The Use of Bicycle Helmets in a Western Canadian Province Without Legislation

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ABSTRACT

Introduction: This study examined the use of helmets in adults, adolescents, and children in a western Canadian province that has no helmet legislation.

Methods: A prospective survey of cyclists in two urban Alberta regions was completed. Cyclist demographics, helmet wearing and helmet use were recorded.

Results: Helmets were observed in 2,259 (55%; 99% CI: 52-57) of 4,141 cyclists; however, only 75% (CI 71, 78) were wearing the helmet properly. Patterns of use varied according to age: 75% (CI 71, 78) of children, 29% (CI 23, 34) of adolescents, and 52% (CI 49, 55) of adults wore helmets. Percentages were higher in Calgary than Edmonton (63% vs. 45%; $p < 0.0001$) and females wore helmets more often (64% vs. 50%; $p < 0.0001$).

Discussion: These results identify large within- and between-region variation in the use of cycling helmets in Alberta. Injury prevention planners need to use these data to adopt interventions that are focused on age groupings, gender, and place of residence.

La traduction du résumé se trouve à la fin de l'article.

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Bicycling is one of the most popular physical activities for Canadians of all ages. In Alberta, respondents to a telephone survey ranked bicycling as an activity they would like to pursue as a new activity.¹ Physical activities are known to have many health benefits. While every activity is accompanied by inherent risks, managing those risks is essential to the promotion of healthy lifestyles.

Bicycling continues to be a significant cause of injury-related mortality, morbidity and disability. Research shows head injuries account for a significant proportion of injuries to bicyclists. Almost half of injuries to cyclists under 11 years of age and one third of injuries to cyclists of all ages involve head injuries.² In Canada, fatal injuries to cyclists are the result of collisions with motor vehicles resulting in head injury.³ Non-fatal injuries are far more frequent and require additional health care resources.

The use of helmets to protect against head, brain, and facial injuries has been established in well-designed case-controlled studies.⁴⁻⁸ Helmets reduce the risk of head injury by 85%, brain injury by 88%, and severe brain injury by at least 75%.⁴⁻⁸ The protective effect for mid and upper facial injuries is 65%.⁴ Despite these results, the acceptance of bicycle helmets is less than ideal and wearing behaviours in Canada have been infrequently studied.

The purpose of this study was to document current bike helmet use in the two major urban centres of Alberta. The objectives of this study were to determine: 1) helmet-wearing percentages of cyclists, 2) compliance with wearing recommendations, and 3) factors associated with bicycle helmet-wearing use.

METHODS

This observational cohort survey was conducted in Alberta's two largest cities: Edmonton and Calgary. Communities surrounding Edmonton and Calgary were included if they were within 50 km from either city centre and their population exceeded 9,500. These communities together comprise approximately 60% of Alberta's total population of 2,819,423 (Census, 1999).

A convenience sample of all people cycling on bicycles presenting to survey locations from June 1 to September 30, 2000 were observed by trained researchers.

Tricyclists were excluded; however, cyclists using training wheels were included.

The cities each were divided into six strata in an attempt to efficiently observe cyclists. Our location strata were: schools, parks, commuter routes, designated cycling paths, universities/colleges, and residential areas. Since children are over-represented in injury data,^{9,10} schools were over-represented in this survey in an effort to increase observations of younger ages.

A pilot study was conducted in order to estimate cycling rates at different location types. We targeted 35% of our sample size to come from school sites, 15% from campuses, and approximately 17% from each of the rest of our location types. The number of sites in the major urban centres and their surrounding communities was allocated according to the size of their population. Thus, our survey is more representative of Alberta cyclists, with the drawback of obtaining less information from the smaller communities. The sites were selected randomly using S-PLUS 2000 (Insightful Corporation, Seattle, Washington) computer code.

All cyclists passing an observer were recorded for: helmet use, approximate age, gender, correctness of helmet use, their riding companionship, and helmet use on their riding companions. Cyclist companions were assumed to be those riding in the same group of riders. Carrying a helmet did not qualify as wearing one. No subjects were stopped for verification.

When a cyclist was found to be wearing a helmet, proper use was determined. A properly worn helmet was considered to sit level with the rest of the head, the bottom of a helmet had to be approximately two finger widths away from the top of the rider's eyebrows, and the helmet straps fastened with approximately one-finger width space between the chin and the straps. Observers were trained by KIDSAFE Connection staff and observed for accuracy; however, observers were instructed *not* to record an observation if they were "unclear" (see results). No formal inter-rater reliability assessments were performed.

