

# Factors associated with bicycle helmet use

Wayne J. Millar and Ivan B. Pless

## Abstract

### Objectives

This article examines characteristics associated with the use of bicycles and bicycle helmets by children and adults.

### Data sources

The data on bicycle use and bicycle helmet use are from a Health Canada-sponsored supplement to Statistics Canada's 1994/95 National Population Health Survey. Mortality data are from the Canadian Vital Statistics Data Base, maintained by Statistics Canada.

### Analytical techniques

Rates of bicycle use and of bicycle helmet use by children and adults were calculated.

### Main results

The majority (58%) of parents of children aged 12 and younger reported that their children always wear helmets when riding a bicycle. Low rates of helmet use among children in lower-income households may be attributable to the cost of helmets and to differences in the perception of the consequences of injuries. Only a minority of teenage and adult cyclists were helmet users. The leading reason for not wearing a helmet was not owning one, followed by discomfort. Helmet use tended to be higher in provinces with legislation requiring it.

### Conclusion

Although bicycle helmets have proven effective in reducing injury and death, relatively few Canadian cyclists wear them, and few provinces have helmet laws.

## Key words

head protective devices, head injuries, athletic injuries

## Authors

Wayne J. Millar (613-951-1631) is with the Health Statistics Division at Statistics Canada, Ottawa, K1A 0T6. Ivan B. Pless (514-934-4465) is with the Montreal Children's Hospital, Montreal H3H 1P3.

Harsh winters and a level of affluence that puts motor vehicles within the reach of most people probably militate against bicycles ever becoming the indispensable mode of transportation in Canada that they are in many other parts of the world. Nonetheless, millions of Canadians ride bicycles for pleasure, for commuting, and for exercise.<sup>1</sup>

But cycling is not without risk. In 1993, more than 10,000 cyclists were injured in traffic collisions.<sup>2</sup> Bicycle-associated injuries can cause death or result in a disability.<sup>3</sup> The most serious injuries and the majority of bicycle-related deaths result from head injuries. Several studies have demonstrated that such injuries can be prevented, or their severity greatly reduced, through the use of an approved, properly fitted and properly worn bicycle helmet.<sup>4-7</sup> Yet in 1994/95, about four in ten children and the majority of teenagers and adults who rode bicycles did not always wear a helmet.

This article uses data from the 1994/95 National Population Health Survey (NPHS) to examine the use of bicycles and bicycle helmets by Canadians (see *Methods* and *Limitations*). It also explores attitudes toward helmet use and the status of helmet legislation.

## Methods

### Data sources

The data in this article are from the household component of the National Population Health Survey (NPHS), conducted by Statistics Canada from June 1994 through June 1995. A detailed description of the survey design, sample, and interview procedures has been published.<sup>8,9</sup>

Data on the use of bicycles and bicycle helmets are based on a Health Canada-sponsored supplement to the NPHS. The sample size of this supplement was 13,400. The response rate for the supplement was 90.6%.

In households with children aged 12 and younger, a parent answered questions about the children's use of bicycles and of bicycle helmets. Parents were asked: "Does ... ride a bicycle (including tricycles)?" For each child who rode a bicycle or tricycle, parents were asked: "When riding a bicycle how often does ... wear a helmet?" Response options were: *always, most of the time, rarely, never*. For this article, only those who reported "always" were considered to be **helmet users**. This is consistent with a recent report that suggests that restricting the definition of helmet use to those who always wear a helmet may better emulate community studies in which cyclists are actually observed on the roads.<sup>10</sup>

An additional question asked, "What is the main reason ... doesn't wear a helmet all the time?" Response options were: *don't have one; aren't effective; aren't necessary/don't need one; costs too much; uncomfortable to wear helmet/helmet doesn't fit/don't like them; would be laughed at/would be silly; only ride in safe areas; interferes with riding; friends don't wear them; inconvenient/difficult to store; any other reason*. Interviewers were instructed to record only the first-mentioned response.

Respondents aged 12 and older were asked if they had cycled in the past three months as a leisure time activity. In addition, they were asked, "In a typical week [in the last three months], how much time did you usually spend bicycling to work or to school or while doing errands." Response options ranged from none to more than 20 hours. Respondents who had cycled in the last three months during leisure or non-leisure time were defined as **cyclists**. They were asked: "When riding a bicycle how often did you wear a helmet?" Those who did not wear a helmet all the time were asked the main reason for not doing so. Response options were: *don't have one; aren't effective; aren't necessary/don't need one; costs too much; uncomfortable to wear helmet/helmet doesn't fit/don't like them; would be laughed at/would be silly; only ride in safe areas; interferes with riding; friends don't wear them; inconvenient/difficult to store; any other reason*. Interviewers recorded only the first-stated response.

