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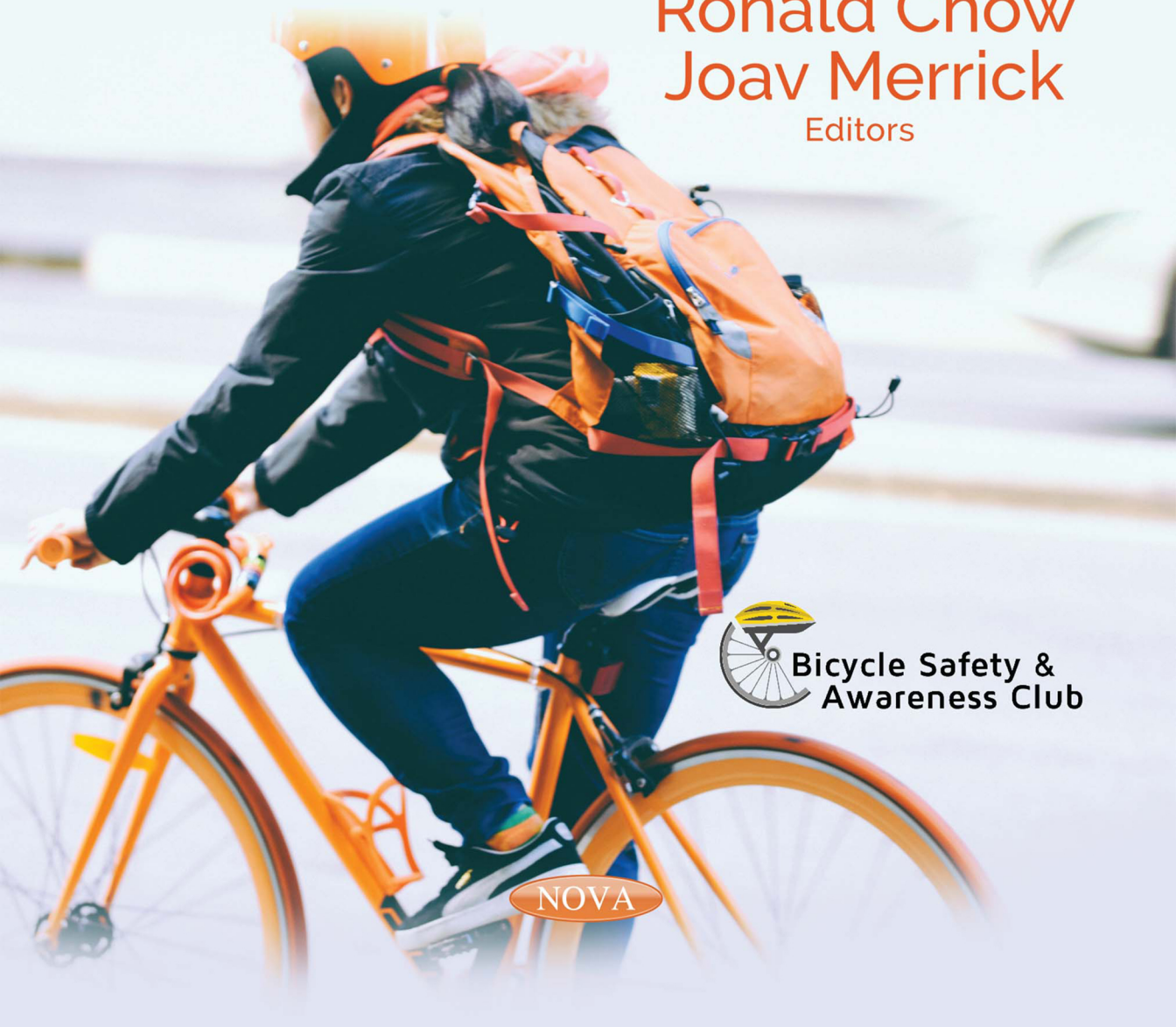
Adolescence

Bicycle and Helmet Use of Adolescents and Young Adults

Ronald Chow
Joav Merrick
Editors



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ADOLESCENCE

BICYCLE AND HELMET USE OF ADOLESCENTS AND YOUNG ADULTS

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PEDIATRICS, CHILD AND ADOLESCENT HEALTH

ADOLESCENCE

BICYCLE AND HELMET USE OF ADOLESCENTS AND YOUNG ADULTS

RONALD CHOW
AND
JOAV MERRICK
EDITORS

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INTRODUCTION

In: Adolescence ISBN: 978-1-53612-039-4
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Chapter 1

CYCLISTS: THE IMPORTANCE OF HELMET USE

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Sport and recreation is a positive for our children and youth. Bicycle activity is great for our health and getting or keeping in shape. It can be

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part of sport activities or it can be a means of transportation as part of our daily life. But there are also risks and bicycle accidents happens and can cause serious injury. Helmet use can substantially reduce the risks associated with bicycle injuries, as these protective devices can prevent an array of serious facial injuries. In this book we present survey studies conducted in various settlements around the world, looking into bicycle and helmet use of adolescent and young adults.

INTRODUCTION

Bicycle crashes are a common cause of serious injury associated with sports and recreation among youth (1). One-third of bicycle injuries treated in emergency departments in the United States are head injuries, of which two-thirds result in hospitalization and three-fourths lead to death (2-6). Children under the age of 15 years old are much more likely to experience a bicycle-related injury compared to older riders (430.7 injuries per million trips compared to 296.2 injuries per million trips) (2). Sacks et al. (4) revealed that forty-one percent of head injury deaths and seventy-six percent of all head injuries related to cycling accidents are registered to children under 15 years old.

Helmet use can substantially reduce the risks associated with bicycle injuries, as these protective devices can prevent an array of serious facial injuries (7). Thompson et al. (6), who conducted a case-control study of 99 patients who had severe brain injury as a result of bicycle accidents, observed that only four percent wore helmets at the time of their accident (6). A meta-analysis by Atetwell et al. (8) determined that helmets were more efficacious than its alternative – lack of helmet use – with respect to head injury (odds ratio (OR) = 0.40), brain injury (OR = 0.42), facial injury (OR = 0.53) and fatal injury (OR = 0.27) (8). For those cyclists who used a helmet, they were three times less likely to be involved in a cycling head injury resulting in death (6, 9).

A nationwide survey carried out in 1990 in the United States showed that as few as 20 percent of children and less than half of adults wore a helmet while cycling (10). Another study, dated 1992, reported that under four percent of children used helmets in certain rural areas (11). Since then,

however, a lot has changed; countries such as Australia, Canada, New Zealand and the United States have passed and enforced legislation mandating helmet use for cyclists (12).

Two recent studies have been conducted in the Greater Toronto Area among adolescents. Chow et al. published a survey study in 2016 documenting helmet use of adolescent cyclists at an all-boys independent day school in Toronto, Canada. A survey was circulated to Grade 7 to 12 students, and helmet-use rates when students commute to school and during their recreational time was recorded. Among school cyclists, 96%, 76% and 59% of students in Grade 7 and 8, Grade 9 and 10, and Grade 11 and 12, respectively, used helmets regularly. For recreational cyclists, 88%, 60% and 58% of the same groups used a helmet frequently (13).

Borean et al. (14) also recorded a higher rate amongst high school students in Markham, Canada in their survey study. Helmet-use rates for public high school students were 14% and 30% amongst cyclists who commute to school, and 41% and 38% for those who used their bicycle during their recreational time (14).

Both of these recent studies (13, 14) revealed higher helmet use rates than those previously reported (10, 11). However, it is important to note that the recent studies and dated studies differ with respect to population demographics (i.e., location, age group). These two studies also reveal an intriguing trend – there exists a negative correlation between age and helmet use; generally, as adolescents age, regular helmet use decreases.

These findings call for further studies into the adolescent and young adult population, in different regions of the world. These studies would update figures in literature to reflect today's society and a different generation of youth (with different upbringings and different environmental factors), as well as determine whether the trends are also observed in other regions. This book contains survey studies conducted in various settlements around the world, looking into bicycle and helmet use of adolescent and young adults. It also contains a meta-analysis, conglomerating the results of all the studies to synthesize and determine if there is an overarching theme.

REFERENCES

[1] Thompson MJ, Rivara FP. Bicycle-Related Injuries. Am Fam Physician 2001;63:2007-14.

[2] Baker SP, Li G, Fowler G, Dannenberg AL. Injuries to bicyclists: a national perspective. Baltimore, MD: Johns Hopkins Injury Prevention Center, 1993.

[3] Friede AM, Azzara CV, Gallagher SS, Guyer B. The epidemiology of injuries to bicycle riders. Pediatr Clin North Am 1985;32:141–51.

[4] Sacks JJ, Holmgreen P, Smith SM, Sosin DM. Bicycle-associated head injuries and deaths in the United States from 1984 through 1988. How many are preventable? JAMA 1991;266:3016–8.

[5] Selbst SM, Alexander D, Ruddy R. Bicycle-related injuries. Am J Dis Child 1987;141:140–4.

[6] Thompson RS, Rivara RP, Thompson DC. A case control study of the effectiveness of bicycle safety helmets. N Engl J Med 1989;320:1361–7.

[7] Thompson DC, Thompson RS, Rivara P, Wolf M. A case control study of the ffectiveness of bicycle safety helmets in preventing facial injuries. Am J Public Health 1990;80:1471-4.

[8] Attewell RG, Glase K, McFadden M. Bicycle helmet efficacy: a meta-analysis. Accid Anal Prev 2001;33(3):345-52.

[9] Persaud N, Coleman E, Zwolakowski D, Lauwers B, Cass D. Nonuse of bicycle helmets and risk of fatal head injury: a proportional mortality, case-control study. CMAJ 2012;184(17):E921-3.

[10] Rivara FP, Thompson DC, Patterson M, Thompson RS. Prevention of bicycle-related injuries: helmets, education and legislation. Ann Rev Public Health 1998;19:293-318.

[11] Cote TR, Sacks JJ, Kresnow MJ, Lambert-Huber DA, Schmidt ER, Dannenberg AL, Lipsitz CM. Bicycle helmet use among Maryland children: effect of legislation and education. Pediatrics 1992;89(6):1216-20.

[12] Lee B, Schofer J, Koppelman F. Bicycle safety helmet legislation and bicycle-related non-fatal injuries in California. Accid Anal Prev 2004;37:93-102.

[13] Chow R, Hollenberg D, Pintilie A, Midroni C, Cumner S. Helmet use of adolescent cyclists at Crescent School in Toronto, Canada. Int J Adolesc Med Health 2016 Mar 12. Doi: 10.1515/ijamh-2015-0123.

[14] Borean M, Ho S, Hollenberg D, Anpalagan T, Rzepka A, Viehweger J, et al. Helmet use of adolescents in Markham, Canada. Int J Adolesc Med Health 2017, in press.

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Chapter 2

BICYCLE HELMET USE: THE SURVEY AND SURVEY INSTRUMENT

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Qualitative observations from students who recently moved to a new community predominantly of young adults from a community mainly composed of adolescents noticed that helmet use was lower in their new environment. To definitively verify this observation, the Bicycle Safety and Awareness Club was established. Its first objective was to conduct survey studies to evaluate bicycle and helmet use, and then cater their education/advocacy programs based on the responses gathered. Two similar surveys were employed to determine bicycle and helmet use for adolescents and young adults. The primary objective was to determine bicycle and helmet use of the survey population during 1) their commute to school/university, and 2) their recreational time. The secondary objective was to record the reasons why individuals opt not to use a helmet when cycling.

INTRODUCTION

Helmets are efficacious safety equipment for riding a helmet, yet shockingly adolescents do not use helmets on a regular basis (see chapter 1). One might infer this may be a result of the stereotypical rebellious nature of adolescents; adolescents would use helmets at the lowest rate compared to other populations (i.e., young adults).

A group of students across the Canadian Province of Ontario that recently matriculated from high school and progressed into university were shocked by their personal experience in their new environment. They qualitatively noticed that helmet use among cyclists was even lower in their new community of young adults, compared to their prior environment of predominantly adolescents. These observations failed to be explained by their predetermined notion regarding rebellious adolescents; however, it should be noted that these observations would simple eye-observations without any quantitative data.

To definitively determine whether helmet rates were lower among young adult cyclists, the Bicycle Safety and Awareness Club was established. The club first conducted survey studies to evaluate bicycle and helmet use among the young adult population, and compare it to prior studies in the adolescent population (see chapter 1), to determine whether the eye-observations were quantitatively supported. Regardless of whether

the trend was verified, helmet use was lacking amongst riders; the club aimed to educate/advocate the local community about helmet use in hopes to improve rider safety. The data gathered from the survey would direct the club's resources towards a specific age population, and also provide a list of reasons for why young adults do not wear helmets, for which the club could work with the community to overcome.

SURVEY QUESTIONNAIRES

Two similar questionnaires were employed to determine bicycle and helmet use for adolescents (see Figures 1-4) and young adults (see Figures 5-9); these questionnaires had similar primary and secondary objectives. The primary objective was to determine bicycle and helmet use of the survey population during 1) their commute to school/university, and 2) their recreational time. The secondary objective was to record the reasons why individuals opt not to use a helmet when cycling. The questionnaires were anonymous, and advertised as voluntary; completion of the questionnaire meant implied consent, which was explicitly documented when the survey was circulated via media channels.

The questionnaire for adolescents first queried about school-grade. For those surveys that were circulated in a population where there were also Grade 7 and 8 students, those options were added to the first page of the questionnaire. The second question on the first page was a Yes/No question regarding whether the participant commutes to school using a bicycle; should they answer "Yes," they would have been re-directed to page 2, while an answer of "No" directs them to progress to page 3 (see Figure 1). The second page of the questionnaire for adolescents asked participants about the duration of a typical ride to school, the frequency at which they commute, frequency for which they use a helmet, and whether they are aware of the legislation in Ontario regarding mandatory helmet use; there is also a short-answer question asking for reasons why individuals choose not to wear helmets (see Figure 2).

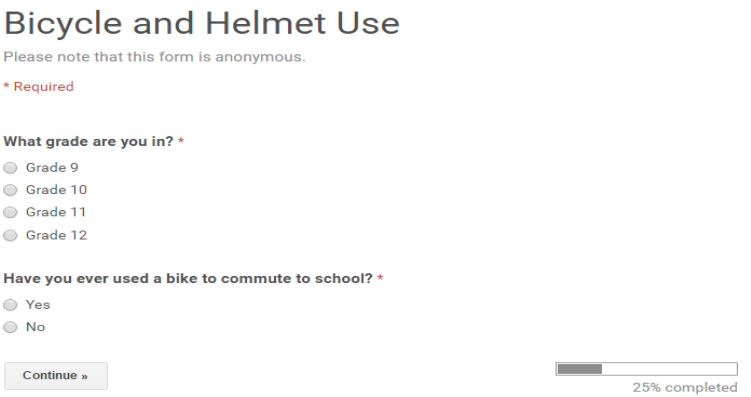


Figure 1. Survey for adolescents (page 1).

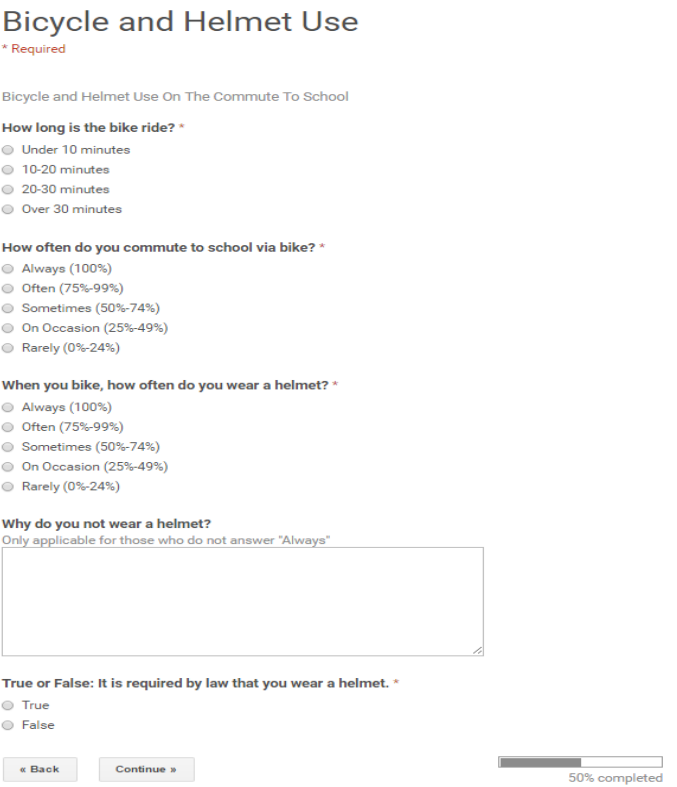


Figure 2. Survey for adolescents (page 2).

The third page has another Yes/No question asking whether an adolescent uses a bike during their recreational time; as with the prior Yes/No question, an answer of "Yes" progressed the participant to page 4 whereas an answer of "No" brought the survey to an end (see Figure 3). The fourth page investigated into the frequency of helmet use during recreational cycling, reasons for not using a helmet, and inquired about the knowledge of bicycle legislation (see Figure 4).

The survey circulated to young adults varied slightly. The landing page of the questionnaire had an explicit consent form, just to serve as a reminder to the participants. The first page of questions asked for young adults to specify their age rather than their level of education; the Yes/No criteria to progress to the next page was the same as the questionnaire for adolescents (see Figure 6). The next page of questions for young adults had a similar set of questions compared to those for adolescent school cyclists; the only exception was that the bicycle legislation question was replaced with a True/False question about the proven efficacy of helmet use while cycling (see Figure 7). The third and fourth page of questions were also identical to the questionnaire for adolescents, again except for the True/False question regarding helmet efficacy (see Figures 8-9).

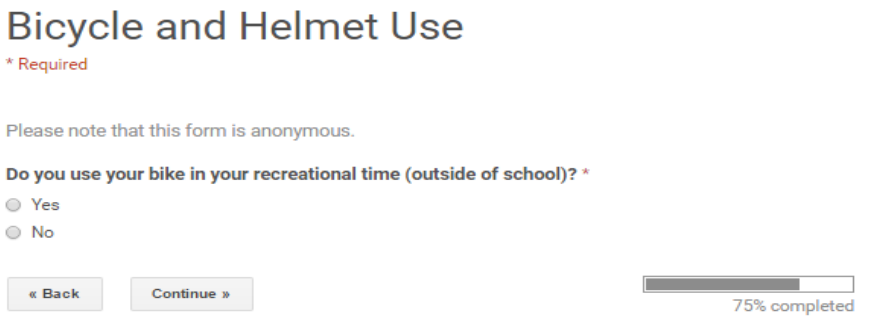


Figure 3. Survey for adolescents (page 3).

For the statistical analyses of the collected data, responses for questions on page 2 and 4 of both questionnaires were collapsed into a few categories. For the question about duration of bicycle commute to school/university, the responses were grouped into "Under 20 Minutes"

and "Over 20 Minutes". The questions regarding frequency (of commute, and of helmet use) were similarly grouped into two responses "Always/Often" and "Rarely/On Occasion/Sometimes." The resulting contingency tables for the multiple-choice questions were analyzed using the Statistical Analysis Software (Version 9.4 for Windows), using either the chi-square test or the Fisher exact test, depending on the sample size. The reason(s) for lack of helmet use was conveyed via descriptive statistics.

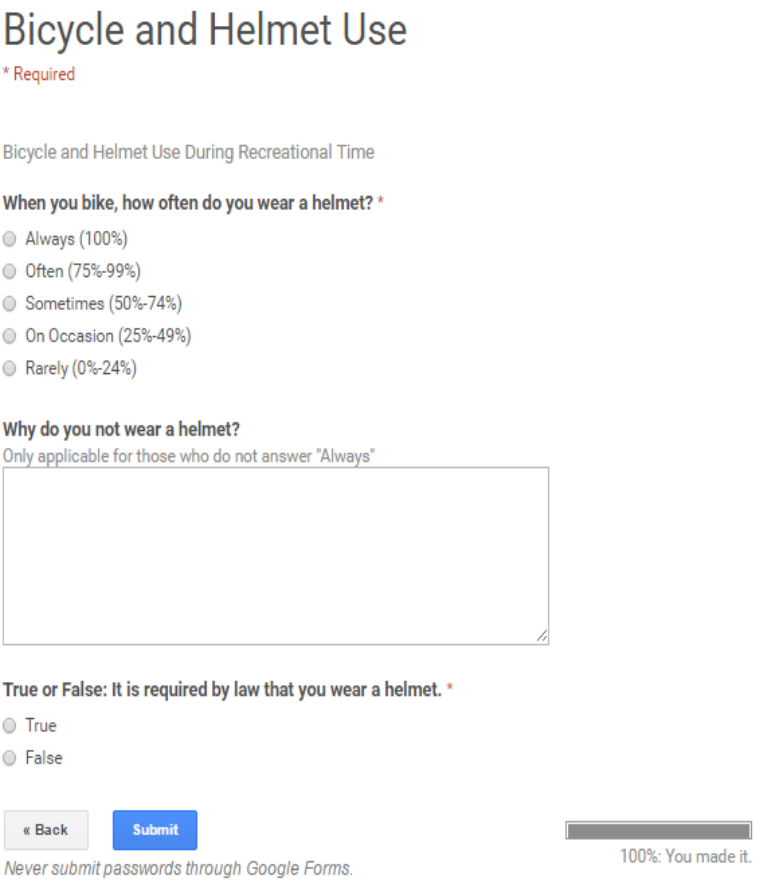


Figure 4. Survey for adolescents (page 4).

Bicycle and Helmet Use

INFORMED CONSENT TO PARTICIPATE IN A RESEARCH STUDY

Full Study Title: Surveying Young Adults of Bicycle Use

Principal Investigator: Ronald Chow
Bicycle Safety & Awareness Club
rchow48@uwo.ca

INFORMED CONSENT

You are being asked to consider participating in a research study. A research study is a way of gathering information on something that is not well understood.

Participating in this study is your choice (voluntary). You have the right to choose not to participate, or to stop participating in this study at any time.

INTRODUCTION

You are being asked to consider participating in this study because you are a young adult in London, Canada.

WHY IS THE STUDY BEING DONE?

Around the campus it has been noticed that improvements in bicycle safety are very needed and possible.

BENEFITS AND COSTS

There are no direct benefits or costs to participating in the study.

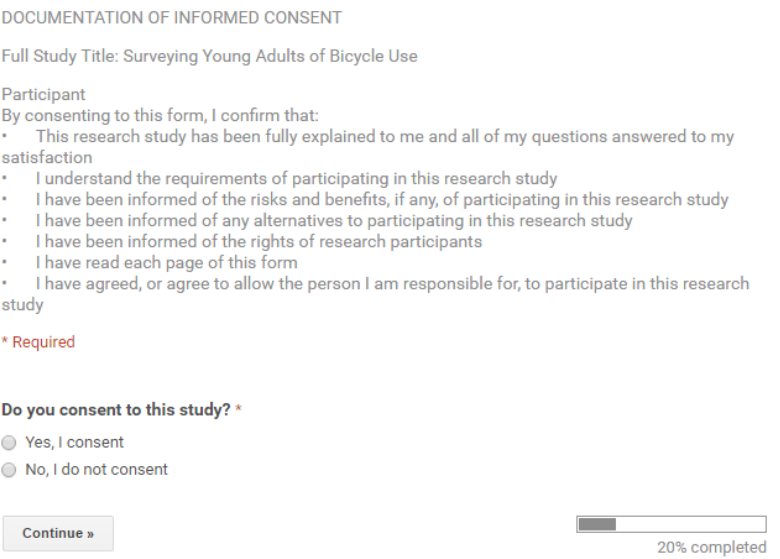
HOW WILL MY INFORMATION BE SECURE?

The study is anonymous, and therefore no names or personal information with be involved in the process.

WHAT ARE THE RIGHTS OF PARTICIPANTS IN A RESEARCH STUDY?

You have the right to receive all information that could help you make a decision about participating in this study. You also have the right to ask questions about this study and your rights as a research participant, and to have them answered to your satisfaction, before you make any decision. You also have the right to ask questions and to receive answers throughout this study.

If you have any questions about this study you may contact the person in charge of this study (Principal Investigator) – Ronald Chow


DOCUMENTATION OF INFORMED CONSENT

Full Study Title: Surveying Young Adults of Bicycle Use

Participant
By consenting to this form, I confirm that:
- This research study has been fully explained to me and all of my questions answered to my satisfaction
- I understand the requirements of participating in this research study
- I have been informed of the risks and benefits, if any, of participating in this research study
- I have been informed of any alternatives to participating in this research study
- I have been informed of the rights of research participants
- I have read each page of this form
- I have agreed, or agree to allow the person I am responsible for, to participate in this research study

* Required

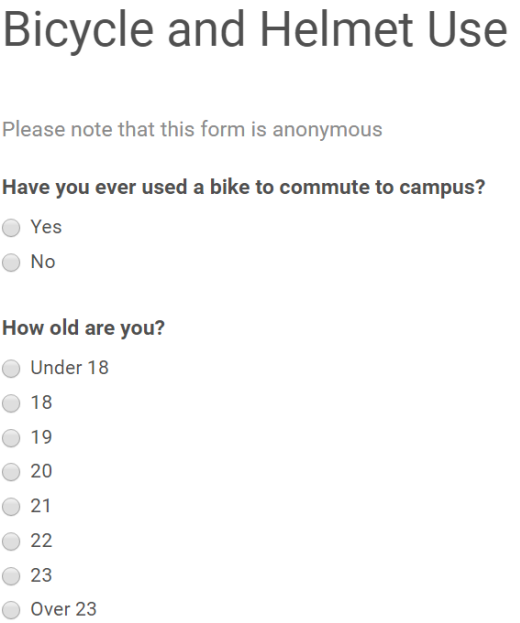
Do you consent to this study? *

- Yes, I consent
- No, I do not consent

Continue »

20% completed

Figure 5. Survey for young adults (page 1).


Bicycle and Helmet Use

Please note that this form is anonymous

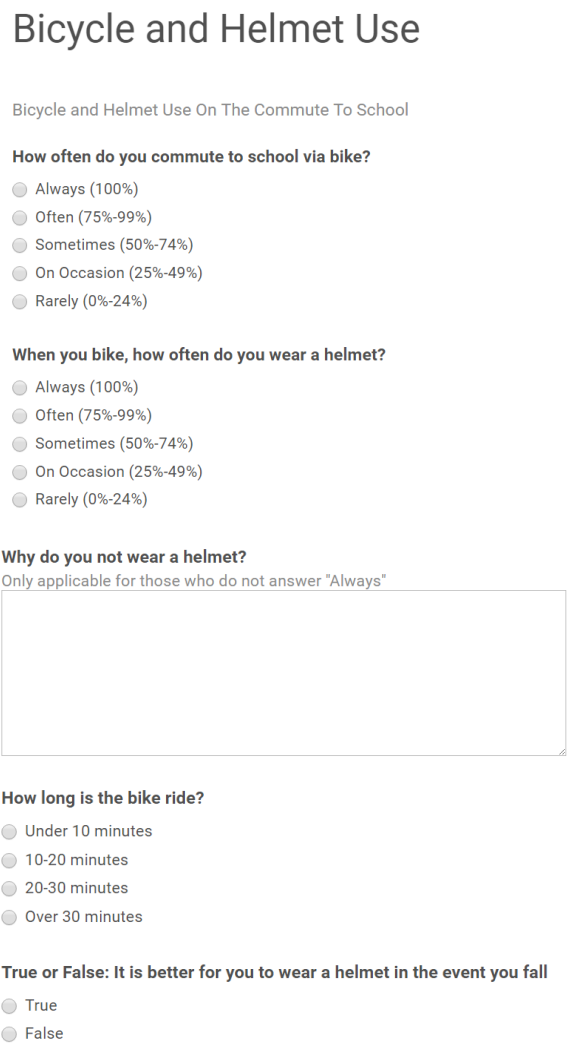
Have you ever used a bike to commute to campus?

- Yes
- No

How old are you?

- Under 18
- 18
- 19
- 20
- 21
- 22
- 23
- Over 23

Figure 6. Survey for young adults (page 2).



Bicycle and Helmet Use

Bicycle and Helmet Use On The Commute To School

How often do you commute to school via bike?

- Always (100%)
- Often (75%-99%)
- Sometimes (50%-74%)
- On Occasion (25%-49%)
- Rarely (0%-24%)

When you bike, how often do you wear a helmet?

- Always (100%)
- Often (75%-99%)
- Sometimes (50%-74%)
- On Occasion (25%-49%)
- Rarely (0%-24%)

Why do you not wear a helmet?

Only applicable for those who do not answer "Always"

How long is the bike ride?

- Under 10 minutes
- 10-20 minutes
- 20-30 minutes
- Over 30 minutes

True or False: It is better for you to wear a helmet in the event you fall

- True
- False

Figure 7. Survey for young adults (page 3).

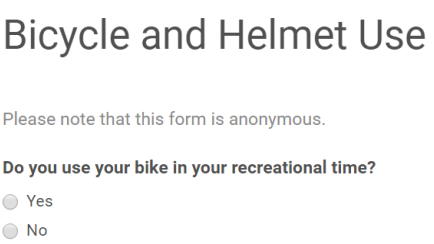


Figure 8. Survey for young adults (page 4).

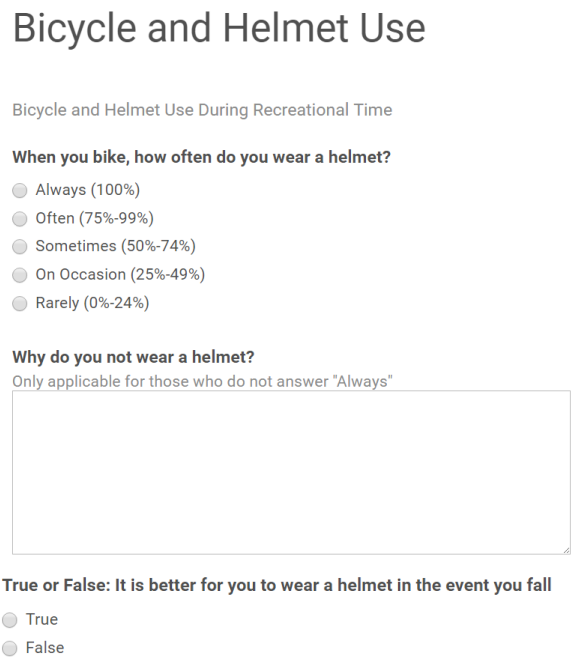


Figure 9. Survey for young adults (page 5).

