



THE GEORGE INSTITUTE
for Global Health

AUSTRALIA

THE PEDAL STUDY

FURTHER ANALYSIS CONCERNING BICYCLE CRASHES AND INJURY SEVERITY IN THE ACT

Final report

The George Institute for Global Health, University of Sydney

MARCH 2015

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INTRODUCTION

Cycling is an increasingly popular mode of travel in Australia, with many advantages over motorized transport including personal and public health benefits (ASC 2008). Cycling is also relatively risky compared to other forms of transport, due to the fragility of the unprotected human body (Shinar 2012). Between 2002-2008 the cycling population in Australia increased by an estimated 36% while the age-standardized rates of seriously injured cyclists increased by 47% per 100,000 population (ASC 2008, AIHW 2009).

The Australian Capital Territory presents an ideal natural laboratory to investigate the relative injury risks for cyclists riding in traffic compared to a variety of degrees and styles of separated and off-road cycling paths. This is because the ACT has a well-established and extensive network of linked on-road and off-road cycling routes. The network includes cycling environments with a range of degrees of segregation from motorised traffic such as separated road-side and fully segregated paths shared with pedestrians.

The provision of cycling facilities in the ACT appears to have been successful in encouraging people to ride bicycles. This is reflected in the higher proportion of cyclists in the ACT when compared to other States. For example, in the 2006 Census, cycling was the mode of travel to work for 3% of ACT residents compared to just 1% of NSW residents (ABS 2007). The higher proportion of cyclists is, unfortunately, also reflected in the number of bicycle crashes and casualties attending emergency services.

The aim of the Pedal Study was to identify the associations between riding environment and other factors contributing to the risk and severity of bicycle related injury. The objective was to inform roads policy and management and the cycling community about issues that need to be addressed to make cycling safer for cyclists and pedestrians in the ACT.

Data collection was completed and a report submitted to the Trust in 2010. The report generated considerable interest as the first study of its kind, including on and off-road facilities. The study generated a large volume of data which was reported descriptively in the report, but which required further analysis to explore the richness of the information contained.

A second research grant was awarded to the researchers to undertake detailed multivariable analysis of the data to determine the strength of associations between factors associated with three key issues of interest that have emerged. These include crashes on shared paths, examination of the protective benefits of clothing and the circumstances of off-road crashes.

OUTCOMES

In addition to the initial report describing the findings of the study which was published on the Trust's website, the outcomes of the Pedal Study to date include:

1. Three peer-reviewed papers published, a further paper is currently under review by a scientific journal
2. Public presentations included a seminar for key stakeholders organized by the Trust was held in Canberra (2012) and three papers presented at scientific conferences: Road Safety Researchers Forum, Brisbane 2012, Australian College of Road Safety Annual Conference, 2012, Sydney and International Cycling Safety Conference in Göteborg, Sweden in 2014.
3. The findings were presented in a submission to the ACT parliamentary inquiry into Vulnerable Road Users.
4. There media coverage by radio and newspapers in Canberra and Sydney when the initial results of the study were first released.
5. In a little over a year since the initial publication in 2013 of the first paper in a scientific journal, this body of work has been cited by other researchers in 14 scientific publications. It is anticipated that together with a further three papers on different aspects of cycling safety, this study will continue to be cited as a significant source for research and policy development on bicycle safety issues.

The following describes the focus and findings of each of the published papers. Copies of all papers and the Parliamentary submission are attached in the appendices.



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1. BICYCLE CRASHES IN DIFFERENT RIDING ENVIRONMENTS IN THE AUSTRALIAN CAPITAL TERRITORY.

The focus of this paper is the injury outcomes of crashes in different cycling environments comparing on-road cycling, cycle lanes and shared pedestrian facilities. The paper has been published in *Traffic Injury Prevention*. It has been cited 9 times.

de Rome, L., Boufous, S., Gregerson, T., Senserrick, T., Richardson, D., Ivers, R., 2013. Bicycle crashes in different riding environments in the Australian Capital Territory, Traffic Injury Prevention 15 (1), 81-88.