Parents of children aged 12 and younger were asked their perception of the relative importance of five causes of death in childhood: "I am going to read five health problems which can cause

death in young children after the first birthday. Please tell me which one you think is the leading cause of death." Response options were: *cancer, injuries, cystic fibrosis, meningitis, heart disease*.

Data on deaths from bicycle-related accidents are from the Canadian Vital Statistics Data Base, managed by the Health Statistics Division of Statistics Canada. For each external cause of death associated with bicycle use,<sup>a</sup> the nature of the injury that led to death is recorded and coded according to the Ninth Revision of the International Classification of Diseases (ICD-9).<sup>11</sup> The ICD-9 codes examined for this article were:

E810-E819 - motor vehicle traffic accidents (with .6 appended to identify injured person as a pedal cyclist)

E820-E825 - motor vehicle non-traffic accidents (with .6 appended)

E826 - pedal cycle accident

### Analytical techniques

Age-specific rates of use of bicycles and helmets were analyzed to determine if there were differences by sex, region, and level of income.

All estimates were weighted to represent the Canadian population at the date of the survey. The total 1994/95 population of Canada aged 12 and older was used as the reference population for direct standardization of rates.

Estimates of helmet use by children aged 12 and younger are based on information provided by a parent. If more than one child lived in the household, the parent reported on each child separately. The analysis in this article concerns only one child in each household. Sampling weights apply to the parent rather than to the child. Consequently, the weighted estimates do not equal the population of children.

As well as being among the children for whom parents responded, 12-year-olds could also have been selected as respondents in the complete survey, so they are included in the analysis of the adult population (aged 12 and older).

Households were grouped into five categories based on the number of members and their combined annual income: lowest, lower-middle, middle, upper-middle and highest. In cases where the count for a lower-middle or middle income category would lead to imprecise estimates, the household income categories were combined into four levels: lowest, lower-middle/middle, upper-middle and highest.

<sup>a</sup> According to ICD-9, a pedal cycle is any road transport vehicle operated solely by pedals and includes bicycle, pedal cycle, or tricycle. A pedal cyclist is defined as any person riding on a pedal cycle or in a side car attached to such a vehicle.<sup>11</sup>

## Most kids ride bikes/wear helmets

Most children ride bicycles or tricycles. In 1994/95, 62% of parents with a child aged 12 and younger reported that their child rode a bicycle or tricycle. The percentage ranged from 59% in Quebec to 66% in British Columbia (Table 1). Rural or urban residence had little relationship to bicycle or tricycle use, but differences by household income were notable.

Children's use of bicycle helmets differed depending on where they lived. Nationally, 58% of parents reported that their child who rode a bicycle or tricycle always wore a helmet, but the figure varied from 44% in the Prairies to 65% in Ontario and British Columbia. To some extent, Ontario's high

rate may reflect laws mandating the use of helmets in that province. British Columbia has helmet legislation, but it was enacted in 1996, after the NPHS was conducted (see *Bicycle helmet legislation*). However, the impending legislation in British Columbia may have reflected public sentiment and practice.

Helmet use was relatively low in rural areas. Whereas 59% of parents in urban communities reported that their child always wore a helmet, the figure was 34% in rural areas.

Differences in helmet use by household income were also striking. Of children in the highest income households, 69% wore helmets, compared with 50% or less in the two lowest income groups. One reason for these low rates may be differences in the perception of the danger of injuries during childhood. Although injuries are the leading cause of death among children, only 42% of parents in the lowest household income group knew this, compared with 62% in the middle and 82% in the highest income groups (Chart 1).

Table 1  
**Bicycle use and helmet use, children aged 12 and younger, by region, rural/urban residence, and household income, Canada, 1994/95**

	Parents of child aged 12 and younger†	Parents whose child used bicycle/tricycle	Bicycle/tricycle use rate	Parents whose child always wore helmet	Helmet use rate
	'000	'000	%	'000	% of bicycle/tricycle users
<b>Total</b>	<b>5,883</b>	<b>3,619</b>	<b>62</b>	<b>2,084</b>	<b>58</b>
<b>Region‡</b>					
Atlantic	463	288	62	168	58
Quebec	1,441	844	59	428	51
Ontario	2,267	1,405	62	912	65
Prairies	990	607	61	268	44
British Columbia	723	474	66	309	65
<b>Rural/Urban§</b>					
Rural	799	518	65	177	34
Urban	2,793	1,684	60	990	59
<b>Household income¶</b>					
Lowest	235	119	51	60	50
Lower-middle	819	470	57	204	43
Middle	1,799	1,119	62	602	54
Upper-middle	2,036	1,242	61	786	63
Highest	801	534	67	368	69

**Data source:** National Population Health Survey, 1994/95

**Note:** Based on the first-mentioned child only.

† Based on information provided by parents of children aged 12 and younger; does not reflect the population aged 12 and younger.

‡ Because of rounding, detail may not sum to total.

§ Rural/urban does not sum to total because of a category added to ensure confidentiality.

