Prevalence and predictors of bicycle helmet use in a southeastern, US city

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Abstract:

Fatalities and head injuries from bicycle-related crashes remain a concern in the United States. Despite legislation in many states, helmet use remains low. This observational study examined the helmet use and related factors in a North Carolina city. The sample consisted of 2088 observations of bicyclists. The objectives were to (1) determine helmet use; (2) describe other safe bicycling practices; and (3) examine the relationship of demographic variables and safe riding practices with helmet use. Helmet use was observed for 25% of the sample. Demographic factors related to helmet use were being female (OR = 1.32), 26 years old or older (OR = 4.94), and White (OR = 2.17). Bicyclists riding on the road with traffic were more likely to wear a helmet than bicyclists riding on the sidewalk (OR = 2.04). Findings indicate that helmet use remains low in the city. Research to monitor, better understand, and promote helmet use is needed.

Keywords: bicycle | helmets | injury prevention | United States

Article:

INTRODUCTION

Deaths and injuries from bicycle-related crashes continue to be a public health issue in the United States. According to the Centers for Disease Control and Prevention's most current data, there were 900 bicyclists killed in 2012 in the United States, up from 601 in 2011 and 551 in 2010 (Centers for Disease Control and Prevention [CDC], 2014a). Although data for the last four years indicate that the crude rate for bicycle-related injuries have declined in recent years, the number of injuries remains high. The crude rate for bicycle-related injuries was 172, 169, and 156 per 100,000 in 2011, 2012, and 2013, respectively (CDC, 2014b). In North Carolina, bicycle fatalities accounted for 2% of all the traffic fatalities in the state (National Highway Transportation Safety Administration [NHTSA], 2013). Greensboro, North Carolina, where this

study was conducted, has the fifth highest average annual bicycle crash rate in the state (North Carolina Department of Transportation [NCDOT], 2011).

Bicycle helmet use is the most effective strategy for reducing the risk of head injury and death in a crash event (NHTSA,2013). Attewell et al. (2001) found that those not wearing a helmet were two and a half times more likely to have head injuries and more than three and half times more likely to die in a crash than helmet wearers (Attewell, Glase, & McFadden, 2001). In an earlier study, Thompson, Rivara, and Thompson (1989) found an 85% reduction in head injury with helmet use and more recently Elvik (2011) supported the efficacy of helmets for preventing injury.

Fatality and injury rates are affected by demographic and behavioural factors, likely because these factors are associated with bicycle helmet use. Findings suggest that women (Klein, Thompson, Scheidt, Overpeck, Gross, & the HBSC International Investigators, 2005; Thomas, Hunter, Feaganes, & Foss, 2002), people over age 16 (Ji, Gilchick, & Bender, 2006; Kakefuda, Henry, & Stallones, 2009; Klein et all., 2005), and Whites(Ji et al., 2006; Webman et al., 2013) wear helmets more often than men, people under 16 years old and people of other races.

In addition to demographic factors, safe bicycle riding behaviours are also associated with helmet use. Bicyclists who ride on the road are more likely to wear a helmet than those riding on sidewalks or in parking lots (Ludwig, Buchholz, & Clarke, 2005). Additionally, a statistically significant difference was found for several bicycling driving behaviours between helmet users and non-users. Bicyclists wearing helmets rode with the flow of traffic ($p = 0.001$) and used bike lanes when available ($p = 0.013$), more often than bicyclists without helmets (Webman et al., 2013). Use of other safety equipment appears to be positively associated with the likelihood that a rider wears a helmet. Teschke et al. (2012) found that riders who ride with at least one light turned on and wear brightly coloured clothing are more likely to wear helmets.

Over the years interventions to promote and regulate helmet use have been implemented in the United States and in North Carolina. Interventions for increasing bicycle helmet use include legislation, education, and promotion. Twenty-two of the 50 United States have statewide helmet laws and approximately 201 individual municipalities have local helmet laws, but only a few local ordinances mandate helmet use for all ages (Bicycle Helmet Safety Institute, 2015). In North Carolina, a helmet law for people under 16 years old has been in effect since October 2001. Currently, Greensboro does not have a local helmet ordinance (Bicycle Helmet Safety Institute, 2015). Despite this law, helmet use in North Carolina during the first six years post legislation was not widespread (Carter, Brewer & Garrison, 2007). Educational and promotional interventions have been successful at increasing helmet use from baseline to immediately post intervention. For example, the Safety Central helmet education and biking safety programme successfully increased helmet use among programme participants (Kirsch & Pullen, 2003). In another study, Ludwig et al. (2005) increased helmet use from 27.6% at baseline to 49.3% during the last week of the intervention using a social marketing campaign. Even with these interventions, helmet use remains low among children and adults. Nationally, helmet use is estimated at 25%–41% among children and adults (Cody, Quraishi, & Mickalide, 2004).

The objectives of this study were to (1) determine helmet use by adult bicyclists; (2) describe the extent of other safe bicycling practices; and (3) examine the relationship of demographic variables and safe riding practices with helmet use. Based on the existing literature, it was hypothesized that helmet use would be related to safe riding behaviours and certain demographic variables.

