Barriers to Bicycle Helmet Use

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ABSTRACT. *Objective.* **To determine why people do or do not wear helmets while bicycling.**

Methods. **A survey was conducted from August through October 1999. Two survey areas were chosen for this study: local public schools and paved bicycle trails. For the school arm of the study, 3 public elementary, middle, and high schools were selected from 3 different regions of Rochester, Minnesota, for participation in the study. For the bicycle arm of the study, 3 paved trails located in southeastern Minnesota were selected. A total of 2970 surveys were distributed to the public school system, and 463 surveys were collected from bicyclists on the paved bicycle trails. The survey population was split into 3 age categories for analysis: child (7–10), adolescent (11–19), and adult (older than 19).**

Results. **Of the 2970 surveys distributed to Rochester public schools, 2039 (69%) were returned for analysis. Seventy-eight of the surveys that were completed in the public school system were discarded for the following reasons: age <10 years (35), insufficient completion (24), and selection of every reason for not wearing a bicycle helmet (19). A total of 463 surveys were completed on the 3 paved bicycle trails. One survey from the paved bicycle trail arm of the study was discarded because of insufficient completion. The total number of surveys used for statistical analysis was 2424. The distribution of male (52.7%) and female (47.3%) participants was similar. No significant difference in bicycle helmet use was found between genders.**

The age groups with the highest rate of bicycle helmet use were 50 to 59 years (62%) and older than 59 years (70%). The age groups with the lowest rate of bicycle helmet use were 11 to 19 years (31%) and 30 to 39 years (30%). The most common reasons given for not wearing a bicycle helmet were "uncomfortable," "annoying," "it's hot," "don't need it," and "don't own one." Bicycle helmet use was significantly influenced by peer helmet use in all 3 age groups. Children also were more likely to wear a bicycle helmet when their parents wore bicycle helmets.

A majority of respondents in all 3 age groups indicated that bicycle helmets provided either "moderate" or "great" protection from head injury, although significantly more adults (65.9%) than adolescents (43.9%) believed that the protection afforded by bicycle helmets was "great." Despite this belief, a majority of adolescents and adults indicated that there was only a "slight risk" of head injury when bicycling without a helmet. Participants in all 3 categories were more likely to wear a bicycle helmet when they indicated either that there was a "great risk" of head injury when bicycling without a helmet or that helmets provided "great protection" from head injury. Adolescents and adults who believed that bicycling without a helmet put one at "great risk" for head injury also were more likely to indicate that helmets provided "great protection" from head injury.

Conclusions. **The prevalence of bicycle helmet use remains low despite research indicating the high level of head injury risk when bicycling without a helmet and the significant protection afforded by bicycle helmets. With the information provided by this survey, a well-designed intervention to increase the use of bicycle helmets can be implemented. Suggestions for a campaign to promote an increase in bicycle helmet use include focusing efforts on males and females between 11 and 19 years and 30 and 39 years of age; educating the public on new bicycle helmet designs that address comfort, ventilation, and fashion; educating adolescents on the significant protection from head injury afforded by bicycle helmets; and educating the public on the risk and severity of head injury associated with bicycling without a helmet. The influence of parents and peers on bicycle helmet use may be targeted through education and statements such as, "If you wear a bicycle helmet, you are not only protecting yourself, you are also helping to protect your friends and/or children."** *Pediatrics* **2001;108(1). URL: http://www.pediatrics.org/cgi/content/full/108/1/e4;** ***bicycle, helmet, injury, accident, prevention.***

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Bicycling is a common recreational activity and aerobic exercise enjoyed by the pediatric, adult, and geriatric populations. Bicycle accidents result in 544 561 emergency department visits and 793 deaths in the United States annually.[1] The percentage of traffic-related fatalities attributed to bicycle accidents is between 3.3% and 15%.[2,3] Bicycle accidents occur more often during summer months,[3,4] on weekdays,[3] and in the daylight hours.[3,5–7] Cars are involved in 8.5% to 70.2% of bicycle accidents and in 96% to 100% of fatal accidents.[2,7–11] The male-to-female ratio of injured bicyclists is 1.4 to 3.5:1.[9,12–15] A majority of bicycle accidents occur in people younger than 21 years,[4–6,8,12,13] and 30% of pediatric bicycle accidents occur while children are riding to and from school.[16]

Head injuries occur in 31% to 65% of bicycle accidents,[5,7,8,11–14] and up to 6.3% of bicycle accidents result in death.[5,7,17,18] Seventy percent to 86% of bicycle accident–related deaths are because of head injury.[10,11,19] In those who survive the initial injury, symptoms from injuries related to the accident often persist for >2 years.[6] It is apparent that prevention of bicycle-related head injury is a public health concern.