¶ Income does not sum to total because of not stated category which is not shown.

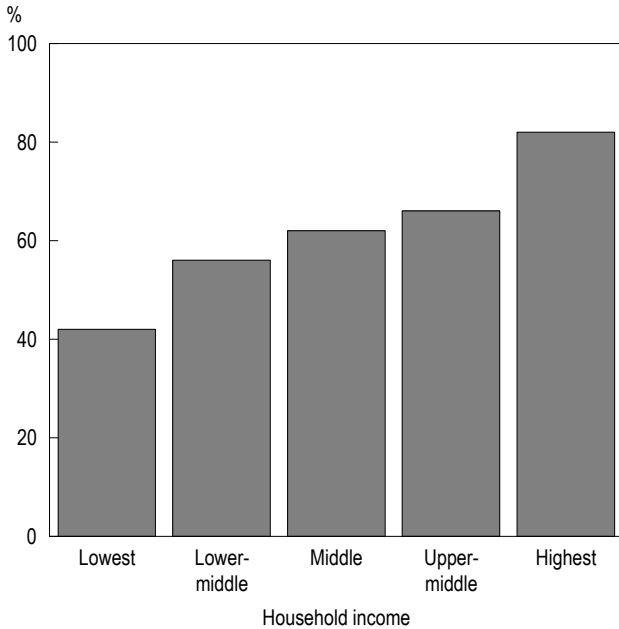
## Bicycle helmet legislation

Currently, helmet legislation affects only a small proportion of Canadian cyclists, and the focus has tended to be on children. Manitoba's legislation, for instance, applies to children under age 6 riding in bicycle carriers. Ontario introduced legislation making bicycle helmet use mandatory for cyclists younger than age 18. However, British Columbia's legislation covers cyclists of all ages. In 1996, Nova Scotia gave first reading to a bill that would make bicycle helmet use mandatory. Although most provinces lack legislation, individual municipalities may have laws requiring helmet use.

### Provincial bicycle helmet legislation, Canada, 1996

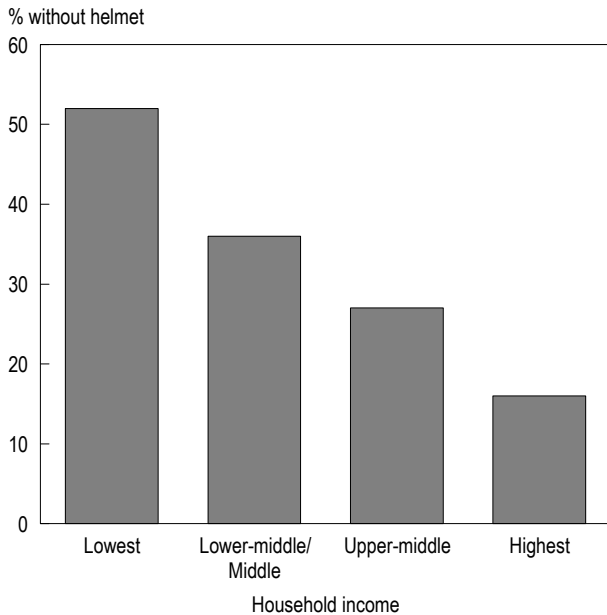
Newfoundland	No provincial legislation
Prince Edward Island	No provincial legislation
Nova Scotia	First reading passed; all ages
New Brunswick	No provincial legislation
Quebec	No provincial legislation
Ontario	Law introduced October 1995; persons younger than 18
Manitoba	Children younger than 6 in rear bicycle carriers
Saskatchewan	No provincial legislation
Alberta	No provincial legislation
British Columbia	Law introduced September 1996; all ages

Chart 1  
**Percentage of parents reporting injury as leading cause of death of children, by household income, Canada, 1994/95**



Data source: National Population Health Survey, 1994/95

Chart 2  
**Percentage of parents reporting their cyclist child did not wear bicycle helmet because he/she did not have one, by household income, Canada, 1994/95**



Data source: National Population Health Survey, 1994/95  
 Note: Based on first-mentioned child only.

The leading reason why children did not wear a helmet was not owning one (30%). The second most cited reason (18%) was that the children only rode in safe areas, followed by helmets being uncomfortable (15%).

Because only the first-mentioned reason for non-use was recorded, the percentage of children who did not wear helmets because of the cost may be underestimated. Parents in the lowest income households were far more likely than those in the highest income households to report that their children did not wear a helmet because they did not own one (Chart 2). Since these parents were also less likely to perceive injuries as the leading cause of death among children, they may have been less likely to consider a bicycle helmet a necessary purchase.