Outcome

The major outcomes of interest for this study were helmet-wearing percentages among different age subgroups. Gender, location, city, riding companions, and helmet wearing of others were also consid-

TABLE I

Univariate Unstratified Percentage Wearing a Helmet While Riding a Bicycle

Variable	Grouping	Sample Size	Percentage	99% Confidence Interval
Age	Children	1236	74.6	[70.8,78.4]
	Adolescents	677	28.7	[23.4,33.9]
	Adults	2107	51.8	[48.5,55.1]
Gender	Male	2833	50.3	[47.5,53.2]
	Female	1204	64.0	[59.8,68.1]
Location	Campus	196	37.2	[26.6,47.9]
	Commuter route	664	44.4	[38.6,50.3]
	Residential	575	45.4	[39.1,51.7]
	Cycling path	614	53.1	[47.5,59.2]
	Park	709	58.3	[52.6,63.9]
	School	1383	64.4	[60.5,68.3]
	Greater City Region	2012	45.7	[42.3,49.0]
Density	Edmonton region	2129	62.9	[59.8,66.1]
	Calgary region	3734	54.6	[52.1,57.1]
	Less urban	407	54.1	[46.5,61.6]

TABLE II

Univariate Stratified Percentage Wearing a Helmet While Riding a Bicycle

Variable	Age Strata	Grouping	Sample Size	Percentage	99% Confidence Interval
Gender	Children	Male	814	71.3	[66.4,76.1]
		Female	404	80.4	[74.4,86.5]
	Adolescents	Male	484	26.7	[20.5,32.8]
		Female	191	34.0	[23.5,44.6]
	Adults	Male	1493	47.4	[43.4,51.3]
		Female	582	62.5	[56.4,68.7]
Location	Children	Commuter route	95	53.7	[37.7,69.6]
		Residential	108	69.4	[55.6,83.3]
		Cycling path	78	70.5	[54.3,83.3]
		Park	70	74.3	[57.8,90.8]
		School	883	77.9	[73.7,82.2]
		Commuter route	106	25.5	[12.2,38.7]
		Residential	90	18.9	[5.9,31.9]
	Adolescents	Cycling path	103	19.4	[7.2,31.7]
		Park	48	22.9	[3.5,42.4]
		School	323	36.5	[28.3,44.7]
		Commuter route	421	48.2	[48.2,55.7]
		Residential	364	45.1	[37.1,53.0]
		Cycling path	411	58.4	[51.0,65.8]
		Park	583	59.2	[53.0,65.4]
	Adults	School	150	47.3	[34.7,59.9]
		Campus	178	38.8	[27.5,50.0]
Greater City Region	Children	Edmonton region	578	60.4	[54.2,66.6]
		Calgary region	658	87.1	[83.1,91.1]
	Adolescents	Edmonton region	375	19.7	[13.4,26.0]
		Calgary region	302	39.7	[31.1,48.4]
	Adults	Edmonton region	950	48.1	[43.2,53.0]
		Calgary region	1157	54.9	[50.4,59.3]
Riding Companions	Children	Without adults	1069	71.7	[67.6,75.9]
		With adults	167	92.8	[86.5,99.1]
	Adolescents	Alone	520	25.8	[19.9,31.6]
		With someone	157	38.2	[26.2,50.2]
	Adults	Alone	1819	50.9	[47.4,54.5]
		With someone	288	57.6	[48.7,66.6]
Helmets on Others	Children	With adults not wearing helmets	62	83.9	[68.9,98.8]
		With adults where at least one is wearing a helmet	99	99.0	[95.5,100]

ered. Cyclists were also observed for correct helmet usage.

To achieve a 3% margin of error for the children subgroup helmet-wearing percentage (with an alpha of 0.05), we targeted a sample size of 4,000.

Data analyses

Data analyses were completed using the S-PLUS 2000 statistical package. Proportions

and their associated 99% confidence intervals (99% CI) were calculated for each variable. These univariate statistics were also calculated for each age group. Pearson chi-squared tests were performed to test for differences; an alpha level less than 0.0027 was considered significant using Bonferroni's correction for multiple testing.¹¹ Logistic regression was performed to account for multiple correlations between variables.