SECTION TWO:
HEMET USE OF ADOLESCENTS

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Chapter 3

HELMET USE OF ADOLESCENT CYCLISTS AT CRESCENT SCHOOL IN TORONTO, CANADA

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Crescent School, Toronto,
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Ontario, Canada

Numerous studies have highlighted that bicycle helmets reduce the risk of head injury; the purpose of this study was to determine the helmet-wearing rate of adolescent boys and the reasons for those who do not wear helmets. A questionnaire was developed and completed by 257 students. A higher percentage of older students reported a long bike commute to school (over 20 minutes). The frequency of helmet use and awareness of helmet legislation was lower amongst the older students. Common reasons for not using a helmet across all ages included its uncomfortable nature, the confidence of the rider's cycling ability to not crash, and negligence. Further reminders and educational sessions

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regarding the importance of helmets could help to increase the helmet use of students across the grades.

INTRODUCTION

Head injuries comprise about one-third of bicycle injuries treated in the emergency departments of the United States, with two-thirds resulting in hospitalization and three-fourths in bicycle death (1-5). The injuries experienced by children aged 5-15 (430.7 injuries per million trips) was found to be much higher than that of the tier of riders over 50 (296.2 injuries per million trips) (1).

Numerous studies have highlighted that bicycle helmets reduce the risk of head injury, such as Thompson et al. (5) citing an 85% reduction. As a corollary, other studies suggest that helmets can serve as a protective device, preventing a variety of serious facial injuries (6). Despite these positive effects, national surveys from the 1990s showed that helmet use among United States citizens was less than 20% in children and less than 50% in adults (7).

Since then, Australia, Canada, New Zealand, and the United States have enforced legislation to mandate the wearing of safety helmets for bicyclists (8). Post-legislation, Howard Co, Maryland, USA observed helmet use rise from 4% to 47% just eight months after the law was originally passed in 1990 (9). In 1994, a similar law in Oregon observed an immediate rise from 24.5% to 49.3% (10). The contrast is stark when compared to New York City's mandate in 1994, which targeted helmet use among riders and passengers aged 1 to 14. The following months showed no increase in helmet use in Brooklyn, with a rise from 4.7% to 13.9% in Queens, which supplemented the mandate with an educational program. The rise was found to be predominantly in white children (6.5% to 23.5%), with small increases noticed in Black, Hispanic and Asian children (1.1% to 8.6%; 2.1% to 7.7%; and 13.3% to 15.2%) (11).

When a helmet use law came into effect in Victoria, Australia in 1990, there was an immediate increase in average helmet-wearing rates from 31% to 75% the following year. Teenagers did, however, continue to show

lower rates of helmet-wearing than adults. All in all, insurance claims from bicyclists killed or admitted to hospital following head injury decreased by 48% in the first year (12). The purpose of this chapter was to determine the helmet-wearing rate of adolescent boys and the reasons for those who do not wear helmets.

OUR STUDY

Crescent School is an all-boys independent day-school in Toronto, Canada, with over 700 students. It consists of three divisions: Grades 3-6 (Lower School), Grades 7-8 (Middle School) and Grades 9-12 (Upper School) (13).

A questionnaire was developed regarding bicycle and helmet use (see chapter 2). The primary objectives of the survey were to determine 1) the percentage of cyclists at the school and 2) the percentage of cyclists who wear a helmet. The questionnaire posed questions regarding bicycle-use in two main instances - the first instance was centred around bicycle-use as a means of transportation to arrive at the school, and the second focused on bicycle-use during recreational time. The secondary objective of the questionnaire was to determine the reasoning or motive of those who do not wear helmets, and subsequently gauge the students' knowledge on legislation around helmet-use. The questionnaire was anonymous, and students were strongly encouraged during school-allotted time to complete the survey.

The results of the questionnaire were examined by cohorts of grades - Grades 7 and 8, Grades 9 and 10, and Grades 11 and 12. For questions pertaining to frequency of commute and frequency of helmet use, results were collapsed to yield two responses - "Always/Often" and "Rarely/On Occasion/Sometimes." The duration of the commute to school was also collapsed into two responses - "Under 20 minutes" and "Over 20 minutes." Statistical tests, Chi-square test, Fisher test and Cochran-Armitage test for trend, were used to examine the difference in proportions for multiple-choice results. Descriptive statistics were used for the short-answer

question inquiring about helmet use. All analyses were performed using R statistical package (Version 3.1 for Windows).

OUR FINDINGS

Of the 257 students who responded to the email, 120 (47%) reported that they have used a bicycle as a method of transportation to the school. There was no statistical difference in the proportion of cyclists and non-cyclists by grades (Fisher test, $p = 0.79$). Of the 120 students, 100 students (83%) reported that the duration of their bike ride was less than 20 minutes. There was a trend that older students tended to take longer commutes, proportionally, than the younger students (Cochran-Armitage test for trend, $p = 0.032$). It is important to note that only 19 students (16%) reported frequent bike commutes to school ("Always/Often"); there was no difference in proportion across the grades (Fisher test, $p = 0.73$). Of the 120 student cyclists, 95 reported frequent use of bicycle helmets ("Always/Often"). Students in higher grades tended not to wear a helmet as frequently (Fisher test, $p = 0.0002$) - a reported 59% helmet use in Grades 11 and 12 compared to 96% helmet use in Grades 7 and 8. Interestingly, Grades 9 and 10 students had much higher awareness of the law in Ontario for children (aged 18 and below) mandating helmet-use (Fisher test, $p = 0.028$) - 98% awareness rate compared to 79% and 89% awareness rates for Grades 11 and 12, and Grades 7 and 8, respectively (see Table 1).

226 of the 257 (88%) students registered that they rode their bike during their recreational time. The Cochran-Armitage test detected a trend for older students to engage in recreational cycling less frequently (Cochran-Armitage Test for Trend, $p = 0.02$) - 92% of Grades 7 and 8 compared to 79% of Grades 11 and 12 reporting cycling during their recreational time. 161 recreational cyclists (63%) reported frequent use of helmets. The Grade 7 and 8 students reported a more frequent use of helmets when compared to the older grades (Fisher test, $p = 0.000007$). Additionally, 200 recreational cyclists (88%) reported they were aware of the helmet legislation in Ontario (see Table 2).

Of the 119 student cyclists who did not confirm they "always" wore their helmet, only 30 (25%) provided a reason for not wearing a helmet. For Grade 7 and 8 students, the lack of helmet use was most often attributed to absent-mindedness and the uncomfortable nature of helmets (29% for each). Grade 9 and 10 students most commonly attributed the underuse of helmets to discomfort, as did the Grade 11 and 12 students. Only 2 of the 30 (7%) students reported that they did not wear helmets as they did not want to mess their hair (see Table 3).

Table 1. Demographics of cyclists to school

	Grades 7 & 8	Grades 9 & 10	Grades 11 & 12	Chi-Square Test (*p*)	Fisher Test (*p*)	Cochran-Armitage Test for Trend (*p*)
Cyclist/Non-Cyclist				0.79	0.79	0.55
Cyclist	46 (46%)	45 (46%)	29 (51%)			
Non-Cyclist	55 (54%)	53 (54%)	28 (49%)			
Duration				0.055*	0.08	0.032*
Under 20 min	41 (89%)	39 (87%)	20 (69%)			
Over 20 min	5 (12%)	6 (13%)	9 (31%)			
Frequency of commute				0.69*	0.73	0.49*
Always/Often	9 (20%)	6 (13%)	4 (14%)			
Rarely/On Occasion/Sometimes	37 (80%)	39 (87%)	24 (86%)			
Frequency of helmet use				0.00046	0.0002	0.0001
Always/Often	44 (96%)	34 (76%)	17 (59%)			
Rarely/On Occasion/Sometimes	2 (4%)	11 (24%)	12 (41%)			
Educated of law				0.034*	0.028	0.29*
Yes	41 (89%)	44 (98%)	23 (79%)			
No	5 (11%)	1 (2%)	6 (21%)			

* Chi-square is suspect as the expected number is smaller than 5 in at least one cell.

Table 2. Demographics of recreational cyclists

	Grades 7 & 8	Grades 9 & 10	Grades 11 & 12	Chi-Square Test (*p*)	Fisher Test (*p*)	Cochran-Armitage Test for Trend (*p*)
Cyclist/Non-Cyclist				0.048	0.059	0.02
Cyclist	93 (92%)	88 (89%)	45 (79%)			
Non-Cyclist	8 (8%)	11 (11%)	12 (21%)			
Frequency of helmet use				0.000015	0.0000066	0.000021
Always/Often	82 (88%)	53 (60%)	26 (58%)			
Rarely/On Occasion/Sometimes	11 (12%)	35 (40%)	19 (42%)			
Educated of law				0.20*	0.22	0.13*
Yes	85 (91%)	80 (91%)	36 (82%)			
No	8 (9%)	8 (9%)	8 (18%)			

* Chi-square is suspect as the expected number is smaller than 5 in at least one cell.

Table 3. Reasons for not wearing a helmet - school commute

Reported Reasons	**Grades 7 & 8**	**Grades 9 & 10**	**Grades 11 & 12**
"Laziness/Negligence"	2 (29%)	0 (0%)	0 (0%)
"Forgot"	0 (0%)	2 (20%)	2 (15%)
"In a rush"	0 (0%)	2 (20%)	0 (0%)
"Uncomfortable"	2 (29%)	3 (30%)	6 (46%)
"Broken/too small/ I don't own one"	1 (14%)	0 (0%)	1 (8%)
"Messes up my hair"	0 (0%)	1 (10%)	1 (8%)
Other*	2 (14%)	2 (20%)	3 (23%)

Other includes: "I refuse", "Takes up too much space in the lockers."

88 of the eligible 115 recreational cyclists (77%) provided an explanation for not using a helmet. The most frequently reported reason for Grades 7 and 8 students was the uncomfortable nature and their absent-mindedness (26%). In the two older cohorts, students made more intentional decisions not to wear their helmet reporting their confidence in their cycling ability or the short travel distance as a reason for not wearing

a helmet - 32% for Grades 9 and 10, and 11% for Grades 11 and 12 (see Table 4).

Table 4. Reasons for not wearing a helmet - recreational cycling

Reported Reasons	Grades 7 & 8	Grades 9 & 10	Grades 11 & 12
"Laziness/Negligence"	3 (11%)	3 (9%)	3 (11%)
"Forgot"	7 (26%)	3 (9%)	1 (4%)
"In a rush"	0 (0%)	1 (3%)	1 (4%)
"Uncomfortable"	7 (26%)	6 (18%)	4 (15%)
"Broken/too small/I don't own one"	1 (4%)	3 (9%)	1 (4%)
"Messes up my hair"	0 (0%)	4 (12%)	4 (15%)
"I don't crash/I travel short distances"	5 (19%)	11 (32%)	8 (30%)
Other*	4 (15%)	3 (9%)	5 (19%)

Other includes: "I refuse", "I don't want to carry it?", "I feel more free."

DISCUSSION

With only 47% of students reporting cycling as a means of transportation to school, and only 16% of those cyclists reporting frequent reliance on cycling; the results of this survey highlight the "car-culture" of Crescent School. Most students are dropped off by their parents, with many of the older students (Grades 11 and 12) using their own vehicle to commute. The majority of the student population engage in car-pooling, with a smaller cohort using public transit. This comes as no surprise - Crescent School is an independent school which attracts the affluent families from the Toronto community, and hence, families are more likely to use vehicular transportation. Additionally, unlike schools in the public system, an independent school will accept students from geographical locations outside the district. This would infer that there are students in attendance at Crescent School whose only practical method of transportation is by car, omitting possible cyclists.

For those who do commute to school via bicycle, it seems that younger students are more likely to commute if they live a short distance from

school. The older students, on the other hand, had a larger proportion of individuals commuting to school from a greater distance. This may be a result of certain characteristics of each age group. Older students may be obliged to commute via bike if there is no vehicular option; they hence will need to travel regardless of the distance. Younger students, on the other hand, are more "looked-after" by their parents for long distance journeys; their parents will allot time in their schedules to drive them, as opposed to encouraging the long bike journey.

The high frequency of helmet use in the Grade 7 and 8 students is an encouraging statistic. It displays that a greater number of students of this age group would be wearing protective gear in the event of a crash or collision-related incident. The low frequency of helmet-wearing in the older grades are in-line with results from the international community, where the older children do not wear helmets as often as the younger children and even adults (12, 14). When coupled with the fact that a larger proportion of older students are travelling longer distances, this is an unfortunately negative finding.

The uncomfortable nature of bicycle helmets was a common reason for a lower helmet-usage across all grades. During recreational cycling, the high school students most commonly cited their confidence in their cycling abilities to prevent crashes as a reason for not wearing a helmet. The older students believed they would not be involved in an accident due to being in control, and hence did not see any value in wearing a helmet.

The awareness of helmet legislation was surprising. Students are constantly reminded of safe cycling practices, including wearing a helmet, starting at a very young age. However, as students age, the school and teachers veer away from the constant reminders - they believe the reminders to the students in their more formative years serve as a strong foundation. The statistically lower awareness in older students may call for a need to have more frequent reminders to the older group.

This study was not without limitations. Although the questionnaire was anonymous, there exists the possibility of a response bias - students may recognize that the administration of Crescent School will see the results, and hence may report their cycling habits in a more "positive" light. In

particular, younger students tend to overstate their results as they may not be so confident in the "anonymity" of the survey, as determined from group discussions with the students. Furthermore, the participation of only 62%, 53% and 32% of students in the three grade cohorts may have yielded responses that are not representative of the whole population. Furthermore, some of the statistical tests, namely the chi-square test, had cells with expected values less than 5 - although this is undesirable, the expected values were close to 5 and serve as a good approximation.

In conclusion, only a small cohort of students regularly use a bicycle to commute to school. Younger students typically travel shorter distances by bike between their home and school, while older students have to travel greater distances. The older students wear helmets less frequently than younger students, and are also not as aware of the legislation in place for helmet use. Further reminders and educational sessions regarding the importance of helmets could help to increase the helmet use of students across the grades.

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REFERENCES

[1] Baker SP, Li G, Fowler G, Dannenberg AL. Injuries to bicyclists: A national perspective. Baltimore, MD: John Hopkins University Injury Prevention Center, 1993.

[2] Friede AM, Azzara CV, Gallagher SS, Guyer B. The epidemiology of injures to bicycle riders. Pediatr Clin North Am 1985;32(1):141-51.

[3] Sacks JJ, Holmgreen P, Smith SM, Sosin DM. Bicycle-associated head injuries and deaths in the United States from 1984 through 1988. How many are preventable? JAMA 1991;266(21):3016-8.

[4] Selbst SM, Alexander D, Ruddy R. Bicycle-related injuries. Am J Dis Child 1987;141(2):140-4.

[5] Thompson RS, Rivara RP, Thompson DC. A case control study of the effectiveness of bicycle safety helmets. N Engl J Med 1989;320:1361-7.

[6] Thompson DC, Thompson RS, Rivara P, Wolf M. A case control study of the effectiveness of bicycle safety helmets in preventing facial injuries. Am J Public Health 1990;80(12):1471-4.

[7] Rivara FP, Thompson DC, Patterson M, Thompson RS. Prevention of bicycle-related injuries: helmets, education and legislation. Anna Rev Public Health 1998;19:293-318.

[8] Lee B, Schofer J, Koppelman F. Bicycle safety helmet legislation and bicycle-related non-fatal injuries in California. Accid Anal Prev 2004;37(1):93-102.

[9] Dannenberg AL, Cote TR, Kresnow MJ, Sacks JJ, Lipsitz CM, Schmidt ER. Bicycle helmet use by adults: the impact of companionship. Public Health Rep 1993;108(2):212-7.

[10] Ni H, Sacks JJ, Curtis L, Cieslak PR, Hedberg K. Evaluation of a statewide bicycle helmet law via multiple measures of helmet use. Arch Pediatr Adolesc Med 1997;151(1):59-65.

[11] Abularrage JJ, DeLuca AJ, Abularrage CJ. Effect of education and legislation on bicycle helmet use in a multiracial population. Arch Pediatr Adolesc Med 1997;151(1):41-4.

[12] Cameron M, Vulcan AP, Finch C, Newstead S. Mandatory bicycle helmet use following a decade of helmet promotion in Victoria, Australia - an evaluation. Accid Anal Prev 1994;26(3):325-7.

[13] Chow R. A pilot project of an online cross-age tutoring program: crescent school virtual learning (vLearning). Int J Adolesc Med Health 2016;28(4):451-3.

[14] Wood T, Milne P. Head injuries to pedal cyclists and the promotion of helmet use in Victoria, Australia. Accid Anal Prev 1988;20:177-85.

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Chapter 4

HELMET USE OF ADOLESCENTS IN MARKHAM, CANADA

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Bicycle crashes are the second most common sports or recreation associated cause of serious injury. While the literature suggests that wearing protective helmets can significantly decrease risks associated with bicycle - related injuries, overall helmet use remains sub-optimal. Recent research suggested that helmet wearing rates in adolescent boys are negatively correlated with age. The aim of this chapter was to determine if similar trends are observed in a co-educational high school setting. A questionnaire was circulated at Unionville High School, a co-

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ed public high school in Markham, Canada. Of the 144 participants, 27 of them were in Grade 9 or 10, and 117 of them were in Grade 11 or 12. While there was no statistical difference between helmet wearing rates in Grade 9-10 and Grade 11-12 students, overall usage rates were low (41% and 38% respectively for recreational cyclists). This trend is interesting, considering that nearly ninety percent of all students were aware that wearing a helmet while cycling is required under Ontario law. Further studies should be conducted among the young adult population to determine whether the alarming trends discovered by this study and Chow et al. continue.

INTRODUCTION

Bicycle crashes are the second most common sports or recreation associated cause of serious injury (1). One-third of all bicycle - related injuries involve head injury. Of these injuries, two-thirds require hospitalization, and up to three-quarters result in death (2-6). A study by Sacks et al. (7) indicated that forty-one percent of head injury deaths, and seventy-six percent of all head injuries related to biking accidents occur in children under 15 years old (7).

The literature strongly suggests that wearing protective helmets can significantly decrease risks associated with bicycle injuries. A case-control study by Thompson et al. (6) reported that of 99 patients presenting with severe brain injury associated with bicycle accidents, only four percent were wearing helmets at the time of their accident (6). Other studies suggest that wearing bicycle helmets can reduce the risk of head injury by 74 to 85 percent (1). A meta-analysis by Atetwell et al. computed the summary odds ratio estimate for efficacy to be 0.40 for head injury, 0.42 for brain injury, 0.53 for facial injury, and 0.27 for fatal injury (8).

Despite the proven effectiveness of helmet use in protection against bicycle injuries, overall helmet use remains sub-optimal. A nationwide survey conducted in 1990 in the United States indicated that as little as twenty percent of children and less than half of adults wear helmets while cycling (9). Researchers in Maryland (10) suggested that as little as four percent of children in certain rural areas across the state equip helmets.

A recent study by Chow et al. (11) suggested that helmet wearing rates in adolescent boys are negatively correlated with age. In students aged 13 and 14, 96% reported helmet use. However, as age progressed to 15-16 year olds and 17-18 year olds, helmet usage rates decreased to 76% and 59%, respectively (11). These findings are disturbing, and hopefully do not generalize to this age-group. The aim of this study was to determine if similar trends are observed in a co-educational high school setting.

OUR RESEARCH

A questionnaire focused on bicycle and helmet use, similar to that employed at Crescent School in Toronto (11), was circulated at Unionville High School, a co-ed public high school in Markham, Canada, with over 1,000 students (see chapter 2). The survey was anonymous, and students were strongly urged to complete the survey. There were two phases of the questionnaire - the first portion prodded about bicycle-use as a means of transportation to school, while the latter half focused on cycling use during student's recreational time.

The primary objectives were to determine the proportion of students who identify themselves as cyclists, and also the fraction of the cyclists who utilize a helmet. The secondary objectives were to discover the reasoning/motives for why students do not wear helmets, and also evaluate their knowledge of the laws pertaining to helmet-use.

Statistical analyses were similar to those carried out by Chow et al. (11). The recorded data were examined by cohorts of grades - Grades 9 and 10, and Grades 11 and 12. Questions related to frequency of commute and frequency of helmet use were collapsed into two responses - "Always/Often" and "Rarely/On Occasion/Sometimes". Two responses for duration of commute to school were used in the analysis, as responses were collapsed to "Under 20 min" and "Over 20 min". χ^2-tests were used to determine if there was a difference in proportions for questions that had pre-defined results. Descriptive statistics were utilized to display the data

from the short-answer questions. All analyses were performed using the Statistical Analysis Software (SAS Version 9.4 for Windows).

FINDINGS

The questionnaire was completed by 144 participants. Of the 144 participants, 27 of them were in Grade 9 or 10 (15 or 16 years old), and 117 of them were in Grade 11 or 12 (17 or 18 years old).

Students in Grade 9-10 and students in Grade 11-12 cycle to school in statistically equivalent proportions (p = 0.7534); 26% of Grade 9-10 students have cycled to school, compared to 23% of Grade 11-12 students. 100% and 74% of students in Grade 9-10 and Grade 11-12, respectively, reported commuting less than 20 minutes via bicycle to school. While this difference is statistically insignificant (p = 0.1306), there is a strong trend to suggest that the students in Grade 9-10 experience shorter bicycle commutes to school. None of the Grade 9-10 students and 15% of the Grade 11-12 students reported commuting via bicycle "Always/Often". Again, while this difference may not be statistically significant (p = 0.2783), there is a trend to suggest that students in Grade 9-10 cycle to school less often than their Grade 11-12 counterparts. The proportion of Grade 9-10 and Grade 11-12 students who wear helmets "Always/Often" is statistically equal (p = 0.4122); only 14% and 30% of Grade 9-10 and Grade 11-12 students respectively report consistently equipping a helmet while cycling to school. Despite this, 86% and 89% of Grade 9-10 and Grade 11-12 students, respectively, were aware that helmet use while cycling is mandatory under Ontario law (12); there was no difference noted (p = 0.8163) (see Table 10).

Grade 9-10 and Grade 11-12 students reported cycling during recreational time in equal proportions (p = 0.7143); 63% and 67% of students in these groups, respectively, cycle in their recreational time. While there is no statistical difference in helmet wearing rates between Grade 9-10 and Grade 11-12 students (p = 0.8352), proportions of reported helmet users remained low, at 41% and 38% respectively. Despite these

low rates, both Grade 9-10 students and Grade 11-12 students were relatively aware of the legalities of helmet use ($p = 0.2557$); 94% and 83% of Grade 9-10 and Grade 11-12 students, respectively, were educated about Ontario cyclist helmet requirements (see Table 2).

Table 1. Demographics of cyclists to school

	Grade 9-10	**Grade 11-12**	***p*-value**
Cyclist/Non-Cyclist			0.7534
Cyclist	7 (26%)	27 (23%)	
Non-Cyclist	20 (74%)	90 (77%)	
Duration			0.1306
Under 20 min	7 (100%)	20 (74%)	
Over 20 min	0 (0%)	7 (26%)	
Frequency of commute			0.2783
Always/Often	0 (0%)	4 (15%)	
Rarely/On Occasion/Sometimes	7 (100%)	23 (85%)	
Frequency of helmet use			0.4122
Always/Often	1 (14%)	8 (30%)	
Rarely/On Occasion/Sometimes	6 (86%)	19 (70%)	
Educated of law			0.8163
Yes	6 (86%)	24 (89%)	
No	1 (14%)	3 (11%)	

Table 2. Demographics of recreational cyclists

	Grade 9-10	**Grade 11-12**	***p*-value**
Cyclist/Non-Cyclist			0.7143
Cyclist	17 (63%)	78 (67%)	
Non-Cyclist	10 (37%)	39 (33%)	
Frequency of helmet use			0.8352
Always/Often	7 (41%)	30 (38%)	
Rarely/On Occasion/Sometimes	10 (59%)	48 (62%)	
Educated of law			0.2557
Yes	16 (94%)	65 (83%)	
No	1 (6%)	13 (17%)	

Table 3. Reasons for not wearing a helmet - school commute

Reasons	Grade 9-10	Grade 11-12
"Laziness/negligence"	1 (11%)	5 (19%)
"Inconvenience"	1 (11%)	6 (23%)
"Uncomfortable"	1 (11%)	4 (14%)
"Broken/too small/I don't own one"	1 (11%)	3 (12%)
"Messes up my hair/it looks bad"	2 (22%)	4 (14%)
"I don't crash/I travel short distances"	2 (22%)	3 (12%)
Other*	1 (11%)	1 (4%)

*Other includes: "It will get stolen", "A helmet will not protect me."

Table 4. Reasons for not wearing a helmet - recreational cycling

Reasons	Grade 9-10	Grade 11-12
"Laziness/negligence"	3 (15%)	5 (7%)
"Inconvenience"	4 (20%)	16 (20%)
"Uncomfortable"	3 (15%)	11 (15%)
"Broken/too small/I don't own one"	3 (15%)	10 (14%)
"Messes up my hair/it looks bad"	3 (15%)	11 (15%)
"I don't crash/I travel short distances"	3 (15%)	11 (15%)
Other*	1 (5%)	8 (11%)

*Other include: "My friends don't wear helmets", "I refuse", "A helmet will not protect me."

Thirty - five explanations were provided as reasons why students do not wear a helmet while commuting to school. For students in Grade 9-10, the most common reasons for not equipping a helmet were that it messes up their hair or is unfashionable (22%), or that the rider felt that they were a competent biker or travelled a short enough distance that a helmet would not be necessary (22%). Other explanations for sub-ideal helmet use while commuting to school included laziness/negligence (11%), inconvenience (11%), discomfort (11%), broken/too small/don't own a helmet (11%), and other reasons, including the belief that a helmet will be stolen while at school (11%). For Grade 11-12 students, the most common reasons to not

wear a helmet while cycling to school were inconvenience (23%) and laziness/negligence (19%). This population also justified not wearing a helmet for reasons including discomfort (14%), broken/too small/don't own a helmet (12%), it messes up their hair or is unfashionable (14%), the belief that they will not be involved in an accident or that they travel a short distance (12%), and other explanations (4%). Reasons classified as "other" included belief that helmet use does not cause physical protection (see Table 3).

Ninety - two explanations were provided to justify not wearing a helmet while bicycling during recreational time. For students in Grade 9-10, inconvenience was the most common reason against wearing a helmet during recreational cycling (20%). Other reasons include laziness/negligence (15%), discomfort (15%), broken/too small/don't own a helmet (15%), it messes up their hair or is unfashionable (15%), belief that they will not crash or that they travel short distances (15%), and other reasons, such as friends not wearing helmets (5%). Students in Grade 11-12 also refer to inconvenience as the most common reason for not wearing a helmet while cycling in their recreational time (20%). These students also provide explanations such as discomfort (15%), belief that they do not crash or travel short distances (15%), it messes up their hair or is unfashionable (15%), broken/too small/don't own a helmet (14%), laziness/negligence (7%), or other reasons (11%), such as refusal or the belief that wearing a helmet provides no physical protection (see Table 4)

DISCUSSION

This study, despite its similar design to the Chow et al. study (11), yielded rather dissimilar results. Helmet use rates among Grade 9-10 and Grade 11-12 students in this study were drastically lower than those reported by Chow et al. Only 41% of Grade 9-10 and 38% of Grade 11-12 students at Unionville High School reported wearing helmets during recreational bicycling, compared to 60% and 58% at Crescent School respectively.

However, much like the Chow et al. study, helmet use did decrease slightly from Grade 9-10 to Grade 11-12 (11).

Interestingly, helmet use rates decrease significantly when cyclists are commuting to school. Only 14% and 30% of Grade 9-10 and Grade 11-12 students respectively reported consistently equipping a helmet when cycling to school (compared to 41% and 38% use rates during recreational cycling). This might be explained by influences such as peer pressure that might be experienced in a school environment. A survey conducted in 1990 of 792 children indicated that up to one-quarter of children did not wear bicycle helmets simply because their friends did not (13).

While certain results of this study differ from that of the Chow et al. study (11), an evident consistency is that helmet use rates among adolescents do not appear to increase significantly as a result of legal requirements (12). At Unionville High School, 86% and 89% of recreational Grade 9-10 and Grade 11-12 cyclists respectively are aware of Ontario helmet use law. These numbers are surprisingly high, especially when considering that overall helmet use rates were reported to be only about forty percent.

This study was not without limitations. As the survey was optional for Unionville High School students and also a self-report survey, there existed a possibility of response bias. Furthermore, the sample size was slightly smaller than desirable for the statistical tests. As a result, the p-values yielded need to be interpreted with caution.

In conclusion, overall helmet use rates at Unionville High School were remarkably lower than those reported by Chow et al. Students in both age categories were also even less likely to equip a helmet when commuting to school, perhaps due to social influences. Remarkably, this study supports the Chow et al. study's findings that education of the law does not appear to be an effective means of promoting bicycle helmet usage to young people. It might be worthwhile to implement educational programs directed towards adolescents about the importance of using protective helmets while cycling, in order to increase overall usage rates. Further studies should be conducted among the young adult population to

determine whether the alarming trends discovered by this study and Chow et al. (12) continue.

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REFERENCES

[1] Thompson MJ, Rivara FP. Bicycle-related injuries. Am Fam Physician 2001;63:2007-14.

[2] Baker SP, Li G, Fowler G, Dannenberg AL. Injuries to bicyclists: A national perspective. Baltimore, MD: The Johns Hopkins Injury Prevention Center, 1993.

[3] Friede AM, Azzara CV, Gallagher SS, Guyer B. The epidemiology of injuries to bicycle riders. Pediatr Clin North Am 1985;32:141–51.

[4] Sacks JJ, Holmgreen P, Smith SM, Sosin DM. Bicycle-associated head injuries and deaths in the United States from 1984 through 1988. How many are preventable? JAMA 1991;266:3016–8.

[5] Selbst SM, Alexander D, Ruddy R. Bicycle-related injuries. Am J Dis Child 1987;141:140–4.

[6] Thompson RS, Rivara RP, Thompson DC. A case control study of the effectiveness of bicycle safety helmets. N Engl J Med 1989;320:1361–7.

[7] Sacks JJ, Holmgreen P, Smith SM, Sosin DM. Bicycle-associated head injuries and deaths in the United States from 1984 through 1988. How many are preventable. JAMA 1991;266(21):3016-8.

[8] Attewell RG, Glase K, McFadden M. Bicycle helmet efficacy: a meta-analysis. Accid Anal Prev 2001;33(3):345-52.