Table 2  
**Bicycle use and helmet use, population aged 12 and older, by sex and age group, Canada, 1994/95**

	Population	Bicycle users†	Bicycle use rate	Helmet users‡	Helmet use rate
	'000	'000	% of population	'000	% of bicycle users
<b>Both sexes</b>	<b>23,949</b>	<b>6,856</b>	<b>29</b>	<b>1,304</b>	<b>19</b>
12-14	1,312	820	62	133	16
15-19	2,088	1,029	49	85	8
20-44	11,331	3,651	32	874	24
45 and over	9,217	1,357	15	212	16
<b>Males</b>	<b>11,780</b>	<b>3,938</b>	<b>33</b>	<b>764</b>	<b>19</b>
12-14	686	508	74	105	21
15-19	1,082	637	59	42	7
20-44	5,644	1,967	35	467	24
45 and over	4,368	826	19	150	18
<b>Females</b>	<b>12,168</b>	<b>2,919</b>	<b>24</b>	<b>539</b>	<b>18</b>
12-14	626	312	50	28	9
15-19	1,006	391	39	43	11
25-44	5,687	1,684	30	407	24
45 and over	4,849	531	11	62	12

Data source: National Population Health Survey, 1994/95

Note: Because of rounding, detail may not sum to totals.

† Based on respondents who cycled in past three months

‡ Bicycle users who always wear a helmet

### Teenagers shun helmets

In 1994/95, 1.85 million teenagers (aged 12-19) were bicycle riders (Table 2). Cycling declined from 62% at ages 12-14 to 49% at ages 15-19, perhaps reflecting the transition from two wheels to four. Teenage boys were more likely than girls to be cyclists.

Rates of helmet use among teenagers were much lower than among children, and fell sharply among older teenagers. At ages 12-14, 16% of cyclists always wore a helmet, but by ages 15-19, the percentage was just 8%. Overall, the rate of helmet use by teenage boys was somewhat higher than that for girls.

Teenagers' reasons for not wearing helmets also differed by sex (Chart 3). The leading reason was lack of a helmet, but this was more common among girls than boys (44% versus 36%) and increased with age (Table 3). Discomfort ranked next for both sexes. Girls were more likely than boys to cite fear

of ridicule. Significantly, the fear of ridicule was a more important deterrent for 12-14-year-olds than for any other age group.

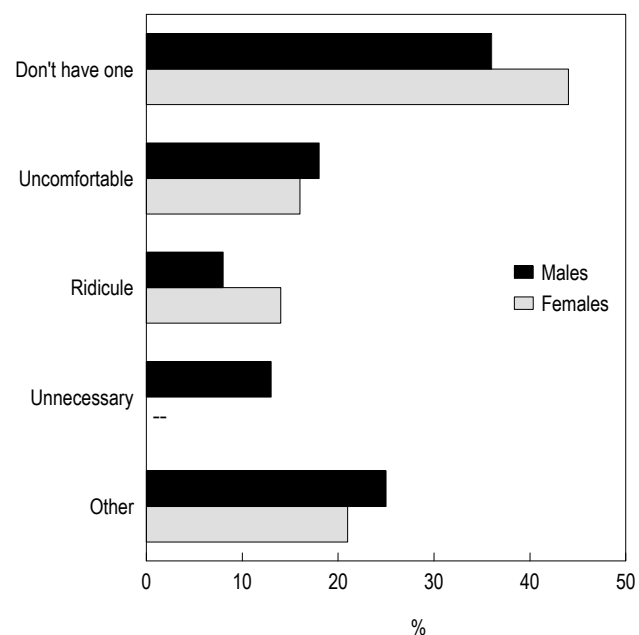
### Adult cycling

Bicycle use was less common at older ages than among children and teenagers. Just 32% of 20-44-year-olds were bicycle riders; at age 45 and over, the rate was 15%. Men in both age groups had higher rates of bicycle use than did women.

Cyclists aged 20-44 were somewhat more likely than teenagers to wear helmets: 24% always wore one. By age 45 and older, helmet use declined, particularly among women.

Similar to younger age groups, adults' chief reason for not wearing a helmet was not owning one (Table 3).

Chart 3  
Percentage distribution of teenage cyclists<sup>†</sup> main reason<sup>‡</sup> for not wearing helmet, by sex, Canada, 1994/95



**Data source:** National Population Health Survey, 1994/95  
<sup>†</sup> Aged 12-19 who cycled in past three months  
<sup>‡</sup> Interviewers recorded only one reason.  
 -- Amount too small to be expressed

Table 3  
Percentage distribution of main reason for not wearing helmet, cyclists aged 12 and older,<sup>†</sup> by age and sex, Canada, 1994/95

