COMMENTARY

Effectiveness of bicycle safety helmets in preventing head injuries: a case-control study

Thompson DC, Rivara FP, Thompson RS. JAMA, 1996 Dec 25;276(24):1968-73

The same data set is used in these other papers by the same authors:
Effectiveness of bicycle safety helmets in preventing serious facial injury. JAMA, 1996a;276(24):1974-1975.
Epidemiology of bicycle injuries and risk factors for serious injury. Injury Prevention, 1997 3: 110-114.

Original authors' abstract

OBJECTIVES: To examine the protective effectiveness of bicycle helmets in 4 different age groups of bicyclists, in crashes involving motor vehicles, and by helmet type and certification standards.
RESEARCH DESIGN: Prospective case-control study
SETTING: Emergency departments (EDs) in 7 Seattle, Wash, area hospitals between March 1, 1992, and August 31, 1994.
PARTICIPANTS: Case subjects were all bicyclists treated in EDs for head injuries, all who were hospitalized, and all who died at the scene. Control subjects were bicyclists treated for nonhead injuries.
MAIN RESULTS: There were 3390 injured bicyclists in the study; 29% of cases and 56% of controls were helmeted. Risk of head injury in helmeted vs unhelmeted cyclists adjusted for age and motor vehicle involvement indicate a protective effect of 69% to 74% for helmets for 3 different categories of head injury: any head injury (odds ratio [OR], 0.31; 95% confidence interval [CI], 0.26-0.37), brain injury (OR, 0.35; 95% CI, 0.25-0.48), or severe brain injury (OR, 0.26; 95% CI, 0.14-0.48). Adjusted ORs for each of 4 age groups (<6 y, 6-12 y, 13-19 y, and > or = 20 years) indicate similar levels of helmet protection by age (OR range, 0.27-0.40). Helmets were equally effective in crashes involving motor vehicles (OR, 0.31; 95% CI, 0.20-0.48) and those not involving motor vehicles (OR, 0.32; 95% CI, 0.20-0.39). There was no effect modification by age or motor vehicle involvement (P=.7 and P=.3). No significant differences were found for the protective effect of hard-shell, thin-shell, or no-shell helmets (P=.5).
CONCLUSIONS: Bicycle helmets, regardless of type, provide substantial protection against head injuries for cyclists of all ages involved in crashes, including crashes involving motor vehicles.

BHRF Commentary

Differences between 'cases' and 'controls'

Case-control studies are valid only if the 'control' group is representative of the population at risk, the cyclists who might suffer head injuries. The authors admit major differences between the two groups in this study; cyclists with head injuries (the 'cases') were more likely to be younger, male, less educated and with lower income. Crashes involving head injury were more likely to involve motor vehicles and to have sustained damage to cycles.

Potential conflict of interest

This research was supported by a grant from the Snell Memorial Foundation, to which the principal bicycle helmet manufacturers are contributors.

Adjustments are said to have been applied for age and motor vehicle involvement. but the exact mechanism of these adjustments is not stated.

Motor vehicle involvement

Motor vehicle involvement increases the risk of head injury 3-5 times and the risk of head injury for children is something like double that of adults. Non wearers in this study were younger than wearers (so should have had a higher rate of head injury because of that) and also 41% more likely to have collided with a motor vehicle (18.0% of non wearers vs 12.7% of wearers), again increasing the rate of head injury for non-wearers relative to wearers.

Adjustment for motor vehicle involvement would not be straight forward. A motorist crashing into a bicyclist has very different injury potential than a bicyclist crashing into a motor vehicle. Hitting a slow-moving vehicle on a residential street has nothing like the impact of being hit by a truck on a major road. In each of these scenarios, the adjustment would need to be different. As the authors make no reference to the complexity of this problem, it must be assumed that their correction for motor vehicle involvment was simplistic.