[9] Rivara FP, Thompson DC, Patterson M, Thompson RS. Prevention of bicycle-related injuries: helmets, education and legislation. Anna Rev Public Health 1998;19:293-318.

[10] Cote TR, Sacks JJ, Kresnow MJ, Lambert-Huber DA, Schmidt ER, Dannenberg AL, et al.. Bicycle helmet use among Maryland children: effect of legislation and education. Pediatrics 1992;89(6):1216-20.

[11] Chow R, Hollenberg D, Pintilie A, Midroni C, Cumner S. Helmet use of adolescent cyclists at Crescent School in Toronto, Canada. Int J Adolesc Med Health 2016 Mar 12. doi: 10.1515/ijamh-2015-0123.

[12] Bicycle safety, 2016. URL: http://www.mto.gov.on.ca/english/safety/bicycle-safety.shtml.

[13] DiGuiseppi CG, Rivara FP, Koepsell TD. Attitudes toward bicycle helmet ownership and use by school-age children. Am J Dis Child 1990;144(1):83-6.

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Chapter 5

HELMET USE OF ADOLESCENTS IN TORONTO, CANADA

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Cycling is an alternative form of transportation for adolescents when travelling to school. In this chapter we wanted to determine the helmet use of adolescents at a public high school in Toronto, Canada. Fisher Exact and χ^2 tests were used to determine if there was any difference between the helmet wearing rates of different grades. As students progressed through their grades, their helmet wearing rate declined - 83% to 71% for younger and older school cyclists, respectively; 61% and 50% respectively for younger and older recreational cyclists. Students of all

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ages were equally educated of the law, which required adolescent cyclists to use a helmet while cycling. Commonly cited reasons for disobeying the law included inconvenience, laziness, lack of comfort, and confidence in cycling activity (and hence not leading to any collisions). This study unfortunately confirms the trend we have observed, that there is a negative correlation between adolescent age and helmet use. Actions should be taken to increase student's knowledge about the law (as the proportion is still not 100%), and programs can be established to advocate and encourage safe cycling practices.

INTRODUCTION

The City of Toronto reported that biking rates continue to increase; more people are opting for their bikes over other means of transportation (1). Unfortunately, along with the increase in biking rates, the rates of cycling casualties have also skyrocketed over the years (2). According to the Canadian Automobile Association, around 7,500 bikers are seriously injured every year in Canada (3). Although bike crashes are inevitable, the head injuries sustained from these crashes can be mitigated with the use of a bike helmet.

Bike helmets have been proven to effectively protect the head; studies showed that wearing a helmet reduce the risk of head injury by 88% (4). Despite this proven benefit, bike helmet wearing rates are still low. A study conducted by Robert et al. (5) reported that of the 99% of cyclists who sustained a brain injury, only 4% wore their helmets (5). Statistics Canada stated that of those aged 12 years and older, only 34% reported wearing bike helmets all the time (6).

A study by Chow et al. (7) suggested that helmet wearing rates in adolescent boys are negatively correlated with age. Although students aged 13 and 14 years reported a high helmet use rate of 96%, this rate decreased as the ages of the boys increased, specifically to 76% and 59% for 15-16 year olds and 17-18 year olds respectively. A similar study conducted in Markham by Borean et al. noted a similar trend (8). The aim of this study was to further verify the reported negative correlation by Chow et al. (7) at another public high school in Toronto.

OUR STUDY

A questionnaire (see chapter 2) similar to the one used at Crescent School by Chow et al. (7) and at Unionville High School by Borean et al. (8) was circulated amongst students of William Lyon Mackenzie Collegiate Institute, a public high school in Toronto, Canada. The anonymous survey was posted on social media and all students attending the high school were urged to complete it. The survey was divided into two sections; the first part questioned students' about their means of transportation to school, while the latter component asked about the student's cycling use during their recreational time.

In this survey we wanted to determine the number of students who categorize themselves as cyclists as well as the proportion of these students who wear their helmets while cycling. The survey also hoped to unearth the common reasons why students chose not to wear their helmets, while also evaluating their knowledge on the laws regarding helmet use in Canada.

Statistical analyses were similar to those carried out by Chow et al. (7). The recorded data were examined by cohorts of grades - Grades 9 and 10, and Grades 11 and 12. Questions related to frequency of commute and frequency of helmet use were collapsed into two responses - "Always/Often" and "Rarely/On Occasion/Sometimes." Two responses for duration of commute to school were used in the analysis, as responses were collapsed to "Under 20 min" and "Over 20 min." Fisher Exact and χ^2-tests were used to determine if there was a difference in proportions for questions that had pre-defined results; the former was applied for questions pertaining to cycling to school while the later was employed with respect to questions touching on recreational cycling. Descriptive statistics were utilized to convey the data from the short-answer questions. All analyses were performed using the Statistical Analysis Software (SAS Version 9.4 for Windows).

OUR FINDINGS

The survey was completed by 126 people, all of which consented to the survey. Of those who completed the survey, 47 were in Grades 9 or 10 and 79 in Grades 11 or 12.

Students in Grade 9-10 and students in Grade 11-12 cycle to school in equivalent proportions (p = 0.0763); 13% of Grade 9-10 students have cycled to school, compared to 27% of Grade 11-12 students. 67% and 52% of students in Grade 9-10 and Grade 11-12, respectively, reported commuting less than 20 minutes via bicycle to school. None of the Grade 9-10 students and 14% of the Grade 11-12 students reported commuting via bicycle "Always/Often." There is only a minor difference between the proportion of Grade 9-10 and Grade 11-12 students who "Always/Often" wear their helmets (p = 0.6563); 83% and 71% of Grade 9-10 and Grade 11-12 students, respectively, report consistently utilizing a helmet while cycling to school. 83% and 76% of Grade 9-10 and Grade 11-12 students, respectively, were aware that helmet use while cycling is mandatory under Ontario law; there was no difference noted (p = 0.6563) (see Table 1).

Table 1. Demographics of cyclists to school

	Grade 9-10	**Grade 11-12**	***p*-value**
Cyclist/Non-Cyclist			0.0763
Cyclist	6 (13%)	21 (27%)	
Non-Cyclist	41 (87%)	58 (73%)	
Duration			0.6618
Under 20 min	4 (67%)	11 (52%)	
Over 20 min	2 (33%)	10 (48%)	
Frequency of commute			0.5692
Always/Often	0 (0%)	3 (14%)	
Rarely/On Occasion/Sometimes	6 (100%)	18 (86%)	
Frequency of helmet use			0.6563
Always/Often	5 (83%)	15 (71%)	
Rarely/On Occasion/Sometimes	1 (17%)	6 (29%)	
Educated of law			0.6563
Yes	5 (83%)	16 (76%)	
No	1 (17%)	5 (24%)	

Table 2. Demographics of recreational cyclists

	Grade 9-10	**Grade 11-12**	***p*-value**
Cyclist/Non-Cyclist			0.2146
Cyclist	38 (81%)	56 (71%)	
Non-Cyclist	9 (19%)	23 (29%)	
Frequency of helmet use			0.3149
Always/Often	23 (61%)	28 (50%)	
Rarely/On Occasion/Sometimes	15 (39%)	28 (50%)	
Educated of law			0.4975
Yes	32 (84%)	44 (79%)	
No	6 (16%)	12 (21%)	

Table 3. Reasons for not wearing a helmet - school commute

Reasons	**Grade 9-10**	**Grade 11-12**
"Inconvenience"	1 (33%)	0 (0%)
"Uncomfortable"	1 (33%)	2 (33%)
"Messes up my hair/it looks bad"	0 (0%)	3 (50%)
"I don't crash/I travel short distances"	1 (33%)	1 (17%)

Table 4. Reasons for not wearing a helmet - recreational cycling

Reasons	**Grade 9-10**	**Grade 11-12**
"Laziness/negligence"	1 (17%)	1 (17%)
"Inconvenience"	0 (0%)	1 (17%)
"Uncomfortable"	1 (17%)	0 (0%)
"Broken/too small/I don't own one"	1 (17%)	0 (0%)
"Messes up my hair/it looks bad"	0 (0%)	0 (0%)
"I don't crash/I travel short distances"	3 (50%)	4 (67%)

Grade 9-10 and Grade 11-12 students reported cycling during their recreational time in equal proportions (p = 0.2146); 81% and 71% of students in these groups, respectively, cycle in their recreational time. There was no difference among the different age groups in terms of helmet wearing rates (p = 0.3149), where Grade 9-10 students wore their helmets 61% of the time and Grade 11-12 students wore it 50% of the time. Despite these low rates, both Grade 9-10 students and Grade 11-12 students were equally aware of the legalities of helmet use (p = 0.4975); 84% and 79% of

Grade 9-10 and Grade 11-12 students, respectively, were educated about Ontario cyclist helmet requirements (see Table 2).

There were a total of nine responses that explained why students opted against wearing their helmet to school. For the younger students in Grades 9-10, there were three answers given; the helmet was inconvenient, it was uncomfortable and the belief that they will not be involved in an accident or that they travel a short distance. For Grade 11-12 students, the most popular response was that it messes up their hair (50%), the helmet is uncomfortable (33%) and the belief that they will not be involved in an accident or that they travel a short distance (17%) (see Table 3).

Twelve explanations were provided to justify not wearing a helmet while bicycling during recreational time. Students in Grade 9-10 had four different reasons; 50% of students said they wouldn't crash or that they were travelling a short distance, 17% said they were lazy, 17% thought helmets were uncomfortable and 17% of students did not own a helmet. For students in Grade 11-12, the most popular reason was that the helmets mess up their hair (67%), they are too lazy (17%) and that it was inconvenient (17%) (see Table 4).

DISCUSSION

The results of this study were compared to those yielded by Chow et al. (7), which showed that students at William Lyon Mackenzie Collegiate Institute wear their bike helmets more frequently than those at both Crescent School and Unionville High School. While 83% of Grade 9-10 and 71% of Grade 11-12 students at William Lyon Mackenzie Collegiate Institute wore their helmets during their commute to school, only 60% and 58% of the same age groups respectively wore their helmets at Crescent School. There was a drastic difference in the percentage of helmet wearers at William Lyon Mackenzie Collegiate Institute while compared to Unionville High School. 41% of Grade 9-10 and 38% of Grade 11-12 students wore their helmets at that school. This drastic difference could be a result of the distance that the students were travelling, the social

pressures in both environments as well as their confidence in their riding abilities. Despite these differences, the trend proposed by Chow et al. (7) that was seen in Borean et al. can also be observed here; as helmet use did decrease as students got older.

There was also another notable trend: students were more inclined to wear their helmets during recreational cycling as opposed to biking to school. Only 61% and 50% of Grade 9-10 and Grade 11-12 students, respectively, report wearing their helmet during recreational cycling, while 83% and 71% of the same age groups wear their helmet while biking to school. This decline in helmet-wearing rate could be a result of the shorter commute time during recreational cycling.

This study verified that the majority of students are aware of the Ontario legislation regarding bicycle helmet laws. 83% of those in Grade 9-10 and 76% of those in Grade 11-12 are aware of the law surrounding bicycle helmet safety, according to this study. These findings are in line with the studies conducted by Chow et al. and as Borean et al. (7, 8). Although most students are knowledgeable about this obligation, students still persist to not using their helmets.

This study was not without limitations. The small sample size, particularly for the first portion of the survey which queried about commutes to school, only allowed for trends to be discovered. No statistically significant data relative to duration, frequency of commute and frequency of helmet use, although the raw proportions would suggest otherwise. Future studies can be conducted with larger sample sizes to determine whether these trends matriculate into significant differences. Additionally, as with any survey, there exists the possibility of a sampling/response bias.

Overall, bicycle helmet rates at William Lyon Mackenzie Collegiate Institute were significantly higher than those reported by Chow et al. at Crescent School (7) and Borean et al. at Unionville High School (8). Students in both age groups were less likely to wear their helmet during recreational cycling. In addition, this study displays that students are quite knowledgeable about the laws surrounding bicycle safety, despite the lack of its obedience. To improve the helmet wearing rates among these youth,

an educational program may be implemented, educating them about the importance of wearing the helmet and the benefits that may be reaped. Further studies should be conducted to determine whether the alarming trend unearthed by Chow et al. and verified in this study and Borean et al. continues among the young adult population.

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REFERENCES

[1] Statistics: Reports, studies and plans. Cycling in City of Toronto. URL: http://www1.toronto.ca/wps/portal/contentonly?vgnextoid=caa5970aa08c1410VgnVCM10000071d60f89RCRD.

[2] Cycling accidents facts and figures. URL: http://www.rospa.com/road-safety/advice/pedal-cyclists/facts-figures/.

[3] CAA bike safety. URL: http://bikesafety.caa.ca/cyclists/bicycle-statistics.php.

[4] Three benefits of wearing a bike helmet. Cyclist at law. URL: http://www.cyclistatlaw.com/blog/3-benefits-of-wearing-a-bike-helmet/.

[5] 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.

[6] Bicycle helmet use 2009. URL: http://www.statcan.gc.ca/pub/82-625-x/2010002/article/11274-eng.htm.

[7] Chow R, Hollenberg D, Pintilie A, Midroni C, Cumner S. Helmet use of adolescent cyclists at Crescent School in Toronto, Canada. Int J Adolesc Med Health 2016 Mar 12. doi: 10.1515/ijamh-2015-0123.

[8] Borean M, Ho S, Hollenberg D, Anpalagan T, Rzepka A, Viehweger J, et al. Helmet use of adolescents in Markham, Canada. Int J Adolesc Med Health 2017, in press.

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Chapter 6

HELMET USE OF ADOLESCENTS AT DE LA SALLE COLLEGE OAKLANDS IN TORONTO, CANADA

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It has been observed that age was negatively correlated with helmet use amongst adolescent boys at a high school in Toronto. The purpose of this chapter was to determine whether the observed trends prevail amongst adolescent boys and girls in a private high school, also in Toronto. A similar questionnaire was developed to determine helmet use, knowledge about bicycle laws, and also reasons for why cyclists choose not to wear

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helmets. Statistical tests (Fisher Exact and χ^2 tests) were employed to determine if there were any differences in response between Grade 7 and 8, Grade 9 and 10, and Grade 11 and 12. The results showed that helmet use similarly declined with age - 80% to 63% to 55% amongst school cyclists, and 74% to 66% and 55% amongst recreational cyclists. However, all age groups were equally knowledgeable about the law mandating helmet use. It is disappointing that the trend reported by Chow et al. was similarly noticed in another private high school amongst both adolescent boys and adolescent girls. In an attempt to increase helmet use, advocacy and educational programs can be established to articulate the benefits of helmet use (beyond simply adhering to the law).

INTRODUCTION

Cycling is a popular transportation and recreational option. However, injuries resulting from cycling are incredibly common. The Canadian Association of Emergency Physicians reports that cycling-related injuries are becoming increasingly more common at Emergency Department presentations, with severity ranging from minor to life-threatening (1).

Provincial reviews of cycling incidents within Ontario strongly suggest that the vast majority of bicycle injuries are preventable. A recent review of bicycle death in Ontario compiled data that supported the conclusion that all of the 129 deaths under review were preventable (2). Other literature proposes that cycling deaths and injuries are far more likely to occur in individuals who are not wearing helmets – estimates indicate that cyclists whose cause of death included a head injury were three times more likely to not be wearing a helmet (3-4).

In spite of the proven safety benefits associated with helmet usage, overall helmet usage continues to be reported at alarmingly low rates. Existing literature reports overall helmet use rates in Ontario being no higher than 44% (5-7). Three studies carried out at high schools in Ontario, Canada indicate a negative correlation between helmet use rate and age in young adolescents. Chow et al. (8) reported an 88% helmet use rate among Grade 7-8 students, which drastically declined to just 60% and 58% in Grade 9-10 and Grade 11-12 students respectively. A study by Borean et al. (9) highlighted a similar trend – only 41% of Grade 9-10 students and

38% of Grade 11-12 students reported frequent helmet use. Similarly, Anpalagan et al. (10) reported that 61% and 50% of Grade 9-10 and Grade 11-12 students used helmets.

Given the severity of bicycle injury, these trends among high school students are disturbing, and hopefully not generalizable. A similar study to those at other Ontario high schools (8-10) was employed to survey students at De La Salle College "Oaklands," a private coeducational school in Toronto, Canada, in an attempt to validate the observed trend.

OUR STUDY

The survey used by Chow et al. (8) was circulated to students at De La Salle College "Oaklands" by the school administration (see chapter 2. The primary objective was to determine the bicycle and helmet use of adolescents (Grades 7 through 12) for their commute to school, and during their recreational time. The secondary objective was to collect the reasons why adolescents do not use helmets when cycling. The survey was advertised as anonymous, so that students could respond as honestly as possible.

Responses were analyzed according to three age groups - Grade 7 to 8, Grade 9 to 10 and Grade 11 to 12 students. Descriptive statistics were used to report the secondary objective. Frequency of commute and frequency of helmet use was collapsed into two answers - Always/Often and Rarely/On Occasion/Sometimes. The duration of commute was also compiled into two responses - Under 20 minutes and Over 20 minutes. Fisher Exact tests were used to determine if there were any differences, proportionally, in responses between the three cohorts. P-values less than 0.05 were considered statistically significant; all analyses were conducted using the Statistical Analysis Software (SAS Version 9.4 for Windows).

FINDINGS

The survey was completed by 234 consenting students from De La Salle College. Of these students, 37 (16%) of them were in Grade 7-8, 71 (31%) of them were in Grade 9-10, and 126 (54%) of them were in Grade 11-12.

Students of all age groups bicycle to school at relatively low rates - 14% of Grade 7-8 students, 11% of Grade 9-10 students, and 16% of Grade 11-12 students report ever cycling to school (p = 0.7101). All cohorts experience similar commute times to school (p = 0.1340); 80%, 88%, and 50% of Grade 7-8, Grade 9-10, and Grade 11-12 students, respectively, travel less than 20 minutes by bicycle to school. There is a statistically significant decline in frequency of commute from the youngest to the oldest cohorts (p = 0.0002); while 80% of Grade 7-8 students who have ever cycled to school reported doing so Always/Often, only 25% of Grade 9-10 students and none of the Grade 11-12 students report Always/Often cycling to school. 80% of Grade 7-8 students, 63% of Grade 9-10 students, and 55% of Grade 11-12 students report Always/Often wearing a helmet. While this difference is statistically insignificant (p = 0.7002), perhaps due to a relatively small Grade 7-8 sample size, there seems to be a trend suggesting that helmet use decreases with age. Despite these low rates, all age groups seem to be well-educated about Ontario law; 80%, 88%, and 70% of Grade 7-8, Grade 9-10, and Grade 11-12 students respectively were aware about local legalities of helmet use. No difference was noted (p = 0.8437) (see Table 1).

Bicycle use in recreational time is statistically equivalent proportions (p = 0.4188); 73%, 82%, and 83% of Grade 7-8, Grade 9-10, and Grade 11-12 students report using bicycles in their recreational time. While there is no statistical difference in helmet wearing rates for recreational cycling among the three cohorts, there is another strong trend to suggest that helmet use decreases with age; while 74% of Grade 7-8 students report wearing a helmet while cycling for recreational purposes, only 66% and 55% of Grade 9-10 and Grade 11-12 students report same, respectively. Again, no difference was noted (p = 0.2154) among recreational cyclists in terms of education of the law; 63%, 78%, and 79% of Grade 7-8, Grade 9-

10, and Grade 11-12 students respectively were aware of Ontario helmet legislation (see Table 2).

Table 1. Demographics of cyclists to school

	Grade 7 and 8	**Grade 9 and 10**	**Grade 11 and 12**	***p*-value**
Cyclist/Non-Cyclist				0.7101
Cyclist	5 (14%)	8 (11%)	20 (16%)	
Non-Cyclist	32 (85%)	63 (89%)	106 (84%)	
Duration				0.1340
Under 20 min	4 (80%)	7 (88%)	10 (50%)	
Over 20 min	1 (20%)	1 (13%)	10 (50%)	
Frequency of commute				0.0002
Always/Often	4 (80%)	2 (25%)	0 (0%)	
Rarely/On Occasion/Sometimes	1 (20%)	6 (75%)	20 (100%)	
Frequency of helmet use				0.7002
Always/Often	4 (80%)	5 (63%)	11 (55%)	
Rarely/On Occasion/Sometimes	1 (20%)	3 (38%)	9 (45%)	
Educated of Law				0.8437
Yes	4 (80%)	7 (88%)	14 (70%)	
No	1 (20%)	1 (13%)	6 (30%)	

Table 2. Demographics of recreational cyclists

	Grade 7 and 8	**Grade 9 and 10**	**Grade 11 and 12**	***p*-value**
Cyclist/Non-Cyclist				0.4188
Cyclist	27 (73%)	58 (82%)	104 (83%)	
Non-Cyclist	10 (27%)	13 (18%)	22 (17%)	
Frequency of helmet use				0.1283
Always/Often	20 (74%)	38 (66%)	57 (55%)	
Rarely/On Occasion/ Sometimes	7 (26%)	20 (34%)	47 (45%)	
Educated of Law				0.2154
Yes	17 (63%)	45 (78%)	82 (79%)	
No	10 (37%)	13 (22%)	22 (21%)	

Eighteen explanations were provided by students to justify not wearing a helmet while cycling to school. For Grade 7-8 students, the only explanation provided was the belief that they will not be involved in an accident or that they travel short distances (100%). For Grade 9-10 students, laziness or negligence accounted for half of the explanations (50%), while discomfort associated with helmet use accounted for the other half (50%). For the Grade 11-12 group, the most common reason for not wearing a helmet to school was belief that they would not be involved in a crash or that they travel short distances (36%). Other common reasons in this cohort included laziness or negligence (29%), and feeling discomfort when wearing a helmet (21%). Alternate explanations provided by Grade 11-12 students included the inconvenience of helmet use (7%) and that it is unfashionable (7%) (see Table 3).

Eighty-one explanations were provided by students regarding why they do not wear helmets during recreational bicycling. For Grade 7-8 students, the most common reason was the belief that they would not crash or that they travel short distances (50%), followed by inconvenience (17%), discomfort (17%), and not owning a helmet (17%). Grade 9-10 students cite laziness or negligence (22%), inconvenience (22%), and discomfort (22%) as the main reasons for not using a helmet during recreational cycling. Further explanations within this cohort included citing helmets as messing up their hair or being unfashionable (17%), the belief that they would not be involved in a bicycle accident or that they travel short distances (7%), and other explanations (14%), including the feeling that helmets are unnecessary or that their friends do not wear helmets. Grade 11-12 students reported the self-belief that they would not crash or that they have short travel times as the major reason for not wearing a helmet during recreational cycling (32%). Other reasons for failure to use a helmet within the oldest cohort included laziness or negligence (14%), inconvenience (14%), discomfort (14%), not owning a helmet (11%), feeling like helmets are unfashionable or mess up their hair (11%), and other reasons (5%), including peer pressure (see Table 4).

Table 3. Reasons for not wearing a helmet - school commute

Reasons	Grade 7-8	Grade 9-10	Grade 11-12
"Laziness/negligence"	0 (0%)	1 (50%)	4 (29%)
"Inconvenience"	0 (0%)	0 (0%)	1 (7%)
"Uncomfortable"	0 (0%)	1 (50%)	3 (21%)
"Messes up my hair/it looks bad"	0 (0%)	0 (0%)	1 (7%)
"I don't crash/I travel short distances"	2 (100%)	0 (0%)	5 (36%)

Table 4. Reasons for not wearing a helmet - recreational cycling

Reasons	Grade 7-8	Grade 9-10	Grade 11-12
"Laziness/negligence"	0 (0%)	4 (22%)	8 (14%)
"Inconvenience"	1 (17%)	4 (22%)	8 (14%)
"Uncomfortable"	1 (17%)	4 (22%)	8 (14%)
"I don't own one"	1 (17%)	0 (0%)	6 (11%)
"Messes up my hair/it looks bad"	0 (0%)	3 (17%)	6 (11%)
"I don't crash/I travel short distances"	3 (50%)	1 (7%)	18 (32%)
Other*	0 (0%)	2 (14%)	3 (5%)

*Other includes: "Not necessary," "Not cool."

DISCUSSION

This study yielded very similar to those reported by Chow et al. at Crescent School (8). Overall helmet use rates at De La Salle College were incredibly similar to those at Crescent School at all age groups (74% vs 88% for Grade 7-8, 66% vs 60% for Grade 9-10, and 55% vs 58% for Grade 11-12). Both of these studies also presented noticeably higher helmet use rates than those reported by Borean et al. (9) and Anpalagan et al. (10) in similar high school environments. These findings are encouraging; however, the strong negative association between helmet use and age as reported in previous high school studies (8-10) seems to be supported by the findings of this study, and is ultimately concerning.

Another consistency between this study and previous studies (8-10) is the high rate of knowledge of legislation regarding bicycle helmets. Almost 80% of all respondents were educated of Ontario bicycle law, but

helmet use remained suboptimal. These findings continue to suggest that other proactive approaches to bicycle safety might be necessary to supplement existing legislation to improve the current sub-optimal helmet use rates in young adolescents.

Interestingly, the predominant reason for not wearing a helmet is the rider's belief that he or she will not fall or that they travel short enough distances. This is especially true when considering the Grade 11-12 cohort. It is likely that this trend is influenced by unreasonable confidence in the rider's own bicycling ability. Nonetheless, bicycle crashes and injuries are common (1-4), and even skilled riders are at risk for accidents. Education on bicycle safety should include informing riders that accidents can be caused by uncontrollable circumstances (slippery roads, cars, other riders, etc.); a helmet is an effective protective equipment that can hopefully mitigate severe damages.

This study was not without limitations. As the survey was optional for De La Salle College students and also a self-report survey, response bias is possible. Furthermore, the sample size was slightly smaller than desirable (especially for the Grade 7-8 student population) for the statistical tests. As a result, the p-values yielded need to be interpreted with caution.

In conclusion, overall helmet use rates at De La Salle College were similar to those reported by Chow et al. at Crescent School (8), and higher than those reported in similar studies by Borean et al. and Anpalagan et al. (9-10). However, helmet use rates remain suboptimal. The results of this study also supported the trend that helmet use in young adolescents decreases with age. This may be influenced strongly by older students' increased confidence in their personal cycling abilities. While legislation may help to promote bicycle helmet wearing among youths, low overall usage rates suggest that additional educational programs might be needed to continue to address this issue. Further studies should be conducted outside of Ontario to see if the trends noted at Ontario high schools (8-10) continue.

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REFERENCES

[1] Letovsky E, Rowe B, Friedman S, Snider C, Sullivan E. Improving bicycle safety in Canada. CJEM 2015;17(3):323-7.

[2] Office of the Chief Coroner for Ontario. Cycling death review: A review of all accidental cycling deaths in Ontario from January 1st, 2006 to December 31st, 2010. Toronto, ON: OCC, 2012.

[3] Persaud N, Coleman E, Zwolakowski D, Lauwers B, Cass D. Nonuse of bicycle helmets and risk of fatal head injury: a proportional mortality, case-control study. CMAJ 2012;184(17):E921-3.

[4] Thompson RS, Rivara RP, Thompson DC. A case control study of the effectiveness of bicycle safety helmets. N Engl J Med 1989;320:1361–7.

[5] Viehweger J, Borean M, Tang M, Hollenberg D, Anpalagan T, Rzepka A, et al. Helmet use of young adults in St. Catherines, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[6] Anpalagan T, Hollenberg D, Borean M, Rzepka A, Chow R. Helmet use of young adults in London, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[7] Anpalagan T, Duarte N, Borean M, Anpalagan J, Camilleri R, Hollenberg D, et al. Helmet use of young adults in Waterloo, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[8] Chow R, Hollenberg D, Pintilie A, Midroni C, Cumner S. Helmet use of adolescent cyclists at Crescent School in Toronto, Canada. Int J Adolesc Med Health 2016 Mar 12. Doi: 10.1515/ijamh-2015-0123.

[9] Borean M, Ho S, Hollenberg D, Anpalagan T, Rzepka A, Viehweger J, et al. Helmet use of adolescents in Markham, Canada. Int J Adolesc Med Health 2017;in press.

[10] Anpalagan T, Borean M, Chen L, Viehweger J, Hollenberg D, Rzepka A, et al. Helmet use of adolescents in Toronto, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

SECTION THREE: HELMET USE OF YOUNG ADULTS IN THE CANADIAN PROVINCE OF ONTARIO

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Chapter 7

HELMET USE OF YOUNG ADULTS IN LONDON, CANADA

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It has been reported that helmet-wearing rate in adolescent boys decrease with increasing age. This trend is alarming and worrisome, and it would be interesting to see whether such a trend continues in young adults. The purpose of this chapter was to determine the helmet-wearing rate of young adults, and the reasons why certain riders ride without helmets. An online questionnaire, inquiring about bicycle and helmet use, was developed, and circulated to young adults in London, Ontario, Canada. The results of the questionnaire were examined by cohorts of age – ages 19 years old and below, ages 20 to 22 years old, and 23 years old and above. Chi-square (χ^2) tests were used to examine the difference in proportions for multiple-choice results. Descriptive statistics were utilized for the short-answer question inquiring about helmet use. Of the 477 participants, 257 were 19 years old or younger, 199 were between the ages of 20 years old and 22 years old, and 21 were 23 years old or older.

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The 46% helmet use across young adults was in line with earlier research; the young adults had lower helmet-wearing rates than the oldest adolescents, which had a 59% rate. During recreational cycling, the older cohorts reported higher rates of helmet use than the younger cohorts, even though all cohorts equally acknowledged that helmets are safe preventative tools.

INTRODUCTION

One-third of bicycle injuries treated in emergency rooms in the United States are head injuries, of which two-thirds leads to hospitalization and three-fourths of cases conclude in death (1-5). Thompson et al. (5) is one of multiple studies in the literature that cites helmets can reduce the risk of head injury. Other studies have also found that helmets can serve as protective devices against a variety of serious facial injuries (6).

Although helmets have been proven to be effective protective devices, the percentage of people using them remain low. In 1990, a national United States survey showed that less than 20% of children and less than 50% of adults used helmets during their bicycle ride (7). Researchers from Howard Co, MD, USA observed helmet use of 47% (8), a study in Oregon, USA noted helmet use by 49% of the sample population, while another paper from Victoria (9), Australia documented helmet-wearing rates of 75% (10).

