



## Motorcycle In-depth Crash Study Summary

Motorcyclists represent an increasing proportion of road crash casualties in NSW and Australia. To develop effective countermeasures to this problem there is a need for detailed understanding of the risk factors influencing crash involvement and poor injury outcomes among motorcyclists.

### At a Glance

- Austroads contracted Neuroscience Research Australia (NeuRA) to investigate a sample of motorcycle crashes to gain a better understanding of contributing factors to crash involvement and to inform the development of targeted road safety policies and programs to reduce motorcycle crashes and road trauma.
- The crash sample included 102 riders, comprising 92 serious injury crashes and 10 fatal injury crashes. The 102 crashes were reviewed by the multidisciplinary Panel. A total of 336 control riders were surveyed, providing matched controls for 99 of the crashes.
- Riders using sports motorcycles have greater odds of being involved in serious injury crashes
- The most common injury sources were the roadway, another vehicle, and contact with their own motorcycle.
- Minor injury predominately involved the extremities, moderate to severe injury predominately involved the torso (the thorax, abdomen and pelvis). Head injury was uncommon as most riders wore helmets.

### Detailed Summary

In-depth investigation is the best method for collecting high levels of detail about all of the potential factors in a crash. Given that the last Australian in-depth study occurred in 1997 and a number of significant motorcycle interventions have been implemented since that time (e.g., graduated licence schemes, numerous education and awareness campaigns), Australian road and transport agencies commissioned a new in-depth study of motorcycle crashes. The aims of this study were to examine:

1. causal relationships between human, vehicle, road and other environmental factors and motorcyclist involvement in serious injury crashes; and
2. the influence of the total system (i.e. the rider, the vehicles and the crash site) on the nature and pattern of injuries sustained by seriously injured motorcyclists.

A case-control in-depth investigation approach was coupled with expert multidisciplinary review of crashes to achieve these aims. Data collection occurred over a 24 month period between August 2012 and July 2014 across the greater Sydney, Hunter and Illawarra regions. These locations were selected for reasons of efficiency while still allowing inclusion of a mix of urban and rural crash locations. Case recruitment and data collection followed the protocols of the Australian National In-depth Crash Study (ANCIS). To ensure the full spectrum of serious crashes were represented, 10% of the sample involved fatal crashes.

Data collected during the investigations were summarised and presented to an expert multidisciplinary Panel consisting of NeuRA researchers and engineers, a leading trauma forensic pathologist, road engineering and motorcycling experts from the NSW Centre for Road Safety, motorcycle safety research and crash investigation experts and behavioural scientists. The Panel considered factors contributing to the crash and injury outcome, as well as potential countermeasures using the Haddon matrix as a framework.

Recruitment of controls relied on a method where riders nominated themselves based on previous travel through the crash location without crashing. While self-selection of controls is a potential limitation, this proved to be the most efficient possible method, and comparison of the resulting sample with the population of riders allowed any bias in the control sample to be identified. Furthermore the analysis methods controls for any differences in the composition of the samples.

The final crash sample included 102 riders, comprising 92 serious injury crashes and 10 fatal injury crashes. The 102 crashes were reviewed by the multidisciplinary Panel. A total of 336 control riders were surveyed, providing matched controls for 99 of the crashes.

The results of this study indicate that riders using sports motorcycles have greater odds of being involved in serious injury crashes than riders using other motorcycle types. Furthermore, the association between motorcycle type and crash involvement differed across age groups, with the elevated crash risk associated with sports bikes more prominent among older riders. Riding an unfamiliar motorcycle also significantly increased the odds of being in the crash sample. Another novel finding is that riders who rode the crash location daily had seven times the odds of being in the crash sample than the control sample. However, the mixed methods used in this study also identified route unfamiliarity as a contributory factor in a small number of crashes. These two concurrent findings suggest a non-linear relationship between familiarity and crash risk.

The older the rider, the lower the odds they were in the crash sample. However older riders who were in the crash sample had significantly longer stays in hospital compared to younger riders. This indication of increased severity of outcome with older age has not been previously reported in motorcyclists. Riders who wore more protective clothing also had lower odds of being in the crash sample and this likely suggests that attitudes to riding and/or risk, associated with the use of protective clothing, may also be associated with reduced odds of crashing.

There was also a suggestion of some difference in the nature of the trip between riders who crashed (cases) and those who did not (controls). Control riders were more likely to report they had been riding in heavy traffic and in freeway type conditions prior to travelling through the crash location. Similarly, a protective effect was observed when the trip purpose was reported as commuting or general transport rather than for recreational purposes

Most injuries sustained by the motorcyclists were minor, and involved the arms and legs. However, there were differences in the nature and pattern of injury by injury severity. While minor injury predominately involved the extremities, moderate to severe injury predominately involved the torso (the thorax, abdomen and pelvis). The most common injury sources were the roadway, another vehicle, and contact with their own motorcycle. Extremity injury resulted mainly from contact with the roadway, while more serious injuries to the thorax and abdomen resulted from contact with roadside objects, such as guardrails and fences. The motorcycle fuel tank was a common source of injury to the pelvis.

Head injury was uncommon as most riders wore helmets. However, examination of helmet performance indicated full face helmets provided better protection than open face helmets, and most impacts to the helmet or head of the rider, occurred to the front of the helmet or the face of the rider. This supports the need to extend the coverage of AS 1698.

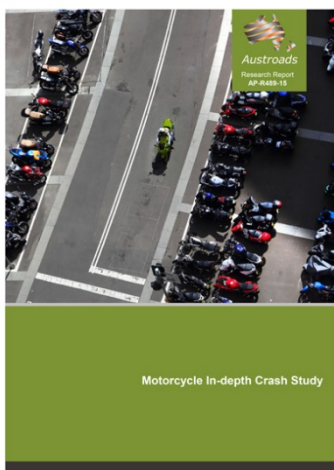
Consistent with previous studies, riders who wore clothing specifically designed for motorcycle use were provided with effective protection against abrasions and lacerations. However, some motorcycle specific clothing failed to prevent even minor injury. Furthermore, there was little additional benefit provided from impact protectors. There is significant scope to improve the quality of motorcycle protective clothing available to Australian riders.

Using a qualitative approach, four major themes emerged from the multidisciplinary Panel reviews. The benefit of the thematic approach is that it allows motorcycle safety issues to be examined from a whole system perspective. For the *'riders need to be seen'* theme, vehicle factors related to poor bike conspicuity and blind spots in cars; human factors included drivers having inherent difficulties judging motorcycle speed, and riders travelling too close to other vehicles and taking poor lane positions; and environmental features included objects within the road environment obscuring vision of motorcycles, and treatments failing to effectively control approaches to uncontrolled intersections. For the riders *'need to stop in time'* theme, vehicle factors related to inherent braking deficiencies; human factors related to rider speed and braking techniques; and environmental factors included obstructions to riders vision, roadway features leading to variable traffic flow and lack of appropriate road shoulders. Within the *'maintaining control'* theme vehicle factors such as inherent instability of motorcycles and rider technique and approach speed were noted, however, road environment deficiencies were the most common. Finally for *'rider experience'*, Panel discussion highlighted the importance of experience with the motorcycle, and the match between the rider's experience/skill level and the level of difficulty of the route being ridden.

Across the themes, recurring countermeasures that were identified included enhanced motorcycle technologies and intelligent transport technologies, the need to ride with awareness, and optimising the road environment for motorcycles and/or providing better control and guidance to road users.

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