METHODS AND MATERIALS

Sample

A total of 2088 observations of bicyclists were made for this study; 783 in 2009 and 1117 in 2010. Observations were made at six different locations in the city of Greensboro, North Carolina, during mid-September of 2009 and 2010. Data were collected between the hours of 7 am and 7 pm. At each location observations took place at two-hour intervals for seven consecutive days, including both weekday and weekend days. Helmet use data were not available for 188 observations and thus were not included in the analysis. No significant differences were identified between these 188 observations missing helmet use data and the 1900 included in analyses on any variables.

Instrument

Data were collected using the National Bicycle and Pedestrian Documentation Project data collection instrument with modifications. This is a user-friendly form that allows for data to be collected on the date, time, and weather of the observation, the number of bicyclists, pedestrians, and people using other equipment, such as skateboards or scooters at 15-minute intervals. Thus, several items were added to the original instrument including safe riding behaviours, such as travel direction (with traffic, against traffic), travel path (sidewalk, road), and information on the bicyclists including helmet use (yes, no), age (<26, ≥ 26), and race/ethnicity (White, Black, American Indian/Alaskan Native, Hispanic/Latino, Asian, Unknown). These factors were examined because of their reported association with the frequency of crashes and fatalities (Basch, Zagnit, Rajan, Ethan & Basch, 2014; Bolen, Kresnow & Sacks, 1998; Thomas et al., 2002).

Procedure

Trained, stationary volunteers conducted observations. Specific training focused on how to count multiple individuals on one bicycle, and how to classify sex, estimate age, and race/ethnicity by appearance according to their judgment. Researchers conducted site checks at selected date, time, and locations to confirm that observations were being made. Data were analysed using PASW Statistics ver. 18 (SPSS, Inc., Chicago, IL). A descriptive analysis was conducted to estimate the helmet use and to describe safe riding practices. A multivariate logistic regression model was used to identify factors related to helmet use. In order to reduce the redundancy in the model, travel path and traffic direction variables were combined into one variable with three categories. The bicyclists observed were either riding on the road with traffic, on the road against traffic, or riding on a sidewalk where traffic direction was not an issue. Sidewalk riders were the referent category. In addition, we assessed the independent effects of sex, age, race, and year on

the likelihood that a person would be wearing a helmet. Only those observations for which race/ethnicity was Black or White were included. The regression analysis included 1612 cases for which complete data on these six variables were available. Observers had difficulty identifying races and ethnicities other than White and Black, thus the third largest race or ethnicity was Unknown.

RESULTS

The sample was predominately male (71.8%), White (73.4%) and estimated to be below the age of 26 (69.7%). The unadjusted frequency to helmet use by sex, age, race, and travel path are presented in Table 1. Twenty-five per cent were observed wearing a helmet. The frequency of helmet use was greater in older bicyclists, females, White riders, and those who travelled on the road with traffic. Forty-three per cent of older bicyclists were observed wearing a helmet compared to only 18% of younger bicyclists. Twenty-seven per cent of the female riders versus 25% of the male riders were observed wearing a helmet. By race, 28% of the White bicyclists compared to 17% of the Black riders were wearing a helmet. Thirty-one per cent of bicyclists travelling on the road and with the flow of traffic were observed wearing a helmet compared to 18% of bicyclists riding on the sidewalk and 22% travelling on the road against traffic.

Table 1. Unadjusted frequency of helmet use by sex, age, race, and travel path[1].

		Total sample[1]			
		Helmet		No helmet	
	Variable	*n*	%	*n*	%
Sex	Male	340	24.9	1025	75.1
	Female	135	27.0	365	73.0
Age***	<26	238	18.0	1087	82.0
	>26	236	43.1	311	56.9
Race***	White	387	27.8	1007	72.2
	Black	56	17.4	265	82.6
Travel path***	Sidewalk	136	17.8	626	82.2
	On road with traffic	299	31.2	658	68.8
	On road against traffic	25	21.7	90	78.3
Total		481	25.3	1419	74.7

***$p < .001$.
[1]*n*s vary by pair due to missing values, but range from 1715 to 1872.

The logistic regression analysis indicated that sex, age, race, year, and travel path were independently associated with helmet use. Odds ratios with 95% CIs are presented in Table 2. Bicyclists travelling on roads with the flow of traffic and bicyclists who were White had higher odds of wearing a helmet than those who were travelling against traffic, riding on sidewalks, and were Black. Female bicyclists were 1.32 ($p < .05$) times more likely to wear a helmet than male bicyclists. Older bicyclists were nearly five ($p < .001$) times more likely to wear a helmet than

bicyclists under 26 years old. White bicyclists were 2.17 ($p < .001$) times more likely to wear a helmet compared to their Black counterparts. Bicyclists riding on the road with the flow of traffic were two times ($p < .001$) more likely to wear a helmet than bicyclists riding on the sidewalk. There was no difference found in helmet use between bicyclists riding in the road against traffic and those riding on the sidewalk.

Table 2. Likelihood of helmet use by sex, age, race, year, and travel path.