A study by Chow et al. (11) reported lower helmet-wearing rate in adolescent boys as they age. Younger adolescent boys (Grade 7 and 8 students, 13- and 14-year-old) had high usage of 96%, while progressively older boys had 76% (Grade 9 and 10 students, 15- and 16-year-old) and 59% (Grade 11 and 12 students, 17- and 18-year-old) helmet-wearing rate (11).

This trend is alarming and worrisome, and it would be interesting to see whether such a trend continues in young adults. The purpose of this chapter was to determine the helmet-wearing rate of young adults, and the reasons that certain riders do not wear helmets.

OUR RESEARCH

A questionnaire modeled after that of Chow et al. (11) was developed (see chapter 2). It was circulated to young adults in London, Ontario, Canada. The primary objectives of the survey were to determine 1) the percentage of cyclists at the institution and 2) the percentage of cyclists who wear a helmet during their bicycle commute to university and during their recreational time. The secondary objective of the questionnaire was to determine the reasoning for those who do not wear helmets. The questionnaire was anonymous, and optional – participants could skip questions they felt uncomfortable answering.

The results of the questionnaire were examined by cohorts of age – ages 19 years old and below, ages 20 to 22 years old, and 23 years old and above. For questions relating to frequency of commute and frequency of helmet use, results were collapsed to yield two responses - "Always/Often" and "Rarely/On Occasion/Sometimes". The duration of the commute to university was also collapsed into two responses - "Under 20 minutes" and "Over 20 minutes". Chi-square (χ^2) tests were used to examine the difference in proportions for multiple-choice results. Descriptive statistics were used for the short-answer question inquiring about helmet use. *P*-values less than 0.05 were deemed statistically significant. All analyses were performed using Statistical Analysis Software (SAS Version 9.4 for Windows).

OUR FINDINGS

The questionnaire was completed by 479 participants. After two participants withdrew consent, there existed 477 eligible responses. Of the 477 participants, 257 were 19 years old or younger, 199 were between the ages of 20 years old and 22 years old, and 21 were 23 years old or older.

Table 1. Demographics of cyclists to university

	≤ 19 years old	**20-22 years old**	**≥ 23 years old**	***p*-value**
Cyclist/Non-Cyclist				0.0002
Cyclist	63 (25%)	78 (39%)	12 (57%)	
Non-Cyclist	194 (75%)	121 (61%)	9 (43%)	
Duration				0.1594
Under 20 min	45 (71%)	64 (82%)	11 (92%)	
Over 20 min	18 (29%)	14 (18%)	1 (8%)	
Frequency of commute				0.1568
Always/Often	14 (22%)	29 (37%)	4 (33%)	
Rarely/On Occasion/Sometimes	49 (78%)	49 (63%)	8 (66%)	
Frequency of helmet use				0.1861
Always/Often	24 (38%)	38 (49%)	8 (66%)	
Rarely/On Occasion/Sometimes	39 (62%)	40 (51%)	4 (33%)	
Is it safer to wear a helmet?				0.0034
Yes	58 (92%)	77 (99%)	9 (75%)	
No	5 (8%)	1 (1%)	3 (25%)	

Table 2. Demographics of recreational cyclists

	≤ 19 years old	**20-22 years old**	**≥ 23 years old**	***p*-value**
Cyclist/Non-Cyclist				<0.0001
Cyclist	171 (67%)	98 (49%)	19 (90%)	
Non-Cyclist	86 (33%)	101 (51%)	2 (10%)	
Frequency of helmet use				0.0366
Always/Often	75 (44%)	55 (56%)	13 (68%)	
Rarely/On Occasion/Sometimes	96 (56%)	43 (44%)	6 (32%)	
Is it safer to wear a helmet?				0.0918
Yes	164 (96%)	97 (99%)	17 (89%)	
No	7 (4%)	1 (1%)	2 (11%)	

A much smaller proportion of adults aged 19 years and below cycle to school, when compared to the other two age cohorts ($p = 0.0002$); 25% of people aged 19 and below have cycled to school, while 39% and 57% of individuals aged 20-22 years old and 23 years or above cycled to university, respectively. 71%, 82% and 92% of people aged 19 and below, 20-22 years, and 23 years and above, respectively, require less than 20 minutes to cycle to university. The same groups often or always cycle to university at a rate of 22%, 37% and 33%. Always/often helmet use did not differ across the age cohorts ($p = 0.1861$); the overall helmet use was 46% across all age groups, with those 19 and below registering 38%, those between 20 and 22 years old notching 49%, and 66% use being boasted by participants 23 years and older. Interestingly, a substantially larger proportion of cyclists aged 23 years and older feel that it is not safer to wear a helmet ($p = 0.0034$); 25% as opposed to 8% and 1% for people aged 19 years and less, and individuals aged 20 to 22 years old, respectively (see Table 1).

A very larger portion of folks aged 23 years and older cycle during their recreational time ($p < 0.0001$) – 90%, as opposed to 49% of people aged 20 to 22 years old and 67% of individuals aged 19 years old and younger. Older age cohorts tend to use helmets more often than younger-aged cohorts ($p = 0.0366$); participants age 23 years and older use helmets always/often 68% of the time, 20-22 years old 56% of time and people aged 19 and less 44% of the time. All age stratifications acknowledge that it is safer to wear a helmet ($p = 0.0918$) – 96%, 99% and 89% report they know it is safer to wear a helmet, for those aged below 19, between 20 and 22, and older than 23 years old, respectively (see Table 2).

Ninety-two explanations were provided as reasons why young adults do not wear helmets to school. For individuals less than 19 years old, the predominant reasons for not wearing a helmet were self-belief that they would not crash (35%) and not wanting to carry around the helmet from class to class (32%). Other reasons in this cohort included it not being fashionable (15%), messing up the hair (12%), that they do not have one (3%) and other reasons (3%). For the age range of 20 to 22 years old, the

primary reason was that they did not want to carry their helmet between classes (33%), followed by the fact they don't have one (19%), they believe they would not crash (17%), it's not fashionable (17%), it messes up their hair (8%) and another reason (6%). In the oldest cohort (ages 23 years and older), 29% of people did not wear a helmet because it messes up their hair, 29% self-justify by their belief they would not crash, and 43% provided an alternative reason. Other reasons included the fact it was warmer to wear a hat than a helmet in the winter, it is cooler in the summer not to wear a helmet, and that a helmet is uncomfortable (see Table 3).

Table 3. Reasons for not wearing a helmet - school commute

Reasons	≤ 19 years old	20-22 years old	≥ 23 years old
"Not fashionable"	5 (15%)	8 (17%)	0 (0%)
"Don't want to carry it around from class to class"	11 (32%)	16 (33%)	0 (0%)
"Messes up my hair"	4 (12%)	4 (8%)	2 (29%)
"Do not have one"	1 (3%)	9 (19%)	0 (0%)
"I'm a great rider, I don't crash"	12 (35%)	8 (17%)	2 (29%)
Other*	1 (3%)	3 (6%)	3 (43%)

* Other: "Wearing a hat is warmer in the winter", "it's cooler in the summer not to wear one", "uncomfortable".

One hundred and twenty five reasons were provided by recreational cyclists to justify why they do not always wear helmets. 60% and 40% of those over the age of 23 years old concluded that helmets were not fashionable, and that they were commuting a short distance, respectively. In participants aged 20 to 22 years old, 23% cited short distance as a reason for not wearing a helmet, followed by their belief they are a great rider (20%), it was unfashionable (17%), they do not have one (17%), other reasons (13%) or that it was uncomfortable (10%). Amongst the participants 19 years and younger, the primary reasons were short distance (24%) and belief that they would not crash (21%). Secondary listed reasons included the fact it was unfashionable (17%), it was uncomfortable (15%),

they did not have one (15%) and other (7%), including it not being accommodating to the weather and that they were too lazy to grab one (see Table 4).

Table 4. Reasons for not wearing a helmet - recreational cycling

Reasons	≤ 19 years old	20-22 years old	≥ 23 years old
"Don't have one"	14 (15%)	5 (17%)	0 (0%)
"I'm a good rider, I don't need it"	19 (21%)	6 (20%)	0 (0%)
"Not fashionable"	15 (17%)	5 (17%)	3 (60%)
"Uncomfortable"	14 (15%)	3 (10%)	0 (0%)
"Short distance"	22 (24%)	7 (23%)	2 (40%)
Other*	6 (7%)	4 (13%)	0 (0%)

* Other: "Wearing a hat is warmer in the winter", "it's cooler in the summer not to wear one", "lazy".

DISCUSSION

This study accrued substantially more participants than another similar questionnaire employed and published by Chow et al. (11), querying about helmet use in adolescent boys in Toronto, Canada. The 46% helmet use was in line with the trend noted by Chow et al. (11); the young adults had lower helmet-wearing rates than the oldest adolescents, which had a 59% rate.

A larger proportion of older-age participants need less than 20 minutes to commute to university by bike, which is consistent with the much larger proportion of older-aged participants who utilize the bicycle to commute. The shorter commute time is more convenient for them to use the bicycle as a vehicle of transportation.

All age cohorts acknowledge that it is safer to wear a helmet, but the helmet use differs between the cohorts. However, the older cohort had a higher frequency of helmet-wearing. As noted by the reasons for not wearing helmets, a larger majority of the younger cohort believe they are

extremely good riders and will not crash. The lower frequency amongst the lower cohort seems to be a result of their confidence in their cycling abilities.

The study was not without limitations. As with any questionnaire, there exists a possibility of response bias – participants may answer questions in a manner to give a more "positive" light. Even though the questionnaire was anonymous, this effect is inevitable. Furthermore, the χ^2-test had some cells with expected values of less than 5 – although it is suboptimal, it simply required greater scrutinization of *p*-values produced.

In conclusion, young adults had a lower helmet-wearing rate than adolescent boys as noted by Chow et al. (11). During recreational cycling, the older cohorts reported higher rates of helmet use than the younger cohorts, even though all cohorts equally acknowledged that helmets are safe preventative tools. Future studies should be conducted to determine whether these results are also noted at other institutions around the world. A Bicycle Safety and Awareness Club should also be established for the local community, in hopes to educate and advocate for safer biking practices.

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REFERENCES

[1] Baker SP, Li G, Fowler G, Dannenberg AL. Injuries to bicyclists: A national perspective. Baltimore, MD: John Hopkins Univ Injury Prev Cent, 1993.

[2] Friede AM, Azzara CV, Gallagher SS, Guyer B. The epidemiology of injures to bicycle riders. Pediatr Clin North Am 1985;32(1):141-51.

[3] Sacks JJ, Holmgreen P, Smith SM, Sosin DM. Bicycle-associated head injuries and deaths in the United States from 1984 through 1988. How many are preventable? JAMA 1991;266(21):3016-8.

[4] Selbst SM, Alexander D, Ruddy R. Bicycle-related injuries. Am J Dis Child 1987;141(2):140-4.

[5] Thompson RS, Rivara RP, Thompson DC. A case control study of the effectiveness of bicycle safety helmets. N Engl J Med 1989;320:1361-7.

[6] Thompson DC, Thompson RS, Rivara P, Wolf M. A case control study of the effectiveness of bicycle safety helmets in preventing facial injuries. Am J Public Health 1990;80(12):1471-4.

[7] Rivara FP, Thompson DC, Patterson M, Thompson RS. Prevention of bicycle-related injuries: helmets, education and legislation. Anna Rev Public Health 1998;19:293-318.

[8] Dannenberg AL, Cote TR, Kresnow MJ, Sacks JJ, Lipsitz CM, Schmidt ER. Bicycle helmet use by adults: the impact of companionship. Public Health Rep 1993;108:212-7.

[9] Ni H, Sacks JJ, Curtis L, Cieslak PR, Hedberg K. Evaluation of a statewide bicycle helmet law via multiple measures of helmet use. Arch Pediatr Adolesc Med 1997;151:59-65.

[10] Cameron M, Vulcan AP, Finch C, Newstead S. Mandatory bicycle use following a decade of helmet promotion in Victoria, Australia – an evaluation. Accid Anal Prev 1994;26(3):325-7.

[11] Chow R, Hollenberg D, Pintilie A, Midroni C, Cumner S. Helmet use of adolescent cyclists at Crescent School in Toronto, Canada. Int J Adolesc Med Health 2016 Mar 12. doi: 10.1515/ijamh-2015-0123.

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Chapter 8

HELMET USE OF YOUNG ADULTS IN WATERLOO, CANADA

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Research has shown a correlation between helmet wearing rates and age - the older adolescents got, the less they wear their helmets. This chapter was conducted to determine whether the negative correlation continues among young adults in Waterloo, Canada. A questionnaire was developed, inquiring about bicycle and helmet use, and circulated to young adults in Waterloo. There was an overall 46% helmet wearing rate

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during commute to school and 49% rate when commuting during recreational time. Despite the differences in helmet wearing rates among the age groups, all age groups were equally able to identify that it is safer to wear a helmet. It is alarming that the negative correlation noted amongst adolescents continues in the youngest cohort in this study, but one may take relief that rates seem to rebound as young adults age. To increase awareness about the importance of wearing a bike helmet, steps may be taken towards advocating for safer cycling practices and perhaps findings solutions to the difficulties related with storing helmets.

INTRODUCTION

Biking is a popular alternative that many people opt for as a means of transportation, as it is simple, efficient, cheap and eco-friendly. Research has consistently shown that helmet use can reduce risks associated with bicycle use. According to a study conducted by the American Public Health Association, cyclists wearing helmets were less likely to sustain head injury (1). One would hope that the vast majority of bikers would wear helmets to improve their safety and reduce the risk of head injury.

Unfortunately, despite the safety benefits from wearing this protective headgear, many opt against wearing a helmet. In fact, the Centre for Disease Control and Prevention states that only 48% of children aged 5-14 years wore a helmet while riding their bike (2). They also found that this rate had a negative correlation to age; thus older children had lower helmet wearing rates.

Further, according to the Canadian Pediatric Society, bike injuries are the fifth-leading cause for child and youth hospitalization, and head injuries are the most severe injuries that are accrued by bikers (3). Overall, the use of helmets could help mitigate this rate and reduce the number of hospitalizations due to head injuries caused by biking.

A study conducted by Chow et al. (4) depicted that there was in fact a correlation between helmet wearing rates and age - the older students get, the less they wore their helmets. In students aged 13 and 14 years, 96% reported helmet use. However, as age progressed to 15-16 year olds and 17-18 year olds, helmet usage rates decreased to 76% and 59%,

respectively (4). This study was conducted to determine whether the negative correlation continues among young adults in Waterloo, Canada.

OUR STUDY

A questionnaire was developed, inquiring about bicycle and helmet use; it was the same questionnaire used by another study in London, Canada (5). It was circulated to young adults in Waterloo, Canada (see chapter 2). The survey was anonymous, and young adults were strongly urged to complete the survey. There were two phases of the questionnaire - the first portion prodded about bicycle-use as a means of transportation to school, while the latter half focused on cycling use during recreational time.

The primary objectives were to determine the proportion of young adults who identify themselves as cyclists, and also the fraction of the cyclists who utilize a helmet. The secondary objectives were to discover the reasoning/motives for why young adults do not wear helmets, and also evaluate their knowledge of the laws pertaining to helmet-use.

The ages as noted in the survey were collapsed into three categories - 19 years old and under, 20 years old to 22 years old, and 23 years old and above. The duration of commute to university and the frequency of commute & helmet use were also collapsed into two categories. Descriptive statistics displayed the answers to the short-answer questions probing about why cyclists do not always wear a helmet. χ^2-tests were used to determine if there was a difference in proportions amongst the age groups for questions with multiple-choice questions. All analyses were performed using the Statistical Analysis Software (SAS Version 9.4 for Windows).

FINDINGS

The questionnaire was filled out by 493 people, of which six did not consent to the survey. Among the remaining 487 people, 270 were 19 years

old and under, 169 were 20 to 22 years old and 48 of them were 23 years old older.

More participants aged 23 years and older tend to bike to school as opposed to the younger ones; 73% of individuals aged 23 years and older bike on campus versus 20% for those 19 and younger and 33% of those between 20 and 22 years old. There was a trend ($p = 0.1535$) for older people to have longer duration rides - 91%, 93% and 80% of riders aged 19 and under, 20-22 and 23 and older respectively state that they ride for less than 20 minutes. There was a difference in the frequency of cycling to school across the cohorts ($p = 0.0034$) - of those aged 19 and under, 38% of riders ride often, while 54% of those riders aged 23 and older registered that they biked frequently. 36%, 49% and 57% of individuals aged 19 years and under, 20-22 and 23 and older respectively use their helmets frequently; there seems to be a trend that older individuals use their helmets more frequently ($p = 0.1252$). Despite this lack of use, there was a general consensus among all young adults, regardless of age that it is safer to use a helmet ($p = 0.2467$) - 94%, 98% and 100% of individuals aged 19 and under, 20-22 years and 23 years and older agreed with the statement that it is safer to wear a helmet (see Table 1).

In terms of recreational cycling, there was no significant trend with regards to age and percentage of bike users ($p = 0.1735$), as 68% of those aged 19 and under, 65% of those aged 20-22 and 79% of those aged 23 and older reported bicycle use to travel leisurely. Helmet-wearing rate was significantly poorer for the younger cohorts, with only 45% of those aged 19 years and under, 48% of those aged 20-22 using it frequently, and 71% of those aged 23 and older using it frequently ($p = 0.0124$). As with cyclists who commute to school, all participants are equally aware of the benefits of wearing a helmet ($p = 0.4910$), with 97%, 96% and 100% of those 19 years and under, between 20 and 22 years, and 23 years and older, respectively, acknowledging the safety benefits (see Table 2).

Table 1. Demographics of cyclists to university

	≤ 19 years old	**20-22 years old**	**≥ 23 years old**	***p*-value**
Cyclist/Non-Cyclist				<0.0001
Cyclist	53 (20%)	55 (33%)	35 (73%)	
Non-Cyclist	213 (80%)	112 (67%)	13 (27%)	
Duration				0.1535
Under 20 min	48 (91%)	51 (93%)	28 (80%)	
Over 20 min	5 (9%)	4 (7%)	7 (20%)	
Frequency of commute				0.0034
Always/Often	20 (38%)	11 (20%)	19 (54%)	
Rarely/On Occasion/Sometimes	33 (62%)	44 (80%)	16 (46%)	
Frequency of helmet use				0.1252
Always/Often	19 (36%)	27 (49%)	20 (57%)	
Rarely/On Occasion/Sometimes	34 (64%)	28 (51%)	15 (43%)	
Is it safer to wear a helmet?				0.2467
Yes	50 (94%)	54 (98%)	35 (100%)	
No	3 (6%)	1 (2%)	0 (0%)	

Table 2. Demographics of recreational cyclists

	≤ 19 years old	**20-22 years old**	**≥ 23 years old**	***p*-value**
Cyclist/Non-Cyclist				0.1735
Cyclist	181 (68%)	109 (65%)	38 (79%)	
Non-Cyclist	87 (32%)	59 (35%)	10 (21%)	
Frequency of helmet use				0.0124
Always/Often	81 (45%)	52 (48%)	27 (71%)	
Rarely/On Occasion/Sometimes	100 (55%)	57 (52%)	11 (29%)	
Is it safer to wear a helmet?				0.4910
Yes	176 (97%)	105 (96%)	38 (100%)	
No	5 (3%)	4 (4%)	0 (0%)	

Table 3. Reasons for not wearing a helmet - school commute

Reasons	≤ 19 years old	20-22 years old	≥ 23 years old
"Seems unnecessary (won't fall or using sidewalk)"	16 (52%)	5 (14%)	3 (16%)
"Inconvenient (bulky and nowhere to store)"	8 (26%)	12 (33%)	9 (47%)
"Don't have one"	0 (0%)	6 (17%)	4 (21%)
"Doesn't look good"	0 (0%)	3 (8%)	2 (11%)
"Makes head warm and uncomfortable"	4 (12%)	4 (11%)	0 (0%)
Other*	3 (10%)	6 (17%)	1 (5%)

Other: "May get stolen", "Don't want hair to be messed", "Not in the habit of wearing", "Too cold in the winter (need a hat)".

Seventy-six excuses were given for why young adults do not wear their helmets while cycling on campus. For the individuals aged 19 and under, 52% of them stated that the helmet seems unnecessary as they were confident in their cycling abilities, 26% said that it was inconvenient (difficult to carry around) and 12% said that it made their head feel warm and uncomfortable. For those aged 20 to 22, 33% of responders said it was inconvenient, 17% of them did not own a helmet, 17% had less common reasons (such that it would mess up their hair), 14% thought it was unnecessary, 11% said it made their head feel uncomfortable and 8% said it didn't look good on them. Finally, for those aged 23 and older, the most common reason (47%) was that it was inconvenient, 21% did not have one, 16% thought it was unnecessary, 11% thought it didn't look good and 5% of responders had other reasons (see Table 3).

There were 41 provided reasons as to why participants do not wear helmets during recreational cycling. For the people aged 19 and under, 27% of them stated that the helmet seems unnecessary, 18% said that it was inconvenient, 11% said that it made their head feel warm and uncomfortable, 7% said they didn't have one and 7% said the distance they travelled was too short; 29% recorded other reasons. As for those between

20 to 22 years old, 24% of responders said it was inconvenient, 24% thought it was unnecessary, 15% said it made their head feel uncomfortable, 13% of them did not own a helmet, 13% had less common reasons (such that it would mess up their hair), and 11% said the distance travelled was too short. Finally, for those aged 23 and older, the most common reason again (31%) was that it was inconvenient, 19% thought it was uncomfortable, 19% had other reasons, 13% stated the distance was too short, 13% did not own one, and 6% thought it was unnecessary (see Table 4).

Table 4. Reasons for not wearing a helmet - recreational cycling

Reasons	≤ 19 years old	20-22 years old	≥ 23 years old
"Seems unnecessary (won't fall or using sidewalk)"	26 (27%)	13 (24%)	1 (6%)
"Inconvenient (bulky and nowhere to store)"	17 (18%)	13 (24%)	5 (31%)
"Don't have one"	7 (7%)	7 (13%)	2 (13%)
"Distance travelled is too short"	7 (7%)	6 (11%)	2 (13%)
"Makes head warm and uncomfortable"	10 (11%)	8 (15%)	3 (19%)

* Other: "Doesn't look good", "Don't want hair to be messed", "Not in the habit of wearing".

DISCUSSION

This study yielded similar results to another study conducted among young adults in London, Canada (5). There was an overall 46% helmet wearing rate during commute to school and 49% rate when commuting during recreational time. In general, older participants did register a higher helmet wearing rate (57%) than all their younger counterparts.

The duration of the ride was similar among all young adults regardless of age, however the frequency of the commute differs, as the oldest

individuals (aged 23 years and older) had a 54% rate of riding while the younger ones both had a rate less than 40%. Those who ride the most frequently have the highest helmet wearing rates as well.

Despite the differences in helmet wearing rates among the age groups, all age groups were equally able to identify that it is safer to wear a helmet. This suggests that although the people understand the safety that the helmet provides, they choose not to wear it. The younger population of people believed that wearing a helmet was unnecessary as they were confident in their riding abilities, they rode on the sidewalk or they believed they wouldn't fall. The next most popular reason was that carrying the helmet was inconvenient as it was bulky, and they had nowhere to store it. The mixture of confidence as well as lack of easy care for helmet results in suboptimal helmet-wearing rates and hence a lower rate than that reported by Chow et al. among adolescents (4). It is alarming that the negative correlation noted amongst adolescents continues amongst the youngest cohort in this study, but one may take relief that rates seem to rebound as young adults age.

This study was not without limitations. There exists the possibility of a response bias, due to the nature of data collection (survey). However, the substantial sample size should hopefully mitigate any abnormalities in self-report. Additionally, as study recruitment was carried out during the winter months in Waterloo, bicycle use and hence responses surrounding biking practices could have drastically altered - less people may report using a bicycle, and those who do may only do so on a less-frequent basis.

Overall, the young adults in Waterloo had similar helmet wearing rates and general trends as those in London, Canada (5). There was a slightly higher helmet wearing rate during recreational riding as opposed to biking on campus. In addition, older individuals generally wore their helmets more frequently than younger ones, despite the equal acknowledgement that bike helmets were an important safety tool among all young adults regardless of age. In order to increase awareness about the importance of wearing a bike helmet, steps may be taken towards advocating for safer cycling practices and perhaps findings solutions to the difficulties related with storing helmets.

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We would like to thank all of those who participated in the questionnaire.

REFERENCES

[1] Wasserman RC, Waller JA, Monty MJ, Emery AB, Robinson DR. Bicyclists, helmets and head injuries: a rider-based study of helmet use and effectiveness. Am J Public Health 1988;78(9):1220-1.

[2] Centers for Disease Control and Prevention. URL: https://www.cdc.gov/healthcommunication/toolstemplates/entertainmented/tips/headinjuries.html

[3] Bicycle helmet use in Canada. URL: http://www.cps.ca/documents/position/bike-helmets-to-reduce-risk-of-head-injury

[4] Chow R, Hollenberg D, Pintilie A, Midroni C, Cumner S. Helmet use of adolescent cyclists at Crescent School in Toronto, Canada. Int J Adolesc Med Health 2016 Mar 12. Doi: 10.1515/ijamh-2015-0123.

[5] Anpalagan T, Hollenberg D, Borean M, Rzepka A, Chow R. Helmet use of young adults in London, Canada. Int J Child Health Hum Dev 2018, in press.

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Chapter 9

HELMET USE OF YOUNG ADULTS IN ST. CATHERINES, CANADA

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For this chapter questions were designed to assess the proportion of the student population that reported themselves to be cyclists, and also cycling routines to university - duration of commute, frequency of commute, frequency of helmet use - and during recreational time - frequency of helmet use. A much smaller proportion of people aged 19 years and younger cycle to school, when compared to the two other age groups, with the number of cyclists increasing proportionally with age. A much larger proportion of individuals aged 23 years and older, 80%, reported frequency of helmet use as “often” or “always” compared to the 32% of their cohorts aged 19 years of age or younger. There was no difference in the awareness of helmet safety between the age groups of recreational bicyclists, further indicating that all age groups are equally

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educated in terms of bicycle safety. This study identifies that the trend noted by Chow et al. and Borean et al. continues in the youngest cohort of young adults, but fortunately the trend does not continue in the older cohorts identified in our study. Nevertheless, promoting safer cycling habits including helmet use can increase helmet use.

INTRODUCTION

Bicycling is an increasingly popular means of transportation (1). However, head injuries from bicycle accidents comprise one third of emergency department treated injuries, three fourths of bicycle related deaths and two thirds of hospitalizations (2). The literature strongly suggests that helmets are effective at reducing the risk of head injury as well as serving as protective devices against maxillofacial and dental injuries (3-5). Using a control based population group, the Thompson et al. study found helmets to be 85% effective at preventing head injury and 88% effective a preventing brain injury (3).

Despite these findings and the associated risks due to not wearing a helmet, a study from the mid-1980s found that less than 2% of children and less than 10% of all bicyclists choose to wear helmets (6). A more recent study conducted in 1994 cited that only 50% of bicyclists owned a helmet while only 25% reported always using a helmet during cycling (7). It has been proven in a variety of studies that legislation programs can be an effective means of increasing helmet use (6). In 1990, Victoria, Australia implemented mandatory use of approved bicycle helmets (8). As a result, helmet use increased from 31% from the previous year to 75% (8). Further, the number of insurance claims related to bicycle accidents decreased by 70% in the years following the implementation of this legislature (8). Further studies cited that age is related to preference for on road bicycle safety infrastructure as well as the need for bicycle education (9).

A study completed by Chow et al. (10) reported a decrease in helmet use with age. Young adolescent boys, specifically in Grade 7 and 8, reported a high usage of helmets at 96%, while grade 9 and 10 students and grade 11 and 12 students reported helmet use at 76% and 59% respectively

(10). A similar trend was noted by Borean et al; as age increases, helmet use decreases (11).

This trend is incredibly concerning. It would be compelling to determine whether or not this trend continues into young adults ages 18 and older. The purpose of this study was to observe any trend in bike safety and helmet usage as it related to age, specifically among young adults, as well as recording and analyzing the main reasons cited for not wearing a helmet.

OUR STUDY

A questionnaire modeled after that employed by Anpalagan et al. (12) was used in St Catherines, Ontario, Canada. The questions were designed to assess the proportion of the young adults that reported themselves to be cyclists to school, and also cycling routines to university - duration of commute, frequency of commute, frequency of helmet use - and during recreational time - frequency of helmet use (see chapter 2). The primary objectives were to determine the proportion of cyclists and proportion of helmet-use among cyclists. Other objectives included determining the reasons for why cyclists do not use helmets all the time, and also their belief whether a helmet is an effective safeguard against injury.

The responses to the survey were analyzed according to the age group of participants; responses were grouped according to whether the participant was 19 years old and below, between 20 and 22 years old, and 23 years old and above. Responses to questions pertaining to frequency of helmet use and frequency of commute were each amalgamated into two responses, and the duration of the commute was collapsed into two responses. Fisher's exact test was used to determine whether there was a difference in responses across the three age cohorts. Descriptive statistics were used to communicate the reasons why cyclists choose not to wear a helmet. All statistical analyses were carried out using the Statistical Analysis Software (SAS Version 9.4 for Windows).

FINDINGS

The questionnaire was completed by 80 participants. After one participant withdrew consent there existed 79 eligible responses. Of the 79 participants, 46 were 19 years old or younger, 28 of them were between the ages of 20 years old and 22 years old and 5 were 23 years or above.

A much smaller proportion of adults aged 19 years and younger cycle to school, when compared to the two other age groups ($p = 0.0064$), with the number of cyclists increasing proportionally with age. 7% of young adults aged 19 and below have cycled to school, while 21% and 60% of individuals aged 20-22 years old, and 23 years or older cycled to university, respectively. 100%, 83%, and 100% of people 19 years of age and below, 20-22 years old, and 23 and above years old respectively, require less than 20 minutes to cycle to campus. Data also showed a trend that older participants commute to campus proportionally more frequently; 33%, 50% and 100% of cyclists age 19 years and older, 20-22 years of age, and 23 years and older respectively cycled to campus "always" or "often". There is a strong trend to suggest that helmet use does increase with age. The youngest group reported use of 33%, and the oldest group reported use of 67% There was no statistical difference in the awareness of helmet safety between the age groups ($p = 0.2667$), indicating all age groups were equally educated in terms of bicycle safety (see Table 1).

A trend was observed showing increased recreational bicycle use with age; 72% and 100% of the youngest and oldest groups respectively, identified as cycling recreationally. This data is however insignificant due to the small sample size. A much larger proportion of subjects aged 23 years and older, 80%, reported frequency of helmet use as "often" or "always" compared to the 32% of their cohorts aged 19 years of age or younger ($p = 0.0217$). There was no difference in the awareness of helmet safety between the age groups of recreational bicyclists, further indicating that all age groups are equally educated in terms of bicycle safety (see Table 2).

