ELSEVIER

Accident Analysis and Prevention 39 (2007) 86–93

ACCIDENT ANALYSIS & PREVENTION

www.elsevier.com/locate/aap

Bicycle helmet legislation: Can we reach a consensus?

D.L. Robinson *

c/o Prof JSF Barker Building, Trevenna Rd, Armidale, NSW 2351, Australia

Received 4 January 2006; received in revised form 12 June 2006; accepted 13 June 2006

Abstract

Debate continues over bicycle helmet laws. Proponents argue that case-control studies of voluntary wearing show helmets reduce head injuries. Opponents argue, even when legislation substantially increased percent helmet wearing, there was no obvious response in percentages of cyclist hospital admissions with head injury—trends for cyclists were virtually identical to those of other road users. Moreover, enforced laws discourage cycling, increasing the costs to society of obesity and lack of exercise and reducing overall safety of cycling through reduced safety in numbers. Countries with low helmet wearing have more cyclists and lower fatality rates per kilometre.

Cost-benefit analyses are a useful tool to determine if interventions are worthwhile. The two published cost-benefit analyses of helmet law data found that the cost of buying helmets to satisfy legislation probably exceeded any savings in reduced head injuries. Analyses of other road safety measures, e.g. reducing speeding and drink-driving or treating accident blackspots, often show that benefits are significantly greater than costs. Assuming all parties agree that helmet laws should not be implemented unless benefits exceed costs, agreement is needed on how to derive monetary values for the consequences of helmet laws, including changes in injury rates, cycle-use and enjoyment of cycling. Suggestions are made concerning the data and methodology needed to help clarify the issue, e.g. relating pre- and post-law surveys of cycle use to numbers with head and other injuries and ensuring that trends are not confused with effects of increased helmet wearing.

Keywords: Bicycle; Helmet; Legislation; Head injury; Case-control; Bias

1. Introduction

Hagel and Pless (2006) criticised evidence against bicycle helmet legislation (Curnow, 2005) arguing that large population studies of the effects of helmet laws provide weaker evidence than case-control studies. The two sources of data are compared and discussed, along with what information should ideally be collected to provide the best possible evaluation and understanding of helmet legislation, including effects related to risk compensation or reduced safety in numbers.

2. Case-control studies

Serious problems in the methodology of analysing self-selected samples came to light after publication of randomised control trials showing hormone replacement therapy (HRT) significantly increased the risk of heart disease. Yet a review of what were considered the best quality observational studies (11 case-control studies, 16 prospective studies, 3 cross-sectional studies) concluded that HRT decreased the risk by 50% (Lawlor et al., 2004a). The problem was attributed to the same sort of differences between users and non-users of HRT being present in nearly all studies, leading to difficulties in correctly adjusting for confounders. Similar misleading results were also reported for studies of other self-selected populations, e.g. users of vitamin supplements (Lawlor et al., 2004b).

Evidence suggests that cyclists who choose to wear helmets may differ substantially from those who do not. Helmet wearers are more likely to ride in parks, playgrounds or bicycle paths than city streets (DiGuisseppi et al., 1989), obey traffic laws (Farris et al., 1997), wear fluorescent clothing and use lights at night (McGuire and Smith, 2000). These factors affect both the risk of colliding with motor vehicles, and impact speed when collisions occur. The former was evident in the data of Thompson et al. (1996) in that non-helmeted cyclists collided with motor vehicles 41% more frequently than helmet wearers (OR = 1.50, $P < 0.0001$). The latter was demonstrated by a study of bike/motor vehicle collisions. The authors (Spaite et al., 1991) concluded: “*This implies that non-users of helmets tend to be in higher impact crashes than helmet users, since the*

* Tel.: +61 267 726475.
E-mail address: drobinso@aanet.com.au.

0001-4575/$ – see front matter © 2006 Elsevier Ltd. All rights reserved.
doi:10.1016/j.aap.2006.06.007

injuries suffered in body areas other than the head also tend to be much more severe".

Bike/motor vehicle collisions caused a majority (34 out of 62) brain injuries >AIS2 in the case-control study of Thompson et al. (1996). The authors attempted to adjust for age and whether a motor vehicle was involved (reporting no significant effect of other factors), but did not consider impact speed in collisions with motor vehicles, although this significantly affects the risk of head injury (Janssen and Wismans, 1985). Thus any differences in head injuries due to differences in impact speed between wearers and non-wearers, as observed by Spaite et al. (1991), would be incorrectly attributed to helmets.

There may also have been difficulties in correctly adjusting for other confounders. Thompson et al. (1989) reported only 3 age categories: <15, 15–24 and >25. However, a subsequent analysis of a subset of the same data (Thompson et al., 1990) showed that 83% of children aged 0–4 suffered head injury, compared to 42% of 5–9 year olds and 23% of 10–14 year olds. Such large differences indicate that age adjustment in the original study may have been inadequate. Another indication of confounding in Thompson et al. (1989) was the vast discrepancy between helmet wearing of children in the control (CC) group (21.1%; $n = 478$) and an observational study (OS) of children riding round the same city in the same year (3.2%; $n = 4501$, DiGuisseppi et al., 1989). The larger OS study was intended to estimate population helmet wearing rates. If the sole difference between CC and OS cyclists was that the former fell off their bikes, it would imply that helmet wearing was associated with a seven-fold increase in the risk of falling off the bike, negating any benefit of helmets.

