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Risk Compensation: A Male Phenomenon? Results From a Controlled Intervention Trial Promoting Helmet Use Among Cyclists

Antoine Messiah, MD, PhD, DSc, Aymery Constant, PhD, Benjamin Contrand, MS, Marie-Line Felonneau, PhD, and Emmanuel Lagarde, PhD, DSc

Prevention tools are challenged by risky behaviors that follow their adoption. Speed increase following helmet use adoption was analyzed among bicyclists enrolled in a controlled intervention trial. Speed and helmet use were assessed by video (2621 recordings, 587 participants). Speeds were similar among helmeted and nonhelmeted female cyclists (16.5 km/h and 16.1 km/h, respectively) but not among male cyclists (helmeted: 19.2 km/h, nonhelmeted: 16.8 km/h). Risk compensation, observed only among male cyclists, was moderate, thus unlikely to offset helmet preventive efficacy. (*Am J Public Health.* 2012;102:S204–S206. doi:10.2105/AJPH.2012.300711)

Public health measures based on diffusion of preventive innovations can be undermined by risk compensation: feeling safer makes some people adopt riskier behaviors.[1–13] Despite documented effectiveness of helmet use for the prevention of injuries,[14] its benefit in bicyclists is disputed; the documentation is insufficient, especially among adult bicyclists outside of a sport or recreation context.[15–18] Studies of risk compensation by helmet users in the context of recreational sports have yielded equivocal results.[12,19–22] In the present study, we aimed to assess the speed of new helmet users among adult urban bicycle riders enrolled in a controlled intervention trial.

METHODS

An intervention trial promoting bicycle helmet use was performed at a municipal center in Bordeaux, France. We recruited 1798 participants from June 2009 to August 2010; only individuals declaring that they were borrowing a bicycle for their own use were included.

Sociodemographic variables (gender, age, education level, occupation), history of bicycle injuries in the last 12 months, and helmet use in the past month were collected through a standardized questionnaire.

Speed Determination and Observation of Helmet Use

Seven observation sites were deployed in Bordeaux. Each observation spot had 2 cameras: a first camera with an image analysis processor was programmed to detect moving objects, isolate cyclists, and calculate speed; it shot cyclists from above. A second high-definition camera automatically shot a series of photos of each detected cyclist from behind. All cameras collected data 6 hours a day, 7 days a week.

Data Analysis

Participants who reported previous helmet use (n = 241) were excluded. The characteristics of the 1557 remaining participants are reported elsewhere.[23] The cameras recorded 2621 moves made by 587 of these participants. Participants who were not seen by any of the cameras were excluded. Each participant's recorded move was considered a statistical unit. Because participants could be observed several times, we used Generalized Estimating Equation techniques to analyze repeated correlated measurements[24–26];

TABLE 1—GEE Linear Model for Speed Among Male Cyclists, by Factors Significantly Associated With Speed: Bordeaux, France, June 2009–2010

Parameter	B (95% CI)	P
Intercept	12.9 (12.2, 13.6)	< .001
Helmet: yes (= 1) vs no (= 0)	3.8 (1.1, 6.6)	.007
Observation site (values = 1–5)	1.6 (1.5, 1.8)	< .001
Age, y		
18–24 (Ref)	0	
25–29	−1.0 (−2.2, 0.1)	< .001
≥ 30	−1.7 (−2.4, −0.9)	
Interaction: helmet (yes) x observation site	−0.8 (−1.2, −0.3)	.003

Note. CI = confidence interval; GEE = Generalized Estimating Equation.

autocorrelated regression was used to model speed. Same-participant speed measurements were considered as autocorrelated, whereas different-participant speed measurements were considered as dependent only on factors entered into the model. Analyses were performed using SPSS software.[27]

RESULTS

Helmet use was observed in 3.8% of observed moves (99 out of 2621). The average speed was 16.5 kilometers per hour, with a small but statistically significant difference between male (16.9 km/h) and female cyclists (16.1 km/h, $P < .001$) and an age-related negative trend (17.3, 16.6, and 15.7 km/h for ages 18–24, 25–29, and ≥ 30 years, respectively; $P < .001$). Speed varied considerably by observation site, with an average of 12.9 kilometers per hour for the slowest and 20.0 kilometers per hour for the fastest ($P < .001$). Speed was higher among helmeted male cyclists (19.2 km/h) than among nonhelmeted male cyclists (16.8 km/h, $P < .001$), but the same was not true for female cyclists (helmeted 16.5 km/h, nonhelmeted 16.1 km/h, $P = .56$). Therefore, subsequent analyses were performed among male cyclists only (251 participants, 1172 observed moves, helmet use in 5.1% of moves).

