

# Effect of legislation on the use of bicycle helmets

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## Abstract

**Background:** About 50 Canadian children and adolescents die each year from bicycle-related injuries, and 75% of all bicycle-related deaths are due to head injuries. Although the use of helmets can reduce the risk of head injury by 85%, the rate of voluntary helmet use continues to be low in many North American jurisdictions. We measured compliance before, during and after 1997, when legislation making the use of helmets mandatory for cyclists was enacted in Nova Scotia.

**Methods:** In the summers and autumns of 1995 through 1999, trained observers who had a direct view of oncoming bicycle traffic recorded helmet use, sex and age group of cyclists in Halifax on arterial, residential and recreational roads. Sampling was done during peak traffic times of sunny days. We abstracted data from the Canadian Hospitals Injury Reporting and Prevention Program database on bicycle-related injuries treated during the same period at the Emergency Department of the IWK Health Centre, Halifax.

**Results:** The rate of helmet use rose dramatically after legislation was enacted, from 36% in 1995 and 38% in 1996, to 75% in 1997, 86% in 1998 and 84% in 1999. The proportion of injured cyclists with head injuries in 1998/99 was half that in 1995/96 (7/443 [1.6%] v. 15/416 [3.6%]) ( $p = 0.06$ ). Police carried out regular education and enforcement. There were no helmet-promoting mass media education campaigns after 1997.

**Interpretation:** Rates of helmet use rose rapidly following the introduction of legislation mandating the use of helmets while bicycling. The increased rates were sustained for 2 years afterward, with regular education and enforcement by police.

From Apr. 1, 1990, to Mar. 31, 1992, bicycle-related injuries accounted for a mean of 46 deaths and 3644 hospital admissions per year among Canadian children and adolescents.<sup>1</sup> Seventy-five percent of deaths among injured cyclists are due to head injuries.<sup>2</sup> In one case-control study the wearing of helmets reduced the risk of head and brain injury by 85% and 88% respectively.<sup>3</sup> Five ecologic studies, summarized in a Cochrane Collaboration systematic review,<sup>4</sup> have provided evidence that increased helmet use resulting from education or legislation is linked to significant decreases in bicycle-related head injuries.<sup>5-9</sup> Unfortunately, rates of helmet use in North American jurisdictions have been low, ranging from 3.4% to 48%.<sup>10-13</sup> Strategies to increase compliance include education, health promotion, subsidization of helmet costs and legislation.

The passing of legislation mandating the use of helmets while cycling has been followed by increased helmet use. In Howard County, Md., the rate of self-reported helmet use rose from 11% in 1990, before legislation was introduced, to 37% in 1991, after legislation was introduced.<sup>12</sup> In contrast, the rate increased from 8% to 13% over the same period in a neighbouring county with education strategies but no legislation.<sup>12</sup> A single published report addressed long-term compliance following the introduction of helmet legislation in New Zealand: after the legislation was enacted, in 1994, the rate of compliance exceeded 92% in 1995 and 1996 and then declined (amount not reported) in 1997.<sup>14</sup>

We measured the rates of bicycle helmet use in Halifax in the 2 years preceding and the 3 years following the introduction of provincial legislation mandating helmet use while cycling. We hypothesized that (a) the proportion of helmeted bicyclists would increase sharply after the legislation was introduced, (b) there would be

## Research

## Recherche

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a decrease in the proportion of helmeted cyclists in subsequent years and (c) helmet use would be highest among children.

## Methods

We collected observational data in metropolitan Halifax (population 360 000 in 1999) from July through November of 1995 through 1999. Sites were chosen from the north, south, east and west quadrants of Halifax peninsula to sample neighbourhoods with different property values. When insufficient numbers of cyclists were observed, the observer chose a different neighbourhood or abandoned observations for that day. Data were collected through direct observation by 2 observers (T.L.B. and C.C.) using a standardized data collection sheet. Cyclists were observed on urban arterial roads and residential roads and at recreational areas at various times during daylight hours. All cyclists who were observed riding a bicycle during an observational session were included in the analyses. The following information was noted: sex, age group (coded as child, adolescent or adult), accompaniment (whether the cyclist was travelling alone, with a companion of the same age group or with a companion of a different age group) and type of road. Age group and sex were not coded if the observer was unsure of assignment. The observer was positioned along roadways with a direct view of oncoming cyclists. For residential areas the observer was either stationary or mobile on a bicycle. To reduce the likelihood of recounting cyclists, the observer collected data for no more than 4 hours at a time at 1 site. To reduce double counting at recreational sites, the observer counted cyclists entering a site only.