Curnow (2005) argued that fear of death or chronic disability (which he defined as brain injuries of severity AIS4-6) was the main motive for wearing helmets. However, the majority of head injuries treated in emergency departments (73% of the 757 head injuries in the study of 3390 injured cyclists by Thompson et al., 1996) did not involve brain injury. Brain injuries >AIS2 comprised only 8% of head injuries (Thompson et al., 1996). The Cochrane review (Thompson et al., 2003) calculated odds for brain injury >AIS2 from at most 90 such injuries in two studies (4.2% and 1.8% of injuries in Thompson et al., 1989, 1996, respectively). The small numbers and potential problems of confounding noted above suggest that the conclusions concerning brain injury >AIS2 should be treated with caution.

3. Helmet law studies

A published review examined data from enforced helmet laws in all jurisdictions where legislation increased percent helmet wearing (%HW) by at least 40 percentage points within a year. In contrast to the 90 brain injuries >AIS2 in the Cochrane review, the helmet-law review included 10,479 head injuries severe enough to appear in hospital admissions databases (Robinson, 2006). In five jurisdictions with hospital admissions data, %HW increased from a pre-law average of 35% to a post-law average of 84%. If, as claimed by the Cochrane review, helmets reduce serious head injuries by 63–88%, an increase from 35% to 84% helmet wearing would reduce percent head injury (%HI) by 39–62%. It would be impossible to miss such large, sudden changes in time series data. Yet there was little or no noticeable response in %HI to the changes in %HW, leading to serious doubts about the benefits of helmet legislation (Robinson, 2006).

Fig. 1a illustrates some of the factors involved, contrasting %HW in Victoria, Australia with (1) numbers of *non-head* injuries from bike/motor vehicle collisions to cyclists and pedestrians and (2) percentages of serious injuries in collisions with motor vehicles involving death or serious head injury (%DSHI). Police enforced the helmet law. Surveys in the first month (July 1990) showed 94%, 87% and 89% of primary and secondary school children and adults wore helmets, compared to 65%, 37% and 44% in March 1990 (Sullivan, 1990).

The obvious and sharp decline in numbers of *non-head* injuries (Fig. 1a) coinciding exactly with legislation can be explained by noting that numbers counted in identical pre- and post-law observational surveys declined by 36% (Robinson, 1996); non-head injuries declined because cycle-use declined. There was also a more gradual change in the ratio of adult to child cyclists. Helmet laws discouraged children (42% reduction in the first year) more than adults (29% reduction), resulting in an

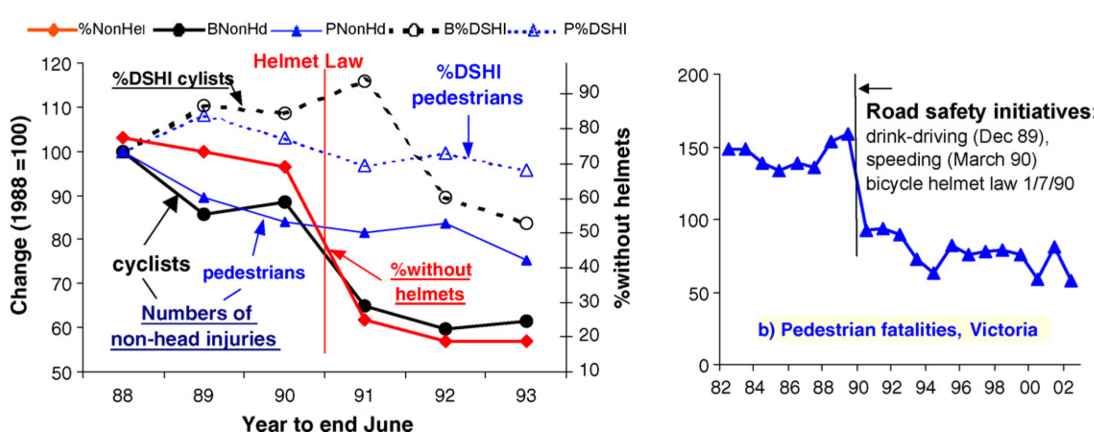

Fig. 1. Comparison of two road safety interventions in Victoria, Australia. (a, left) Percent without helmets (%NonHel) before and after helmet legislation, compared with numbers of *non-head* injuries to bicyclists (BNonHd) and pedestrians (PNonHd) and percentages of serious injuries involving death or serious head injury from collisions with motor vehicles for bicyclists (B%DSHI) and pedestrians (P%DSHI). (b, right) Numbers of pedestrian fatalities and timing of campaigns against speeding and drink-driving. Sources: ATSB (2002) and the Victorian Transport Accident Commission.