Misleading use of odds ratios

As in their earlier work (Thompson, Rivara and Thompson, 1989), the authors use odds ratios for the protective effect of helmets for risk of head injury. It is more informative to use risk ratios (RR) = %HIH / %HIN where %HIH and %HIN are the percentages of helmeted and non-helmeted cyclists with head injuries.

Severity of head injuries - helmet benefit may be less than suggested

73% of the head injuries were wounds to the head. Nobody doubts that helmets can prevent minor head wounds, but these are not injuries that are in any way life-threatening.

Severe brain injuries are defined as anything worse than loss of consciousness for under 15 mins. There weren't many - 62 out of the 3,390 cyclist injuries - and the majority were caused by bike/motor vehicle collisions, even though only 12.7% of helmet wearers and 18.0% of non-wearers collided with motor vehicles.

The fact that helmeted wearers were in proportionately fewer bike/motor-vehicle crashes and probably in lower impact crashes may have accounted for some of the claimed protection of helmets. This would be consistent with findings by Spaite et al, 1991. Despite the fact that non-wearers had a 41% higher risk of motor vehicle involvement, the adjusted odds ratios (0.35 for brain injury) are very similar to the unadjusted ones (0.33).

For adults (>20) the authors cite an adjusted odds ratio of 0.51 for brain injury (crude odds 0.49), equivalent to about 35% of brain injuries being prevented. This suggests that helmets have limited efficacy in preventing any brain injury (even concussions lasting less than 15 minutes) in the sort of crashes typically experienced by adults. The paper acknowledges that helmets were ineffective in preventing injuries greater than ISS = 8 (which are called 'severe' but are more often termed 'moderate' – Beattie, Currie, Williams and Wright, 1998).

The study infers that helmet protection increases with increasing severity of injury. That is, it is suggested that a helmet provides greater protection against serious brain injuries than against a gashed scalp. This is not plausible, but reinforces the possibility that those who wore helmets were in generally less serious crashes.

Risk taking

The authors acknowledge that those who chose to wear helmets may also be lower risk-takers having less severe accidents, an odd remark given that they said they had corrected for accident severity. Does this indicate that their own regression analysis was not robust?

Compatibility with previous research

This study finds a protective effect for helmets of 69% for head injury and 65% for brain injury. However, the authors are keen to suggest that the results are completely compatible with their 1989 findings of 85% protection for head injury and 88% for brain injury (Thompson, Rivara and Thompson, 1989), arguing that such results might have been repeated in this instance with population (instead of hospital) controls. This is pure conjecture, particularly as the earlier study has been extensively criticised for the non-representative nature of its population control group. The authors ignore the lack of evidence of helmet benefit at even the lower levels of magnitude in real-world situations.

Conclusion

This study was intended by its authors to address uncertainty about the benefits of cycle helmets across age groups, in motor vehicle crashes and according to helmet type. However, it provokes as many questions as it answers. Like other non-randomised case-control studies, confounding remains a problem and the study's ability to address this has been limited.

References

Beattie, Currie, Williams and Wright, 1998

Beattie TF, Currie CE, Williams JM, Wright P, 1998. Measures of injury severity in childhood: a critical overview. Injury Prevention 1998;4:228-231. External Link
http://ip.bmjjournals.com/cgi/content/full/4/3/228

Spaite et al, 1991

Spaite DW, Murphy M, Criss EA, Valenzuela TD, Meislin HW, 1991. A prospective analysis of injury severity among helmeted and non helmeted bicyclists involved in collisions with motor vehicles. Journal of Trauma 1991 Nov;31(11):1510-6.. Link includes commentary
http://www.cyclehelmets.org/1164.html

Thompson, Rivara and Thompson, 1989

Thompson RS, Rivara FP, Thompson DC, 1989. A case control study of the effectiveness of bicycle safety helmets. New England Journal of Medicine 1989 v320 n21 p1361-7. Link includes commentary
http://www.cyclehelmets.org/1068.html