The legislation was passed in December 1996 and was proclaimed into law on July 1, 1997. An extensive media campaign (pamphlets, newspapers, radio and television) was conducted in July and August to inform the public about the law. Key information communicated included the application of the legislation to all cyclists, grounds for exemption (medical reasons, religious beliefs or head circumference greater than 64 cm) and the commencement of enforcement on Sept. 1, 1997, with police officers issuing \$25 fines for noncompliance. To assess the use of the print media and the public reaction, we conducted an electronic search of the largest daily newspaper in Halifax, the *Chronicle-Herald* (circulation 325 000), for articles or letters to the editor discussing bicycle helmet legislation. We also contacted the Halifax Regional Police Department for information regarding compliance and enforcement of the legislation as well as other Canadian jurisdictions to assess the status of helmet legislation across the country.

We abstracted data from the Canadian Hospitals Injury Reporting and Prevention Program database on bicycle-related injuries treated from 1995 to 1999 at the Emergency Department of the IWK Health Centre, Halifax. Head injuries were defined as concussions, lacerations, dental injuries and other head injuries that required follow-up, observation in the Emergency Department, admission to hospital or transfer to another health facility, or that resulted in death.

We calculated proportions and confi-

dence intervals using the binomial distribution. We tested group and subgroup rates for statistical significance using the univariate  $\chi^2$  test. The  $\chi^2$  statistic for trend was used to calculate the significance of change in head injury rates over 3 periods (1995/96, 1997 and 1998/99).

Ethics approval was obtained from the Research Ethics Board of the IWK Health Centre.

## Results

In 1995/96, 1494 cyclists were observed on 17 days. In 1997, 636 cyclists were observed on 19 days. In 1998/99, 672 cyclists were observed on 13 days. The proportion of helmeted cyclists was below 40% in 1995 and 1996, climbed to 75% in 1997, and remained above 80% in 1998 and 1999 (Fig. 1). The rates of helmet use were statistically significantly higher among females than among males until 1998/99 (Table 1). They were lower among adolescents than among children and adults in all 3 study periods. For 1997 only, rates during the period September through November were higher than those during July through August (enforcement began Sept. 1), and rates on weekends were statistically significantly higher than rates on weekdays.

During spring and summer, 4 to 10 police officers patrolled the region on bicycles and concentrated on cycling safety and compliance with the helmet legislation (Sgt. Christopher Melvin, Halifax Regional Police Department: personal communication, 2000). Among cyclists aged 16 and older, police issued 60 summary offences in 1997 (September to December), 176 in 1998 and 113 in 1999. As well, several youths aged 12 to 16 who did not heed police warnings were issued summonses to appear in youth court.

Four articles discussing the new legislation were published in the *Chronicle-Herald* between May and September 1997. One verbal complaint was reported directly to the