The protective effect of bicycle helmets has been well established by several studies.[20–27] Head injuries are sustained by 1% to 4% of helmeted bicyclists and 11% to 22% of unhelmeted bicyclists.[20,21] Case-control studies indicate that helmets reduce risk of head injury by 45% to 85%, of traumatic brain injury by 65% to 88%, of facial injury by 28% to 65%, and of loss of consciousness by 86%.[22–27]

Despite the evidence indicating that bicycle helmets reduce the incidence and severity of head injury associated with bicycle accidents, observational studies have reported bicycle helmet use to be between 0% and 21.3% in areas that have not received interventions designed to increase bicycle helmet use.[2,5,7,8,10,13,14,28–33] Studies have determined that educational campaigns that promote bicycle helmet use and legislation that mandates bicycle helmet use can increase the prevalence of bicycle helmet use.[14,18,28,33–45] Head injuries sustained from bicycle accidents have decreased after the implementation of educational campaigns[46,47] and legislation.[33]

Although educational campaigns significantly increase the use of bicycle helmets, they seem to plateau when helmet use reaches between 50% and 60%.[42] This plateau may be attributable to the lack of information regarding why people do not wear bicycle helmets. Without knowing why people do not wear bicycle helmets, the most effective strategy to promote their use cannot be designed.

A literature review found few previous studies that addressed this question. Weaknesses of previous studies included narrow age range in the study group,[31,32,48,49] no information regarding barriers to helmet use in participants older than 18 years,[31,32,48,49] too few participants,[13,32] and not including participants from within the United States.[31,32] Ashbaugh et al[13] reported that the primary reason for not wearing a bicycle helmet was "never thought of it" (28%). Joshi et al[48] reported that the most common reason adolescents between 14 and 18 years old did not wear a bicycle helmet was "they are hot and uncomfortable" (81%). Joshi et al[48] also suggested that factors that correlate with higher bicycle helmet use were 1) more frequent thought on the subject of helmet use, 2) anticipated regret if an injury occurred while not wearing a helmet, and 3) higher bicycle helmet use among peers. DiGuiseppi et al[49] reported that among parents of third-grade children, the most frequent reasons for not purchasing a bicycle helmet for their child were "never thought about purchasing one"(51%) and "costs too much"(29%). Children in third grade did not wear bicycle helmets as frequently when their friends did not wear them. The research of both the Joshi and the DiGuiseppi groups suggests that peer bicycle helmet use influences a person's bicycle helmet use.

It is apparent from the above literature review that previous research has not sufficiently addressed the reasons that people do not wear bicycle helmets. The objective of this study was to survey a large sample of school-aged children and adults to determine why they did or did not wear helmets while riding a bicycle. To our knowledge, no previous intervention designed to increase the use of bicycle helmets has been implemented in southeastern Minnesota.

METHODS

This study used a survey design and was conducted in southeastern Minnesota between August and October 1999. Two separate survey forms were created. The first form used language that was understood easily by children between 7 and 10 years of age and is referred to as the "child's survey." The second form was designed for people older than 10 years and is referred to as the "adult survey." Similar questions were asked on both surveys. The initial questions on the survey collected information on patterns of bicycle use. Participants were then asked how frequently they wore a bicycle helmet. Participants who indicated that they did not wear a bicycle helmet every time they rode a bicycle were asked to indicate the reasons for not wearing a bicycle helmet from a list of barriers to bicycle helmet use on the survey. Participants were allowed to select >1 choice from the list. Bicycle helmet use patterns of friends also were obtained. The child's survey asked whether the children's parents wore bicycle helmets while riding a bicycle. Both the adult's and the child's surveys asked how much protection the rider thought that a helmet afforded from head injury, and the adult survey also asked what the rider thought that his or her risk of head injury was when bicycling without a helmet. Demographic information also was collected.