Table 1. Demographics of cyclists to university

	≤ 19 years old	**20-22 years old**	**≥ 23 years old**	***p*-value**
Cyclist/Non-Cyclist				0.0064
Cyclist	3 (7%)	6 (21%)	3 (60%)	
Non-Cyclist	43 (93%)	22 (79%)	2 (40%)	
Duration				0.9999
Under 20 min	3 (100%)	5 (83%)	3 (100%)	
Over 20 min	0 (0%)	1 (17%)	0 (0%)	
Frequency of commute				0.4318
Always/Often	1 (33%)	3 (50%)	3 (100%)	
Rarely/On Occasion/Sometimes	2 (67%)	3 (50%)	0 (0%)	
Frequency of helmet use				0.4848
Always/Often	1 (33%)	1 (17%)	2 (67%)	
Rarely/On Occasion/Sometimes	2 (67%)	5 (83%)	1 (33%)	
Is it safer to wear a helmet?				0.2667
Yes	1 (33%)	4 (67%)	3 (100%)	
No	2 (67%)	2 (33%)	0 (0%)	

Table 2. Demographics of recreational cyclists

	≤ 19 years old	**20-22 years old**	**≥ 23 years old**	***p*-value**
Cyclist/Non-Cyclist				0.5465
Cyclist	33 (72%)	20 (71%)	5 (100%)	
Non-Cyclist	13 (28%)	8 (29%)	0 (0%)	
Frequency of helmet use				0.0217
Always/Often	8 (32%)	3 (15%)	4 (80%)	
Rarely/On Occasion/Sometimes	25 (64%)	17 (85%)	1 (20%)	
Is it safer to wear a helmet?				0.2813
Yes	33 (100%)	18 (90%)	5 (100%)	
No	0 (0%)	2 (10%)	0 (0%)	

Table 3. Reasons for not wearing a helmet - school commute

Reasons	≤ 19 years old	20-22 years old	≥ 23 years old
"Above legal age"	0 (0%)	1 (10%)	0 (0%)
"Not fashionable"	1 (100%)	3 (30%)	0 (0%)
"I'm a great rider, I don't crash"	0 (0%)	2 (20%)	0 (0%)
"Annoying, hot and sweaty"	0 (0%)	1 (10%)	0 (0%)
"I only ride short distances and on sidewalks, I don't need one"	0 (0%)	2 (20%)	0 (0%)
Other*	0 (0%)	1 (10%)	1 (100%)

* Other: "If I were riding for sport I would definitely wear one", "Cannot afford one".

Twelve explanations were provided as reasons why young adults do not wear helmets to commute to campus. For individuals 19 years old or younger, the predominant reason for not wearing a helmet was belief that helmets are not fashionable (100%). The most popular reason for not wearing a helmet in people aged 20-22 years old was also the belief that helmets were not fashionable (30%). Alternate explanations in this cohort included being a self-belief that they would not crash (20%), not needing one due to travel on sidewalks for short distances (20%), being above the legal age (10%), helmets being annoying, hot, and sweaty (10%) and other reasons (10%). The oldest age group provided other reasons (100%), including not being able to afford a helmet, and not riding for sport, as the predominant reasons for not using helmets (see Table 3).

Twenty-one explanations were provided as to why recreational riders do not wear helmets. The predominant reason cited by the 19 years old and younger age group was other reasons (50%), including but not limited to: forgetting a helmet, it messing up their hair, helmets being too costly, helmets not helping in the event of a crash, etc. Other reasons in this cohort include helmets being unattractive (25%), not owning a helmet (17%) and the self belief that they would not crash (8%). For individuals aged 20-22 years old the most popular reason against wearing a helmet was believing them to be unattractive (38%). Secondary listed reasons included other reasons (25%), not owning a helmet (13%), being above the legal age

(13%), and not wanting to (13%). In the 23 years and older age group, the predominant reason for not wearing a helmet was another (100%), including not needing one due to short distances, never being told to wear a helmet or helmets being too costly.

Table 4. Reasons for not wearing a helmet - recreational cycling

Reasons	≤ 19 years old	20-22 years old	≥ 23 years old
"I do not own a helmet"	2 (17%)	1 (13%)	0 (0%)
"Unattractive"	3 (25%)	3 (38%)	0 (0%)
"Above legal age"	0 (0%)	1 (13%)	0 (0%)
"Do not want to"	0 (0%)	1 (13%)	0 (0%)
"I am a great rider, I don't crash"	1 (8%)	0 (0%)	0 (0%)
Other*	6 (50%)	2 (25%)	1 (100%)

* Other: "Messes up my hair", "I forget", "Uncomfortable", "Too costly", "Would not help anyway", "Cannot fit in my bag", "Was never told to wear one", "Do not need one because I only bike short distances".

DISCUSSION

This study accrued far less participants than similar questionnaires employed by Chow et al. and Borean et al. (10, 11), querying about helmet use in adolescent in Toronto, Canada and Markham Canada, respectively. Due to the small sample size, there were few statistically significant differences among the three age groups. Data showed that there appeared to be no trend in the duration of bicycle trip duration among age groups. Additionally, data appears to show that all age groups (both recreation and commuter groups) are equally educated in terms of awareness about the safety of bicycle helmets. This is concerning given the trend that many young people, although aware of the safety of wearing a helmet, deliberately choose not to.

A larger proportion of older-age participants identified as cyclists, and there was a strong trend in increased helmet use and frequency of commute with older-age. This indicates that there could be a correlation between

older age, frequency of commute and an increased reliance on protective head gear. However, the small sample size of this study makes it difficult to test for statistical significance in this possible correlation. The data does indicate a statistically significant trend between increased frequency of helmet use with increased age in recreational cyclists.

20-22 year old bicycle commuters and 19 years old and younger recreational cyclists had the most excuses for not wearing helmets. The most concerning excuse was that a "helmet would not help anyway". This seems to indicate that education about bicycle safety has the potential to help increase the number of people who wear helmets. The statistical data shows that everyone is equally educated on bicycle safety; as such, in order to increase the effectiveness of bicycle safety education, new approaches could be established.

This study was not without limitations. With any survey, there existed the possibility of a sampling/response bias. Additionally, the study accrued a small sample size (only 79 participants), and consequently resulted in only trends noticed rather than significant differences. Future studies can be conducted with larger sample size to see whether these trends continue in larger populations.

The trend in equal education among bicycle riders and the blatant disregard for bike safety even with this knowledge was consistent with studies performed by Chow et al. and Borean et al. (10, 11). A much smaller proportion of people aged 19 years and younger cycle to school, when compared to the two other age groups. A much larger proportion of individuals aged 23 years and older, 80%, reported frequency of helmet use as "often" or "always" compared to the 32% of their cohorts aged 19 years of age or younger. As this trend is concerning, further studies should observe if this continues in larger populations. Additionally, advocacy and education could further contribute to better awareness and commitment to bike safety.

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REFERENCES

[1] Attewell RG, Glase K, McFadden M. Bicycle helmet efficacy: a meta-analysis. Accid Anal Prev 2001;33(3):345-52.

[2] Sacks JJ, Holmgreen P, Smith SM, Sosin DM. Bicycle-associated head injuries and deaths in the United States from 1984 through 1988: how many are preventable? JAMA 1991;266(21):3016-8.

[3] Thompson DC, Nunn ME, Thompson RS, Rivara FP. Effectiveness of bicycle safety helmets in preventing serious facial injury. JAMA 1996;276(24):1974-5.

[4] Macknin ML, Medendorp SV. Association between bicycle helmet legislation, bicycle safety education, and use of bicycle helmets in children. Arch Pediatr Adolesc Med 1994;148(3):255-9.

[5] Rivara FP, Thompson DC, Patterson MQ, Thompson RS. Prevention of bicycle-related injuries: helmets, education, and legislation. Annu Rev Public Health 1998;19(1):293-318.

[6] Antonakos CL. Environmental and travel preferences of cyclists. Doctoral dissertation, 1994. URL: https://trid.trb.org/view.aspx?id=413764.

[7] Karkhaneh M, Kalenga JC, Hagel BE, Rowe BH. Effectiveness of bicycle helmet legislation to increase helmet use: a systematic review. Inj Prev 2006;12(2):76-82.

[8] Cameron MH, Vulcan AP, Finch CF, Newstead SV. Mandatory bicycle helmet use following a decade of helmet promotion in Victoria, Australia—an evaluation. Accid Anal Prev 1994;26(3):325-37.

[9] Hall-Long B, Schell K, Corrigan V. Youth safety education and injury prevention program. Pediatr Nurs 2001;27(2):141-6.

[10] Chow R, Hollenberg D, Pintilie A, Midroni C, Cumner S. Helmet use of adolescent cyclists at Crescent School in Toronto, Canada. Int J Adolesc Med Health 2016 Mar 12. doi: 10.1515/ijamh-2015-0123.

[11] Borean M, Ho S, Hollenberg D, Anpalagan T, Rzepka A, Viehweger J, et al. Helmet use of adolescents in Markham, Canada. Int J Adolesc Med Health 2017, in press.

[12] Anpalagan T, Hollenberg D, Borean M, Rzepka A, Chow R. Helmet use of young adults in London, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

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Chapter 10

HELMET USE OF YOUNG ADULTS IN TORONTO, CANADA

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Numerous studies have been carried out amongst adolescent and young adult populations to evaluate bicycle and helmet use in different regions across the world. The major take-away point from these studies is that helmet-use rates vary by region. However, none of the studies were conducted in Toronto, where the research on adolescents was conducted. The aim of this chapter was to look into helmet-use rates for young adults in Toronto, Canada. An anonymous questionnaire was circulated to young adults, and completed by 358 individuals. The results showed that

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young adults who recently progressed from adolescence maintain the low helmet-use rates. There is a positive correlation among young adults, as helmet-use increases with age. Most of the commutes to university last under 20 minutes in duration, which may be a result of the public transportation system offered in the region. The trends noted by prior studies were also observed in Toronto, where the original study by Chow et al. was conducted; it seems that the trend is similar, but the degree of change differs by region.

INTRODUCTION

Numerous studies (1-11) have been carried out amongst adolescent and young adult populations to evaluate bicycle and helmet use across different regions of the world.

The first of these studies was completed by Chow et al. (1) at an independent all-boys high school in Toronto, Canada. A trend was observed based on the helmet use rates reported - 88% of Grade 7 and 8 students, 60% of Grade 9 and 10, and 58% of Grade 11 and 12 students, regularly use a helmet when cycling (1). This interesting negative correlation was followed-up by multiple other studies in the adolescent population. Borean et al. (2) reported similar rates of helmet use among students at an independent co-educational high school also situated in Toronto - 74%, 66% and 55% for the three cohorts, respectively. Two studies carried out at public high schools in Markham and Toronto reported helmet-usage rates of 41% and 61% respectively for Grade 9 and 10 students, while observing a 38% and 50% rate for the Grade 11 and 12 students (3-4). All three follow-up studies (2-4) noted the same trend as Chow et al; a negative correlation exists between age and helmet-use.

A group based in London, Canada, has carried out many studies among the young adult population, to determine whether the negative-correlation trend brought about by Chow et al. (1) and validated by other studies (2-4) continues into adulthood. Three studies in the Province of Ontario, in Canada, found helmet-wearing rates between 32% and 44%, remarking that the negative correlation continues into young adulthood but eventually goes back up (5-7). Recently-published literature of studies carried out in

the Provinces of Quebec and Saskatchewan in Canada reported slightly higher helmet-use rates (8-9). Helmet-use rates were remarkably lower for young adults in New York State, USA (10), and significantly higher for those residing in Dublin, Ireland (11).

The studies in Canada suggest that the trend observed by Chow et al. (1) continues into young adulthood. However, as pre-existing literature has shown, helmet-use rates vary by region - none of the studies were conducted in Toronto, where the research on adolescents was conducted. The aim of this study was to look into helmet-use rates for young adults in Toronto, Canada.

OUR PROJECT

An anonymous questionnaire was circulated among young adults in Toronto, Canada (see chapter 2). The survey had two primary objectives - to assess bicycle and helmet use for young adults when they commute to school, and when they commute during their recreational time. The secondary objective was to collect reasons as to why young adults choose not to wear helmets.

The responses were grouped analyzed according to age group - 19 years old and below, between 20 and 22 years old, and 23 years old and older. Responses to questions were collapsed for the statistical test. The questions pertaining to frequency of commute and helmet use were classified as Always/Often and Rarely/On Occasion/Sometimes. The duration of commute was consolidated into two responses - Under 20 min and Over 20 min. χ^2-tests were used to determine whether there exists a difference in responses, proportionally, between the ages. Descriptive statistics were used to convey the reasons provided by cyclists not wearing a helmet. P-values less than 0.05 were considered statistically significant. All statistical analyses were performed using the Statistical Analysis Software (SAS Version 9.4 for Windows).

Table 1. Demographics of cyclists to university

	≤ 19 years old	**20-22 years old**	**≥ 23 years old**	***p*-value**
Cyclist/Non-Cyclist				0.0324
Cyclist	36 (19%)	29 (34%)	21 (31%)	
Non-Cyclist	149 (81%)	56 (66%)	67 (69%)	
Duration				0.8479
Under 20 min	25 (69%)	22 (76%)	15 (71%)	
Over 20 min	11 (31%)	7 (24%)	6 (29%)	
Frequency of commute				0.1645
Always/Often	7 (19%)	9 (31%)	9 (43%)	
Rarely/On Occasion/Sometimes	29 (81%)	20 (69%)	12 (57%)	
Frequency of helmet use				0.4916
Always/Often	20 (56%)	18 (62%)	15 (71%)	
Rarely/On Occasion/Sometimes	16 (44%)	11 (38%)	6 (29%)	
Is it safer to wear a helmet?				0.2842
Yes	33 (92%)	29 (100%)	20 (95%)	
No	3 (8%)	0 (0%)	1 (5%)	

FINDINGS

One hundred and eighty-five young adults of ages 19 years and below, eighty-five adults between the ages of 20 and 22 years old, and eighty-eight young adults of ages 23 years and older completed the questionnaire. There was a significantly lower proportion (19%) of school cyclists in the youngest cohort ($p = 0.0324$); 34% and 31% of the other two groups identified themselves as cyclists who commute to school. All age groups reported that most of their commutes to school lasted under 20 minutes ($p = 0.8479$); 69% of those aged 19 years and below, 76% of those in between

20 and 22 years old, and 71% of those over 22 years old reported short commutes. There exists a trend that older individuals commute to school more often via bicycles (p = 0.1645), with the oldest group commuting 43% of the time and the youngest group only commuting 19% of the time. Helmet use was lowest for the youngest cohort (56% frequent use), with a trend of for a positive correlation (p = 0.4916) - as age increases, helmet use increases. All young adults were equally well-educated about the safety benefits offered by helmets (p = 0.2842), with 92%, 100% and 95% of the youngest, middle and oldest group, respectively, acknowledging the safety benefits (see Table 1).

There exists equal proportions recreational cyclists in all groups (p = 0.9512); 74% of those below 19 years old, 75% of those in between 20 and 22 years old, and 74% of those above 22 years old identified themselves as recreational cyclists. A positive correlation exists between helmet use and age (p = 0.0380); helmet use increased from 38% to 52%. 97% of all age groups cited that there exists safety benefits in using a helmet (p = 0.9970) (see Table 2).

Table 2. Demographics of recreational cyclists

	≤ 19 years old	**20-22 years old**	**≥ 23 years old**	***p*-value**
Cyclist/Non-Cyclist				0.9512
Cyclist	136 (74%)	64 (75%)	65 (74%)	
Non-Cyclist	49 (26%)	21 (25%)	23 (26%)	
Frequency of helmet use				0.0380
Always/Often	46 (34%)	28 (44%)	34 (52%)	
Rarely/On Occasion/Sometimes	90 (66%)	36 (56%)	31 (48%)	
Is it safer to wear a helmet?				0.9970
Yes	132 (97%)	62 (97%)	63 (97%)	
No	4 (3%)	2 (3%)	2 (3%)	

Table 3. Reasons for not wearing a helmet - school commute

Reasons	≤ 19 years old	20-22 years old	≥ 23 years old
"Inconvenient (storage, too lazy, easy to forget)"	10 (34%)	5 (29%)	4 (31%)
"Doesn't look good"	5 (17%)	5 (29%)	6 (46%)
"Seems unnecessary (no traffic, safe bike path)"	3 (10%)	3 (18%)	0 (0%)
"Don't have one"	2 (7%)	2 (12%)	3 (23%)
"Too hot (or cold) outside"	2 (7%)	1 (6%)	0 (0%)
Other*	7 (24%)	1 (6%)	0 (0%)

* Other: "Don't have the habit", "Feels uncomfortable", "Hair gets messed".

Twenty-nine reasons were collected from school cyclists 19 years and below, for why helmets were not frequently used. The most common reasons were inconvenience (34%) and that it doesn't look good (17%). Additional reasons included the cyclist's beliefs that a helmet is unnecessary (10%), the fact that they do not own one (7%), and that it is often too hot or cold outside (7%). Of the 17 responses collected from the middle-aged cohorts, 29% reported inconvenience, 29% cited the cosmetic reasons, 18% believed it was unnecessary, 12% do not own a helmet, and 6% informed about climatic reasons. 46% of the thirteen reasons for the oldest group do not use helmets because it doesn't look good, while 31% and 23% reported inconvenience and lack of ownership, respectively (see Table 3).

The most frequently cited excuses for recreational cyclists in the youngest two cohorts were belief that it was unnecessary due to no traffic and/or safe bike paths - 30% and 31% for the two cohorts, with the former value relating being the younger cohort. The next most commonly cited reasons for those 19 years and below included inconvenience (17%), discomfort (11%), lack of ownership (9%) and short distance (8%). Not owning a bike was the second most cited reasons for those in between 20 and 22 years old (18%), followed by short distance (10%), inconvenience (8%) and discomfort (8%). Inconvenience was the most reported reason by

those 22 years and older (53%), followed by its seemingly unnecessary use (28%), short distance (8%), uncomfortable nature (6%) and that they do not own one (3%) (see Table 4).

Table 4. Reasons for not wearing a helmet - recreational cycling

Reasons	≤ 19 years old	20-22 years old	≥ 23 years old
"Seems unnecessary (no traffic, safe bike path)"	31 (30%)	12 (31%)	10 (28%)
"Inconvenient (storage, too lazy, easy to forget)"	17 (17%)	3 (8%)	19 (53%)
"Feels uncomfortable"	11 (11%)	3 (8%)	2 (6%)
"Don't own one"	9 (9%)	7 (18%)	1 (3%)
"Short distance"	8 (8%)	4 (10%)	3 (8%)
Other*	26 (25%)	10 (26%)	1 (3%)

* Other: "Doesn't look good", "Hair gets messed", "Don't have the habit", "Too hot (or cold) outside".

DISCUSSION

Helmet use as reported in this study is similar to young adults in other cities within the Province of Ontario in Canada (5-7); there exists a positive correlation between age and helmet use. When comparing this study to the four papers looking into helmet use of adolescents in Toronto (1-4), the trend of helmet use during adolescence and young adulthood in Toronto seems to resemble a U-shaped pattern. Helmet use declines as adolescents progress in age (1-4), with the rate hitting an all-time-low among young adults of age 19 years and below. As young adults grow older, helmet use increases (5-7), with the degree of increase varying between regions (5-11).

Most of the commutes to school are under 20 minutes in duration, which is similar to the results conveyed by Chow et al. in studies conducted in New York State, USA (10) and Dublin, Ireland (11). These

observations may be explained by a similar trait that all these regions have - developed public transportation systems that are an effective alternative to cycling.

This study was not without limitations. As with any survey, there is the possibility of response/sampling bias. The large sample size should minimize the effect of anomalies/outliers in the statistical analysis. It is also important to note that the survey was circulated in January, which is among the coldest and snowiest months of the year in Toronto. As a result, a smaller proportion of young adults may identify themselves as cyclists.

This study of young adults in Toronto, Canada, shows that young adults who recently progressed from adolescence maintain the low helmet-use rates. There is a positive correlation in young adulthood, with helmet-use increasing as young adults progress in age. Most of the commutes to school last under 20 minutes in duration, which may be a result of the public transportation system offered in the region. The trends noted by studies in other regions of Canada are prevalent in Toronto, where the original study by Chow et al. was conducted; it seems that the trend is similar but the degree of change differs by region.

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REFERENCES

[1] Chow R, Hollenberg D, Pintilie A, Midroni C, Cumner S. Helmet use of adolescent cyclists at Crescent School in Toronto, Canada. Int J Adolesc Med Health 2016 Mar 12. Doi: 10.1515/ijamh-2015-0123.

[2] Borean M, Trasente V, Rzepka A, Viggiani D, Viotto D, Hollenberg D, et al. Helmet use of adolescents at De La Salle College Oaklands in Toronto, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[3] Anpalagan T, Borean M, Chen L, Viehweger J, Hollenberg D, Rzepka A, et al. Helmet use of adolescents in Toronto, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[4] Borean M, Ho S, Hollenberg D, Anpalagan T, Rzepka A, Viehweger J, et al. Helmet use of adolescents in Markham, Canada. Int J Adolesc Med Health 2017;in press.

[5] Anpalagan T, Hollenberg D, Borean M, Rzepka A, Chow R. Helmet use of young adults in London, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[6] Viehweger J, Borean M, Tang M, Hollenberg D, Anpalagan T, Rzepka A, et al. Helmet use of young adults in St. Catherines, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[7] Anpalagan T, Duarte N, Borean M, Anpalagan J, Camilleri R, Hollenberg D, et al. Helmet use of young adults in Waterloo, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[8] Chow R, Borean M, Hollenberg D, Song K, Liu J, Young T, et al. Helmet use of young adults in Montreal, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[9] Chow R, Rzepka A, Borean M, Parekh R, Hollenberg D, Anpalagan T, et al. Helmet use of young adults in Saskatoon, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[10] Chow R, Borean M, Hollenberg D, Ganguli N, Freedman Z, Kang R, et al. Helmet use of young adults in New York State, United States of America. Int J Child Health Hum Dev 2018;11(1), in press.

[11] Chow R, Hollenberg D, Borean M, Goh S, Anpalagan T, Rzepka A, et al. Helmet use of young adults in Dublin, Ireland. Int J Child Health Hum Dev 2018;11(1), in press.

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Chapter 11

HELMET USE OF YOUNG ADULTS IN KINGSTON, CANADA

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A study completed in Toronto, Canada noted a negative correlation between helmet use and age, specifically in high school students. This chapter aimed to determine whether the trend observed by the earlier study continued into adulthood. Numerous studies observing these trends were carried out in other regions of the world - however, none of these studies observed the young adults of Kingston, in Ontario, Canada. The anonymous questionnaire that was circulated to young adults was completed by 142 participants. This study found a much smaller proportion of adults aged 19 years and younger cycle to school, when compared to the two other age groups, with the number of cyclists increasing proportionally with age. Although this shows that adolescents

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who recently graduated from high school still maintain low rates of helmet use, it is encouraging to observe that these rates increase again into adulthood. Most commuters noted that their travel time was under 20 minutes, leading to excuses such as not wearing a helmet because of a short trip. This study found similar trends to that of previous studies in other regions of Canada, indicating that promoting safer cycling habits including helmet use can benefit the entire country.

INTRODUCTION

Using a bicycle as a means of transport is becoming increasingly popular. However, this mode of transportation is not immune to injury (1). Head injuries from bicycle accidents compose two thirds of bicycle related hospitalizations and three quarters of bike related fatalities. Further, head injuries from bicycle related accidents makeup one third of emergency department treated injuries (2). Various studies strongly suggest that helmets are effective as protection devices against maxillofacial and dental injuries in addition to use as a head protection device (3-5). A study by Thompson et al. (3) found helmets to be 88% and 85% effective at preventing brain injury and head injury respectively.

Despite the associated risks with not wearing a helmet and the findings indicating the efficacy of wearing one, studies by Chow et al. and Borean et al. have suggested that many individuals deliberately choose not to wear a helmet, even if they are fully aware of the inherent safety benefits (6-7). These studies supported the findings of an earlier study from the mid 1980's which found that less than 10% of all cyclists chose to wear helmets as well as the findings of a mid-1990s study which reported only 50% of cyclists owned a helmet with only 25% of those always wearing one during cycling (8). However, studies in Australia have found that legislation programs can be effective at increasing the use of helmets as a protective device. The mandatory use of approved bicycle helmet was approved in Australia in 1990, and since then, helmet use in the country has increased significantly. In the following years after his legislature was

passed the number of insurance claims related to bicycle accidents decreased by 70% (9).

More recently, a team of student researchers in London, Ontario have carried out various studies worldwide to evaluate the use of helmets and bicycles in young adolescents. These studies are based on a similar study performed by Chow et al., at an all boys independent school in Toronto, Canada (10-13). Chow et al., reported a decrease in helmet use with age; 96% of grade 7 and 8 students wore helmets, while 76% and 59% of students in grade 9 and 10, and grade 11 and 12 respectively wore helmets (10). This trend was supported by Borean et al; helmet use decreases with increased age (11). Although helmet use decreases with age until the point of 19 years of age, use begins to slowly increase in the following years of young adulthood (14-15).Three studies performed in different locations in Canada also observed a similar positive parabolic trend in helmet use (14-15). Data retrieved from studies employed in Quebec, Canada and Saskatchewan, Canada reported slightly higher rates of helmet use than studies completed in Ontario (16, 17). However, a study completed in Dublin, Ireland reported the highest use of helmets and bicycles (18). Contrasting to this, the lowest rates of helmet use during bicycling were recorded by a study to be in New York State, USA (19).

This trend is incredibly concerning but it is important that this parabolic trend is resolved; young adults beyond 19 year olds eventually increase their frequency of helmet use when biking. The purpose of this study was to determine if this U-Shaped trend in helmet use among young adults is observed in Kingston, Canada.

OUR RESEARCH

An anonymous questionnaire was circulated to young adults in Kingston, Canada (see chapter 2). The primary objective was to determine bicycle and helmet use of young adults for commuting to university, and during

their recreational time. The secondary objective was to collect the reasons why young adults did not use helmets frequently.

Responses were compiled into three groups based on age - 19 years and below, between 20 and 22 years old, and 23 years and older. The frequency of commute and helmet use questions were collapsed to yield two responses for the analyses - Always/Often and Rarely/On Occasion/Sometimes. The duration of bicycle commute to university was similarly consolidated into two answers - Under 20 min and Over 20 min. Descriptive statistics were used to report the reasons why cyclists do not frequently use a helmet. All values were conducted using the Statistical Analysis Software (SAS Version 9.4 for Windows), with p-values less than 0.05 considered statistically significant.

Table 1. Demographics of cyclists to university

	≤ 19 years old	**20-22 years old**	**≥ 23 years old**	***p*-value**
Cyclist/Non-Cyclist				0.0009
Cyclist	31 (36%)	26 (59%)	11 (85%)	
Non-Cyclist	54 (64%)	18 (41%)	2 (15%)	
Duration				0.0207
Under 20 min	29 (94%)	26 (100%)	8 (73%)	
Over 20 min	2 (6%)	0 (0%)	3 (27%)	
Frequency of commute				0.0492
Always/Often	6 (19%)	11 (42%)	6 (55%)	
Rarely/On Occasion/Sometimes	25 (81%)	15 (58%)	5 (45%)	
Frequency of helmet use				0.0951
Always/Often	11 (35%)	5 (19%)	6 (55%)	
Rarely/On Occasion/Sometimes	20 (65%)	21 (81%)	5 (45%)	
Is it safer to wear a helmet?				0.9999
Yes	30 (97%)	26 (100%)	11 (100%)	
No	1 (3%)	0 (0%)	0 (0%)	

WHAT WE FOUND

The questionnaire was completed by 142 participants. Of the 142 participants, 85 of them were 19 years old or younger, 44 of them were between the ages of 20 years old and 22 years old and 13 were 23 years or above.

A much smaller proportion of adults aged 19 years and younger cycle to school, when compared to the two other age groups ($p = 0.0009$), with the number of cyclists increasing proportionally with age. 36% of young adults aged 19 and below have cycled to school, while 59% and 85% of individuals aged 20-22 years old and 23 years old or older cycled to university respectively. 94%, 100%, and 73% of students 19 years of age and below, 20-22 years old, and 23 and above years old, respectively, require less than 20 minutes to cycle to campus ($p = 0.0207$). Data also showed that older participants commute to campus proportionally more frequently ($p = 0.0492$); 19%, 42%, and 55% of cyclists age 19 years and older, 20-22 years of age, and 23 years and older respectively cycled to campus "always" or "often". The frequency of helmet use seems to increase with age as 35% of individuals aged 19 years and younger wore helmets "always" or "often" compared with 55% of individuals aged 23 years or older ($p = 0.0951$). There was no statistical difference in the awareness of helmet safety between the age groups ($p = 0.9999$), indicating all age groups were equally educated in terms of bicycle safety (see Table 1).

A trend was observed showing increased recreational bicycle use with age; 62% and 77% of the youngest and oldest groups respectively, identified as cycling recreationally ($p = 0.4260$). The data is however insignificant, possibly due to the small sample size. A larger proportion of subjects aged 23 years and older, 70%, reported frequency of helmet use as "often" or "always" compared to the 60% of their cohorts aged 19 years of age or younger ($p = 0.0313$). There was no difference in the awareness of

helmet safety between the age groups of recreational bicyclists further indicating that all age groups are equally educated in terms of bicycle safety (see Table 2).

Forty-four explanations were provided as reasons why young adults do not wear helmets to commute to campus. For individuals 19 year old or younger the predominant reasons for not wearing helmets was other (25%), including helmets messing their hair, just not wanting to, no reason, social norms and believing helmets to be not necessary. Alternate explanations in this cohort included helmets being inconvenient (20%), always biking on safe streets (20%), forgetting (15%), helmets being sweaty and uncomfortable (10%), and not having one (10%). The 20-22 year old age group also provided other reasons (37%), as their predominant reason for not utilizing head protection when biking. Alternate explanations in this cohort included helmets being inconvenient (26%), always biking on safe streets (26%), helmets being sweaty and uncomfortable (5%), and not having one (5%). The most popular reason for not wearing a helmet in the oldest age group was not having one (40%). Alternate explanations included other (20%), biking slowly and on safe streets (20%), as well as helmets being sweaty and uncomfortable (20%) (see Table 3).