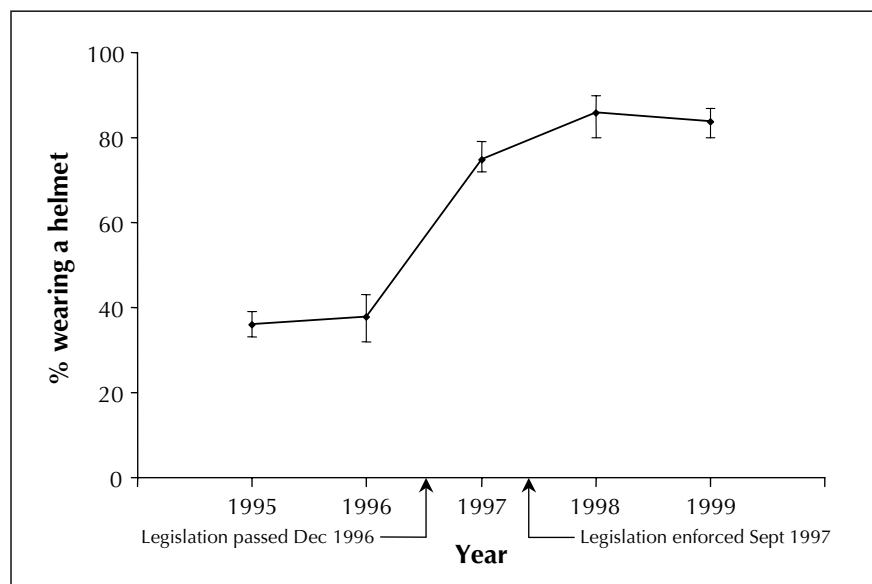


Fig. 1: Proportion of bicyclists in Halifax observed wearing a helmet, by year. Vertical bars denote 95% confidence intervals.

Nova Scotia Registry of Motor Vehicles, and 3 letters to the editor, 1 of which was in opposition to the legislation, were published in the *Chronicle-Herald* from May to September 1997.

**Table 1: Characteristics of bicyclists in Halifax observed wearing a helmet, by year**

Characteristic	Period; % (and no.) of bicyclists wearing a helmet		
	1995/96 <i>n</i> = 1494	1997 <i>n</i> = 636	1998/99 <i>n</i> = 672
<b>Sex</b>			
Male	34 (391/1136)	72 (337/468)	84 (455/539)
Female	42 (151/358)	85 (142/168)	84 (112/133)
<i>p</i> value	0.008	0.001	0.953
<b>Age group</b>			
Child	49 (59/121)	95 (37/39)	84 (21/25)
Adolescent	29 (72/246)	68 (30/44)	70 (33/47)
Adult	36 (411/1127)	75 (412/553)	86 (513/600)
<i>p</i> value	0.001	0.009	0.021
<b>Time of year observed</b>			
July–Aug	36 (427/1189)	52 (28/54)	83 (505/608)
Sept–Nov	38 (115/305)	77 (451/582)	81 (52/64)
<i>p</i> value	0.561	0.001	0.469
<b>Time of week observed</b>			
Weekday	36 (447/1231)	63 (116/183)	84 (553/657)
Weekend	36 (95/263)	80 (363/453)	93 (14/15)
<i>p</i> value	0.954	0.001	0.334

Four Canadian provinces — British Columbia, Ontario, New Brunswick and Nova Scotia — passed legislation mandating helmet use in the period 1995 to 1997. In November 2001 Alberta passed a private member's bill that makes helmets mandatory for cyclists under 18 years old (Table 2).

A total of 416 bicycle-related injuries were recorded at the IWK Health Centre in 1995/96, 222 in 1997 and 443 in 1998/99. Head injuries accounted for 15 (3.6%), 3 (1.4%) and 7 (1.6%) of the injuries respectively ( $p = 0.06$ ).

## Interpretation

We found a dramatic increase in helmet use after provincial legislation was passed and mass education conducted during the summer of 1997. The compliance rate increased the following year and remained high 2 years afterward despite the absence of public mass media campaigns, although there was ongoing education and enforcement by the Halifax Regional Police Department. Our observational study cannot rule out the possibility that other factors were responsible for the increase in compliance during the study period. Nevertheless, the increase during 1997 was dramatic, and 1997 was the only period during which the rate of helmet use was significantly higher during September through November than during the preceding July through August.