Two survey areas were chosen for this study: local public schools and paved bicycle trails. For the school arm of the study, 3 public elementary, middle, and high schools were selected from 3 different regions of Rochester, Minnesota, for participation in the study. Permission was obtained from the Rochester public school district to proceed with the investigation in these schools. The principal of each school was contacted by an investigator, and the purpose and the protocol for the survey were discussed. Arrangements were made to distribute surveys to 3 separate classrooms in each grade from the 2nd through the 12th at each school. This created a consistent sample size from each age range present in the schools. It was believed that kindergarten and first-grade children would have difficulty reading and understanding the survey independently and therefore they were excluded from the study.

The child's survey was distributed in the elementary schools, and the adult survey was used in the middle and high schools. The surveys were given to the teacher of each selected classroom in early September. The teacher was instructed to discuss with the students the purpose of the survey, to indicate to the students that they were under no obligation to complete the survey, and to explain that the information obtained from the survey would remain confidential. The students were given ~4 weeks for survey completion. The surveys then were collected by the investigators for analysis.

For the bicycle trail arm of the study, 3 paved bicycle trails (Cannon Valley trail, Douglas trail, and Silver Lake trail) located in southeastern Minnesota were selected. The investigators were stationed at tables set up at entry points or water stops along the bicycle trails. The tables were identified clearly by a Mayo Clinic Sports Medicine sign. As bicyclists entered or exited the trail or stopped for water, they were approached and asked to fill out a survey. The investigators attempted to survey as many people as possible, but no discrete capture rate could be calculated, because the trails had unrestricted public access. Only the adult survey form was used on the bicycle trails, and all bicyclists >6 years old were eligible for participation.

Statistical analysis was performed by the Biostatistics Department of the Mayo Clinic using SAS software (SAS Institute Inc, Cary, NC). Descriptive statistics were prepared by using χ^2 analysis. Significance was determined by $P < .05$. The survey population was split into 3 age categories for analysis: child (7–10 years), adolescent (11–19 years), and adult (older than 19 years).

RESULTS

A total of 2424 surveys were available for analysis. Of the 2970 surveys distributed to Rochester public schools, 2039 (69%) were returned for analysis. Seventy-eight of the surveys completed in the public school system were discarded for the following reasons: age less than 10 years (35), insufficient comple-

tion (24), and selection of every reason for not wearing a bicycle helmet (19). A total of 463 surveys were completed on the 3 paved bicycle trails. One survey from the paved bicycle trail arm of the study was discarded because of insufficient completion. The number of participants on the bicycle trails who refused to complete surveys was not recorded. However, surveyors noted that very few people refused to participate in the study. Because bicyclists did not know that the survey pertained to bicycle helmet use, it is unlikely that they chose not to participate on the basis of whether they were wearing a bicycle helmet. Demographic information from the population surveyed is displayed in Table 1. On the basis of demographic information obtained from the 1990 census of Olmsted County, the survey was a descriptive representation of the local population.[50]

The distribution of male (52.7%) and female (47.3%) participants was similar. The frequency of helmet use by age group is listed in Table 2. No significant difference in bicycle helmet use was found between genders. The 10 most frequently selected answers from the list of barriers to bicycle helmet use are listed for children, adolescents, and adults in Table 3.

A significant percentage of adults (n = 355 [76.7%]) and adolescents (n = 883 [64%]) rode their bicycles fewer than 3 days per week, whereas 60% of children rode their bicycles more often than 3 days per week, and 26% of children (n = 152) rode 7 days per week. Bicycle helmet use increased with riding frequency in children (P = .001). There was no correlation between bicycling frequency and bicycle helmet use in adolescents or adults. The duration of bicycle riding for children was evenly distributed from <15 minutes to >46 minutes, with adolescents usually riding <30 minutes (n = 684 [61%]) and adults riding >46 minutes (n = 265 [59.8%]). Adults who rode their bicycles for a longer duration wore bicycle helmets more often (P = .001). Adolescents who rode their bicycles more frequently also rode for a longer duration (P = .001). Children's bicycling locations were, in decreasing order of frequency, sidewalk (n = 222 [39.8%]), street (n = 193 [34.6%]), paved bicycle trail (n = 63 [11.3%]), driveway (n = 40 [7.2%]), dirt bicycle trail (n = 31 [5.6%]), and dirt country road (n = 9 [1.6%]).