TABLE III
Risks for Not Wearing a Helmet When Riding a Bicycle

Variable	Adjusted Odds Ratio	95% Confidence Interval
Children		
Male vs. Female	1.1752	[1.0058, 1.3731]
Without adults vs. With adults	1.7526	[1.2741, 2.4110]
Edmonton region vs. Calgary region	2.0249	[1.7334, 2.3655]
Urban vs. Less urban	1.2666	[1.0412, 1.5407]
Campus vs. School	1.2504	[0.3097, 5.0479]
Park vs. School	0.9139	[0.5525, 1.5115]
Residential vs. School	1.0400	[0.8003, 1.3516]
Cycling path vs. School	1.0643	[0.8883, 1.2750]
Commuter route vs. School	1.1019	[0.9747, 1.2458]
Adolescents		
Male vs. Female	1.1108	[0.9175, 1.3448]
Alone vs. With someone	1.3096	[1.0589, 1.6195]
Edmonton vs. Calgary	1.5473	[1.2855, 1.8624]
Urban vs. Less urban	0.7722	[0.5985, 0.9964]
Campus vs. School	1.6450	[0.5589, 4.8417]
Park vs. School	1.1947	[0.7776, 1.8357]
Residential vs. School	1.0974	[0.8702, 1.3839]
Cycling path vs. School	1.0446	[0.8946, 1.2498]
Commuter route vs. School	0.9482	[0.8499, 1.0577]
Adults		
Male vs. Female	1.3303	[1.2030, 1.4709]
Alone vs. With someone	1.0183	[0.8930, 1.1613]
Edmonton vs. Calgary	1.0802	[0.9829, 1.1870]
Urban vs. Less urban	1.0658	[0.8555, 1.3279]
Cycling path vs. Park	1.0081	[0.8848, 1.1486]
Commuter route vs. Park	1.1355	[1.0484, 1.2299]
School vs. Park	1.0525	[0.9621, 1.1514]
Campus vs. Park	1.1174	[1.0456, 1.1943]
Residential vs. Park	1.0387	[0.9981, 1.0809]

Note: Bolded text represent significant variables/odds ratios.

Figure 1. Correct Usage of Helmet Wearing while Riding a Bicycle

This study was approved by the Research Ethics Review Committee at the University of Alberta.

RESULTS

All of the results are from univariate analysis unless otherwise stated.

Data were collected from 274 sites: 99 from Edmonton, 137 from Calgary, and 38 from surrounding areas. The bulk of

the observations occurred in the summer months: 103 sites in July and 98 sites in August. In total, there were: 1,383 observations made at school sites, 709 in parks, 614 on cycling paths, 664 on commuter routes, 575 in residential areas, and 196 at university/college campuses.

Observations were made on 4,156 riders, with 4,141 (99.6%) of these recording whether the subject was wearing a helmet or not. Eighteen of these helmets were not

bicycle helmets. The sample's helmet-wearing percentage, unadjusted for age, was 55% (99% CI: 52 to 57).

Helmet-wearing Percentages: Observations were recorded for children (≤ 12), adolescents (13-17), and adults (≥ 18). Significant differences between the age groups with respect to helmet wearing ($p < 0.0001$) were identified (Table I).

Gender Comparisons: Significant gender differences were noted ($p < 0.0001$; Table I). Gender differences were found in children and adults, but not in adolescents (Table II), when considering the corrected alpha. The logistic regression analysis confirmed that the difference in the adolescent age group was not significant (Table III).

Location Comparisons: Significant differences were identified between location types (Table I). School sites had the highest helmet-wearing percentage, followed by parks and cycling paths ($p < 0.0001$, school sites vs. park and cycling path sites), and residential and commuter route sites ($p < 0.0001$, park and cycling path sites vs. residential and commuter route sites). Significant differences were found between campuses and residential/commuter route sites ($p < 0.0001$) even though there were few observations recorded there ($N = 196$).

Regional Differences: Significant differences were found between Edmonton and Calgary communities ($p < 0.0001$), with riders in the Calgary region wearing helmets more often (63 vs. 46%). Helmet use in the surrounding communities was similar to that of their closest major urban centre; differences between the surrounding communities and Edmonton ($p = 0.0941$) and the surrounding communities and Calgary ($p = 0.9398$) were non-significant.

Riding Companions: Due to small numbers in some of the cells, categories in the riding companions variable were collapsed (Table II). A strong significant difference was found between children riding with adults versus children riding without adults ($p < 0.0001$). Of those children who rode with adults, the children who rode with at least one adult wearing a helmet were more likely to wear helmets themselves (84 vs. 99%, $p < 0.0001$).

Multivariate Analysis: Due to the many interactions between age and the other variables, the logistic regression analysis was stratified by age groups. The variables explaining differences within the children

(≤12) (gender, riding companions, greater city region, and size of community; Table III) were similar to adolescents (13-17), except that gender was no longer a significant factor associated with helmet use and adolescents living in less populated communities were more significantly at risk. Finally, the variables explaining helmet use within the adults were slightly different from children and adolescents (Table III).

Helmet-wearing Compliance: Compliance with helmet-wearing recommendations was recorded on 2,090 (93%) of 2,259 helmeted riders (Figure 1). Only 25% (99% CI: 22 to 29) of helmets were noted to be worn incorrectly or noted to be of the wrong type.