Strengths of our study include the use of a validated method of observation<sup>10</sup> and data collection over a 5-year period, with the intervention taking place during the middle year. Although it was conducted in a medium-size Canadian city, the findings are likely generalizable to other North

**Table 2: Status of bicycle helmet legislation in Canadian jurisdictions as of November 2001**

Province / territory	Year passed	Comments
British Columbia	1996	For all ages ( <a href="http://www.th.gov.bc.ca/bchighways/cycling/bicycle.htm">www.th.gov.bc.ca/bchighways/cycling/bicycle.htm</a> )
Alberta	2001	For cyclists up to age 18 years
Saskatchewan	–	Legislation permits municipalities to pass bylaws
Manitoba	–	None planned
Ontario	1995	For cyclists up to age 18 years ( <a href="http://www.mto.gov.on.ca/english/faq/index.html#BicycleHelmets">www.mto.gov.on.ca/english/faq/index.html#BicycleHelmets</a> )
Quebec	–	Legislation permits municipalities to pass bylaws ( <a href="http://www.helmets.org/mandator.htm">www.helmets.org/mandator.htm</a> )
New Brunswick	1995	For all ages ( <a href="http://www.gnb.ca/acts/acts/m-17.htm">www.gnb.ca/acts/acts/m-17.htm</a> )
Nova Scotia	1996	For all ages ( <a href="http://www.gov.ns.ca/legi/96chap/96_ch35.htm">www.gov.ns.ca/legi/96chap/96_ch35.htm</a> )
Prince Edward Island	–	None planned
Newfoundland and Labrador	–	Legislation permits municipalities to pass bylaws ( <a href="http://www.gov.nf.ca/hoa/chapters/1999/m24.c99.htm">www.gov.nf.ca/hoa/chapters/1999/m24.c99.htm</a> )
Yukon Territory	–	None planned
Northwest Territories	–	None planned
Nunavut	–	None planned

\*The information was obtained from government Web sites where available or from provincial or territorial officials.

American cities that have similar or lower rates of helmet use. The proportion of cycling-related head injuries captured by the Canadian Hospitals Injury Reporting and Prevention Program database at the IWK Health Centre decreased by half in the years after the legislation was passed. Despite the *p* value of 0.06, this decrease is unlikely to be explained by chance owing to the small numbers of head injuries available for analysis and given the consistency of this finding with previous studies demonstrating the effectiveness of bicycle helmets in reducing head injuries.<sup>4</sup>

We cannot explain the significant difference between weekend and weekday rates of helmet use that were observed in 1997 but not in 1995/96 or 1998/99. This may be a spurious association, or it may indicate that weekend cyclists differ from weekday cyclists with respect to compliance with helmet legislation. This factor should be considered in the design and analysis of future studies that measure compliance with bicycle helmet legislation. Rates of helmet use by cyclists on arterial, residential and recreational roads did not differ significantly for any period, nor did the rates of riding alone compared with riding with another cyclist (data available from the authors on request).

Critics of helmet legislation cite 2 ecologic studies from Australia and New Zealand in which the observed proportion of cyclists with head injuries was no different from the downward trend predicted from helmet use rates before legislation.<sup>15,16</sup> However, the first study<sup>15</sup> was a presentation of a work in progress. In the final published analysis the authors concluded that mandatory helmet use had a positive and persistent effect on the number and severity of head injuries.<sup>8</sup> The second ecologic study was restricted to 1 year of postlegislation data;<sup>16</sup> subsequent analysis of 3 years of postlegislation data by the same principal author showed that the helmet law led to a 19% reduction in the rate of head injury.<sup>14</sup>

Although the use of seat belts in motor vehicles is mandatory in all Canadian provinces and territories, only 5 provinces — British Columbia, Alberta, Ontario, New Brunswick and Nova Scotia — mandate the use of helmets by cyclists. Ontario and Alberta mandate it only for children up to age 18 years. Saskatchewan, Quebec, and Newfoundland and Labrador allow municipalities to pass bylaws regarding bicycle helmet use. Deaths due to head injuries while riding a bicycle are eminently preventable at low cost and with little inconvenience. Legislation has an immediate effect on bicycle helmet compliance and, as illustrated in Halifax, a persistent effect. Guidance by physicians about safe cycling practices and helmet use should be incorporated into routine primary care. Given that less than half of Canada's provincial and territorial jurisdictions have legislation making the use of bicycle helmets mandatory, physi-

cians and provincial medical associations in jurisdictions where there is none should advocate for helmet legislation.

*Competing interests:* None declared.