All 3 age groups surveyed reported that a majority of their friends did not wear a helmet or wore it only sometimes. To the question of how often their parents wore their helmets, 29.6% of the children (n = 172) said never, 23.9% (n = 139) said always, and 19.4% (n = 113) said sometimes. Twenty-seven percent of children (n = 157) said that their parents did not ride bicycles. Children rode most often with friends (n = 413 [70.7%]), less often alone (n = 375 [64.2%]), and least often with family members (n = 336 [57.5%]). Children often selected >1 response to this question. Helmet use by friends or parents had a significant influence on whether the participant used a helmet (P = .001). This modeling effect is shown in Tables 4 and 5.

A majority of children believed that bicycle helmets provided significant protection from head injury (n = 443 [76.8%]), whereas 19.9% (n = 115) and 3.3% (n = 19) believed that they provided little or no protection, respectively. This trend also was found in the adolescent and adult groups. Despite that most people in all 3 age categories indicated that helmets provide "great protection" from head injury, a majority of adolescents and adults indicated that there was only a "slight risk" of head injury when bicycling without a helmet. Participants in all 3 age groups were more likely to wear a bicycle helmet when they indicated that there was a "great risk" for head injury if a helmet was not worn (P = .001). Adolescents and adults who believed that bicycling without a helmet put one at "great risk" for head injury also were more likely to indicate that helmets provide "great protection" from head injury (P = .001). There was a statistically significant (P = .001) correlation between a higher perception of head injury risk while bicycling without a helmet and increased helmet use.

DISCUSSION

Several important observations are apparent from the literature review. Bicycling is an activity that is enjoyed by millions of people worldwide.[1,16,51] Bicycle accidents occur frequently.[2–8,10–14,17,29,30,51,52] Head and traumatic brain injuries are a common sequela of bicycle accidents.[5,7,11–14] Bicycle helmets help prevent the occurrence and severity of head, traumatic brain, and facial injuries.[20–26,33] Despite this information, most people continue to bicycle without helmets. Why don't they wear bicycle helmets? Our survey provides vital information to help answer this question.

On the basis of demographic information obtained from the 1990 census of Olmsted County, the survey was a descriptive representation of the local population.[50] There was a similar distribution of males and females in our study, and no statistically significant difference was found in bicycle helmet use between genders. Some authors have observed similar helmet use between genders,[39,53] whereas others have found a higher helmet use in female bicyclists.[20,27,34,47] The

TABLE 1. Demographic Information*

Population	Male	Female	White	Black	Hispanic	Asian	American Indian	Other
Child	301 (51.5)	283 (48.5)	480 (82.2)	20 (3.4)	35 (6)	20 (3.4)	7 (1.2)	11 (1.9)
Adolescent	730 (53)	647 (47)	1198 (87)	37 (2.7)	29 (2.1)	93 (6.8)	14 (1)	20 (1.5)
Adult	261 (56.4)	202 (43.6)	436 (94.2)	9 (1.9)	6 (1.3)	15 (3.2)	1 (0.2)	3 (0.6)

* Data are number of people, with percentages in parentheses. Eleven children did not indicate their race on the survey, and several adolescent and adult respondents marked more than one race.

TABLE 2. Bicycle Helmet Use by Age Group*

Helmet Use†	Age Group (Year)						
	7–10	11–19	20–29	30–39	40–49	50–59	Older than 59
Yes	329 (44)	431 (31)	36 (35)	27 (30)	49 (35)	57 (62)	25 (70)
No	255 (56)	946 (69)	66 (65)	62 (70)	91 (65)	35 (38)	11 (30)

* Data are the number of people, with percentages in parentheses. Four people did not list their age.
† A "yes" response indicates bicycle helmet use either sometimes or always.