Background: Cyclists are increasingly over represented in traffic crash casualties in Australia. There is evidence that better cycling infrastructure increases participation, but whether it reduces the numbers of injured cyclists is less clear. This study examined injury outcomes of crashes in different cycling environments. Participants who had crashed in transport-related areas (n=202, 64.5%) are the focus of this paper.

Results: Participants had crashed in-traffic (39.1%); in cycle-lanes (7.9%), on shared-paths (36.1%) and footpaths (16.8%). Based on average weekly traffic counts, the crash involvement rate per 1000 cyclists was 11.8 on shared-paths compared to 5.8 on cycle-lanes.

Over half the participants (52.0%) were injured in single vehicle bicycle crashes. The remainder involved other road users including motor vehicles (20.8%), other bicycles (18.8%), pedestrians (6.4%) and animals (2.0%). Pedestrians were involved in 16.4% of crashes on shared-paths. Minor injuries (AIS 1), were sustained by 58.4% cyclists, moderately severe injuries (AIS 2) by 36.1% and 5.4% seriously injured (AIS 3+). The average treatment required was 1.8 days with 7.5 days off work and cost to the cyclist of \$869 excluding medical treatment. Cyclists who crashed on shared-paths or in-traffic had higher Injury Severity Scores (4.4, 4.0) compared to those in cycle-lanes or footpaths (3.3, 3.4) and required more treatment days (2.8, 1.7 versus 0.0, 0.2).

Conclusions: Fewer cyclists were injured in on-road cycle-lanes than other cycling environments, while a high proportion of injuries were incurred on shared-paths. This study highlights an urgent need to determine appropriate criteria and management strategies for paths classified as suitable for shared or segregated usage.

2. CIRCUMSTANCES OF ON-ROAD SINGLE-VEHICLE CYCLIST CRASHES IN THE AUSTRALIAN CAPITAL TERRITORY - (GCPI-2013-0083)

The focus of this paper was the circumstances of single vehicle bicycle crashes. The paper was peer-reviewed for presentation at the International Cycling Safety Conference in Göteborg, Sweden in 2014. It is published in the proceedings and may be downloaded from <http://www.icsc2014.eu/program/program-proceedings>.

Boufous, S., Senserrick, T., Ivers, R.Q., Richardson, D., de Rome, L. 2014. Circumstances of on-road single-vehicle cyclist crashes in the Australian Capital Territory. In: Proceedings of the Proceedings, International Cycling Safety Conference 2014, Göteborg, Sweden.

Background: Despite the large number of single-vehicle bicycle crashes, very little is known about their risk factors. The lack of research in this area is mainly due to under reporting of these crashes in police crash data and lack of information about the circumstances leading to their occurrence in other administrative data (i.e. hospital data). The study examines the circumstances of single-vehicle cyclist crashes that occur on public roads. A survey of adult cyclists who were injured as a result of a crash and presented to emergency departments in the Australian Capital Territory over a period of 6 months, November 2009 to May 2010. Participants injured in on-road single-vehicle crashes are the focus of this paper.

Results: Overall, 105 cyclists reported being involved in on-road single-vehicle crashes which corresponds to 32% of all study participants and just over half of those involved in all single-vehicle crashes, including those that occurred off-road. Just over 66% of cyclists involved in on-road single-vehicle crashes first learned to ride when they were aged 5 to 9 years and just under 90% were regular cyclists riding an average of over 30Km. Almost three quarters reported losing control of the bicycle and about a quarter reported surface characteristics as contributing factors to the crash. Behavioural factors such as distraction (21%), speeding (16.2%) and alcohol (5.7%) as well as bike failure (19.6%) also contributed to the crash according to study participants.

Conclusions: The findings point to the importance of maintenance of roads frequently used by cyclists and the need for more research into the role of riding and bicycle handling skills training as well as cyclists education in preventing on-road single-vehicle crashes.

3. BICYCLE CRASH INJURIES AND THE CLOTHING WORN BY CYCLISTS

The focus of this paper is an analysis of the association between injuries sustained and type of clothing worn by cyclists in crashes. The paper has been published in *Accident, Analysis and Prevention*.

de Rome, L., Boufous, S., Georgeson, T., Senserrick, T., Ivers, R., 2014. Cyclists' clothing and reduced risk of injury in crashes 10.1016/j.Aap.2014.09.022. Accident Analysis and Prevention 73, 392-398.

