motorcycles. - surprising as sports machines are not primarily designed for pillion passenger carriage. This factor may contribute to a greater crash risk for this type of motorcycle when carrying a pillion passenger. Both female and male pillion claimants were most likely to have been injured on a sports motorcycle and least likely to have been injured on a touring machine.

For all types of motorcycle, most claims related to crashes that occurred in the SSD – highest for sports motorcycles and lowest for trail bikes. Outside of the SSD, claims related to trail bike claims were the highest. For riders aged above and below 25 years, the majority of sports bike claims originated from the SSD. Almost 80% of scooter claims related to riders aged 25 or more years in the SSD. In areas outside the SSD, trail bike claims were more common for riders aged above and below 25 years

Trail bikes represented the highest mean total claim cost for pillions overall (about $104,000). For pillions aged over 25 years, sports type machines represented the highest mean total cost (about $134,000). Small cell sizes prevented the inclusion of data for all under 25 year old pillions except for those on sports motorcycles. Where age comparison was possible, higher mean total claim costs were evident for older (ie 25 years and above) pillion passengers for all types of motorcycle (eg for sports machines, about $58,000 for younger pillions and $134,000 for older pillions).

Conclusions

Few age-related differences in crash patterns were found between riders aged above or below 25 years of age. However, overall casualty crash involvement has reduced by up to 50% for riders in NSW aged to 25 years between 1990 and 2000 while riders aged over 25 years have experienced steady to increasing involvement. There appear to be fewer younger riders, riding fewer kilometres per annum relative to riders aged over 25 years. Indeed, the exposure to risk of younger riders has fallen steadily across the last decade and crash involvement has fallen proportionally. This suggests that older rather than younger riders may present a greater crash-reduction challenge to road safety agencies.

Older riders tended to have crashes on larger capacity motorcycles, particularly those of European and US manufacture (eg Harley Davidson and BMW), and to generate greater mean total cost claims than their younger counterparts. Indeed, mean total claim cost rose uniformly with motorcycle engine size. Mean total claims cost was also higher for pillions in the older age group. Crash involved younger age group riders (ie aged 17-25 years) incurred lower mean total claims costs and were more likely to be riding smaller capacity motorcycles of Japanese manufacture.

It is of note, however, that unlicensed riders were over-represented in the up to 25 year old age group – three times greater proportion than in over 25 year old group. These riders include those below minimum NSW

licence age (ie under 17 years old). Unlicensed riders pose a particular risk to themselves and others, including the pillion passengers that they may carry. These unlicensed riders, and their pillions, were less likely to have been wearing helmets when involved in crashes and more likely to be more severely injured and to accrue higher mean total claims costs. This suggests that underage and unlicensed riders should be a particular target of any countermeasure strategy.

The clear relationship between injury severity and mean total claim cost established via multiple regression analysis suggests that severity reduction should be a feature of any motorcycle safety strategy. Particular countermeasure components would relate to helmet wearing and the use of protective clothing for riders and pillions.

Gender difference between riders and pillions suggests that males should be the principal target of countermeasures aimed at riders (ie > 90% of riders of all ages are male) while females should be the major target in respect of pillion countermeasures (about 70% of all pillions of all ages were female). This suggests that gender-specific measures and emphases may be required in a countermeasure strategy.

While most motorcycle crashes occurred within 10 kilometres of the rider's home –regardless of age - crash location by severity and location patterns suggest that countermeasure development should emphasise areas excluding the Sydney and Hunter Statistical Divisions for younger riders and the reverse for older riders. For pillions, a nearly opposite pattern should be emphasised as younger pillions should be the focus for the SSD and areas other than Sydney and Hunter Statistical Divisions for older pillions.

Analysis of MAA (CTP) claim patterns suggest that sports type motorcycles are of concern for all ages of rider, but perhaps most for those aged below 25 year years, particularly males. Sports motorcycles also represent a particular risk for pillion passengers, both male and female. This finding suggests that there may be merit in MAA monitoring crash and claim patterns for motorcycles by type. This would enable the organization to detect change in risk or cost for particular motorcycle types and, if necessary, develop/implement appropriate countermeasures alone or in concert with other road safety agencies in NSW.

The concentration of motorcycle crash claims in the SSD, particularly for male riders on sports bikes, suggests that concentrating countermeasure efforts in the Greater Sydney area may be appropriate. Outside of the SSD, a particular emphasis should be on trail bike safety given the higher representation of this type of machine in claims in the Hunter and Rest of NSW SDs. Trail bikes also deserve attention as, though claims are small in number, they do generate the highest mean claim cost for pillion passengers.

Cruisers are also of some concern as sales of this type of motorcycle are strong and cruisers have the highest total claim cost for crash-involved riders.

It is of concern that older riders and pillions generate higher mean total claims cost. This may be age related in terms of the greater susceptibility to injury with advancing age reported in the literature (Evans, 2001). While professionals are aware of age and gender injury susceptibility for riders and pillions, the general public, including motorcycle riders and pillions may not be. This suggests that it may be worthwhile providing information on road injury risk by age to those engaged in motorcycle use or contemplating taking it up or returning to it.