TABLE 3. The 10 Most Frequently Selected Barriers to Bicycle Helmet Use*

Barrier to Helmet Use	No. (%)
Children	
Uncomfortable	118 (20.2)
Don't need it	88 (15.1)
It's hot	80 (13.7)
Don't own one	70 (12)
Messes up my hair	57 (9.8)
Doesn't fit	56 (9.6)
Too difficult to put on	54 (9.2)
I forgot it	53 (9.1)
I outgrew it	51 (8.7)
It's funny looking	42 (7.2)
Adolescents	
Annoying	555 (40.3)
Uncomfortable	534 (38.8)
Don't own one	342 (24.8)
Ugly	333 (24.2)
It's hot	329 (23.9)
Unfashionable	321 (23.3)
Funny looking	311 (22.6)
Messes up my hair	307 (22.3)
I forgot it	229 (16.6)
Friends tease me when I wear it	195 (14.2)
Adults	
Don't own one	135 (29.2)
It's hot	96 (20.7)
Annoying	58 (12.5)
Uncomfortable	53 (11.4)
Forgot it	38 (8.2)
I'm not at risk for injury	34 (7.3)
It messes up my hair	25 (5.4)
Unfashionable	23 (5.0)
Other	22 (4.8)
Ugly	21 (4.5)

* More than one answer could be selected.

TABLE 4. Influence of Friends on Bicycle Helmet Use*

Friend's Bicycle Helmet Use	Participant's Bicycle Helmet Use†		
	Child	Adolescent	Adult
Never	40 (24.1)	210 (27.2)	9 (10.6)
Sometimes	160 (63)	196 (34.5)	110 (38.5)
Always	127 (80.9)	24 (68.6)	78 (83)

* Data are number of people, with percentages in parentheses.
† Percentages are based on the number of participants who did or did not wear bicycle helmets, not on the total population in each age category.

reasons for this discrepancy in previous studies have not been reported.

Children rode their bicycles more often than adolescents and adults, and adults rode for a longer duration than adolescents or children. This finding indicates that children have the highest frequency of exposure to head injury risk, whereas adults have the most sustained exposure. The only association of bicycle helmet use with bicycling duration or frequency was found in the adult group, in which bicycle rides of longer duration correlated with an increased use of bicycle helmets ($P = .001$).

TABLE 5. Influence of Parents on Child's Bicycle Helmet Use*

Parent's Bicycle Helmet Use	Child's Bicycle Helmet Use†
Never	65 (37.8)
Sometimes	79 (70)
Always	116 (83.5)

* Data are number of people, with percentages in parentheses.
† Percentages are based on the number of participants who did or did not wear bicycle helmets, not on the total children's population.

The frequency of bicycle helmet use was relatively high in all age groups of this study (Table 2). This finding likely represents a regional phenomenon (no previous study had determined the prevalence of bicycle helmet use in Minnesota). The lowest bicycle helmet use occurred among people who were 11 to 19 years of age and 30 to 39 years of age, whose reported helmet use was 31% and 30%, respectively. It is interesting to note that people in their 30s are of parenting age and thus are acting as poor role models for their children. Modeling of parental bicycle helmet use was significant for the children in this study.

Bicycle helmet use was highest in those who were 7 to 10 years of age (44%), 50 to 59 years of age (62%), and older than 59 years (70%). The increase in bicycle helmet use after 49 years of age, which was statistically significant ($P = .001$), has not been reported previously. The influence of modeling, which was found to be statistically significant ($P = .001$) in all age categories, may be partially responsible for the higher bicycle helmet use in those who are 7 to 10 years of age and those who are older than 49 years, because more of their peers wear helmets. Additional studies need to be performed to elicit the reasons that these people wear bicycle helmets more often than other age groups.

The top 10 reasons in each age group for not wearing bicycle helmets are listed in Table 3. The second most common reason that children did not wear a bicycle helmet was "don't need it," indicating that children do not think that they are going to crash. "Don't own one" was the fifth most common reason for lack of bicycle helmet use in the child's survey, the third most common in the adolescent's, and the most common in the adult's. Previous researchers have suggested that people do not purchase bicycle helmets because of expense or low income.[13,18,28,31,34–36,47–49,54–56] Many campaigns to promote bicycle helmet use have focused on decreasing the price of bicycle helmets combined with edu-

cational campaigns.[18,34–36,47,55,56] In our survey, 4.6% of children, 4.8% of adolescents, and 4.3% of adults selected expense as a reason not to wear a bicycle helmet. These percentages were not high enough to enter into our top 10 reasons not to wear a bicycle helmet, in any age category. It is possible that the results of our survey reflect the trend of decreasing bicycle helmet prices, which reduces the influence of bicycle helmet price on bicycle helmet use. Previous studies comparing bicycle helmet use after educational campaigns alone versus educational campaigns combined with reduction of helmet cost have reported mixed results.[57,58] Additional research to determine the influence of bicycle helmet price on the success of an intervention to promote bicycle helmet use may be warranted.