Table 2. Demographics of recreational cyclists

	≤ 19 years old	**20-22 years old**	**≥ 23 years old**	***p*-value**
Cyclist/Non-Cyclist				0.4260
Cyclist	53 (62%)	25 (57%)	10 (77%)	
Non-Cyclist	32 (38%)	19 (43%)	3 (23%)	
Frequency of helmet use				0.0313
Always/Often	32 (60%)	8 (32%)	7 (70%)	
Rarely/On Occasion/Sometimes	21 (40%)	17 (68%)	3 (30%)	
Is it safer to wear a helmet?				0.9999
Yes	53 (100%)	25 (100%)	10 (100%)	
No	0 (0%)	0 (0%)	0 (0%)	

Table 3. Reasons for not wearing a helmet - school commute

Reasons	≤ 19 years old	20-22 years old	≥ 23 years old
"Inconvenience"	4 (20%)	5 (26%)	0 (0%)
"I always take safe streets, I bike slowly and don't need one"	4 (20%)	5 (26%)	1 (20%)
"Forget to"	3 (15%)	0 (0%)	0 (0%)
"Don't have one"	2 (10%)	1 (5%)	2 (40%)
"Sweaty, uncomfortable"	2 (10%)	1 (5%)	1 (20%)
Other*	5 (25%)	7 (37%)	1 (20%)

* Other: "Messes my hair", "Just don't want to", "No reason", "Social norms", "Not necessary".

Forty-one explanations were provided as reasons why recreational riders do not wear helmets. The predominant reason cited by the 19 years old and younger age group was biking on roads for short distances (30%). Other reasons (25%) were provided including: messes my hair, I don't have one, not necessary, social norms, and no reason. Additional reasons provided by this cohort included they forget (20%), a helmet is inconvenient (15%) and it looks uncool (10%). The major reason provided by individuals 20-22 years of age was other (39%). Alternate explanations included not caring (17%), only biking on roads for short distances (17%), inconvenience (11%), looking uncool (11%), and forgetting (6%). In the 23 years and older group, the predominant reason for not wearing a helmet was other (66%) followed by looking uncool (33%) (see Table 4).

Table 4. Reasons for not wearing a helmet - recreational cycling

Reasons	≤ 19 years old	20-22 years old	≥ 23 years old
"Looks uncool"	2 (10%)	2 (11%)	1 (33%)
"Forget"	4 (20%)	1 (6%)	0 (0%)
"Inconvenient"	3 (15%)	2 (11%)	0 (0%)
"Don't care"	0 (0%)	3 (17%)	0 (0%)
"I only bike on roads with no traffic and short distances"	6 (30%)	3 (17%)	0 (0%)
Other*	5 (25%)	7 (39%)	2 (66%)

* Other: "Messes my hair", "I don't have one", "Not necessary", "Social norms", "No reason".

DISCUSSION

This study accrued fewer participants than a similar questionnaire employed by Chow et al., querying about helmet use in adolescent boys in Toronto, Canada (6). The sample size did, however, yield various statistically significant results. Data indicated that not only does the prevalence of commuting to school via bike increase proportionally with age, most students who do choose to bike to school have less than a 20 minute commute. Older participants also choose to commute to school and use helmets more frequently than their younger cohorts. Additionally, data appears to show that all age groups (both recreational and commuter groups) are equally educated in terms of awareness about the safety of bicycle helmets. It is extremely concerning that many young people are aware of the safety benefits of wearing a helmet and deliberately choose not to.

A large proportion of older age participants identified as cyclists and there was a significant correlation between older age, frequency of commute to school and an increased use of helmets as a safety precaution. Further, the 19 years old and younger age group of both the commuters and recreational cyclists both cited the greatest number of excuses for not wearing helmets when compared to their cohorts in other age brackets. These excuses ranged from “messing up my hair” to “I don’t care”. The two most concerning excuses however were “I don’t own one” and “Social norms”. It is important that every person has access to affordable safety equipment when operating a bike. Data suggests that although individuals were aware of the importance of wearing a helmet, they did not own one. Although the specific reasons for this are inconclusive, possible explanations may include the cost of bike helmets, or the lack of education available in terms of proper fitting helmets and where to buy them. Additionally, it is important to change the discussion and general attitude of society, especially teens, towards safety equipment such as helmets. If

the discussion around bicycle helmets can be changed from being "uncool" and individuals being persecuted for wearing one to a proactive discussion that acknowledges helmets as being necessary and respectable for safety purposes, the number of individuals who wear helmets could increase dramatically.

This study was not without limitations. There exists the possibility of response/sampling bias. The survey was also circulated during the winter months, which may have resulted in a smaller proportion of young adults identifying them as cyclists; there may be a smaller sample size for analysis of subsequent questions due to the deployment timeframe of the survey.

Data shows that there is no trend in increased awareness of safety with age. A study conducted by Chow et al., in Toronto (20) and Anpalagan et al., in London (13) yielded similar observations. As every age group appears to be equally educated on bike safety, it is important to explore new ways to approach bicycle safety education in the hopes of decreasing the number of bicycle related fatalities especially among adolescents and young adults.

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We would like to thank all of those who participated in the questionnaire.

REFERENCES

[1] Attewell RG, Glase K, McFadden M. Bicycle helmet efficacy: a meta-analysis. Accid Anal Prev 2001;33(3):345-52.

[2] Sacks JJ, Holmgreen P, Smith SM, Sosin DM. Bicycle-associated head injuries and deaths in the United States from 1984 through 1988: how many are preventable? JAMA 1991;226(21):3016-8.

[3] Thompson DC, Nunn ME, Thompson RS, Rivara FP. Effectiveness of bicycle safety helmets in preventing serious facial injury. JAMA 1996;276(24):1974-5.

[4] Macknin ML, Medendorp SV. Association between bicycle helmet legislation, bicycle safety education, and use of bicycle helmets in children. Arch Pediatr Adolesc Med 1994;148(3):255-9.

[5] Rivara FP, Thompson DC, Patterson MQ, Thompson RS. Prevention of bicycle-related injuries: helmets, education, and legislation. Ann Rev Public Health 1998;19(1):293-318.

[6] Chow R, Hollenberg D, Pintilie A, Midroni C, Cumner S. Helmet use of adolescent cyclists at Crescent School in Toronto, Canada. Int J Adolesc Med Health 2016 Mar 12. Doi: 10.1515/ijamh-2015-0123.

[7] Borean M, Trasente V, Rzepka A, Viggiani D, Viotto D, Hollenberg D, et al. Helmet use of adolescents at De La Salle College Oaklands in Toronto, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[8] Antonakos CL. Environmental and travel preferences of cyclists. Doctoral dissertation, 1994. URL: https://trid.trb.org/view.aspx?id=413764.

[9] Karkhaneh M, Kalenga JC, Hagel BE, Rowe BH. Effectiveness of bicycle helmet legislation to increase helmet use: a systematic review. Inj Prev 2006;12(2):76-82.

[10] Cameron MH, Vulcan AP, Finch CF, Newstead SV. Mandatory bicycle helmet use following a decade of helmet promotion in Victoria, Australia- an evaluation. Accid Anal Prev 1994;26(3):325-37.

[11] Anpalagan T, Borean M, Chen L, Viehweger J, Hollenberg D, Rzepka A, et al. Helmet use of adolescents in Toronto, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[12] Borean M, Ho S, Hollenberg D, Anpalagan T, Rzepka A, Viehweger J, et al. Helmet use of adolescents in Markham, Canada. Int J Adolesc Med Health 2017;in press.

[13] Anpalagan T, Hollenberg D, Borean M, Rzepka A, Chow R. Helmet use of young adults in London, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[14] Viehweger J, Borean M, Tang M, Hollenberg D, Anpalagan T, Rzepka A, et al. Helmet use of young adults in St. Catherines, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[15] Anpalagan T, Duarte N, Borean M, Anpalagan J, Camilleri R, Hollenberg D, et al. Helmet use of young adults in Waterloo, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[16] Chow R, Borean M, Hollenberg D, Song K, Liu J, Young T, et al. Helmet use of young adults in Montreal, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[17] Chow R, Rzepka A, Borean M, Parekh R, Hollenberg D, Anpalagan T, et al. Helmet use of young adults in Saskatoon, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[18] Chow R, Hollenberg D, Borean M, Goh S, Anpalagan T, Rzepka A, et al. Helmet use of young adults in Dublin, Ireland. Int J Child Health Hum Dev 2018;11(1), in press.

[19] Chow R, Borean M, Hollenberg D, Ganguli N, Freedman Z, Kang R, et al. Helmet use of young adults in New York State, United States of America. Int J Child Health Hum Dev 2018;11(1), in press.

[20] Chow R, Borean M, Hollenberg D, Ho C, Ng W, Guo W, et al. Helmet use of young adults in Toronto, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

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Chapter 12

HELMET USE OF YOUNG ADULTS IN HAMILTON, CANADA

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Biking is a popular alternative for many people as it is eco-friendly, cost efficient and also healthy. There is ample evidence suggesting that wearing protective headgear will protect bikers against potential dangers. Despite this, helmet-wearing rates remain low among adolescents. We have observed that adolescent boys have lower helmet-wearing rates as they age. In order to see if this trend generalizes among an older age group, multiple studies were conducted across Canada. All studies indicate that in young adulthood, there is a positive correlation between age and helmet-wearing rate; as youth get older they had higher rates. To verify this in Hamilton, Canada, a similar survey was circulated across youth in that area. The survey was completed by 87 participants. The data shows that there is no correlation between age and helmet use in

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Hamilton, as both the younger age cohort of 19 years old and younger and the older group of 20 years old and older wore their helmets in roughly the same proportion. The majority of the cyclers had a short commute time of less than 20 minutes and all participants were able to identify that it is safer to ride with a helmet on. The excuses that arose for reasons as to why young adults chose not to wear a helmet is that it was inconvenient, it was a short distance and that they were confident in their riding ability. Overall, despite the fact that the data is not inline with the trend depicted by the other studies, this study demonstrates that the helmet-wearing rate of youth can definitely be improved. Implementing programs that promote safe biking practices will benefit youth across Canada.

INTRODUCTION

Biking is a popular alternative for many people as it is eco-friendly, cost efficient, and a form of exercise. Safe biking practices, including wearing protective headgear, are essential to ensure that the biker is protected against potential dangers. According to a study conducted by the Australian Transport Safety Bureau (1), there is clear evidence that bicycle helmets prevent serious injury and death. Injuries to the head and brain are reduced by 66-88% if one wears a bike helmet (2). There have been many legislations enacted to encourage youth to wear their helmet (3). Due to the immense amount of benefits that are accrued by wearing a helmet, one would expect these rates to rise along with the rise in the number of people riding their bikes.

Unfortunately, recent studies done by a group based in London, Ontario show that helmet-wearing rates are significantly lower than expected. There have been a number of studies conducted (4-16) across Canada, the United States of America and Ireland featuring the helmet-wearing rates for adolescents and young adults, and how it correlates to the age of bikers.

A study conducted by Chow et al. (5) reported that helmet-wearing rates in adolescent boys decrease as they age. The younger age cohort (Grades 7 and 8, age 13-14) had a 96% helmet use while older boys (Grades 9-10) had a 76% rate, and the oldest cohort (Grades 11-12) had a

59% helmet-wearing rate. This study suggests that there is a negative correlation between age and helmet-wearing rate (5).

A similar study was conducted in London, Ontario (9) to evaluate if this trend would be present in an older group. This study shows that those aged 19 and under had a 38% helmet-wearing rate, those between the ages of 20 and 22 reported a 49% rate and the oldest age group of 23 and older had the highest rate of 66% (9). Interestingly, this study depicted a positive correlation between age and helmet-wearing rates; the older age group had a higher rate than the younger ones. In order to validate this conclusion, similar studies were conducted across Ontario, in Guelph, Kingston, St. Catherines, Toronto and Waterloo. All of these studies had similar results that were inline with the trend of the older cohorts reporting a lower helmet-wearing rate.

The study was also carried out in Saskatchewan and Quebec - both studies revealed a positive correlation trend. In the United States, the study was conducted in New York and California, both of which report similar findings as the other studies that were presented (4-16). This alarming trend is also found in Ireland, although notably with a much lower overall helmet-wearing rate.

The trend that is found among all these cities is frightening, as bicycle helmets have been proven to increase safety among cyclers. In order to further validate this trend, the survey was circulated in Hamilton, Canada among young adults.

OUR STUDY

An anonymous survey was circulated in Hamilton, Ontario. This survey aimed to evaluate the bicycle and helmet use of young adults commuting to university and during their recreational time (see chapter 2). In addition to this, the survey seeked to determine the main reasons why young adults chose not to wear helmets while cycling.

Table 1. Demographics of cyclists to university

	≤ 19 years old	**≥ 20 years old**	***p*-value**
Cyclist/Non-Cyclist			0.6078
Cyclist	17 (21%)	2 (33%)	
Non-Cyclist	64 (79%)	4 (66%)	
Duration			0.9999
Under 20 min	16 (94%)	2 (100%)	
Over 20 min	1 (6%)	0 (0%)	
Frequency of commute			0.9999
Always/Often	6 (35%)	1 (50%)	
Rarely/On Occasion/Sometimes	11 (65%)	1 (50%)	
Frequency of helmet use			0.9999
Always/Often	6 (35%)	1 (50%)	
Rarely/On Occasion/Sometimes	11 (65%)	1 (50%)	
Is it safer to wear a helmet?			0.9999
Yes	17 (100%)	2 (100%)	
No	0 (0%)	0 (0%)	

The collected data was divided into two cohorts, aged 19 and under, and ages 20 and over. The frequency of commute was categorized into two; as Always/Often and Rarely/On Occasion/Sometimes. Similarly, the frequency of helmet use was also divided into Always/Often and Rarely/On Occasion/Sometimes. The duration of cycling was collapsed into two subdivisions, under 20 minutes and over 20 minutes. Fisher exact tests were used to determine if there was any difference in responses, by age cohorts. To describe the reasons for why young adults chose not to wear their helmets, descriptive statistics were used. All values were conducted using the Statistical Analysis Software (SAS Version 9.4 for Windows), with p-values less than 0.05 considered statistically significant.

FINDINGS

The questionnaire was completed by 87 participants, all of whom consented to the survey. Of these respondents, 81 were 19 years old and younger and the remaining 6 were 20 years old or older.

Table 2. Demographics of recreational cyclists

	≤ 19 years old	**≥ 20 years old**	***p*-value**
Cyclist/Non-Cyclist			0.6527
Cyclist	60 (74%)	4 (66%)	
Non-Cyclist	21 (26%)	2 (33%)	
Frequency of helmet use			0.9999
Always/Often	33 (55%)	2 (50%)	
Rarely/On Occasion/Sometimes	27 (45%)	2 (50%)	
Is it safer to wear a helmet?			0.9999
Yes	60 (100%)	4 (100%)	
No	0 (0%)	0 (0%)	

While comparing the two age cohorts, there is a relatively equal proportion of each group that cycles to school (p = 0.6078). 21% of those aged 19 and under and 33% of those 20 and older cycle to school. Most of the young adults, 94% and 100% of those aged 19 and under, and 20 and older, respectively, ride for less than 20 minutes; no difference was noted (p = 0.9999). In terms of the frequency of commute, 35% of those aged 19 and under ride their bike often to campus. This is different to the 50% of the older cohort that ride often to campus, however this is not statistically significant (p = 0.9999). 35% and 50% of those 19 and under and 20 and older respectively wear their helmets more frequently (p = 0.9999). Both age groups were able to identify that it is safer to wear a helmet; 100% of both age groups responded true to the question (p = 0.9999) (see Table 1).

Next, the survey pondered the safety practices of recreational cyclists. 74% of those aged 19 and under and 66% of those older than 19 years of age reported that they bike during their leisure time (p = 0.6527); this value is not statistically significant. Of these cyclists, 55% and 50% of those aged 19 and under and those 20 years and older, respectively, said they wore their helmets more frequently (p = 0.9999); thus, no difference was noted. Again, both age cohorts equally identified that it was safer to wear a helmet; 100% of respondents in both age ranges (p = 0.9999) (see Table 2).

Table 3. Reasons for not wearing a helmet - school commute

Reasons	≤ 19 years old	≥ 20 years old
"Don't Have One"	2 (22%)	0 (0%)
"Can't Afford One"	1 (11%)	0 (0%)
"Inconvenience"	1 (11%)	1 (100%)
"Confidence in Riding Ability"	2 (22%)	0 (0%)
"Ruins Hair"	1 (11%)	0 (0%)
Other*	2 (22%)	0 (0%)

* Other: "Don't want to", "too much effort".

Table 4. Reasons for not wearing a helmet - recreational cycling

Reasons	≤ 19 years old	≥ 20 years old
"Uncomfortable"	1 (3%)	1 (100%)
"Don't Have One"	8 (27%)	0 (0%)
"Confidence in Riding Ability"	7 (23%)	0 (0%)
"Inconvenient"	6 (20%)	0 (0%)
"Short Distance"	4 (13%)	0 (0%)
Other*	4 (13%)	0 (0%)

* Other: "Doesn't look cool".

There were ten reasons given to why young adults do not wear their helmet during their commute to school. For those aged 19 and under, 22% of young adults said that they do not have a helmet, 22% reported that they were confident in their riding ability, 22% had other reasons including that they simply did not want to use a helmet, and that it was too much effort to wear one. 11% of these young adults said they couldn't afford a helmet, 11% said it was inconvenient and the remaining 11% commented that wearing a helmet would ruin their hair. For those aged 20 and older, the sole reason that was given was that wearing a helmet was inconvenience (see Table 3).

Next, there were 31 responses given for reasons as to why young adults did not wear their helmet during recreational cycling. For the younger age division, 27% of participants said they did not have a helmet, 23% reported that they were confident in their riding ability, 20%

commented that it was inconvenient to wear a helmet, 13% said that their riding distance was too short to wear a helmet, 13% had other reasons including the helmet was not visually appealing and the remaining 3% reported that the helmet was uncomfortable. The older cohort reported one reason, which was that wearing a helmet is uncomfortable (see Table 4).

DISCUSSION

There were less participants in this study compared to similar studies conducted in other areas of Ontario. Chow et al. (5) unearthed the negative correlation between age and helmet use among adolescents in high school, and Anpalagan et al. (9) determined a positive correlation among the young adults after high school; this trend generalized across many different studies that were conducted across Canada and other countries (4-16). This study did not yield statistically significant data that was inline with the previously noted trend, however this could be due to the lack of older respondents. In the older age cohort of those aged 20 and older, there were only 6 participants.

Noteworthy patterns exist in the data. Overall, between the two groups, there was no difference in the proportion of young adults that bike to campus as well as recreational cycling. There was also no difference in helmet-wearing rates between the two groups. It should, however, that 100% of respondents in both age groups demonstrated a strong knowledge of biking practices; all agreed that it is safer to wear a helmet while riding but refuse to wear a helmet. Most of the young adults in Hamilton had a short bike ride, under 20 minutes, to campus. This is most probably due to the smaller campus and close proximity of the housing in the area.

Excuses provided for the lack of helmet use include “Don’t have one”, “Inconvenience” and “Can’t afford one”. There are feasible solutions to each of these issues. Bicycle helmets should be made more accessible, perhaps by allowing youth to rent them; this would eliminate the cost barrier. To decrease inconvenience associated with bicycle helmet use, it

might be worthwhile to allocate spaces to store helmets, such as lockers, in the buildings where most young adults have classes.

This study also shows a high frequency of bikers in Hamilton in comparison to Toronto and New York City. On average, 69% and 71% of bikers in Toronto and New York State respectively report that they only ride their bike rarely or on occasion (4, 10). This figure is compared to the 57% of respondents who answered that they rode at the frequency. Bikers in Hamilton seem to opt for their bikes more often than those in Toronto and New York State. This may be explained by the fact that both Toronto and New York State have a functional subway system that transports many people in a short amount of time.

This study has certain limitations which pertain to the sample. The most significant one would be the small sample size, namely in the older cohort. Due to this, it was difficult to his draw significant patterns based on the age groups. In the future, this study can be repeated with a larger sample size to determine trends. It should also be noted that there exists a possibility of sampling and response bias, as with any survey.

To conclude, this study demonstrates that all participants equally wear their helmets. In addition, all young adults are equally knowledgeable that wearing a helmet is safer. Alternate safety measures need to be taken to increase the proportion of young adults that wear their helmets while cycling.

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We would like to thank all of those who participated in the questionnaire.

REFERENCES

[1] Attewell RG, Glase K, McFadden M. Bicycle helmet efficacy: a meta-analysis. Accid Anal Prev 2001;33(3):345-52.

[2] Bicycle Safety and Helmet Institute. URL: http://www.helmets.org/stats. htm# effectiveness.

[3] McMaster University. URL: https://security.mcmaster.ca/crime_prevention_cycling.html.

[4] Chow R, Borean M, Hollenberg D, Ganguli N, Freedman Z, Kang R, et al. Helmet use of young adults in New York State, United States of America. Int J Child Health Hum Dev 2018;11(1), in press.

[5] Chow R, Hollenberg D, Pintilie A, Midroni C, Cumner S. Helmet use of adolescent cyclists at Crescent School in Toronto, Canada. Int J Adolesc Med Health 2016 Mar 12. Doi: 10.1515/ijamh-2015-0123.

[6] Borean M, Trasente V, Rzepka A, Viggiani D, Viotto D, Hollenberg D, et al. Helmet use of adolescents at De La Salle College Oaklands in Toronto, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[7] Anpalagan T, Borean M, Chen L, Viehweger J, Rzepka A, et al. Helmet use of adolescents in Toronto, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[8] Borean M, Ho S, Hollenberg D, Anpalagan T, Rzepka A, Viehweger J, et al. Helmet use of adolescents in Markham, Canada. Int J Adolesc Med Health 2017;in press.

[9] Anpalagan T, Hollenberg D, Borean M, Rzepka A, Chow R. Helmet use of young adults in London, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[10] Chow R, Hollenberg D, Pintilie A, Midroni C, Cumner S. Helmet use of adolescent cyclists at Crescent School in Toronto, Canada. Int J Adolesc Med Health 2016 Mar 12. Doi: 10.1515/ijamh-2015-0123.

[11] Viehweger J, Borean M, Tang M, Hollenberg D, Anpalagan T, Rzepka A, et al. Helmet use of young adults in St. Catherines, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[12] Anpalagan T, Duarte N, Borean M, Anpalagan J, Camilleri R, Hollenberg D, et al. Helmet use of young adults in Waterloo, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[13] Chow R, Borean M, Hollenberg D, Song K, Liu J, Young T, et al. Helmet use of young adults in Montreal, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[14] Chow R, Rzepka A, Borean M, Parekh R, Hollenberg D, Anpalagan T, et al. Helmet use of young adults in Saskatoon, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[15] Chow R, Hollenberg D, Borean M, Goh S, Anpalagan T, Rzepka A, et al. Helmet use of young adults in Dublin, Ireland. Int J Child Health Hum Dev 2018;11(1), in press.

[16] Viehweger J, Borean M, Midroni L, Midroni C, Hollenberg D, Anpalagan T et al. Helmet use of young adults in Kingston, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

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Chapter 13

HELMET USE OF YOUNG ADULTS IN GUELPH, CANADA

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Biking is a pleasurable activity and an effective means of transportation, but it carries an inherent risk of injury. Despite this, studies conducted across Canada suggest that helmet use rates remain shockingly low among young adults. The purpose of this chapter was to determine whether this trend continues in Guelph, Canada. A similar survey to the ones used by Anpalagan et al. was created and included questions to evaluate helmet usage, knowledge of the impact of helmets use on bicycle safety, and reasons that cyclists choose not to wear helmets. The Fisher Exact test was used to determine if there were any differences in response

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between two age groups: 19 years old and younger, and 20 years old and above. While no participants in the older age group reported cycling to school, the recreational cycling questionnaire presents a negative correlation between increasing age and helmet use (43% of the 19 and below age group and 0% of the 20 and above age group). Though both age groups were knowledgeable about the safety impacts of wearing a helmet while biking, it is unfortunate to see that this understanding does not correlate positively with helmet usage. Seeing as many young adults choose not to wear a helmet to due its physical appearance, bicycle safety advocates should continue to focus on design and effective promotion of helmet use to young adults.

INTRODUCTION

Biking is both a pleasurable recreational activity as well as an effective means of local transportation. However, as with most high speed physical activities, it comes with an inherent risk of injury. Fortunately, wearing bicycle helmets offers an effective method of injury protection for riders. It has been shown that not using a helmet while riding results in an increased risk of death (1), and the risk of head injury can be reduced be reduced by up to 85% through the use of a helmet (2).

Though helmets have been shown to improve bicycle safety, there is an alarming lack of their use amongst adolescents and young adults. There have been numerous studies conducted in Canada and internationally to investigate trends in adolescent and young adult helmet usage rates (3-15). Past studies completed in Ontario high schools indicate that recreational helmet use decreases amongst adolescents with increasing age (4, 5, 7). At De La Salle College in Toronto, the rate started at 74% for grades 7 and 8, then decreased to 66% in grades 9 and 10, and 55% in grades 11 and 12 (5). In young adults, it is positive to see that it has been recorded that recreational helmet usage rates increase above the age of 19 (8, 11). A frequently given reason given by participants throughout the studies as to why they choose not to wear a helmets is that many riders feel confident enough in their cycling ability to avoid an accident (3-15).

Considering the preventability of bicycle accident injury rates through the use of a helmet (1-2), it is alarming to see the low helmet usage rates

amongst adolescents and young adults. A similar study to those conducted in other cities (3-15) was conducted in Guelph to attempt to validate the observed trends.

OUR RESEARCH

Young adults in Guelph received an anonymous question. There were two halves of the survey - the first half looked into bicycle and helmet use of young adults for those who commute to university campus; the latter half posed similar questions but in the context of recreational cycling. All but one question had multiple-choice answers; only the reasons for not using helmets was a short-answer-style question (see chapter 2).

The Fisher Exact Tests were used to determine whether there was a difference in response, proportionally, between three age groups - below 20 years old, between 20 and 22 years old, and above 22 years old. Responses to questions consolidated into a few categories to for the analyses. The frequency of commute and helmet use had two responses - Always/Often and Rarely/On Occasion/Sometimes. The duration of university commute was also consolidated into two answers - Under 20 min and Over 20 min. All statistical analyses were conducted using the Statistical Analysis Software (SAS Version 9.4 for Windows); p-values less than 0.05 were considered statistically significant. Descriptive statistics were used to report the reasons why young adults do not use helmets regularly.

OUR FINDINGS

The questionnaire was completed by 76 participants, all of whom consented to the survey. Of these, 70 were 19 years old or younger while 6 were 20 years old or older.

Table 1. Demographics of cyclists to university

	≤ 19 years old	**≥20 years old**
Cyclist/Non-Cyclist		
Cyclist	6 (9%)	0 (0%)
Non-Cyclist	64 (91%)	6 (100%)
Duration		
Under 20 min	6 (100%)	0 (0%)
Over 20 min	0 (0%)	0 (0%)
Frequency of commute		
Always/Often	6 (100%)	0 (0%)
Rarely/On Occasion/Sometimes	0 (0%)	0 (0%)
Frequency of helmet use		
Always/Often	2 (33%)	0 (0%)
Rarely/On Occasion/Sometimes	4 (66%)	0 (0%)
Is it safer to wear a helmet?		
Yes	6 (100%)	0 (0%)
No	0 (0%)	0 (0%)

Of the 19 year old and younger cohort, only 9% reported bicycling to school, while no students aged 20 years old or older reported so. 100% of students aged 19 and younger that use a bicycle on campus reported commuting 20 minutes or less "Always/Often". Although 100% of these students agree that it is safer to wear a helmet, only 33% do so on a regular basis (see Table 1).

Recreational cycling appears to be more popular amongst both age groups. 67% of the younger cohort and 70% of the older reported using a bicycle in their free time; no difference was noted ($p = 0.6706$). Furthermore, 43% of the younger age group wears a helmet while 0% of the older age group does so. While this difference is statistically insignificant ($p = 0.4132$), there is a trend to suggest that helmet use decreases with age. This is interesting considering that both groups completely agree that biking with a helmet is safer (100% in both age groups, $p = 0.9999$) (see Table 2).

Table 2. Demographics of recreational cyclists

	≤ 19 years old	**≥20 years old**	***p*-value**
Cyclist/Non-Cyclist			0.6706
Cyclist	49 (70%)	4 (67%)	
Non-Cyclist	21 (30%)	2 (33%)	
Frequency of helmet use			0.1432
Always/Often	21 (43%)	0 (0%)	
Rarely/On Occasion/Sometimes	28 (57%)	4 (100%)	
Is it safer to wear a helmet?			0.9999
Yes	49 (100%)	6 (100%)	
No	0 (0%)	0 (0%)	

Four responses were given as to why students don't wear helmets while biking on campus. The reasons given by students in the 19 year old and younger age group were split evenly with one vote for each of the following: the helmet getting in their way, messing up their hair, having nowhere to store it on campus, and being in too much of a rush to use one (see Table 3).

Table 3. Reasons for not wearing a helmet - school commute

Reasons	**≤ 19 years old**	**≥20 years old**
"Gets in the way"	1 (25%)	0 (0%)
"Messes up my hair"	1 (25%)	0 (0%)
"Nowhere to store it on campus"	1 (25%)	0 (0%)
"Rushing"	1 (25%)	0 (0%)

Table 4. Reasons for not wearing a helmet - recreational cycling

Reasons	**≤ 19 years old**	**≥20 years old**
"It's inconvenient"	8 (30%)	1 (33%)
"Not fashionable"	6 (22%)	0 (0%)
"I'm a good biker"	4 (15%)	0 (0%)
"It's only a short trip"	3 (11%)	0 (0%)
"I don't own a helmet"	1 (4%)	2 (67%)
Other*	5 (18%)	0 (0%)

***** Other: "I don't feel the need", "Uncomfortable", "I'm on personal property",

Thirty recreational cyclists responded with explanations as to why they choose not to wear a helmet, and provided a much more varied array of reasons. In the younger age group, the most popular reason was that it is not convenient (30%), followed by helmets not being fashionable (22%). Other reasons include considering one's self a good biker (15%), undertaking trips too short to deem a helmet necessary (11%), not owning a helmet (4%), and numerous other reasons such as not feeling the need to do so (18%). In the 20 year old and above age group, the most popular reason for not wearing a helmet was not owning one (67%), followed by inconvenience at 33% (see Table 4).