TABLE 2—GEE Linear Model for Speed Among Male Cyclists, by Helmet Status and Observation Site: Bordeaux, France, June 2009–2010

	Speed (km/h)	
Site[a]	Not Wearing Helmet	Wearing Helmet
1	14.5	17.5
2	16.1	18.3
3	17.7	19.1
4	19.3	19.9
5	20.9	20.7

Note. GEE = Generalized Estimating Equation. Average speeds are given as predicted by the model for ages 18–24 years. Speeds for ages 25–29 years were obtained by subtracting 1.0 km/h from each speed above; speeds for ages ≥ 30 years were obtained by subtracting 1.7 km/h from each speed above.
[a]Total of 7 observation sites. Sites with similar speeds were merged and subsequently coded by increasing speed from 1 to 5.

We merged sites with similar speeds and subsequently coded them by increasing speed from 1 to 5. Factors significantly associated with speed were age, wearing a helmet, observation site, and interaction between the latter 2 factors (Table 1). Average speed predicted by the model (Table 2) differed the most by helmet use status on sites where it was the lowest; the gap diminished from one site to the next and did not differ on the site where the speed was the highest.

DISCUSSION

In this study, risk compensation was not observed among female bicyclists, whereas helmeted male bicyclists tended to ride faster than non-helmeted ones. This phenomenon was dependent on the overall bicycling speed in the given area; it diminished as the speed tended to increase, and vanished where bicycle traffic was the fastest.

These results suggest that risk compensation is a male behavior. Women have a higher commitment toward health concerns and healthy behaviors, which have been posited as reasons for their longer life span and better health.[28–34] Furthermore, risk compensation tended to vanish as objective risk of injury increased, suggesting that it is subject to a ceiling effect. This ceiling effect cannot be attributed to the legal speed limit, because the average speed at the fastest site was less than half the limit.

Because this study was conducted among new helmet users, reverse causality is unlikely to be at play. Limitations are mostly related to data collection in real-life situations: only one third of recruited participants (587 out of 1557) were observed by cameras. Although sociodemographic characteristics and history of bicycle incidents did not differ between observed and unobserved participants,[23] unobserved participants may have different bicycling behaviors, including risk compensation. Also, this was a single-center study conducted in an urban area with a high rate of bicycle use. Finally, the 60 helmeted observations were unequally distributed across the sites.

In conclusion, helmet use did not result in increased risk-taking among female cyclists. The average speed difference between helmeted and nonhelmeted male cyclists was moderate and tended toward zero as overall speed increased. These results suggest that risk compensation is limited and unlikely to offset the protective effect of helmet use. ■

About the Authors

Antoine Messiah, Benjamin Contrand, and Emmanuel Lagarde are with INSERM, Research Center U-897, Centre de Recherche "Épidémiologie et Biostatistique", Injury Prevention and Control research team (Prévention et Prise en Charge des Traumatismes), Bordeaux, France. Aymery Constant is with EHESP School of Public Health, Rennes, France. Marie-Line Felonneau is with Laboratoire de Psychologie, "Santé et Qualité de Vie," EA 4139, Université Victor Segalen Bordeaux 2, Bordeaux, France.

Correspondence should be sent to Antoine Messiah, MD, PhD, DSc, INSERM, Research Center U-897 "Epidemiology and Biostatistics," Université Bordeaux 2, case 11, 146 rue Léo Saignat, F-33076 Bordeaux Cedex, Bordeaux, Aquitaine F-33076, France (e-mail: antoine.messiah@isped.u-bordeaux2.fr). Reprints can be ordered at http://www.ajph.org by clicking on the "Reprints" link.

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Contributors

All authors contributed to the work and approved the article. E. Lagarde is the principal investigator of the overall project. E. Lagarde, A. Messiah, A. Constant, and M.-L. Felonneau conceived the study. A. Constant and E. Lagarde implemented and supervised the field work, with the help of A. Messiah. A. Messiah completed the analyses with the help of A. Constant and B. Contrand. A. Messiah wrote the article with input from all other authors.

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Human Participant Protection

All participants gave written informed consent. Data were collected anonymously. The study protocol was approved by the French Data Protection Authority (CNIL).

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