All 3 age groups indicated that bicycle helmets were hot and uncomfortable. Ventilation and comfort are being addressed by the bicycle helmet industry. Manufacturers are equipping helmets with more openings for ventilation, along with suspension systems to provide a more optimal fit. New bicycle helmets are lighter and more fashionable than their predecessors. Education of the public on these bicycle helmet updates should be addressed in future interventions to improve helmet use.

In all 3 age groups, a majority of friends either did not wear bicycle helmets or wore them only occasionally. Children also reported that most of the time that they rode their bicycles, they were accompanied by friends. This information is important when combined with the fact that all age groups were significantly influenced by the bicycle helmet use patterns of their friends (Table 4). Children also were influenced by their parents' use of bicycle helmets (Table 5) and reportedly rode bicycles with family members 57.5% of the time. Of the 424 children who indicated that their parents rode bicycles, 67% (n = 285) said that their parents either did not wear their bicycle helmets at all or did so only sometimes. The low percentage of friends and parents who consistently wear their bicycle helmets is a major obstacle to helmet use. Future educational interventions to promote bicycle helmet use may target this barrier through education and statements such as, "If you wear a bicycle helmet, you are not only protecting yourself, you are also helping to protect your friends and/or children."

Several authors have either hypothesized[59,60] or found[39,49] an association between peer and subject bicycle helmet use. Cote et al[39] found that bicyclists younger than 16 years who rode with bicyclists 16 years or older were more likely to be wearing a bicycle helmet than were bicyclists younger than 16 years who rode alone or with any other group. DiGuiseppi et al[55] found that the strongest association with bicycle helmet use was whether a companion used a helmet.

The perception of the level of protection from head injury afforded by a bicycle helmet was either moderate or great in a majority of children (76.8%), adolescents (80%), and adults (92%). However, significantly more adults (65.9%) than adolescents (43.9%) indicated that bicycle helmets provide "great help" in protecting from head injury. This result suggests that adolescents are not as aware of the level of protection from head injury provided by a bicycle helmet. The perception of the protection afforded by bicycle helmets has a significant influence on whether helmets are worn. Education of adolescents on this benefit of bicycle helmets likely would lead to an increase in helmet use.

Although most adolescents and adults thought that bicycle helmets provided moderate to great protection from head injury, a majority of these groups did not think that there was very much risk of head injury when bicycling without a helmet. Seventy-five percent of adolescents and 72% of adults indicated that the risk of head injury when bicycling without a helmet was between "none" and "moderate." Only 25% of adolescents and 28% of adults believed that the risk of head injury was "great." This response indicates that people do not believe that they are going to have a bicycle accident. Previous research has proved that accidents occur frequently and thus severe injuries or death can result.[2–8,10–14,17,29,30,52] In addition, there was a significant correlation between perception of head injury risk and bicycle helmet use. Education on the prevalence and severity of bicycle accidents needs to be included in interventions to improve bicycle helmet use.

The current study has weaknesses that warrant additional discussion. The design of the school survey portion of the study was meant to obtain information from a broad population representative of the geographic area in which the survey was performed. Three public elementary, middle, and high schools from 3 different regions of Rochester, Minnesota, were included in the study. The surveys were distributed to different regions within Rochester to reduce the possibility of a regional selection bias. However, because only the public school system was surveyed, students who attend private schools were not included in this study.

Surveys were distributed in a "homeroom" class, which is required for all students. This eliminated selection bias on the basis of the type of class in which participants were enrolled. However, if a student was absent the day of the survey, then he or she was not able to participate in this study.

The teacher distributed the surveys during class time. Students were given time to complete the surveys, and all of the surveys were collected. Although it is presumed that all students filled out a survey, it is possible that some did not. The number of students present in each class on the day of the survey was not recorded; therefore, the percentage of surveys completed in the schools could not be calculated.

Of the 2970 surveys distributed to Rochester public schools, 2039 were returned for analysis (69%). This completion percentage may be spuriously low because 30 surveys were distributed to every classroom and not every classroom contained 30 students. Because the exact number of students who were present in the classroom on the day that the surveys were distributed is unknown, the exact completion rate cannot be calculated. Despite this fact, the cal-

culated completion percentage (69%) is high for a survey.

