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Contributing factors to motorcycle injury crashes in Victoria, Australia

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ABSTRACT

Introduction: The increased popularity of powered two wheelers (PTWs) in Australia, combined with their vulnerability in the event of a crash, necessitates new strategies to prevent serious injury crashes. The purpose of this study was to use case-series data collected from a recent motorcycle case-control study to analyse contributing factors to crashes using a safe systems approach.

Methods: A total of 235 injured riders were recruited and completed a questionnaire-based interview, each followed by a detailed inspection of the case motorcycle and crash site by a trained crash investigator. Primary and secondary contributors to the crash were judged based on all available information sources. Analysis of the most frequent contributing factors included separation of cases into single and multi-vehicle crashes. A stepwise logistic regression was used to test for factors associated with human error for multi-vehicle crashes.

Results: Two thirds of crashes investigated involved another vehicle or road user(s). For multi-vehicle crashes the most common crash scenario involved another vehicle failing to give way to the rider, and the primary contributor was a perception failure or traffic scan error on the part of the other road user. A number of secondary factors were found to be significantly associated with human error type (other road user or rider error), including rider age, traffic density, inappropriate speed of the PTW, and a road design issue. For single vehicle crashes, the most common primary contributor was a misjudgement or control error on the part of the rider, with inappropriate speed as the most frequent secondary contributor.

Conclusions: Despite the complexity of factors involved in PTW crashes resulting in injury, a number of significant associations exist between road users as the primary contributing factor (rider or other road user) and secondary factors, including rider age, traffic density, speed and road design issues.

1. Introduction

Motorcycles and scooters, jointly known as Powered Two-Wheelers (PTWs), have shown a recent surge in popularity in Australia. In the state of Victoria, the number of registered motorcycles increased by 33% between 2007 and 2012 (ABS, 2012), which was more than 3 times the increase in passenger vehicle registrations over the same period. This increase likely

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reflects the mobility benefits offered by PTWs in traffic-congested and parking-restricted urban areas, as well as the popularity of motorcycles for recreational use.

The challenge of increased PTW popularity facing road safety stakeholders is the over-representation of motorcyclists in road trauma statistics, due at least in part to their vulnerability in the event of a crash. While there has been a decline in road fatalities and serious injuries in Australia over recent years, motorcyclists have represented an increasing proportion of those seriously injured or killed. Less than 1% of all vehicle kilometres travelled are by motorcycle or scooter (ABS, 2012), yet 18% of those seriously injured on Victoria roads in 2013–14 were motorcyclists (including pillions), which has increased from 11% in 2003–4. Similarly, in 2013–14 about 14% of all fatally injured road users in Victoria were motorcyclists (TAC, 2015).

The most recent comprehensive study investigating serious motorcycle crashes in Australia was conducted almost 20 years ago. Since that time, in addition to strong growth in motorcycle numbers (a doubling of registered motorcycles between 1996 and 2012), there have been significant changes to road infrastructure, PTW characteristics and types, motorcycle licensing rules, and characteristics of the rider population. These changes include the introduction of new barrier types on some arterial routes (including flexible barriers, and W beam under-run protection), increased popularity of cruiser style motorcycles, a greater proportion of motorcycles fitted with anti-lock brakes and other assistive technologies, the introduction of power-to-weight restrictions for novice riders, and an increase in the average age of the active rider population (Allen et al., 2016). Updated information on factors that contribute to motorcycle injury crashes is needed in order to continue to mount progressive countermeasures.

Another change to occur in the two decades since the last comprehensive in-depth motorcycle crash study is the adoption of a safe systems approach to road safety. This viewpoint recognises the need to understand the interaction between the key elements of the road system (road users, the road environment, and vehicles and travel speeds), and aims to foster a system that makes allowance for human error to minimise risk of serious injury or death (Bambach & Mitchell, 2015). In the context of motorcycle safety, this approach can be applied to data obtained from real-world crashes to identify potential countermeasures.

In-depth crash investigation methods aim to determine those factors that have likely contributed to a crash and injury outcomes, using data collected from the vehicle(s), the crash site, the road users involved, and police or traffic incident reports where available. Previous studies have reported that human error (both on the part of the rider and other road users) is the most common primary contributor to most PTW crashes (ACEM, 2004; Haworth, Smith, Brumen, & Pronk, 1997). In the safe systems context, this indicates a failure of other elements of the road system to accommodate for human error. Identifying factors that are commonly associated with human error offers potential to find modifiable elements of the road system to prevent future serious injury motorcycle crashes.

One strategy for identifying common factors associated with crashes involving PTWs is to separate multi-vehicle crashes from single vehicle crashes, since the primary contributing factors has been shown to vary between these two crash types (ACEM, 2004; Haworth et al., 1997). An earlier study conducted in the same geographic region targeted for the current study (Haworth et al., 1997) found that excessive speed for the conditions contributed to a greater proportion of single vehicle crashes (35%) than multi-vehicle crashes (17%), and ineffective braking was a more much common contributor to single vehicle crashes (Haworth et al., 1997). While a greater proportion of multi-vehicle crashes were judged as involving no rider contribution, inappropriate rider positioning or a failure to respond were more prevalent in the multi-vehicle crashes compared to single vehicle crashes. A mechanical fault was judged as a more prevalent contributor to single vehicle crashes compared to multi-vehicle crashes. In a European based motorcycle crash investigation study (ACEM, 2004), traffic-scanning related errors were much more common for other vehicle drivers, while a decision failure was a more common human error for motorcyclists.

Therefore the purpose of the current study was to identify the factors contributing to motorcycle serious injury crashes, including separate investigation of multi-vehicle and single vehicle crashes and testing for associations between multiple factors.

2. Material and methods

2.1. Eligibility & recruitment

The population recruited for this study were riders of powered two wheelers (PTWs) who had recently been injured in a crash, and admitted to one of 14 study hospitals (9 metropolitan, 5 regional) in Victoria, Australia. Recruitment of participants occurred between January 2012 and August 2014, as part of a larger case-control study (Day et al., 2013). Eligibility criteria included that the crash occurred on a public road in Victoria between the hours of 6 am and midnight, and that the rider was aged 18 years or over. The time-based selection criteria was chosen for practical and safety reasons related to recruitment of control riders for the larger case-control study (a researcher had to be physically present in the crash location around the crash time to observe control rider participants). This criteria resulting in an exclusion ~2% of all injury crashes in Victoria that occurred between midnight and 6 am. All recruitment and experimental procedures were approved by Monash University Human Research Ethics Committee, and ethics committees representing each of the study hospitals.

Eligible riders were approached by a research nurse while in hospital and invited to participate. Where possible, riders discharged from hospital before being approached were contacted by mail for a follow-up telephone interview. Riders that