Background: Although a majority of cyclists' hospital presentations involve relatively minor soft tissue injuries, little attention have been paid to the potential for clothing to reduce these types of injuries. This study investigated the role of clothing in reducing the risk of such injuries in cyclist crashes.

Results: A high proportion of participants were wearing helmets (89%) and full cover footwear (93%). Fewer wore long sleeved tops (43%), long pants (33%), full cover gloves (14%) or conspicuity aids (34%). The primary cause of injury for the majority of participants (76%) was impact with the ground. Increased likelihood of arm injuries (Adj. OR=2.06, 95% CI:1.02-4.18, P=0.05) and leg injuries (Adj. OR = 3.37, 95%CI: 1.42-7.96, P=0.01) were associated with wearing short rather than long sleeves and pants. Open footwear was associated with increased risk of foot or ankle injuries (Adj. OR=6.21, 95%CI: 1.58-23.56, P=0.01) compared to enclosed shoes. Bare hands were associated with increased likelihood of cuts, lacerations or abrasion injuries (Adj. OR=4.62, 95%CI: 1.23-17.43, P=0.02) compared

to wearing full cover gloves. There were no significant differences by fabric types (such as Lycra/synthetic, natural fibre or leather).

Conclusions: Clothing that fully covers a cyclist's body substantially reduced the risk of injuries in a crash. Coverage of skin was more important than fabric type. Further work is necessary to determine if targeted campaigns can improve cyclists' clothing choices and whether impact protectors can further reduce injury risk.

4. FACTORS ASSOCIATED WITH INJURIES FROM OFF-ROAD CYCLING SPORT AND RECREATION

The focus of this paper is a study of bicycle crashes in off-road cycling environments comparing crashes on sealed (urban) and unsealed (bushland) areas. This paper has been submitted for publication and is pending review.

de Rome, L., Soufiane, B., Senserrick, T., Ivers, R., 2015. Urban stunts versus bush track jumps: A comparison of off-road cyclists and their injuries. (Under review).

Objective: Despite increasing popularity of off-road cycling, characteristics of injured off-road riders are rarely reported. Although several papers have previously described injuries sustained, there has been little research examining characteristics and risk factors of injured riders. This study examined the crash characteristics and injury outcomes for cyclists who crashed in different off-road cycling environments.

Methods: Injured adult cyclists (n=313) presenting to emergency departments in the Australian Capital Territory were interviewed. Those who had crashed off-road in either bushland (e.g. mountain bike trails) or urban (e.g. skate parks) settings are the focus of this paper.

Results: Compared to bushland cyclists, urban cyclists were younger (28.5 vs 36.4 years), less likely to be employed (68% vs 91%) or wear a helmet (74% vs 95%) and more likely to ride for thrills (48% vs 26%). Those injured in bushland were more likely than urban cyclists to sustain thoracic injuries. No other significant differences were observed in type or injury severity, hospital admission or days in treatment or off-work required between the bushland and urban cyclists.

Most cyclists were injured in falls (92%) and impacts with the ground (80%) while avoiding obstacles on the path (18%), jumping (17%), racing (17%), sliding out (16%), riding too fast (13%) or failed stunts (10%). Injuries were mostly minor (58%: AIS 1) with 36% moderately severe (AIS 2) and 6% serious (AIS 3+). Impacts with the ground were associated with head, shoulder and upper limb injuries. Jumping was associated with shoulder injuries whereas sliding out was associated with lower limb injuries. Excessive speed/racing was associated with head, face, neck and spine and lower limb injuries. The most common injuries were abrasions (70%), but 16% sustained serious internal organ injuries, 36% sustained fractures and 22% had facial injuries.

Conclusions: Although most of the injuries sustained off-road were relatively minor, nonetheless there were a sizeable proportion of seriously injured cyclists. The results provide strong evidence of the injury risks associated with specific cycling activities characteristic of off-road cycling in both natural and built environments. Further work is required to establish the prevalence of off-road injuries and the associated risk factors in a population based study to understand how best to manage the risks associated with these increasingly popular activities.