Main Features of Suggested Strategy to Reduce the Involvement of NSW Motorcyclists in Crashes (including those aged 17-25 years)

The strategy components suggested below are a mix of approaches that have been shown to reduce crash risk and/or injury severity and those that have a reasonable logical or theoretical basis, but no empirical support per se. Based on the findings of this investigation and the published literature, it is suggested that a motorcycle strategy focused on reducing the crash risk, involvement and injury severity of riders aged less than 26 years include the following components:

People Focused Elements

- Targeting of "unriders" (ie un-licensed, un-derage, un-registered, un-roadworthy) to reduce the number of unlicensed and/or underage riders and unregistered and/or unroadworthy motorcycles on NSW roads;
- Diversion to RTA approved training and licensing programs for illegal motorcycle users otherwise eligible to hold a motorcycle licence – encourage illegal riders to become legal;
- Discouragement of drinking and riding – alcohol is still a major factor in crashes involving motorcycles in NSW and the proportion of accident involved riders with an illegal BAC has been consistently higher than that for car drivers;

- Discouragement of the borrowing and riding of unfamiliar motorcycles – the literature suggests that crash risk is higher for riders on borrowed motorcycles;
- Discouragement of the riding of 2-stroke race replicas, particularly among young riders – RTA NSW found these machines to be over-represented in crashes involving, young novice riders;
- Discouragement/deterrence of excessive and inappropriate speeding behaviour by motorcycle riders – the research literature suggests that speed contributes to the likelihood of collisions, run-of-the road crashes and to injury severity;
- Measures to improve the injury reduction benefits of motorcycle helmet wearing laws – enforcement of existing helmet laws for riders and pillions combined with information campaign on the dangers of using damaged or second-hand helmets;
- Refresher basic training for older riders returning to motorcycling after a period of years – older riders may be "dormant" licence holders with degraded riding skills;
- Promotion of the use of protective clothing for motorcycle riders and pillion passengers – local and international literature shows that protective clothing such as abrasion resistant jackets, trousers, gloves and boots reduce the likelihood and severity of injury to crash-involved riders and pillions;
- Encouragement of the drivers of other vehicles to be on the lookout for motorcycles - the literature suggests that other road users do not always see motorcycles in traffic;
- Promotion of exposure management among motorcycle riders and pillion passengers (eg not riding during high risk times, pillions not riding with inexperienced riders or those that they do not trust and not riding without protective clothing) - measures may need to be tailored to males/females; and
- Promotion of a "motorcycle aware" community that has some understanding of the risk factors for motorcyclists and how crash risk can be reduced as part of the development of safer communities.

Environment Focused Elements

- Provision of alternative riding locations for underage and non-road registered motorcycles to discourage illegal riding on-road;
- Measures to make the road environment more "motorcycle friendly ";
- Targeting of high risk/exposure sites for motorcycles;
- Adoption and application of motorcycle friendly road building, repair and maintenance standards and procedures (eg in line with Austroads traffic engineering guidelines regarding motorcycles);

Vehicle (and Equipment) Focused Elements

- Promotion of measures to increase motorcycle conspicuity – the literature suggests that motorcycles present a small visual target to other road users therefore increasing conspicuity reduces the risk of collision (eg riding with headlamp/running lights on, use of clothing/helmets in bright/conspicuous colours, choice of bright/conspicuous coloured motorcycles on purchase);

It may be possible to combine some of these components with those from strategies targeting road users more broadly in NSW (eg drink driving, speed management). While each individual strategy component is likely to make only a small contribution to the reduction of crash involvement and/or injury reduction, collectively they may produce worthwhile reductions in motorcycle deaths and injuries for those aged above and below 25 years.

References

Australian Transport Safety Bureau (ATSB) (2000). *Motorcycle Safety: Australia's international motorcycle safety performance 1987 to 1997. Monograph 4*, Canberra: Author.

Christie, R. & Newland, R. (2001). Motorcyclist fatality and motorcycle sales patterns in Australia. In *Proceedings, 2001 Road safety Research Policing and Education Conference*, Melbourne, November 2001.

Christie, R. & Harrison, W. (2002). *Investigation of Motorcycle Crash Patterns for Riders aged 17-25 in NSW and Development of Countermeasure Strategies*. Report produced for Motor Accidents Authority (NSW) (MAA). Sydney: MAA

Christie, R. (2002). *Investigation of Motorcycle Crash Patterns for Riders aged 17-25 in NSW and Development of Countermeasure Strategies*. Supplementary Analysis in Respect of Motorcycle Type, Make & Model Report produced for Motor Accidents Authority (NSW) (MAA). Sydney: MAA

Evans, L. (2001). Age and fatality risk from similar severe impacts. *Journal of Traffic Medicine. 29 (1-2)*, 10-19

NHTSA/MSF (2000). *National Agenda for Motorcycle Safety*. Washington DC: National Highway Traffic Safety Administration (NHTSA)

Roads & Traffic Authority (RTA) (2000). *Road Traffic Accidents in NSW – 1999,* Sydney: Author.

Roads & Traffic Authority (RTA) (2001). Trends in motorcycle crash statistics. Presentation to Motorcycle Safety Consultative Committee, July, Sydney: Author.

VicRoads (2000). *Road safety strategy for Victoria 2000-2005: Discussion paper*. Melbourne: Author.