DISCUSSION

This study yielded results with trends that differ from those observed in a study by Anpalagan et al. (8) in London, Canada. The study conducted by Anpalagan et al. recorded a positive correlation between recreational helmet use and age (44% for 19 years old and younger, 56% between 20 and 22 years old, and 68% for 23 years old and older). However, this study conducted in Guelph showed a negative correlation in helmet use and age (43% for those aged 19 and younger, and 0% for those aged 20 and older). However because of the limited sample size of the older age group, this results must be interpreted with caution.

There is concerning pattern between this study and and previous literature (3-15) regarding acknowledgement of helmet safety and the reported rates of helmet use by those surveyed. In all studies, a large majority of school and recreational cyclists agreed with the statement that cycling with a helmet is much safer than without one. This is however not reflected in the self-reported helmet usage rates in all groups.

It can be seen that young adults in Guelph often prioritize other factors over their understanding of the impact on safety that helmets provide. The two most common reason given by the under 19 year old recreational cohort is that helmets are inconvenient (30%) and unfashionable (22%). This seems to indicate that the issue behind low helmet usage lies not in a

lack of bicycle safety education, but rather in the design of helmets and their promotion to the self-image conscious young adult. Considering that the message of helmet safety has been effective, more emphasis should now be put on the efficient functionality and appearance of helmet design.

This study was not without limitations. The survey was optional for students in Guelph, and this along with its self-reported nature yielded a possibility of response/sampling bias. The study was also completed by a smaller than ideal number of people older than 19 years old, which resulted in p-values that must be interpreted with discretion. It was also not possible to conduct a statistical test on the survey regarding cycling to school, as the above 19 year old age group did not report doing so at all. Additionally, the fact that the study was open for completion during the winter months may have affected the responses of participants by altering their judgement on their regular cycling habits.

In conclusion, the trends seen in this study are similar to many of those observed in previous literature (3-15). It proposes the idea that helmet usage decreases with increasing age and proposes that this may be due to this age group's increased care for self-image. The inconvenience of using a helmet on a daily basis also impedes helmet use in many students and suggests that changes must be made either to the design or implementation of bicycle safety strategies. Advocacy groups need to be established to promote bicycle safety in the local community as people are aware of the safety implications of biking yet in a large part still do not comply with safety precautions.

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REFERENCES

[1] Persaud N, Coleman E, Zwolakowski D, Lauwers B, Cass D. Nonuse of bicycle helmets and risk of fatal head injury: a proportional mortality, case–control study. CMAJ 2012;184(17):E921-3.

[2] Thompson R, Rivara F, Thompson D. A case-control study of the effectiveness of bicycle safety helmets. N Engl J Med 1989; 320:1361-7.

[3] Chow R, Borean M, Hollenberg D, Ganguli N, Freedman Z, Kang R, et al. Helmet use of young adults in New York State, United States of America. Int J Child Health Hum Dev 2018;11(1), in press.

[4] Chow R, Hollenberg D, Pintilie A, Midroni C, Cumner S. Helmet use of adolescent cyclists at Crescent School in Toronto, Canada. Int J Adolesc Med Health 2016 Mar 12. Doi: 10.1515/ijamh-2015-0123.

[5] Borean M, Trasente V, Rzepka A, Viggiani D, Viotto D, Hollenberg D, et al. Helmet use of adolescents at De La Salle College Oaklands in Toronto, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[6] Anpalagan T, Borean M, Chen L, Viehweger J, Hollenberg D, Rzepka A, et al. Helmet use of adolescents in Toronto, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[7] Borean M, Ho S, Hollenberg D, Anpalagan T, Rzepka A, Viehweger J, et al. Helmet use of adolescents in Markham, Canada. Int J Adolesc Med Health 2017;in press.

[8] Anpalagan T, Hollenberg D, Borean M, Rzepka A, Chow R. Helmet use of young adults in London, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[9] Chow R, Borean M, Hollenberg D, Ho C, Ng W, Guo W, et al. Helmet use of young adults in Toronto, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[10] Viehweger J, Borean M, Tang M, Hollenberg D, Anpalagan T, Rzepka A, et al. Helmet use of young adults in St. Catherines, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[11] Anpalagan T, Duarte N, Borean M, Anpalagan J, Camilleri R, Hollenberg D, et al. Helmet use of young adults in Waterloo, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[12] Chow R, Borean M, Hollenberg D, Song K, Liu J, Young T, et al. Helmet use of young adults in Montreal, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[13] Chow R, Rzepka A, Borean M, Parekh R, Hollenberg D, Anpalagan T, et al. Helmet use of young adults in Saskatoon, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[14] Chow R, Hollenberg D, Borean M, Goh S, Anpalagan T, Rzepka A, et al. Helmet use of young adults in Dublin, Ireland. Int J Child Health Hum Dev 2018;11(1), in press.

[15] Viehweger J, Borean M, Midroni L, Midroni C, Hollenberg D, Anpalagan T et al. Helmet use of young adults in Kingston, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

SECTION FOUR: HELMET USE OF YOUNG ADULTS IN OTHER CANADA PROVINCES

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Chapter 14

HELMET USE OF YOUNG ADULTS IN MONTREAL, CANADA

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Studies carried out at high schools in Ontario, Canada, have noticed a decline in helmet use with increase in adolescent age. Other studies conducted amongst young adult populations in Ontario observed a continuation of this decline. This trend is disappointing, especially in a region where there exists legislation mandating minors to use helmets with the intent to establish a good habit for helmet use. This study was conducted to determine whether there exists a trend in Quebec, Canada, a province where such legislation does not exist. A questionnaire was developed and circulated to young adults in Montreal, inquiring about bicycle and helmet use during their commute to university and their

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recreational time. The recorded helmet-wearing rates are slightly higher than studies conducted amongst young adults in Ontario. However, the trend of declining helmet use in the early stages of adulthood was noticed. It seems that a significantly larger proportion of young adults use their bicycles during their free time, compared to those located in Ontario. These differences may be a result of differences in climate, culture and/or childhood development; the data suggests they are equally safe if not more safe when it comes to cycling. Future studies should be conducted in other provinces of Canada to further determine if there is indeed a difference in bicycle and helmet use in different regions.

INTRODUCTION

Bicycle helmets can prevent serious injury and even death. A meta-analysis showed that helmets are effective in reducing head injury, brain injury, facial injury and fatal injury (1). In regions where bicycle helmet use has increased, the number of head injuries has decreased - a study conducted in Seattle observed that an increase of helmet use from 5.5% to 40.2% resulted in a reduction in head injuries by more than 65% (2). However, evidence and recommendations for helmet use has not translated into our practical society. While parents agree that helmets are efficacious, the helmet-use rates among children and adolescents remain lackluster (3).

Three studies have been carried at high schools in Ontario, Canada. Chow et al. (4) reported a 88% helmet-wearing rate among adolescents in Grade 7 and 8, 60% use for Grade 9 and 10 students, and 58% use for Grade 11 and 12 students. Borean et al. (5) similarly noticed a decline with age - only 38% of the older Grade 11 and 12 students used helmets, as opposed to 41% of Grade 9 and 10 students. Anpalagan et al. determined that 61% and 50% of Grade 9 and 10 students and Grade 11 and 12 students, respectively, used a helmet [6]. The declining trends observed in adolescents continued into young adults in Ontario with existing literature reporting extremely low helmet-wearing rates ranging from 32% to 44% (7-9).

These low rates are disappointing, especially in a region where there exists legislation mandating for minors (children under the age of 18 years old) to use helmets when riding their bicycles. In Quebec, Canada, there is

no legislation mandating people to use helmets (3). It would be interesting to see whether these low rates are also observed in a region where legislation does not exist, hence not mandating individuals to wear helmets during their childhood. The aim of this study was to determine the helmet use of young adults in Montreal, Canada.

OUR STUDY

The questionnaire employed for young adults in Ontario (7-9) was used to survey young adults in Montreal, Canada. Young adults were targeted during the circulation of the survey, and were informed it was anonymous. The first half of the questionnaire surveyed bicycle and helmet use for young adults when they commute to university, while the latter half examined bicycle and helmet use amongst the population in their free time. The objective of the questionnaire was to determine the proportion of young adults who identify themselves as cyclists, the percentage of cyclists who use helmets, and also the underlying reasons for why some young adults do not use a helmet (see chapter 2).

The data collected was separated into three cohorts based on age - 19 years and below, ages 20 to 22 years old, and 23 years old and above. Duration of commute to university campus and frequency of helmet use were both collapsed into two categories; Under 20 and over 20 minutes for the former, and Always/Often and Rarely/On Occasion/Sometimes for the latter. χ^2-tests were used to determine whether there was a difference in proportion among the age groups for multiple-choice questions. Descriptive statistics were used to convey the data collected from short-response questions. P-values less than 0.05 were considered to be statistically significant. All analyses were performed using the Statistical Analysis Software (SAS Version 9.4 for Windows).

WHAT DID WE FIND?

The questionnaire was completed by 170 consenting young adults in the Montreal area. Of the 170 young adults, 87 (51%) of them were 19 years old and younger, 54 (32%) were between the ages of 20 and 22 years old, and 29 (17%) were 23 years and older. A larger proportion of the oldest cohort identified themselves as cyclists to university ($p<0.0001$; 76% vs 61% for 20-22 year olds and 26% for those 19 years and below). Most of these older cyclists also reported that their bicycle commute was under 20 minutes in duration ($p=0.0066$; 77% compared to 39% and 36% for those 19 years and below, and between 20 and 22 years old, respectively). 22%, 24% and 41% of the youngest to older cohorts, respectively, reported that they frequently use a bicycle as a means of transportation to university ($p=0.2888$), and helmet use among the groups were roughly equal (48% vs 39% vs 64%, respectively; $p=0.2106$). All three age groups equally recognized that it is safer to wear a helmet when cycling ($p=0.0859$; 91% agreed for those 19 years and below, and 100% of those between 20 and 22 years old, and above 23 years old, held the belief) (see Table 1).

Table 1. Demographics of cyclists to university

	≤ 19 years old	**20-22 years old**	**≥ 23 years old**	***p*-value**
Cyclist/Non-Cyclist				<0.0001
Cyclist	23 (26%)	33 (61%)	22 (76%)	
Non-Cyclist	64 (74%)	21 (39%)	7 (24%)	
Duration				0.0066
Under 20 min	9 (39%)	12 (36%)	17 (77%)	
Over 20 min	14 (61%)	21 (64%)	5 (23%)	
Frequency of commute				0.2888
Always/Often	5 (22%)	8 (24%)	9 (41%)	
Rarely/On Occasion/Sometimes	18 (78%)	25 (76%)	13 (59%)	
Frequency of helmet use				0.2106
Always/Often	11 (48%)	13 (39%)	14 (64%)	
Rarely/On Occasion/Sometimes	12 (52%)	20 (61%)	8 (36%)	
Is it safer to wear a helmet?				0.0859
Yes	21 (91%)	33 (100%)	22 (100%)	
No	2 (9%)	0 (0%)	0 (0%)	

Similar proportions of young adults across the cohorts identified themselves as a cyclist during their recreational time (p=0.3050) - 72% of young adults 19 years and below, 78% of those between 20 and 22 years old, and 86% of those above 22 years in age. Helmet use rate was recorded to be 56%, 55% and 68% for those 19 years and below, between 20 and 22 years old, and 23 years and older, respectively (p=0.5082). In concordance, all three cohorts held a similar belief that helmet use is safer for the cyclist (p=0.6646; 95% agreement for those 19 years and below, whereas 98% and 100% agreement for those between 20 and 22 years old, and older than 22 years old, respectively) (see Table 2).

Table 2. Demographics of recreational cyclists

	≤ 19 years old	**20-22 years old**	**≥ 23 years old**	***p*-value**
Cyclist/Non-Cyclist				0.3050
Cyclist	63 (72%)	42 (78%)	25 (86%)	
Non-Cyclist	24 (28%)	12 (22%)	4 (14%)	
Frequency of helmet use				0.5082
Always/Often	35 (56%)	23 (55%)	17 (68%)	
Rarely/On Occasion/Sometimes	28 (44%)	19 (45%)	8 (32%)	
Is it safer to wear a helmet?				0.6646
Yes	60 (95%)	41 (98%)	25 (100%)	
No	3 (5%)	1 (2%)	0 (0%)	

Young adults 19 years and younger provided 13 reasons for not using a helmet during their school commute, while those between 20 and 22 years old gave 22 reasons and those above 22 years old provided 8 reasons. The youngest cohort commonly cited that they do not have a functional helmet (38% of reasons), as well as an overconfidence in riding abilities (15%), cosmetic reasons (23%), inconvenience (8%) and comfort (8%). For those aged 20 to 22 years old, 32% cited inconvenience as a deterrent for bicycle use; 18% reported they do not own an helmet, 18% were confident in their riding abilities, 14% cited cosmetic reasons, and 4% noted its uncomfort. In the oldest cohort, inconvenience (38%), lack of ownership (25%),

cosmetics (25%) and confidence in riding ability (13%) as reasons for why they do not wear a helmet during their commute to university (see Table 3).

Table 3. Reasons for not wearing a helmet - school commute

Reasons	**≤ 19 years old**	**20-22 years old**	**≥ 23 years old**
"Looks bad/lame/messes up hair"	3 (23%)	3 (14%)	2 (25%)
"Don't need one/stupid"	2 (15%)	4 (18%)	1 (13%)
"Don't have one/broken/forgot"	5 (38%)	4 (18%)	2 (25%)
"Inconvenience"	1 (8%)	7 (32%)	3 (38%)
"Uncomfortable"	1 (8%)	1 (4%)	0 (0%)
Other*	1 (8%)	3 (14%)	0 (0%)

*Other: "Helmets cannot help prevent most fatal cycling accidents."

The oldest cohort recorded 7 reasons for why they do not use a helmet when cycling during their recreational time - 43% cited uncomfort, 29% were confident in their riding ability, 14% did not possess one and 14% noted it messed up their hair. Amongst those between 20 and 22 years old, the reasons included inconvenience (26%), not having one (21%), uncomfort (16%), cosmetics (16%) and confidence in riding ability (10%). The youngest cohort cited uncomfort (26%), inconvenience (20%), poor visual appeal (20%), strong riding abilities (20%) and not owning one (11%) (see Table 4).

Table 4. Reasons for not wearing a helmet - recreational cycling

Reasons	**≤ 19 years old**	**20-22 years old**	**≥ 23 years old**
"Looks bad/lame/messes up hair"	7 (20%)	3 (16%)	1 (14%)
"Don't need one/stupid"	7 (20%)	2 (10%)	2 (29%)
"Don't have one/broken/forgot"	4 (11%)	4 (21%)	1 (14%)
"Inconvenience"	7 (20%)	5 (26%)	3 (43%)
"Uncomfortable"	9 (26%)	3 (16%)	0 (0%)
Other*	1 (3%)	2 (1%)	0 (0%)

*Other: "Helmets cannot help prevent most fatal cycling accidents."

DISCUSSION

The helmet-wearing rates revealed in this study are slightly higher than studies conducted amongst young adults in Ontario (7-9). However, the trend of declining helmet use in the early stages of adulthood is noticed, with helmet use falling between the youngest cohort (19 years and younger) and the second cohort (between 20 and 22 years old) in both the setting of university commute and recreational cycling.

In line with previous studies, this study showed suggested that a larger proportion of those in excess of 22 years old utilize a bicycle to commute to campus. However, this study shows that most of these commutes by the older cohort are short-distance rather than long-distance commutes, a different finding than prior studies conducted in another province of Canada. Helmet use was slightly higher than the other studies as well; it is difficult to determine whether this is due to strong educational programs during the adolescent of locals, or due to the influx of out-of-province students who more strongly adhere to helmet-use (7-9).

It seems that a significantly larger proportion of young adults use their bicycles during their free time, compared to those located in Ontario. This difference may or may not be accounted for by climate and city snow paving, where Montreal may have slightly different temperature and likely a larger group of snow plows to keep the streets clean for cycling. It might also be accounted for by the existing transportation networks - studies conducted in Ontario may be carried out amongst a more suburban population, where there is greater access to personal vehicles. The frequency of helmet use among the recreational cyclists are slightly higher than those in Ontario (7-9).

As with any survey, this study was limited by response/sampling bias. The sample size of 170 young adults hopefully reduced any anomalies, and normalized the data to a certain extent. Furthermore, as the survey was deployed in January (winter months), bicycle use may be slightly lower during these months as a result of the less-favourable climate.

The findings of bicycle and helmet use of young adults in Montreal yielded slightly different conclusions than those previously carried out in Ontario. These differences may be a result of differences in climate, culture and/or childhood development. Although there is no legislation in Montreal regarding helmet use during cycling, the data suggests they are equally safe if not more safe when it comes to cycling. Future studies should be conducted in other provinces of Canada to further determine if there is indeed a difference in bicycle and helmet use in different regions.

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REFERENCES

[1] Attewell RG, Glase K, McFadden M. Bicycle helmet efficacy: A meta-analysis. Accid Anal Prev 2001;33(3):345-52.

[2] 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.

[3] Parkin PC, DeGroot J, Macpherson A, Fuselli P, Macarthur C. Canadian parents' attitudes and beliefs about bicycle helmet legislation in provinces with and without legislation. Chronic Dis Inj Can 2014;34(1):8-11.

[4] Chow R, Hollenberg D, Pintilie A, Midroni C, Cumner S. Helmet use of adolescent cyclists at Crescent School in Toronto, Canada. Int J Adolesc Med Health 2016 Mar 12. doi: 10.1515/ijamh-2015-0123.

[5] Borean M, Ho S, Hollenberg D, Anpalagan T, Rzepka A, Viehweger J, et al. Helmet use of adolescents in Markham, Canada. Int J Adolesc Med Health 2017, in press

[6] Anpalagan T, Borean M, Chen L, Viehweger J, Hollenberg D, Rzepka A, et al. Helmet use of adolescents in Toronto, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[7] Viehweger J, Borean M, Tang M, Hollenberg D, Anpalagan T, Rzepka A, et al. Helmet use of young adults in St. Catherines, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[8] Anpalagan T, Hollenberg D, Borean M, Rzepka A, Chow R. Helmet use of young adults in London, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[9] Anpalagan T, Duarte N, Borean M, Anpalagan J, Camilleri R, Hollenberg D, et al. Helmet use of young adults in Waterloo, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

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Chapter 15

HELMET USE OF YOUNG ADULTS IN SASKATOON, CANADA

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A study conducted among young adults in Montreal, Quebec, showed that there was slightly higher helmet-wearing rate amongst those cyclists in Montreal than those in Ontario. This is an interesting observation, given that the two provinces have different legislations surrounding bicycle use. The aim of this study was to determine whether this trend prevails when comparing other Canadian provinces with different policies. A survey similar to those previously employed was used for this

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study, and circulated to young adults in Saskatoon, Canada (Province of Saskatchewan). The survey had two portions - the former half looked to investigate the bicycle and helmet use for young adults during their commute to school, while the latter half queried about bicycle and helmet use for young adults during their recreational time. This study revealed that young adults in Saskatoon, without helmet legislation, seem to have slightly better helmet-wearing rate than Ontario, a province with helmet legislation. This difference confirms another study previously conducted, and the differences may be a result of cultural and/or childhood development fostered from the local community and family environment. Future studies could investigate to confirm these findings with a larger sample size and perhaps even attempt to pinpoint the exact cause for the slightly-better helmet use.

INTRODUCTION

Three survey studies (1-3) conducted at high schools in Ontario, Canada, reported lackluster helmet-use among adolescents. All three studies noticed a similar trend - helmet use declined as adolescents progressed in age. Chow et al. (1) reported a 88%, 60% and 58% helmet usage for Grade 7 and 8, Grade 9 and 10 and Grade 11 and 12 students, respectively. Anpalagan et al. (2) reported an 11% difference between Grade 9 and 10, and Grade 11 and 12 students - helmet use was reported at 61% for the youngest group and 50% by the older group. Borean et al. (3) concluded that 41% of Grade 9 & 10 use helmets, while 38% of Grade 11 and 12 utilize helmets while cycling. The trend continued amongst young adults in Ontario, as reported by three other studies (4-6).

It is important to note that Ontario has legislation mandating children and adolescents to utilize helmets when cycling. This legislation forces the development of habit among compliant youths, and hopefully would lead to a higher helmet-wearing rate among the adult population (7). By that logic, provinces in Canada that lack legislation (i.e., Quebec, Saskatchewan) should show lower helmet-wearing rates than those in Ontario.

A study by Chow et al. (8), conducted among young adults in Montreal, Quebec, showed that there was slightly higher helmet-wearing rate amongst those cyclists in Montreal than those in Ontario. This may be accounted for by differences in climate, culture and/or childhood development, and may not entirely be explained by the different legislation. The aim of this study was to determine whether there exists different bicycle and helmet use of young adults in provinces outside of Ontario.

OUR STUDY

A survey similar to those previously employed (4-6, 8) was used for this study, and circulated to young adults in Saskatoon, Canada (see chapter 2). The questionnaire was advertised as an anonymous survey to help diagnose the bicycle and helmet using rate. The survey had two portions - the former half looked to investigate the bicycle and helmet use for young adults during their commute to school, while the latter half queried about bicycle and helmet use for young adults during their recreational time.

The duration of commute to university campus was collapsed into two categories for the analysis - under 20 minutes and over 20 minutes. The frequency of helmet use and commute was also collapsed into two responses during the analysis - Always/Often and Rarely/On Occasion/ Sometimes. Fisher Exact tests were conducted to determine whether there was a difference in proportion among the three age-groups - 19 years and below, 20 to 22 years old, and 23 years and older - with respect to multiple-choice questions. P-values less than 0.05 were deemed to be statistically significant. Descriptive statistics were used to convey data collected from the short-response question, querying about why young adults do not use helmets. All analyses were conducted using the Statistical Analysis Software (SAS Version 9.4 for Windows).

OUR FINDINGS

Consent was received from 133 young adults to complete the study. Of these 133 young adults, 85 (64%) were 19 years old or below. 33 (25%) were between ages 20 and 22 years old, and 15 (11%) were 23 years old or older. A larger proportion of the older cohort use a bicycle to commute to university (53%, compared to 33% and 22% for those between 20 and 22 years old, and 19 years old and younger; p=0.0422). There was no difference with respect to the duration of the commute to campus (p=0.9999) - 32%, 27% and 38% of the youngest, middle and oldest cohort, respectively, had a commute in excess of 20 minutes. Frequency of commute was the same across the groups (p=0.3906). There seems to be a trend that older adults use a helmet more regularly (p=0.1791), as 75%, 36% and 37% of young adults from oldest to youngest cohort always/often wear a helmet. All groups are equally aware of the safety benefits of a helmet (p=0.9999; 100% acknowledgement of safety benefits for all cohorts) (see Table 1).

Table 1. Demographics of cyclists to university

	≤ 19 years old	**20-22 years old**	**≥ 23 years old**	***p*-value**
Cyclist/Non-Cyclist				0.0422
Cyclist	19 (22%)	11 (33%)	8 (53%)	
Non-Cyclist	66 (78%)	22 (66%)	7 (47%)	
Duration				0.9999
Under 20 min	13 (68%)	8 (73%)	5 (63%)	
Over 20 min	6 (32%)	3 (27%)	3 (38%)	
Frequency of commute				0.3906
Always/Often	4 (21%)	1 (9%)	3 (38%)	
Rarely/On Occasion/Sometimes	15 (79%)	10 (91%)	5 (63%)	
Frequency of helmet use				0.1791
Always/Often	7 (37%)	4 (36%)	6 (75%)	
Rarely/On Occasion/Sometimes	12 (63%)	7 (64%)	2 (25%)	
Is it safer to wear a helmet?				0.9999
Yes	19 (100%)	11 (100%)	8 (100%)	
No	0 (0%)	0 (0%)	0 (0%)	

Those aged 19 years and under seem to cycle less during their recreational time, with only 64% reporting using a bicycle compared to 85% (20 to 22 years old) and 80% (23 years old and above) (p=0.0493). There seems to be a similar trend for helmet use - 42% of the oldest cohort regularly use a helmet, compared to 22% and 21% for the other two groups. All groups were equally knowledgeable of the safety benefits (p=0.4433) - 100% of the youngest and oldest cohorts agreed on the safety benefits, while 96% of those between 20 and 22 years old similarly acknowledged (see Table 2).

Table 2. Demographics of recreational cyclists

	≤ 19 years old	**20-22 years old**	**≥ 23 years old**	***p*-value**
Cyclist/Non-Cyclist				0.0493
Cyclist	54 (64%)	28 (85%)	12 (80%)	
Non-Cyclist	31 (36%)	5 (15%)	3 (20%)	
Frequency of helmet use				0.3791
Always/Often	12 (22%)	6 (21%)	5 (42%)	
Rarely/On Occasion/Sometimes	42 (78%)	22 (79%)	7 (58%)	
Is it safer to wear a helmet?				0.4433
Yes	54 (100%)	27 (96%)	15 (100%)	
No	0 (0%)	1 (4%)	0 (0%)	

Fourteen reasons were provided by young adults aged 19 years and younger for not using a helmet during their school commute, while seven and five responses were collected from the next two older cohorts. The most common reasons given by those 19 years and below were that it was inconvenient to carry around (29%) and it was unstylish (29%), followed by uncomfort (21%), short trip and belief that they will not be involved in any accident (14%), and that they do not own one (7%). Among the middle-aged group, inconvenience was again cited as the most common reason (43%), with the rest of the reasons distributed across the unstylish nature, lack of ownership, short trip and being too old to use a helmet

(14% for all). Among the five reasons collected for those aged 23 years or older, 40% reported that their trips were short and they would not get into an accident, while 20% cited they do not own one, another 20% quoting a helmet's unstylish nature, and a final 20% noting how inconvenient it is to carry a helmet around during the day (see Table 3).

Table 3. Reasons for not wearing a helmet - school commute

Reasons	≤ 19 years old	20-22 years old	≥ 23 years old
"I don't like how it feels."	3 (21%)	0 (0%)	0 (0%)
"It is inconvenient to carry around throughout the day."	4 (29%)	3 (43%)	1 (20%)
"It is unstylish / It ruins my hair."	4 (29%)	1 (14%)	1 (20%)
"I do not own one."	1 (7%)	1 (14%)	1 (20%)
"My trips are too short / I will not get into an accident/ I will not get injured."	2 (14%)	1 (14%)	2 (40%)
"I'm too old to wear a helmet."	0 (0%)	1 (14%)	0 (0%)

The oldest group collected seven responses, with the youngest two assemblies providing 22 and 41 reasons for not using a helmet during their recreational cycling. 71% of those above 22 years old informed that their trips were short and that they wouldn't get injured, with the remaining 28% split equally across the belief that there is no benefit to wearing one (14%), and that it was unstylish to wear one (14%). The most common reason provided by those between 20 and 22 years old was also short trips (32%), followed by lack of ownership of a helmet (27%), its cosmetic nature (23%), uncomfort (5%) and other (14%) - i.e., general inconvenience. 34% of 44 reasons collected from the youngest cohort attributed not wearing a helmet to their short trips, while 20% cited they didn't want their hair ruined, 15% claiming they do not own one, 12% reporting its general discomfort, 10% saying they are not accustomed to wearing one, and 10% citing other reasons (see Table 4).

Table 4. Reasons for not wearing a helmet - recreational cycling

Reasons	≤ 19 years old	20-22 years old	≥ 23 years old
"I don't like how it feels."	5 (12%)	1 (5%)	0 (0%)
"It is unstylish / It ruins my hair."	8 (20%)	5 (23%)	1 (14%)
"I do not own one."	6 (15%)	6 (27%)	0 (0%)
"My trips are too short / I will not get into an accident/ I will not get injured."	14 (34%)	7 (32%)	5 (71%)
Reasons	≤ 19 years old	20-22 years old	≥ 23 years old
"Accustomed to not wearing one/ Not enough benefits to start wearing one."	4 (10%)	0 (0%)	1 (14%)
Other*	4 (10%)	3 (14%)	0 (0%)

*Other: "General inconvenience."

DISCUSSION

Similar to the study conducted by Chow et al. (8) in Montreal, Canada, this study observed a slightly higher helmet-wearing rate than studies conducted among young adults in Ontario, Canada (4-6). The study does confirm the previously noticed trend, that the oldest cohort typically has higher helmet-wearing rate.

While prior studies in Ontario generally noticed that older adults had a longer commute to campus (4-6), and the study carried out in Montreal [8] reported the opposite trend, the results of this study in Saskatoon determined there was no difference between the cohorts. Frequency of commute did not vary much, although there was a slight quantitative difference between the cohorts, with the larger cohorts commuting more frequently. This finding was also in-line with previous survey studies.

The subpar helmet use observed cannot be explained by the lack of knowledge about a helmet's safety benefits, as most young adults acknowledge the safety benefits. One could criticize that the lack of

legislation for Saskatchewan youths may yield the suboptimal helmet wearing rates, but this study confirms that the young adults in Saskatchewan wear helmets as frequently or even more frequently than those reared in Ontario - a province that has legislation enforcing helmet use. The improved helmet rate may be a result of different cultural and/or childhood development fostered from the local community and family environment.

This study was not without limitations. The survey methodology was subject to a response/sampling bias. A large sample size hopefully removed any outliers and normalized the data to the best of its abilities. Such survey was also circulated during the cold winter months, where bicycle use would be kept to a minimum by the residents.

This study revealed that young adults in a province without helmet legislation seem to have slightly better helmet-wearing rate than another province with helmet legislation. This difference confirms another study previously conducted (8), and the differences may be a result of cultural and/or childhood development fostered from the local community and family environment. Future studies could investigate to confirm these findings and perhaps even attempt to pinpoint the exact cause for the slightly-better helmet use.

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REFERENCES

[1] Chow R, Hollenberg D, Pintilie A, Midroni C, Cumner S. Helmet use of adolescent cyclists at Crescent School in Toronto, Canada. Int J Adolesc Med Health 2016 Mar 12. doi: 10.1515/ijamh-2015-0123.

[2] Borean M, Ho S, Hollenberg D, Anpalagan T, Rzepka A, Viehweger J, et al. Helmet use of adolescents in Markham, Canada. Int J Adolesc Med Health 2017, in press.

