



### The effectiveness of helmets in reducing head injuries and hospital treatment costs: a multicentre study

**TO THE EDITOR:** Debate continues regarding the health benefits and consequences of helmet use in pedal cyclists.<sup>1</sup> Australia is one of few countries in the world with mandatory helmet laws for both pedal cyclists and motorcyclists. To place the protective effect of helmets in pedal cyclists into perspective, we report on the



The protective effect of helmet use ... appears to be greater in pedal cyclists compared with motorcyclists



Dinh et al

relationship between helmet use and head injury severity in a retrospective cohort of both pedal cyclists and motorcyclists.

Trauma registry data on such patients admitted to seven tertiary level hospitals in Sydney, New South Wales (Liverpool, St George, Royal Prince Alfred, Westmead, Royal North Shore, St Vincent's and Prince of Wales hospitals) between July 2008 and June 2009 were obtained. Patients were included if they were aged 15 years or over with an incident occurring on a public road. The Abbreviated Injury Scale and Injury Severity Score were used to classify body regions and severity of injury, respectively. Helmet use, incident and other injury details were routinely collected by trained data and case managers from standard ambulance and trauma clinical case notes. Inhospital costs were calculated using standardised cost weights (NSW Program and Product Data Collection, 2008–09). Primary outcomes were any head injury and severe head injury (Abbreviated Injury Scale severity score  $\geq 3$ ), including significant intracranial haemorrhages, and diffuse axonal injury. Logistic regression was used to determine odds ratios for head injury and severe head injury, adjusting for age (as a continuous variable) and location of incident (based on incident postcode) as a-priori confounders based on previous work.<sup>2</sup>

There were 398 cases identified. Of these, 50 patients (13%) had missing helmet information, leaving 348 cases analysed. Baseline characteristics stratified by helmet use are shown in the Box. For any head injury associated with helmet non-use, the adjusted odds ratio was 5.6 (95% CI, 2.1–14.9;  $P < 0.001$ ) for pedal cyclists and 2.2 (95% CI, 0.9–5.0;  $P = 0.06$ ) for motorcyclists, compared with helmeted patients in each group. For severe head injury associated with helmet non-use, the adjusted odds ratio was 5.5 (95% CI, 1.5–20.6;  $P = 0.01$ ) for pedal cyclists and 3.5 (95% CI, 1.3–8.9;  $P = 0.01$ ) for motorcyclists, compared with helmeted patients in each group. For the 50 patients with severe head injury, inhospital costs (AUD) were around three times higher in non-helmeted patients (median, \$72 000; interquartile range, \$33 000–

## Characteristics of cyclists and motorcyclists with head injuries, by helmet use

Characteristic	Cyclist (n = 110)			Motorcyclist (n = 238)		
	Helmet (n = 70)	Non-helmet (n = 40)	P	Helmet (n = 206)	Non-helmet (n = 32)	P
<b>Demographic</b>						
Median age (IQR), years	41 (29–53)	35 (23–44)	0.02	31 (24–43)	25 (21–38)	0.06
Male	64 (91%)	35 (88%)	0.51	194 (94%)	31 (97%)	0.53
<b>Incident details</b>						
After hours*	25 (36%)	14 (35%)	0.94	65 (32%)	14 (44%)	0.17
Location†						
Inner Sydney	21 (30%)	11 (28%)		40 (19%)	13 (41%)	
Suburban Sydney	26 (37%)	20 (50%)		76 (37%)	11 (34%)	
Regional/rural	23 (33%)	9 (23%)	0.37	91 (44%)	8 (25%)	0.02
<b>Injury severity</b>						
Median ISS (IQR)	9 (5–14)	9 (5–21)	1.0	9 (5–17)	15 (5–25)	0.15
Multiregion injury (%)	46 (66%)	29 (73%)	0.46	153 (74%)	21 (66%)	0.32
ICU	11 (16%)	7 (18%)	0.81	47 (23%)	12 (38%)	0.07
<b>Outcomes</b>						
Head injury	27 (39%)	30 (75%)	< 0.001	68 (33%)	14 (44%)	0.23
Severe head injury	6 (9%)	9 (23%)	0.04	26 (13%)	9 (28%)	0.02
Diffuse axonal injury	0	0	na	5 (2%)	3 (9%)	0.08
Rehabilitation‡	3 (4%)	6 (15%)	0.07	35 (17%)	4 (13%)	0.53
Median cost (IQR), AU\$1000	6.5 (2.8–10.7)	5.6 (2.5–15.2)	0.91	7.7 (3.0–20.7)	11.4 (4.4–41.0)	0.05