*Contributors:* Dr. LeBlanc was the principal author and was responsible for securing funding, the conception and design of the study, supervision of data collection and the preliminary and final analyses. Ms. Beattie was responsible for data collection (1996–1999), the initial analysis of the data for 1995–1999 and the initial draft with an updated literature review. Dr. Culligan, a medical student at the time of the study, was responsible for the collection and analysis of the 1995 data (under the supervision of Dr. LeBlanc) and the literature review.

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## References

1. Choinière R, Dorval D. Bicycle injuries. In: Beaulne G, editor. *For the safety of Canadian children and youth*. Ottawa: Health Canada; 1997. p. 106–17. Cat no H39-412-1997E.
2. Rowe BH, Rowe AM, Bota GW. Bicyclist and environmental factors associated with fatal bicycle-related trauma in Ontario. *CMAJ* 1995;152(1):45–53. Abstract available: [www.cma.ca/cmaj/vol-152/issue-1/0045.htm](http://www.cma.ca/cmaj/vol-152/issue-1/0045.htm)
3. Thompson RS, Rivara FP, Thompson DC. A case-control study of the effectiveness of bicycle safety helmets. *N Engl J Med* 1989;320(21):1361–7.
4. Thompson D, Rivara F, Thompson R. Helmets for preventing head and facial injuries in bicyclists [Cochrane review]. In: The Cochrane Library [database on disc and CD-ROM]. The Cochrane Collaboration. Oxford: Update Software; 2001, issue 3.
5. Vulcan AP, Cameron MH, Watson WL. Mandatory bicycle helmet use: experience in Victoria, Australia. *World J Surg* 1992;16(3):389–97.
6. Pitt WR, Thomas S, Nixon J, Clark R, Battistutta D, Acton C. Trends in head injuries among child bicyclists. *BMJ* 1994;308:177.
7. Rivara FP, Thompson DC, Thompson RS, Rogers LW, Alexander B, Felix D, et al. The Seattle children's bicycle helmet campaign: changes in helmet use and head injury admissions. *Pediatrics* 1994;93(4):567–9.
8. Carr D, Skalova M, Cameron M. *Evaluation of the bicycle helmet wearing law in Victoria during its first four years*. Melbourne: Monash University Accident Research Centre; 1995. Publ. no. 76.
9. Ekman R, Schelp L, Welander G, Svanstrom L. Can a combination of local, regional and national information substantially increase bicycle-helmet wearing and reduce injuries? Experiences from Sweden. *Accid Anal Prev* 1997;29(3):321–8.
10. Parkin P, Morris B, Chipman M, Miller C, Hu X, Wesson D. Measurement of bicycle helmet use by direct observation: accuracy of a measurement methodology [abstract]. *Paediatr Perinat Epidemiol* 1991;5:A22–3.
11. Pendergrast RA, Ashworth CS, Curant RH, Litaker M. Correlates of children's bicycle helmet use and short-term failure of school level interventions. *Pediatrics* 1992;90(3):354–8.
12. Dannenberg AL, Gielen AC, Beilenson PL, Wilson MH, Joffe A. Bicycle helmet laws and educational campaigns: an evaluation of strategies to increase children's helmet use. *Am J Public Health* 1993;83(5):667–74.
13. Hu X, Wesson DE, Parkin PC, Chipman ML, Spence LJ. Current bicycle helmet ownership, use and related factors among school-aged children in Metropolitan Toronto. *Can J Public Health* 1994;85(2):121–4.
14. Scuffham P, Alsop J, Cryer C, Langley JD. Head injuries to bicyclists and the New Zealand bicycle helmet law. *Accid Anal Prev* 2000;32(4):565–73.
15. Cameron M, Newstead S, Vulcan P, Finch C. Effects of the compulsory bicycle helmet wearing law in Victoria during its first three years. In: *Proceedings of the 1994 Australian Pedestrian and Bicyclists Safety and Travel Workshop*. Melbourne: Australian Road Research Board Transport Research; 1995.
16. Scuffham PA, Langley JD. Trends in cycle injury in New Zealand under voluntary helmet use. *Accid Anal Prev* 1997;29(1):1–9.

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