Of the 2039 surveys completed within the schools, 78 were discarded because of inadequate age, incomplete information, or inappropriate responses. Because the surveys with incomplete or inappropriate responses represented only a small minority of surveys collected, it is unlikely that this group had a significant influence on the conclusions of this study. However, those who filled out the survey incompletely or incorrectly may represent a higher-risk group.

It was not possible to determine the demographics of people who were not in school on the day of the survey, chose not to fill out a survey, or completed it incorrectly. The demographics of the completed surveys were representative of the demographic makeup of Olmsted County on the basis of the census data of 1990. This suggests that the people who were not present for the survey, chose not to fill out a survey, or filled the survey out incorrectly were not homogeneous.

Because direct observation of helmet use in the student population was not made, we were unable to confirm the high percentage of bicycle helmet use reported in this study. Additional research to confirm the high prevalence of bicycle helmet use in school-aged people of Rochester, Minnesota, may be indicated.

During the "paved bicycle trail" arm of the study, it is possible that participants who were wearing bicycle helmets were more likely to participate in the survey. Because observational rates of bicycle helmet use on paved bicycle trails were not recorded, a comparison between the surveyed and observational prevalence of bicycle helmet use could not be made. It is possible, therefore, that the prevalence of bicycle helmet use was overestimated and that the barriers to bicycle helmet use were not fully represented. However, it was noted by surveyors that very few people were unwilling to participate in the survey, whether they were wearing a bicycle helmet or not. In addition, bicyclists were unaware of the survey content before taking the survey, and so there was no reason that unhelmeted bicyclists would have attempted to avoid being surveyed more than helmeted bicyclists. Additional research to confirm the high prevalence of bicycle helmet use on paved bicycle trails in southeastern Minnesota may be beneficial.

Participants in the "paved bicycle trail" arm of the study may have been more safety conscious than those not riding on designated bicycle trails. This may be partially responsible for the high prevalence of bicycle helmet use reported in the bicycle trail population of this study. An observational study comparing the prevalence of bicycle helmet use in people who bicycle on paved bicycle trails compared with those who do not bicycle on designated bicycle trails may help clarify this question.

Socioeconomic status was not measured in either arm of this study. It is probable that the public school arm of the survey was representative of the region's socioeconomic makeup, because students were surveyed in their homeroom (which eliminates an educational subject bias) and schools were surveyed in 3 different regions of Rochester (which eliminates a geographic bias). However, because private schools were not surveyed, a selection bias may have occurred. In addition, there may have been a selection bias on the paved bicycle trails because participants from a certain socioeconomic group may be more likely to use the paved bicycle trails.

CONCLUSION

The prevalence of bicycle helmet use remains low despite research indicating the high level of head injury risk when bicycling without a helmet and the significant protection afforded by bicycle helmets. In our survey, representative of the southeastern Minnesota bicycling community, the groups with the lowest bicycle helmet use are male and female adolescents between the ages of 11 and 19 years and adults between 30 and 39 years. Children ride bicycles most frequently, and adults ride for the longest period of time. Therefore, these 2 groups have the highest risk exposure of the 3 groups studied. The most frequently selected reasons for not using a bicycle helmet were "uncomfortable," "annoying," "it's hot," "don't need it," and "don't own one." Helmet expense was not a significant barrier to bicycle helmet use. Bicycle helmet use in all age groups is influenced by the helmet use of peers. Children also are influenced by their parents' bicycle helmet use patterns. Modeling, therefore, is a major contributor to the frequency of bicycle helmet use in people of all ages. Adolescents are not as aware as people of other age groups of the level of protection from head injury afforded by bicycle helmets, and all age groups underestimate the level of head injury risk when bicycling without a helmet. Both of these factors have a direct correlation with the frequency of bicycle helmet use.

With this information, a well-designed intervention to increase the use of bicycle helmets can be implemented. Suggestions for a campaign to promote an increase in bicycle helmet use include focusing efforts on males and females between the ages of 11 and 19 years and 30 and 39 years; educating the public on new bicycle helmet designs that have addressed comfort, ventilation, and fashion; educating parents on the importance of bicycle helmet use because of parental influence on children; educating adolescents on the significant protection from head injury afforded by bicycle helmets; and educating the public on the risk and severity of head injury associated with bicycling without a helmet.

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