ICU = intensive care unit admission required. IQR = interquartile range. ISS = Injury Severity Score. na = not applicable. \* Recorded incident times between 19:00 and 07:00 hours. † Postcode of location of incident was used to classify incident locations in the inner Sydney (within 10 km of central business district), suburban Sydney (bounded by Hornsby to the north, Royal National Park to the south and Penrith to the west), and regional and rural regions of New South Wales. ‡ Discharge from hospital to a rehabilitation facility. ◆

\$140 000) compared with helmeted patients (median, \$24 000; interquartile range, \$15 000–\$60 000) ( $P=0.02$ ).

The protective effect of helmet use with respect to head injury prevention therefore appears to be greater in pedal cyclists compared with motorcyclists. There was no association observed between helmet use and diffuse axonal injury. Limitations to our study include the small number of patients with severe head injury, and the inability to control for other incident factors such as speed, collision details and intoxication. The use of hospital data biases observations towards patients with more severe injuries. Nevertheless, the results add to the growing weight of observational data supporting the use of helmets,<sup>3–5</sup> which should therefore be considered at least as protective for pedal cyclists as they are for motorcyclists.

**Michael M Dinh** Emergency Physician<sup>1</sup>

**Kate Curtis** Trauma Clinical Nurse Consultant<sup>2</sup>

**Rebecca Ivers** Director<sup>3</sup>

<sup>1</sup> Sydney Medical School, University of Sydney, Sydney, NSW.

<sup>2</sup> St George Hospital, Sydney, NSW.

<sup>3</sup> Injury Division, The George Institute for Global Health, Sydney, NSW.

[michael.dinh@sswhs.nsw.gov.au](mailto:michael.dinh@sswhs.nsw.gov.au)

**Acknowledgements:** We acknowledge the work of Mary Lam from the University of Sydney and Kendall Bein from Royal Prince Alfred Hospital for cost and data analysis. We also thank the trauma data managers and trauma coordinators from the major trauma centres who submitted data for the original study.

**Competing interests:** Kate Curtis was supported by a Sydney Nursing School, University of Sydney Postdoctoral Fellowship. Funding support was provided by the NSW Institute of Injury and Trauma Management and St George Honda Trauma and Critical Care Research Program. Rebecca Ivers was supported by a National Health and Medical Research Council Career Development Fellowship. The study sponsors had no involvement in the study design, collection, analysis and interpretation of data, or the writing of the manuscript.

doi:10.5694/mja12.11580

- O'Reilly M. Helmet crackdown makes no sense. *The Age* (Melbourne) 2012; 22 Mar. <http://www.theage.com.au/executive-style/fitness/blogs/on-your-bike/helmet-crackdown-makes-no-sense-20120322-1vl5v.html#ixzz1xGg2mLPP> (accessed Oct 2012).
- Dinh MM, Roncal S, Green TC, et al. Trends in head injuries and helmet use in cyclists at an inner city major trauma centre, 1991–2010. *Med J Aust* 2010; 193: 619–620.
- Amoros E, Chiron M, Martin J-L, et al. Bicycle helmet wearing and the risk of head, face, and neck injury: a French case-control study based on a road trauma registry. *Inj Prev* 2012; 18: 27–32.
- Olivier J, Walter SR, Grzebieta RH. Long term bicycle related head injury trends for New South Wales Australia following mandatory helmet legislation. *Accid Anal Prev* 2013; 50: 1128–1134.
- Liu BC, Ivers R, Norton R, et al. Helmets for preventing injury in motorcycle riders. *Cochrane Database Syst Rev* 2008; (1): CD004333. □