Bicyclists, Helmets and Head Injuries: A Rider-Based Study of Helmet Use and Effectiveness

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Abstract: We interviewed 516 bicyclists over age 10 regarding helmet use and head injuries. Although 19 per cent owned helmets, only 8 per cent were wearing them when interviewed. Riders wearing helmets were more highly educated and reported higher car seat belt use. Nearly 4 per cent of the bicyclists reported striking their heads in a cycling mishap during the previous 18 months; those wearing helmets at the time of the mishap were less likely to have sustained head injuries. (*Am J Public Health* 1988; 78:1220–1221.)

Introduction

Bicycling injuries account for at least 1,000 deaths[1] and 500,000 emergency room visits[2] each year in the United States. Head injuries account for approximately 85 per cent of bicycling deaths[3] and two-thirds of bicycle-related hospital admissions.[4] In light of these statistics, several authorities have suggested that bicyclists wear helmets.[5–7]

Few data are available to either support or refute this recommendation. In laboratory studies, many helmet brands have been shown to absorb the necessary 300–400 G of acceleration to minimize brain injury,[8–10] but a literature search reveals only one published study on the effectiveness of helmets in actual bicycle mishaps. Dorsch, *et al*, demonstrated an association between helmet use and reduced severity of injury in a mail survey of Australian bicycling enthusiasts.[11]

Weiss recently reported the prevalence of helmet use among adult recreational cyclists (85 per cent), university students (10 per cent), and school children (2 per cent) in Arizona,[12] but no published studies address why bicyclists wear helmets.

We therefore designed a study to address the following questions:

- What is the prevalence of helmet use among bicyclists in traffic?
- What factors are associated with bicycle helmet use?
- Are helmets effective in preventing bicycling head injuries?

Methods

Bicyclists were interviewed at roadside during July and August 1984 in and around Burlington, Vermont, a semi-urban university community with a predominantly White population of 120,000. Interviewers were stationed at 16 roadside locations during daylight hours on all days of the week. Using hand-held signs, they attempted to stop and interview all bicyclists who appeared to be over the age of 10.

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TABLE 1—Characteristics of Overall Study Group and of Helmet Users

Characteristics	% of Sample (N=516)	% Wearing Helmets (N=40)
Age		
11–19	41.9	3.7
20–29	39.0	8.0
≥ 30	19.1	16.2
Sex		
Male	64.4	8.5
Female	35.6	6.6
Education (years completed)		
≥ 12	43.0	3.6
13–16	43.0	7.7
> 16	14.0	20.8
Marital status (if > age 18)		
Single	76.8	8.0
Married	23.2	17.1
Cigarette Use		
Nonsmoker	90.3	8.4
Smoker	9.7	2.0
Seat Belt Use (self-estimate of % of time belt worn)		
< 25%	25.2	0.0
25–75%	19.8	3.9
> 75%	55.0	12.7
Belief in Head Injury Susceptibility		
Unlikely to Hit Head	54.6	5.7
Not unlikely to Hit Head	45.4	10.3
Belief in Head Injury Seriousness		
Not serious	44.1	4.4
Serious	55.9	10.2
Belief in Bicycle Helmet Effectiveness		
Not effective	18.1	5.4
Effective	81.9	8.3

Five hundred sixteen (516) of 683 cyclists (76%) stopped and consented to a five-minute interview. There were no differences in helmet use or sex between those who stopped and were interviewed and those who did not.

The interview solicited information about demographics, bicycling practices, attitude toward head injury and helmet use, health-related practices (e.g., cigarette smoking), and bicycling injury experience over the previous 18 months.

Results

The subjects interviewed had a mean age of 23.4 years (SD ± 10.1) and mean education of 13 years (SD ± 3.6); 58 per cent were students.

Although 18.8 per cent of the respondents reported owning a helmet, only 7.8 percent were wearing helmets at the time of interview. The most common reasons given for not wearing a helmet were that the rider was on a short trip (28 per cent), that helmets were uncomfortable (24 per cent), and simple negligence (13 per cent).

Table 1 shows selected characteristics of the study group and the per cent of helmet wearers in each category. Increasing age and education, marriage, seat belt use, and the

TABLE 2.—Multivariate Discriminant Analyses to Predict Helmet Use

Variables	Standardized Canonical Discriminant* Function Coefficient	Canonical† Correlation
Age‡	−.12	
Male Sex‡	.23	
Education‡	.85	
Married‡	.46	
		.231
Age‡	.21	
Male Sex‡	.22	
Education‡	.46	
Seat Belt Use**	.54	
Belief in Susceptibility to Head Injury**	.41	
Belief in Seriousness to Head Injury**	.30	
		.338

*Reflects relative contribution of variable to the discriminant function.
†When squared reflects the proportion of variance in group membership explained by the discriminant function.
‡Entered directly.
**Entered stepwise.

rider's belief in personal susceptibility to and seriousness of head injury appeared associated with helmet use.

Multivariate discriminant analyses were performed to examine the relative contributions of these variables in predicting helmet use. Results are seen in Table 2.

In the analysis of demographic factors alone, the discriminant function coefficients suggest that education and marital status contribute most strongly in predicting helmet use. In an analysis controlling for age, sex, and education, seat belt use and belief in susceptibility to and seriousness of head injury assume importance in predicting helmet use. The proportion of variance in helmet use explained by this second discriminant function, however, is a modest 11.4 per cent.

Head injury experience for the previous 18 months was as follows: 21 bicyclists (4 per cent) had struck their heads in a mishap, and seven (1 per cent) reported sustaining head injury, three with concussions and four with lacerations requiring sutures.

Of the 21 riders who reported falling and striking their heads, eight were wearing helmets at the time of the mishap. All helmets had hard shells and energy absorbing liners which met or exceeded American National Standards Institute.[10] Head injuries were reported by seven of 13 unhelmeted, and none of eight helmeted riders [odds ratio = 19.6 (calculated by adding 0.5 to each cell[13]), 95% confidence interval (1.2, 331)[14]]. No associations were found between head injury and other variable, including the type of surface the head struck and involvement with a motor vehicle. In addition, helmet use was not associated with protection from nonhead injuries, suggesting that the injury events experienced by helmeted and unhelmeted riders were similar in severity.

Discussion

The frequency among respondents of mishaps involving the head suggests that the risk of head injury to active bicyclists is substantial. These locally derived data should be interpreted cautiously; e.g., they may underestimate the head injury risk to riders in warmer or dryer climates, since weather and road conditions in Vermont preclude cycling for several months a year.

Reasons given by helmet owners who were not wearing helmets when interviewed resemble those often cited for not wearing seat belts. In fact, helmet wearers reported higher rates of seat belt use, even after controlling for education.

The findings on helmet use and protection against injury among riders who had hit their heads suggest that helmets may be effective in preventing head injuries. These findings are consistent with the findings of Dorsch, laboratory evidence,[8–10] experience in other sports,[15] and common sense. However, for methodological reasons, this interpretation should be made with caution. The quasi-experimental design of the study makes it possible that unmeasured variables might account for the apparent association between helmet use and protection from head injury. The number of individuals who had struck their heads was small, making the results somewhat fragile statistically. Finally, the study relied entirely on the interview for documentation of both head injury and helmet use at the time of the mishap.

Within these limitations, these data offer very suggestive evidence that helmets afford protection from bicycling head injuries. Given the research design, it is also possible that a true association between helmets and protection from head injury might have been underestimated, since riders who had been killed, severely injured, or who gave up riding would have been unavailable for interview at the time of the study. Future research should further define the role of helmets in reducing bicycling head injuries, and focus on ways to increase helmet use among bicyclists.

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