		Total $n = 1612$	
	Predictor variables	OR	CI
Sex			
	Female	1.32	1.01–1.72*
Age			
	≥26	4.94	3.48–5.80***
Race			
	White	2.17	1.54–3.13***
Year			
	2009	1.28	1.00–1.63*
Travel path			
	On road with traffic	2.04	1.57–2.65***
	On road against traffic	0.93	0.52–1.69

*$p < .05$ ***$p < .001$.

DISCUSSION

The objectives of this study were to determine the prevalence of helmet use by adult bicyclists and examine factors associated with helmet use. Prevalence of helmet use was low in our sample at 25.3%, which is similar to helmet use self-report estimates for the state of North Carolina (Carter et al., 2007) and the observational estimates for United States (Cody et al., 2004). Although older adult riders in our study wore helmets more often than younger riders, the frequency was still below 45%. This finding is similar to the observed helmet use on New England bike trails, where 31% of older adults were observed wearing helmets (Twomey, Bevis, & McGibbon, 2001). n contrast, a national survey conducted in the United States in 2012 found that 54% of bicyclists self-reported wearing a helmet at least some of the time (Schroeder & Wilbur, 2013). Thus, it is possible that more people report wearing them than actually use them.

As hypothesized, helmet use was associated with certain demographic variables. The greatest prevalence of helmet use was observed among older bicyclists. Most notably, White bicyclists and those who were older were much more likely to wear a helmet than Black bicyclists or those under 26 years old. Among Black bicyclists, helmet use was low across the age spectrum. Differences in helmet use have been found across other racial/ethnic groups when compared to Whites (Allen et al., 2007). Only one study examined whether there were statistically significant

differences in children's helmet use by race (Kanny, Schieber, Pryor, & Kresnow, 2001). Kanny found that regardless of whether there was a helmet law in the county, Black children were less likely to wear a helmet compared to White children (2001). To the authors' knowledge, no studies have examined how race impacts helmet use among adults or how to address the disparity. Future studies on how race impacts helmet use are needed to explore this finding.

Additionally, females were observed wearing a helmet more often than males. Although the difference is quite small, it is significant and supports previous research by indicating that women wear helmets more often than men (Bolen et al., 1998 & Rogers, 1995). Similar results were found in a Canadian study (Grenier et al., 2013). This finding is consistent with the fact that men tend to take more risks than women in general. This is demonstrated by lower helmet use for men when motorcycle riding and higher morbidity and mortality rates (Ledesma, Lopez, Tosi, & Poo, 2014). However, other studies have found that men wear helmets more often than women. In a national study of cycling and helmet use patterns, men were 18% more likely to wear a helmet than women (Rogers, 1995). More recently, a study of helmet use among bicyclists in New York City found that helmet use was higher among men (Basch et al., 2014). Possible reasons for the different findings include hours of riding and whether the bicyclist rides on the road or the sidewalk. Basch and colleagues also found that helmet use was related to whether the bicyclists were riding for recreation or transportation, where riders observed during recreation were less likely to wear a helmet. Rogers (1995) found that men tended to ride for more hours per year. These variations indicate that additional research is needed to understand the influence sex has on helmet use and how to address these differences in interventions.

Furthermore, findings from this study support previous evidence that safe practices, such as riding with the flow of traffic and riding on the road, predict helmet use (Ludwig et al., 2005; Rogers, 1995). Evidence on bicyclists' risk perception indicates that riders perceive riding on the road as more risky than riding on other paths (Winters et al., 2012). This study supports the current finding that bicyclists who ride on the road wore their helmets more often than those who ride on the sidewalk, as sidewalk riding is not seen as risky. The increased exposure associated with increased riding time, riding for transportation, and riding on the street may contribute to bicyclists feeling more susceptible to a crash and head injury, motivating them to wear a helmet more often.

Bicycle helmet use remains low in the general population. Results of a 2010 Cochrane Review indicate that bicycle helmet laws increase helmet use and reduce head injuries (Macpherson & Spinks, 2010). Although North Carolina has a state helmet law for people 16 years old and younger, adults are not required to wear a bicycle helmet. Laws that target specific age groups have been effective in increasing helmet use and reducing fatal and non-fatal bicycle crash-related injuries for the target population (Karkhaneh, Kalenga, Hagel & Rowe, 2006; Macpherson & Spinks, 2010). In Ontario, Canada, post helmet legislation enactment for people under 16 years old, Wesson et al. (2005) found a 52% decrease in the number of deaths for the target population and no change for the non-targeted adult population.

Helmet use is a complex behaviour, including demographic, intrapersonal, and contextual variables. As the current study suggests, increasing efforts to promote and increase helmet use are needed. Findings indicate that helmet use predictors may not be similar between all groups of

a population. Thus, additional studies are needed to examine differential helmet use by sex, age, and race in more detail, including why these differences exist and how to address them. Much helmet use promotion has focused on increasing use among children; however increasing use among adults remains a concern because the children model adult and especially their parents' behaviour (Dannenberg et al., 1993; Twomey et al., 2001). Continued education and promotion of the importance of helmet use, safe-riding behaviours, legislation targeting the general population, and enforcement of legislation aimed at increasing the rate of helmet use is needed.

DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

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