Main reason <sup>‡</sup>	Age group				Total
	12-14	15-19	20-44	45+	
<b>Both sexes ('000)</b>	682	944	2,774	1,140	5,540
			%		
Don't have one	32	44	52	48	47
Uncomfortable	22	14	14	10	14
Unnecessary	--	12	8	10	9
Ridicule	14	8	2	--	4
Other	24	23	24	30	25
<b>Males ('000)</b>	398	596	1,497	672	3,162
			%		
Don't have one	32	38	47	48	44
Uncomfortable	--	15	16	--	15
Unnecessary	--	16	9	10	11
Ridicule	--	--	--	--	4
Other	26	23	25	30	26
<b>Females ('000)</b>	284	348	1,278	468	2,378
			%		
Don't have one	32	54	58	49	52
Uncomfortable	--	--	12	--	13
Unnecessary	--	--	7	--	7
Ridicule	--	--	--	--	5
Other	--	21	21	29	23

**Data source:** National Population Health Survey, 1994/95  
**Notes:** Because of rounding, column percentages may not sum to 100%. Excludes reason not stated.  
<sup>†</sup> Based on respondents who cycled in past three months.  
<sup>‡</sup> Interviewers recorded only one reason.  
 -- Amount too small to be expressed

## Regional and socioeconomic variations

Bicycle helmet use by the population aged 12 and older varied across regions. Usage rates were highest in Ontario and British Columbia, again possibly reflecting provincial legislation or impending legislation; the lowest rates were in the Prairies and Quebec (Table 4).

Table 4  
**Bicycle use and helmet use, population aged 12 and older, by selected characteristics, Canada, 1994/95**

	Population	Bicycle users <sup>†</sup>	Bicycle use rate	Helmet users <sup>‡</sup>	Helmet use rate
	'000	'000	% of population	'000	% of bicycle users
<b>Total</b>	<b>23,949</b>	<b>6,856</b>	<b>29</b>	<b>1,304</b>	<b>18</b>
<b>Sex<sup>§</sup></b>					
Male	11,780	3,938	33	764	18
Female	12,168	2,919	24	539	17
<b>Region<sup>§</sup></b>					
Atlantic	1,983	383	19	64	17
Quebec	6,030	1,899	32	271	13
Ontario	9,050	2,443	27	538	20
Prairies	3,849	1,168	30	155	12
British Columbia	3,037	964	32	275	27
<b>Rural/Urban<sup>††</sup></b>					
Rural	3,058	741	24	78	10
Urban	11,740	3,655	31	685	18
<b>Household income<sup>††</sup></b>					
Lowest	1,288	293	24	29	6
Lower-middle	2,768	606	22	94	16
Middle	6,901	1,788	26	239	12
Upper-middle	8,278	2,651	32	531	19
Highest	3,651	1,235	34	378	28
<b>Education<sup>††</sup></b>					
Less than high school	7,863	2,315	24	269	9
High school completion	3,570	941	24	117	11
Some postsecondary	5,550	1,532	25	332	18
Certificate/Diploma	3,787	995	26	184	14
University degree	3,145	1,064	37	402	29

**Data source:** National Population Health Survey, 1994/95

**Note:** Rates of bicycle use and helmet use are age-adjusted to the 1994/95 population.

<sup>†</sup> Based on respondents who cycled in past three months

<sup>‡</sup> Cyclists who always wear a helmet

<sup>§</sup> Because of rounding, detail may not sum to totals.

<sup>††</sup> Rural/urban does not sum to total because of a category added to ensure confidentiality.

<sup>‡‡</sup> Does not sum to total because of not stated category which is not shown.

As is the case for children, adults' bicycle helmet use was lower in rural than in urban areas. While 18% of urban cyclists always wore a helmet, the rate for rural residents was 10%.

And among adults, too, helmet use was associated with high income. The helmet use rate was 28% for cyclists in the highest income households, compared with 6% for those in households with the lowest incomes.

The pattern was similar for education, with helmet use ranging from 29% for cyclists with a university degree to 9% for those who had not graduated from high school.

In provinces that had legislation or pending legislation, the percentage of cyclists who did not always wear a helmet because they did not have one was comparatively low (Table 5). This suggests that legislation may be a factor in the acquisition of helmets.

## Implications

Cycling accidents are responsible for a substantial number of injuries, particularly head injuries. A recent study in Kingston, Ontario, using data from the Canadian Hospitals Injury Reporting and Prevention Program, found that about 8% of injuries to those under age 20 were attributable to

Table 5  
**Percentage distribution of main reason for not wearing helmet, cyclists<sup>†</sup> aged 12 and older, by region, Canada, 1994/95**

Main reason <sup>‡</sup>	Region				
	Atlantic	Quebec	Ontario	Prairies	British Columbia
<b>Cyclists who did not wear helmet ('000)</b>	318	1,627	1,897	1,012	686
			%		
Don't have one	55	48	45	51	44
Uncomfortable	9	17	14	11	12
Unnecessary	9	12	8	6	--
Ridicule	6	--	6	3	--
Only ride in safe areas	--	8	6	6	--
Other	18	11	21	22	24

**Data source:** National Population Health Survey, 1994/95

**Notes:** Because of rounding, column percentages may not sum to 100%. Excludes reason not stated.

<sup>†</sup> Based on respondents who cycled in past three months.