DISCUSSION

Cycling is a sport that enjoys widespread popularity. Despite attempts to encourage helmet wearing, use remains low. This study revealed that only 55% of bicyclists were observed to be wearing a helmet. In addition, wearing rates were lowest in adolescents and young adults, which are groups demonstrating a high number of bicycle-related injuries.¹² It is important to note that 82% of all youth in Alberta who suffered major trauma as a result of bicycling were not wearing a helmet at the time of the injury.¹³

Helmet use variations among different age groups supports the pattern seen in other jurisdictions.^{10,14} Children are most likely to wear a bicycle helmet (75%), followed by adults (55%), and adolescents (29%). These age variations were consistent between greater Edmonton and greater Calgary, with adolescents the least likely to wear a helmet in both cities and surrounding communities. Moreover, helmet use patterns vary consistently between regions, with Calgary and Edmonton demonstrating significantly different percentages.

Helmet wearing was higher for females (64%) than males (50%), which was consistent for all age groups. The positive effect of adult riding companions on the helmet usage of children and adolescents found in earlier studies^{15,16} was also evident in this study. Helmet use increased in children riding alone to 99% when they were riding with at least one helmet-wearing adult.

Helmet use observed in this study is similar to that in British Columbia cities prior to implementation of bicycle helmet legislation (51%)¹⁷ and higher than in Ontario (20%)¹⁴ and Manitoba (21%).¹⁰ The Ontario study involved cyclists in a Northern, urban community where verification of proper helmet use was employed; the Manitoba study included more rural communities. These factors, and the timing of the studies, may account for some observed differences.

Limitations existed in this study. Owner non-use and errors in fit could potentially negate the known protective benefit(s) of helmet use; however, we did not collect this information. A sample of the total population of cyclists was not observed. Rather, the observations were a random selection of cyclists using the identified locations. Finally, age and gender were estimated and helmet compliance was assessed by inspection, as an interview was not part of this study; however, the estimations should have a high level of reliability. We cannot comment on the effect non-compliance with helmet wearing has on actual crash protection.

Notwithstanding the above concerns, this study demonstrates low helmet use, despite strong evidence of effectiveness. Strategies to increase helmet use are warranted, especially in children,¹⁸ and should be multi-faceted. The most effective interventions to increase bicycle helmet-wearing rates appear to be the combination of community-based efforts with universal helmet legislation.^{17,19,20} In other communities, helmet wearing has increased with implementation of prevention strategies such as public awareness and education, social marketing, and equipment discounts.

Despite the efficacy of bicycle helmets in reducing head injuries, most provinces have failed to introduce a comprehensive strategy to reduce the impact of bike-related injuries. In 1996, British Columbia was the first Canadian province to implement universal bike helmet regulation.¹⁷ Helmet legislation for children <18 was instituted in Alberta in May 2002 and further research to determine the effect of legislation is planned.

Strategies to improve these statistics are urgently required. Approaches that target the general public including parents, retailers, and government should be considered.

Interventions targeting parents should focus on the importance of positive role modelling as well as the importance of providing children with the equipment and knowledge needed to prevent bicycle-related injury. Helmet retailers can also play an important role in the educational strategy by promoting the use of helmets and working with cyclists to ensure proper fit of helmets. We must promote healthy lifestyles in Canada by encouraging participation in recreational activities such as bicycling. We must also take precautionary measures to protect all citizens from predictable and preventable injuries.

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RÉSUMÉ

Introduction : Nous avons étudié l'utilisation du casque chez les adultes, les adolescents et les enfants dans une province de l'Ouest canadien où le port du casque n'est pas réglementé.

Méthode : Nous avons mené une enquête prospective auprès de cyclistes dans deux zones urbaines de l'Alberta. Les données démographiques des cyclistes, le port du casque et l'utilisation du casque ont été enregistrés.

Résultats : Des 4 141 cyclistes à l'étude, 2 259 portaient un casque (55 %; IC de 99 % = 52-57); cependant, seulement 75 % (IC = 71-78) le portaient convenablement. L'utilisation variait selon l'âge : 75 % (IC = 71-78) des enfants, 29 % (IC = 23-34) des adolescents et 52 % (IC = 49-55) des adultes portaient un casque. Les pourcentages étaient plus élevés à Calgary qu'à Edmonton (63 % c. 45 %; $p < 0,0001$), et chez les femmes que chez les hommes (64 % c. 50 %; $p < 0,0001$).

Discussion : Ces résultats montrent qu'il existe d'importants écarts inter- et intra-régionaux dans l'utilisation du casque en Alberta. Les planificateurs en prévention des blessures devraient en tenir compte afin d'élaborer des mesures adaptées selon l'âge, le sexe et le lieu de résidence.

Protecting natural treasures requires creative solutions.

Support the wildlife management plans advanced by biologists, and remember legal hunting is an effective tool in maintaining the size and composition of wildlife populations.

All species are at risk when ecosystems are imbalanced by the actions of special interest groups.

Help us build consensus to protect the great outdoors.

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