<sup>‡</sup> Interviewers recorded only one reason.

cycling, and in a retrospective study of 880 children with head injuries, 12% involved bicycles.<sup>12,13</sup> As well, previous research suggests that almost nine out of ten cyclists fatally injured in bicycle accidents had sustained injuries to the neck and head<sup>14</sup> (see *Cycling deaths*).

The use of helmets has been shown to reduce the risk of serious head injury by up to 85%, and the risk of serious brain injury by nearly 90%.<sup>4,7</sup> Yet just 4% of persons involved in fatal bicycle-related accidents in Ontario between 1986 and 1991 had been wearing a helmet.<sup>15</sup> Although it has been argued that when a car is involved, bicycle helmets offer less protection, mounting evidence suggests that this protection applies regardless of the involvement of a motor vehicle.<sup>4,16-20</sup> Time-series analyses of hospital-based surveillance data also support the potential benefit of helmets with, in some cases, a reduction of up to 50% in head injuries.<sup>21</sup>

But despite the known benefits, 1994/95 NPHS data shows that children were the only age group with a majority of regular helmet-users, and 42% of them did not always wear a helmet when they rode bicycles or tricycles. Teenagers were the most resistant to helmet use. Adults' helmet use rates were somewhat higher, but only a minority of cyclists aged 20 and older always wore one.

Even so, although national long-term estimates are not available, bicycle helmet use in some Canadian metropolitan areas has increased substantially within a relatively short time. Between 1988 and 1991, the prevalence of helmet use among youth in Ottawa rose from about 2% to 21%.<sup>22</sup> The increase among children in metropolitan Toronto

was from 3% to 12%.<sup>23</sup> In the Montérégie administrative region of Quebec, helmet use by the school population went from just over 1% in 1988 to 33% in 1993.<sup>24</sup> In each of these urban areas, a community campaign may have been partly responsible for the changes.

Reasons reported to the NPHS for not wearing bicycle helmets suggest a number of strategies that might be pursued to encourage compliance. Concerns about discomfort and the fear of ridicule suggest that the design of helmets may be a factor in their use. Fear of ridicule was most pronounced at ages 12-14. However, if helmets are perceived as normal, stylish or a status symbol, peer pressure can support use.<sup>25</sup> Ideally, programs directed at encouraging helmet use would address issues of style, comfort, and social acceptability.<sup>26,27</sup>

However, at all ages, the leading reason for not wearing a helmet was not owning one. This indicates that the cost of helmets may be a barrier to use. The substantial share of children in low income households who did not have a helmet (52%) is consistent with earlier research, which showed that persons with lower levels of income were less likely to have protective devices, such as smoke detectors, seat belts, fire extinguishers, and bicycle helmets.<sup>28,29</sup>

Because a sizeable proportion of cyclists, particularly males aged 15-19, considered helmets to be unnecessary, ongoing public education is an essential component of injury prevention. Educational strategies to increase helmet use may include the involvement of influential groups, such as pediatricians or family physicians, as well as incentives to reduce the cost of helmets. The media have figured in the most successful of these efforts.<sup>30-33</sup>

However, current research suggests that education alone is not sufficient to reach and maintain high levels of helmet use and that legislation is needed.<sup>34,35</sup> Moreover, some evidence indicates that legislation may be more cost-effective than community- or school-based intervention programs.<sup>36</sup> According to the 1994/95 NPHS, provinces with legislation tend to have higher percentages of both helmet owners and users.

### Cycling deaths

Between 1980 and 1994, there were 1,665 bicycle-associated deaths in Canada, 57% of which involved persons younger than 20. Bicycle-associated injuries accounted for 4% of all injury deaths among children younger than 10, 10% among children aged 10-14, and 2% among 15-19-year-olds. Almost two-thirds of the bicycle fatalities involved head injuries. Half of the deaths (50%) occurred in the months of June, July, and August. In both the child and adult populations, the largest proportion of bicycle-related fatalities occurred among males (80% and 81%, respectively).

## Limitations

High rates of bicycle helmet use among children aged 12 and younger may reflect parents giving socially desirable answers. An alternative interpretation is that parents have more control over young children and are able to ensure that helmets are worn. Nonetheless, parents are reporting their perceptions, and once children are out of the range of direct parental supervision, helmet use may decline. A recent report suggests that adults tend to over-report children's helmet use relative to what is observed in the community and the schools.<sup>37</sup>

The data collected on child and adult cyclists were not the same. For instance, the sex of children aged 12 and younger is not available.

Unlike some other studies,<sup>38</sup> this analysis cannot report usage rates among helmet owners. The survey did not ask a direct question about helmet ownership. People who cycled and did not always wear a helmet were asked why, but interviewers noted only their first response. In some cases, non-users said that they did not own a helmet, but in others, they mentioned reasons such as comfort and concerns about appearance. Therefore, it was not possible to determine what percentage of cyclists actually owned a helmet and what percentage of them did not wear it.

The use of bicycles by the population aged 12 and older may be somewhat underestimated. The NPHS asked about bicycle use "in the past three months." If the interview occurred in the winter or early spring, some respondents who rode bicycles when road conditions were more favourable would not have been recorded as cyclists.

The introduction of such legislation has had a demonstrable effect on bicycle-related injuries in other countries. Generally, after these laws were enacted, helmet use increased substantially and injury rates decreased correspondingly. Although one study suggests that this is partly attributable to a reduced number of riders, the net effect remains clearly beneficial. For example, in Victoria, Australia, after legislation made bicycle helmets mandatory,<sup>39</sup> there was a marked increase in rates of use to between 70% and 90% within a year and a substantial decline in head injuries and mortality.<sup>40,41</sup>

Some bicycle helmet laws affect only children; others are more comprehensive. Targeting children may be based on the assumption that adults would be more likely to challenge regulations and that children are most at risk.<sup>42</sup> However, making laws applicable to the entire population would reinforce their importance, and peer disapproval might be reduced.<sup>43</sup> More important, from a public health

perspective, although young people may be targeted because of their greater use of bicycles, bicycle-associated injuries create a health burden regardless of age.

## References

- 1 Stephens T, Craig CL. *The Well-Being of Canadians. Highlights of the 1988 Campbell's Survey*. Ottawa: Canadian Fitness and Lifestyle Research Institute, 1990.
- 2 Transport Canada. *Traffic Collision Statistics in Canada, 1993* (TP 11743E) Ottawa: Transport Canada, 1996.
- 3 Jaffe KM, Massagli TL, Martin KM, et al. Pediatric traumatic brain injury: Acute and rehabilitative costs. *Archives of Physical Medical Rehabilitation* 1993; 74(7): 681-6.
- 4 Thompson RS, Rivara FP, Thompson DC. A case control study of the effectiveness of bicycle safety helmets. *New England Journal of Medicine* 1989; 320(21): 1361-7.
- 5 McDermott FT, Lane JC, Brazenor GA, et al. The effectiveness of bicyclist helmets: A study of 1,710 casualties. *Journal of Trauma* 1993; 34(6): 834-44.
- 6 Thomas S, Acton C, Nixon J. Effectiveness of bicycle helmets in preventing head injury in children: Case control study. *British Medical Journal* 1994; 308(6922): 173-6.
- 7 Maimaris C, Summers CL, Browning C, et al. Injury patterns in cyclists attending an accident and emergency department: A comparison of helmet wearers and non-wearers. *British Medical Journal* 1994; 308(6943): 1537-40.
- 8 Catlin G, Will P. The National Population Health Survey: Highlights of initial developments. *Health Reports* (Statistics Canada, Catalogue 82-003) 1992; 4(3): 313-9.
- 9 Tambay J-L, Catlin G. Sample design of the National Population Health Survey. *Health Reports* (Statistics Canada, Catalogue 82-003) 1995; 7(1): 29-38.
- 10 Ni H, Sacks JJ, Curtis L, et al. Evaluation of a statewide bicycle helmet law via multiple measures of helmet use. *Archives of Pediatric and Adolescent Medicine* 1997; 151(1): 59-65.
- 11 World Health Organization. *Manual of the International Statistical Classification of Diseases, Injuries, and Causes of Death*. Based on the Recommendations of the Ninth Revision Conference, 1975. Geneva: World Health Organization, 1977.
- 12 Bienefeld M, Pickett W, Carr PA. A descriptive study of childhood injuries in Kingston, Ontario, using data from a computerized injury surveillance system. *Chronic Diseases in Canada* 1996; 17(1): 21-7.
- 13 Ivan LP, Choo SH, Ventureyra ECG. Head injuries in childhood: A 2-year survey. *Canadian Medical Association Journal* 1983; 128(3): 281-4.
- 14 Fife D, Davis J, Tate L, Wells JK, et al. Fatal injuries to bicyclists: The experience of Dade County, Florida. *Journal of Trauma* 1983; 23(8): 745-55.
- 15 Rowe BH, Rowe AM, Bota GW. Bicyclist and environmental factors associated with fatal bicycle-related trauma in Ontario. *Canadian Medical Association Journal* 1995; 152(1): 45-53.



- 16 Wasserman RC, Waller JA, Monty MJ, et al. Bicyclists, helmets and head injuries: A rider-based study of helmet use and effectiveness. *American Journal of Public Health* 1988; 78(9): 1220-1.
- 17 Dorsch M, Woodward A, Somers RL. Do bicycle safety helmets reduce severity of head injury in real crashes? *Accident Analysis and Prevention* 1987; 19(3): 183-90.
- 18 Bishop P, Briard B. Impact performance of bicycle helmets. *Canadian Journal of Applied Sports Science* 1984; 9(2): 94-101.
- 19 Thompson DC, Thompson RS, Rivara FP, et al. A case-control study of the effectiveness of bicycle safety helmets in preventing facial injury. *American Journal of Public Health* 1990; 80(12): 1471-4.
- 20 Thompson DC, Rivara FP, Thompson RS. Effectiveness of bicycle safety helmets in preventing head injuries. A case-control study. *Journal of the American Medical Association* 1996; 276(24): 1968-73.
- 21 Pitt WR, Thomas S, Battistutta D, et al. Trends in head injuries among child bicyclists. *British Medical Journal* 1994; 308(6922): 177.
- 22 Cushman R, Pless R, Hope D, et al. Trends in bicycle helmet use in Ottawa from 1988 to 1991. *Canadian Medical Association Journal* 1992; 146(9): 1581-5.
- 23 Hu X, Wesson DE, Parkin PC, et al. Current bicycle helmet ownership, use and related factors among children in metropolitan Toronto. *Canadian Journal of Public Health* 1994; 85(2): 121-4.
- 24 Farley C, Haddad S, Brown B. The effects of a 4-year program promoting bicycle helmet use among children in Quebec. *American Journal of Public Health* 1996; 86(1): 46-51.
- 25 Otis J, Lesage D, Godin G, et al. Predicting and reinforcing children's intentions to wear protective helmets while bicycling. *Public Health Reports* 1992; 107(3): 283-9.
- 26 MacKenzie EJ, Shapiro S, Siegel JH. The economic impact of traumatic injuries: One year treatment-related expenditures. *Journal of the American Medical Association* 1988; 260(22): 3290-6.
- 27 Dewar RE. Bicycle riding practices: Implications for safety campaigns. *Journal of Safety Research* 1978; 10: 35-42.
- 28 Parkin P, Spence L, Hu X, et al. Bicycle helmet promotion programs—Canada, Australia, and the United States. *Morbidity and Mortality Weekly Report* 1993; 42(11): 203-10.
- 29 DiGiuseppi CG, Rivara FP, Koepsell TD. Attitudes toward bicycle helmet ownership and use among school-age children. *American Journal of Diseases in Childhood* 1990; 144(1): 83-6.
- 30 Ruch-Ross HS, O'Connor KG. Bicycle helmet counseling by pediatricians: A random national survey. *American Journal of Public Health* 1993; 83(5): 728-30.
- 31 Dannenberg AL, Vernick JS. A proposal for the mandatory inclusion of helmets with new children's bicycles. *American Journal of Public Health* 1993; 83(5): 644-6.
- 32 Dannenberg AL, Gielen AC, Beilenson PL, et al. Bicycle helmet laws and educational campaigns: An evaluation of strategies to increase children's helmet use. *American Journal of Public Health* 1993; 83(5): 667-74.
- 33 Schwartz HI, Brison RJ. Bicycle-related injuries in children: A study in two Ontario emergency departments, 1994. *Chronic Diseases in Canada* 1996; 17(2): 56-62.
- 34 Dowswell T, Towner EML, Simpson G, et al. Preventing childhood unintentional injuries: What works? A literature review. *Injury Prevention* 1996; 1: 140-9.
- 35 Henderson M. *The effectiveness of bicycle helmets: A review*. New South Wales, Australia: Motor Vehicle Accidents Authority of New South Wales, 1995.
- 36 Hatziafreu EJ, Sacks JJ, Brown R, et al. The cost effectiveness of 3 programs to increase use of bicycle helmets among children. *Public Health Reports* 1995; 110(3): 251-9.
- 37 Sacks JJ, Kresnow MJ, Houston B, et al. Bicycle helmet use among American children, 1994. *Injury Prevention* 1996; 2: 258-62.
- 38 Rodgers GB. Bicycle helmet use patterns in the United States. A description and analysis of national survey data. *Accident Analysis and Prevention* 1995; 27(1): 43-56.
- 39 McDermott FT. Helmets for bicyclists: Another first for Victoria. *Medical Journal of Australia* 1991; 154(3): 156-7.
- 40 Wood T, Milne P. Head injuries to pedal cyclists and the promotion of helmet use in Victoria, Australia. *Accident Analysis and Prevention* 1988; 20(3): 177-85.
- 41 Vulcan AP, Cameron MH, Watson WL. Mandatory bicycle helmet use: Experience in Victoria, Australia. *World Journal of Surgery* 1992; 16(3): 389-97.
- 42 Runyan CW, Runyan DK. How can physicians get kids to wear bicycle helmets? A prototypic challenge in injury prevention. *American Journal of Public Health* 1991; 81(8): 972-3.
- 43 Dannenberg AL, Coté TR, Kresnow MJ, et al. Bicycle helmet use by adults: The impact of companionship. *Public Health Reports* 1993; 108(2): 212-7.