[3] Anpalagan T, Borean M, Chen L, Viehweger J, Rzepka A, et al. Helmet use of adolescents in Toronto, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[4] Viehweger J, Borean M, Tang M, Hollenberg D, Anpalagan T, Rzepka A, et al. Helmet use of young adults in St. Catherines, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[5] Anpalagan T, Hollenberg D, Borean M, Rzepka A, Chow R. Helmet use of young adults in London, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[6] Anpalagan T, Duarte N, Borean M, Anpalagan J, Camilleri R, Hollenberg D, et al. Helmet use of young adults in Waterloo, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[7] Parkin PC, DeGroot J, Macpherson A, Fuselli P, Macarthur C. Canadian parents' attitudes and beliefs about bicycle helmet legislation in provinces with and without legislation. Chronic Dis Inj Can 2014;34(1):8-11.

[8] Chow R, Borean M, Hollenberg D, Song K, Liu J, Young T, et al. Helmet use of young adults in Montreal, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

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Chapter 16

HELMET USE OF YOUNG ADULTS IN HALIFAX, CANADA

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Previous studies have reported a negative correlation between age in teen boys and helmet usage. This study investigated whether this trend continued among young adults in Halifax, Canada. A survey, created for a prior study in London Canada was circulated to young adults at Dalhousie university. Three cohorts of age groups (19 and under, 20-22, and 23 and over) were created to analyze the data. Descriptive statistics were used for short answer questions while Fisher-exact tests were used for multiple choice questions. 151 total people participated in the study, 72 of which were 19 and younger, 46 between 20 and 22, and 33 were 23 and older. This study showed results that were much more positive than a

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previous study with a helmet usage rate of about 3/4 of the study population commuting to school. Only in recreational cycling was there a positive correlation between usage and age while each cohort equally expressed the knowledge that helmets make for a safer ride.

INTRODUCTION

Bicycle helmets have been shown to reduce the rate of head injuries for cyclists (1). A study published in 1986 reported that only 1.86% of senior high students and 10% of university students used a helmet when cycling (2). Many more recent studies (3-14) have reported higher rates, but not ideal rates.

Four survey studies conducted in the Greater Toronto Area noted a negative correlation trend for adolescents as they age - older students tended to wear helmets less regularly (3-6). Recent literature has also documented helmet-use of young adults. Two studies carried out in New York State, USA (7) and Dublin, Ireland (8) observed a positive correlation for the young adult population, with helmet use increasing as young adults mature. Four studies originating from the Province of Ontario in Canada (9-12), one carried out in the Province of Quebec (13), and another conducted in the Province of Saskatchewan (14) had a similar conclusion.

Although all studies observed a similar trend in the young adult population, different degrees of change were noted. These studies suggested that it may be a result of different cultural, climatic and parental upbringing. It would be interesting to see whether this trend is also observed Maritimes in Canada, and if it exists, the degree of change.

OUR PROJECT

A questionnaire survey was created revolving around bicycle use and safety, with focus on helmet use (also used by a study in London, Canada (9)). It was then circulated in Halifax, Nova Scotia, Canada, targeted

towards young adults. The survey was anonymous. The first portion of the survey asked about those who cycle to campus while the second revolved around those who recreationally cycle (see chapter 2). The primary objectives of the survey were to determine the portion of young adults who are cyclists and how many of these cyclists utilize a helmet. Other objectives included discovering why those who do not wear helmets choose to not do so. The study was divided into three cohorts, those 19 years and younger, 20-22 years old and those 23 years and older. Duration of commute, frequency of travel and helmet use were made into two categories for analysis (see Tables 1-2). Descriptive statistics were used to display the answers to the short answer questions about helmet use (see Tables 3-4) while Fisher-exact tests were used to see if there were differences between the age groups for multiple choice questions. All analyses were performed utilizing the Statistical Analysis Software (SAS Version 9.4 for Windows).

WHAT WE FOUND

The survey was filled out by 151 people, 68 of which cycled to/on campus. Of these 68 cyclists, 16 (22% of demographic rode bicycles on campus) were 19 and under, 28 (61% of demographic rode on campus) were from 20-22 years old, and 24 (71% of demographic rode on campus) were 23 and older. This data shows a positive correlation between riding a bicycle on campus and age of university students. This study shows that both the demographics of 19 and under and over 23 years old rarely embark on longer rides as only 19% and 17% respectively report to rides over 20 minutes while a third of the middle age group describe that they go on these longer rides ($p=0.2813$). It was also shown that younger age groups (19 and under) described their frequency of rides as often (63%) while 20-22 year olds and 23 years and over only reported 43% and 46% respectively ($p=0.4572$). Each different age group (19 and under, 20-22 and 23 and over) showed similar rates of helmet use at 75%, 71% and 75% respectively ($p=0.9999$). Similarly, each age group had unanimous

feedback that wearing a helmet is safer with each at 100% and p=0.9999 (see Table 1).

Table 1. Demographics of cyclists to university

	≤ 19 years old	**20-22 years old**	**≥ 23 years old**	***p*-value**
Cyclist/Non-Cyclist				<0.0001
Cyclist	16 (22%)	28 (61%)	24 (73%)	
Non-Cyclist	56 (78%)	18 (39%)	9 (27%)	
Duration				0.2813
Under 20 min	13 (81%)	18 (64%)	20 (83%)	
Over 20 min	3 (19%)	10 (36%)	4 (17%)	
Frequency of commute				0.4572
Always/Often	10 (63%)	12 (43%)	11 (46%)	
Rarely/On Occasion/Sometimes	6 (38%)	16 (57%)	13 (54%)	
Frequency of helmet use				0.9999
Always/Often	12 (75%)	20 (71%)	18 (75%)	
Rarely/On Occasion/Sometimes	4 (25%)	8 (29%)	6 (25%)	
Is it safer to wear a helmet?				0.9999
Yes	16 (100%)	28 (100%)	24 (100%)	
No	0 (0%)	0 (0%)	0 (0%)	

Of the riders commuting to campus not wearing helmets, 4 reasons were given as explanations. Among the 19 and under group 33% reported that a helmet was unnecessary because they were good bikers while another third said they "like the feel of the wind" and the final third reported other. For 20-22 year olds, 45% reported they were good bikers, while 36% reported helmets were inconvenient and 18% gave the reason as other. Finally, among 23 years and over, one third reported that they were good bikers, 17% said they liked the feel of the wind and 50% described helmets as an inconvenience (see Table 3).

113 of 151 people who responded to the survey described themselves as recreational cyclists. This includes 76%, 70% and 79% of the three respective age groups (19 and under, 20-22 and 23 and over) with p=0.6484. Similar to on campus cycling, each age group shows a similar rate of helmet use as they report their helmet use as always/often at 69%,

72% and 77% (p=0.7964). Each cohort also agreed that helmets made riding safer, reporting back at 100%, 100% and 96 percent respectively (p=0.9999) (see Table 2).

Table 2. Demographics of recreational cyclists

	≤ 19 years old	**20-22 years old**	**≥ 23 years old**	***p*-value**
Cyclist/Non-Cyclist				0.6484
Cyclist	55 (76%)	32 (70%)	26 (79%)	
Non-Cyclist	17 (24%)	14 (30%)	7 (21%)	
Frequency of helmet use				0.7964
Always/Often	38 (69%)	23 (72%)	20 (77%)	
Rarely/On Occasion/Sometimes	17 (31%)	9 (28%)	6 (23%)	
Is it safer to wear a helmet?				0.9999
Yes	55 (100%)	32 (100%)	25 (96%)	
No	0 (0%)	0 (0%)	1 (4%)	

Table 3. Reasons for not wearing a helmet - school commute

Reasons	≤ 19 years old	20-22 years old	≥ 23 years old
"I'm a good biker"	1 (33%)	5 (45%)	2 (33%)
"I like the feel of the wind"	1 (33%)	0 (0%)	1 (17%)
"Inconvenience"	0 (0%)	4 (36%)	3 (50%)
Other*	1 (33%)	2 (18%)	0 (0%)

*Other: General disregard for safety.

Table 4. Reasons for not wearing a helmet - recreational cycling

Reasons	≤ 19 years old	20-22 years old	≥ 23 years old
"Inconvenience"	6 (35%)	5 (24%)	3 (20%)
"Doesn't look cool"	2 (12%)	4 (19%)	0 (0%)
"Uncomfortable"	3 (18%)	5 (24%)	4 (27%)
"I'm a good cyclist"	3 (18%)	2 (10%)	4 (27%)
"Short distance"	1 (6%)	4 (19%)	3 (20%)
Other*	2 (12%)	1 (5%)	1 (7%)

*Other: General disregard for safety.

There were 6 reasons total reported for why recreational cyclists avoid helmets. For the ages of 19 and less, 35% reported helmets were inconvenient, 12% reported that helmets do not look cool, 18% said helmets were uncomfortable, 18% said that they were good cyclists deeming helmets unnecessary, while 6% reported a short commute and 12% reported another reason. 20-22 year olds reported inconvenience of helmets (24%), that helmets do not look cool (19%), that helmets are uncomfortable (24%), that they were good cyclists (10%), a short distance (19%) and another reason (5%). 23 year olds and older reported inconvenience of helmets (20%), that helmets are uncomfortable (27%), that they were good cyclists (27%), a short distance (20%) and another reason (7%) (see Table 4).

DISCUSSION

In this study 74% of school commuters and 72% of recreational cyclists reported that they use helmets always or often, much higher than prior Ontario studies (3-6, 9, 12). Among school commuters, each cohort reported similar helmet use at 75%, 72% and 75% respectively, while among recreational cyclists as positive correlation between age and helmet use is present, although the range is relatively small at 69% for 19 and under to 77% for 23 years and over. This correlation is most likely caused by the maturity of adults rising dramatically in a few years.

The length of the ride among each cohort was reported to be similar independent of age as both the youngest and oldest age groups reported rides over 20 minutes at under a 20% clip, while the middle group reported at a 36% clip. In this study, the youngest group reported the most frequent rides (63% vs 43% and 46% respectively), which could result from a few factors. Two of these include the elder groups deciding to take the bus for their commute because the campus is further from their home, also maybe the campus is spread out and those in residence require a bike to commute to class.

Each age group unanimously agreed that helmet use makes riding safer, matching with the fact that each equally frequently wear helmets (both p values = 0.9999). Of those who chose not to wear a helmet, the belief that they were a good biker (40%) was the most common response, followed by helmets being an inconvenience (35%). In this study the use of helmets is very high in each of these age groups as about 3 quarters of commuters chose to wear them, while those choosing not to wear them are aware that they are risking their safety for convenience or due to confidence, both concerning reasons for jeopardizing one's safety. Contrary to Chow and colleagues study (3), this study shows that helmet use increases with age (although only very slightly and only among recreational riders).

Within this study, a few limitations were obvious. Firstly, although the survey was anonymous, responders tend to answer in a way to make them appear "better" and in this case wear helmets more often. Secondly, this study took place in the winter season meaning that it is possible some usually bikers would have reported that they did not ride to school. Thirdly, the population size of this study was not quite optimal, especially in the reasons when not wearing a helmet.

Overall this study yielded a much more positive result than prior research. In Halifax, helmet use was consistently high among all age groups, and only in recreation was there a correlation between age and helmet use. Also awareness of helmet safety is quite widespread in this region as all but one responder said that they were aware that helmets improved safety conditions. For further studies, a larger sample size should be used to confirm this positive outlook in the Maritimes.

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REFERENCES

[1] Morris BA, Trimble NE. Promotion of bicycle helmet use among schoolchildren: a randomized clinical trial. Can J Public Health 1990;82(2):92-4.

[2] Weiss BD. Bicycle helmet use by children. Pediatrics 1986;77(5):677-9.

[3] Chow R, Hollenberg D, Pintilie A, Midroni C, Cumner S. Helmet use of adolescent cyclists at Crescent School in Toronto, Canada. Int J Adolesc Med Health 2016 Mar 12. Doi: 10.1515/ijamh-2015-0123.

[4] Borean M, Trasente V, Rzepka A, Viggiani D, Viotto D, Hollenberg D, et al. Helmet use of adolescents at De La Salle College Oaklands in Toronto, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[5] Anpalagan T, Borean M, Chen L, Viehweger J, Rzepka A, et al. Helmet use of adolescents in Toronto, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[6] Borean M, Ho S, Hollenberg D, Anpalagan T, Rzepka A, Viehweger J, et al. Helmet use of adolescents in Markham, Canada. Int J Adolesc Med Health 2017;in press.

[7] Chow R, Borean M, Hollenberg D, Ganguli N, Freedman Z, Kang R, et al. Helmet use of young adults in New York State, United States of America. Int J Child Health Hum Dev 2018;11(1), in press.

[8] Chow R, Hollenberg D, Borean M, Goh S, Anpalagan T, Rzepka A, et al. Helmet use of young adults in Dublin, Ireland. Int J Child Health Hum Dev 2018;11(1), in press.

[9] Anpalagan T, Hollenberg D, Borean M, Rzepka A, Chow R. Helmet use of young adults in London, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[10] Viehweger J, Borean M, Tang M, Hollenberg D, Anpalagan T, Rzepka A, et al. Helmet use of young adults in St. Catherines, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[11] Anpalagan T, Duarte N, Borean M, Anpalagan J, Camilleri R, Hollenberg D, et al. Helmet use of young adults in Waterloo, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[12] Chow R, Borean M, Hollenberg D, Ho C, Ng W, Guo W, et al. Helmet use of young adults in Toronto, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[13] Chow R, Borean M, Hollenberg D, Song K, Liu J, Young T, et al. Helmet use of young adults in Montreal, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[14] Chow R, Rzepka A, Borean M, Parekh R, Hollenberg D, Anpalagan T, et al. Helmet use of young adults in Saskatoon, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

SECTION FIVE: HELMET USE OF YOUNG ADULTS OUTSIDE OF CANADA

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Chapter 17

HELMET USE OF YOUNG ADULTS IN NEW YORK STATE, UNITED STATES OF AMERICA

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Studies conducted amongst young adults revealed that there existed some difference in helmet-wearing rates within Canada, between the different regions. However, it would be interesting to see whether different rates persist in different countries. The aim of this chapter was to survey bicycle and helmet use in New York State in the United States of America. A survey was circulated in the New York State region, targeted toward young adults. It was advertised as anonymous, and had two components - the first portion aimed to determine bicycle and helmet use

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of young adults during their commute to university, while the latter half looked into the usage rate during young adults' recreational times. The survey was completed by 750 consenting young adults, of which 358 were 19 years and below, 274 between the ages of 20 and 22 years old, and 118 above the age of 22 years old. A smaller proportion of young adults in New York State identify themselves as a student cyclist, while a much larger group identifies themselves as a recreational cyclist, compared to previous studies. More frequent helmet use and shorter commutes show that New York State young adults have a different mindset than young adults previously reported in the literature. The differences may be accounted for by different climate, cultural and environmental factors, and may be investigated in future studies.

INTRODUCTION

Helmets have been proven to be effective safety equipment against head injuries for cyclists (1-2). However, helmet use is not high; one-third of bicycle injuries treated in emergency rooms are head injuries, with three-fourths of cases resulting in death (1, 3-6).

Many survey studies have been carried out in the Canadian provinces to determine helmet use. Three studies (7-9) to date in the adolescent population have produced the same conclusion - a negative correlation between age and helmet use. In one public high school in Markham, Canada, the helmet-wearing rate for Grade 9 and 10 students was reported to be 41%, while 38% of Grade 11 and 12 students wore helmets regularly (7). Another study carried out at a public high school in Toronto noted a 61% and 50% helmet wearing rate for the Grade 9 and 10, and Grade 11 and 12 students, respectively (8). Chow et al. (9) conducted a study at an independent boys school in Toronto, and surveyed Grade 9 through 12 students, in addition to Grade 7 and 8 students. The study revealed that 88% of adolescent boys in Grade 7 and 8 used a helmet regularly, while regular helmet use was noted amongst 60% and 58% of Grade 9 and 10, and Grade 11 and 12 students, respectively (9).

The trend where helmet use falls as adolescents age continues in young adults, where helmet use rates are remarkably lower. However, the helmet-wearing rate seems to eventually increase among the young adult

population - the oldest surveyed groups across the studies had a higher helmet-use rate than the younger cohorts. Three studies surveying young adults in Ontario, Canada, reported extremely low helmet-wearing rates ranging from 32% to 44% (10-12). Two studies carried out in the Canadian provinces of Quebec and Saskatchewan reported a slightly higher helmet-wearing rate (13-14).

The studies conducted amongst young adults revealed that there existed some difference in helmet-wearing rates within Canada, between the different regions. However, it would be interesting to see whether different rates persist in different countries. The aim of this study was to survey bicycle and helmet use in New York State in the United States of America.

OUR RESEARCH

A survey was circulated in the New York State region, targeted toward young adults. It was advertised as anonymous, and had two components - the first portion aimed to determine bicycle and helmet use of young adults during their commute to university, while the latter half looked into the usage rate during young adults' recreational times (see chapter 2).

Descriptive statistics were used to discover the reasons why young adults do not utilize a helmet regularly. The collected responses for frequency of commute and helmet use was compiled into two broad responses - Always/Often and Rarely/On Occasion/Sometimes. The duration of commute to university was also condensed into two answers - Under 20 minutes and Over 20 minutes. χ^2 -tests were used to determine whether there was a difference in responses between the three cohorts - 19 years and younger, between 20 and 22 years old, and 23 years old and older. P-values less than 0.05 were considered significant. Statistical analyses were conducted using the Statistical Analysis Software (SAS 9.4 for Windows).

FINDINGS

The survey was completed by 750 consenting young adults, of which 358 were 19 years and below, 274 between the ages of 20 and 22 years old, and 118 above the age of 22 years old. A significantly smaller proportion of the youngest cohort cycled to school (14%) compared to the other two cohorts (23% for those between 20 and 22 years old, and 23% for those above 22 years old) (p=0.0088). The vast majority of student cyclists reported commute times of under 20 minutes - 98%, 97% and 93% of young adults from the youngest to oldest cohorts, respectively, reported a short commute (p=0.4670). Those between 20 and 22 years of age commuted slightly, but not significantly, more frequent via bicycle to campus (p=0.5975); 34% rate as opposed to 26% rate for the youngest and oldest group. There seems to be a trend that older individuals use a helmet more frequently, with 64%, 69% and 78% (from the youngest to oldest cohorts) self-reporting frequent use of helmets while cycling. Young adults in all three cohorts equally acknowledged the safety benefits of a helmet (p=0.5350) - 100% agreement in two cohorts (19 years and below, and 23 years and above), and 98% agreement for the middle cohort (between 20 and 22 years old) (see Table 1).

With respect to recreational cycling, a substantially higher proportion of young adults (70%) under the age of 19 years old identified themselves as a recreational cyclist (p=0.0034; 57% and 62% for those between 20 and 22 years old, and 23 years old and older, respectively). Again, a positive correlation between helmet use and age was noticed - 70%, 64% and 59% helmet wearing rates as age decreases (p=0.1707). The populations were similarly aware of the safety benefits that a helmet affords (p=0.5579; 98%, 99% and 100% for the three cohorts in increasing-order of age) (see Table 2).

Young adults 19 years old and younger provided 35 excuses for why they do not use a helmet during their commute to university. 34% remarked they do not own one, 26% conveyed its uncomfortable nature, 14% explained that their commute was a short distance, 11% informed it was inconvenient, 9% found it unnecessary to use a helmet, and 6%

provided other reasons (i.e., "Hair gets messed"). Of the 43 reasons collected from the middle-cohort, 35% expressed they do not own a helmet, 23% cited inconvenience, 16% determined lack of distance meant no need for helmet use, 14% acknowledged a helmet's uncomfortable nature, 9% found it unnecessary to use in a safe environment, and 2% provided another reason. 44% of the 18 responses for the cohort with young adults over the age of 22 years old cited the short distance as a reason for not using a helmet, followed by uncomfort (39%) and other reasons (17%) (see Table 3).

Table 1. Demographics of cyclists to university

	≤ 19 years old	**20-22 years old**	**≥ 23 years old**	***p*-value**
Cyclist/Non-Cyclist				0.0088
Cyclist	50 (14%)	62 (23%)	27 (23%)	
Non-Cyclist	308 (86%)	212 (77%)	91 (77%)	
Duration				0.4670
Under 20 min	49 (98%)	60 (97%)	25 (93%)	
Over 20 min	1 (2%)	2 (3%)	2 (7%)	
Frequency of commute				0.5975
Always/Often	13 (26%)	21 (34%)	7 (26%)	
Rarely/On Occasion/Sometimes	37 (74%)	41 (66%)	20 (74%)	
Frequency of helmet use				0.4579
Always/Often	32 (64%)	43 (69%)	21 (78%)	
Rarely/On Occasion/Sometimes	18 (36%)	19 (31%)	6 (22%)	
Is it safer to wear a helmet?				0.5350
Yes	50 (100%)	61 (98%)	27 (100%)	
No	0 (0%)	1 (2%)	0 (0%)	

With respect to recreational cycling, 171, 112, and 49 reasons were provided for not using a helmet, from the youngest to older cohort. The most common reason (24%) for those 19 years and younger was its unnecessary nature due to a safe commute route, followed by its lack of visual appeal (22%), its uncomfortable nature (18%), a short commute not warranting a helmet (15%), inconvenience (8%) and other reasons (14%) (i.e., "Don't have the habit"). Among those aged 20 to 22 years old, the

most common reason was uncomfort, cited by 30%, followed by short distance (24%), inconvenience (19%), ugliness (14%), a safe commute route (9%) and other reasons (4%). 39% of the oldest cohort cited that a helmet doesn't look good, 27% noted its uncomfortable nature, 14% cited general inconvenience, 8% remarked about the short distance and not needing a helmet, 2% found it unnecessary to use a helmet in a safe commute pathway, and 10% gave other reasons (see Table 4).

Table 2. Demographics of recreational cyclists

	≤ 19 years old	**20-22 years old**	**≥ 23 years old**	***p*-value**
Cyclist/Non-Cyclist				0.0034
Cyclist	251 (70%)	157 (57%)	73 (62%)	
Non-Cyclist	107 (30%)	117 (43%)	45 (38%)	
Frequency of helmet use				0.1707
Always/Often	147 (59%)	101 (64%)	51 (70%)	
Rarely/On Occasion/Sometimes	104 (41%)	56 (36%)	22 (30%)	
Is it safer to wear a helmet?				0.5579
Yes	247 (98%)	155 (99%)	73 (100%)	
No	4 (2%)	2 (1%)	0 (0%)	

Table 3. Reasons for not wearing a helmet - school commute

Reasons	≤ 19 years old	20-22 years old	≥ 23 years old
"Feels uncomfortable"	9 (26%)	6 (14%)	7 (39%)
"Inconvenient (storage, too lazy, easy to forget)"	4 (11%)	10 (23%)	0 (0%)
"Don't have one"	12 (34%)	15 (35%)	0 (0%)
"Seems unnecessary (no traffic, safe bike path)"	3 (9%)	4 (9%)	0 (0%)
"Short distance"	5 (14%)	7 (16%)	8 (44%)
Other*	2 (6%)	1 (2%)	3 (17%)

*Other: "Hair gets messed," "Head gets cold."

Table 4. Reasons for not wearing a helmet - recreational cycling

Reasons	≤ 19 years old	20-22 years old	≥ 23 years old
"Inconvenient (storage, too lazy, easy to forget)"	14 (8%)	21 (19%)	7 (14%)
"Seems unnecessary (no traffic, safe bike path)"	41 (24%)	10 (9%)	1 (2%)
"Doesn't look good"	37 (22%)	16 (14%)	19 (39%)
Reasons	≤ 19 years old	20-22 years old	≥ 23 years old
"Short distance"	25 (15%)	27 (24%)	4 (8%)
"Feels uncomfortable"	30 (18%)	34 (30%)	13 (27%)
Other*	24 (14%)	4 (4%)	5 (10%)

*Other: "Too hot outside," "Don't own one," "Don't have the habit," "Ruins my hair."

DISCUSSION

The proportion of cyclists to university is substantially lower than those conveyed in previous existing literature (10-14). This may be due to the timing of the survey, as it was employed during January/February. It may also be accounted for by the infrastructure in New York State; the public transit system may be a more common and quicker alternative for those who reside relatively far away from campus, and for those who are relatively close, travelling on foot may end up leading to the same commute time as commuting via bike. The duration of the commute to campus is also substantially different from previous studies (10-14). Regardless of age groups, the majority of young adults that use a bicycle travel a short distance.

The proportion of recreational cyclists, however, is noticeably higher than studies conducted in Canada (10-14). Again, this may be a result of climate differences - New York State may receive less adverse events (i.e., snowfall) that would prohibit cycling, or make cycling extremely dangerous. Young adults in New York State, as a result, can more safely indulge in cycling during their recreational time.

The young adult population in New York State was equally educated about the safety benefits of helmets, but their helmet use during commute

to campus and among recreational cyclist is pleasantly higher. This may be accounted for by different environmental and cultural conditions; the roads of New York State may have a higher volume of vehicles and more bicycle crashes may be reported each day, leading to cyclists developing a fear of injury and consequently more frequently using a helmet.

This study was not without limitations. It was employed during the January/February, winter months, where colder conditions may lead to less cycling. This may have affected the proportion of young adults reporting themselves as cyclists. However, the large sample size in this study overcame any potential barriers of lack of data collected, of student cyclists and recreational cyclists.

A smaller proportion of young adults in New York State identify themselves as a student cyclist, while a much larger group identifies themselves as a recreational cyclist, compared to previous studies. More frequent helmet use and shorter commutes show that New York State young adults have a different mindset than young adults previously reported in the literature. The differences may be accounted for by different climate, cultural and environmental factors, and may be investigated in future studies.

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We would like to thank all of those who participated in the questionnaire.

REFERENCES

[1] Thompson RC, Rivara RP, Thompson DC. A case control study of the effectiveness of bicycle safety helmets. N Engl J Med 1989;320:1361-7.

[2] Thompson DC, Thompson RS, Rivara P, Wolf M. A case control of the effectiveness of bicycle safety helmets in preventing facial injuries. AJPH 1990;80(12):1471-4.

[3] Baker SP, Li G, Fowler G, Dannenberg AL. Injuries to bicyclists: A national perspective. Baltimore, MD: John Hopkins University Injury Prevention Center, 1993.

[4] Friede AM, Azzara CV, Gallagher SS, Guyer B. The epidemiology of injuries to bicycle riders. Pediatr Clin North Am 1985;32(1):141-51.

[5] Sacks JJ, Holmgreen P, Smith SM, Sosin DM. Bicycle-associated head injuries and deaths in the United States from 1984 through 1988. How many are preventable? JAMA 1991;266(21):3016-8.

[6] Selbst SM, Alexander D, Ruddy R. Bicycle-related injuries. Am J Dis Child 1987;141(2):140-4.

[7] Borean M, Ho S, Hollenberg D, Anpalagan T, Rzepka A, Viehweger J, et al. Helmet use of adolescents in Markham, Canada. Int J Adolesc Med Health 2017, in press.

[8] Anpalagan T, Borean M, Chen L, Viehweger J, Hollenberg D, Rzepka A, et al. Helmet use of adolescents in Toronto, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[9] Chow R, Hollenberg D, Pintilie A, Midroni C, Cumner S. Helmet use of adolescent cyclists at Crescent School in Toronto, Canada. Int J Adolesc Med Health 2016 Mar 12. Doi: 10.1515/ijamh-2015-0123.

[10] Anpalagan T, Hollenberg D, Borean M, Rzepka A, Chow R. Helmet use of young adults in London, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[11] Viehweger J, Borean M, Tang M, Hollenberg D, Anpalagan T, Rzepka A, et al. Helmet use of young adults in St. Catherines, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[12] Anpalagan T, Duarte N, Borean M, Anpalagan J, Camilleri R, Hollenberg D, et al. Helmet use of young adults in Waterloo, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[13] Chow R, Borean M, Hollenberg D, Song K, Liu J, Young T, et al. Helmet use of young adults in Montreal, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[14] Chow R, Rzepka A, Borean M, Parekh R, Hollenberg D, Anpalagan T, et al. Helmet use of young adults in Saskatoon, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

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Chapter 18

HELMET USE OF YOUNG ADULTS IN DUBLIN, IRELAND

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Cycling with a helmet is much safer than the alternative, cycling without a helmet. However, studies in North America have shown that helmet-use rate among cyclists are low, for adolescents and young adults. Helmet-use among adolescents and young adults vary from region to region, with farther regions having more noticeable differences perhaps due to cultural, climate and environmental factors. There is helmet-use variation within Canada, and even greater variation between Canada and the United States. It would be interesting whether helmet-use among young adults in other countries differ, and to what extent. The aim of this chapter was to determine bicycle and helmet use among young adults in Dublin, Ireland. A survey was completed by 222 respondents and revealed distinctly different results from those carried out in North

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America. A much larger proportion of young adults identified themselves as cyclists, while many report that they have short commute times to university. Helmet wearing rates are remarkably lower than previously-reported literature, and may be accounted for by different cultural environments - using a helmet may not be a cultural-norm. Future studies should investigate whether these different cultural norms permeate in other regions outside of North America.

INTRODUCTION

Cycling with a helmet is much safer than the alternative, cycling without a helmet (1-3). However, studies in North America have shown that helmet-use rate among cyclists are low, for adolescents (4-6) and young adults (7-12).

Adolescents in Canada have varying helmet rates in excess of 35%, as reported by three studies (4-6). Anpalagan et al. (4) reported helmet wearing rates of 41% for Grade 9 and 10 students, and 38% for Grade 11 and 12 students. Borean et al. (5) noted higher rates of 61% and 50% for the two cohorts, respectively. A study conducted at an independent boys school identified helmet use rates of 58% and 60%, for Grade 11 and 12, and Grade 9 and 10 students, respectively (6). The study also showed that Grade 7 and 8 students wore helmets at a rate of 88% (6). All three studies observed the same trend - a negative correlation between age and helmet use.

Follow-up studies were conducted among young adults to determine whether the negative correlation continues into young adulthood. Studies carried out in Ontario, Canada reported low helmet-wearing rates between 32% and 44% (7-9). Two recently published papers (10, 11) by Chow et al, carried out in the Provinces of Quebec and Saskatchewan in Canada, shared slightly higher helmet-use rates than the Province of Ontario. A survey study conducted outside of Canada, in the United States of America, reported substantially higher helmet-wearing rates - 59% to 78% (12).

Helmet-use among adolescents and young adults vary from region to region, with farther regions having more noticeable differences perhaps

due to cultural, climate and environmental factors. There is helmet-use variation within Canada, and even greater variation between Canada and the United States. It would be interesting whether helmet-use among young adults in other countries differ, and to what extent. The aim of this chapter was to determine bicycle and helmet use among young adults in Dublin, Ireland.

OUR PROJECT

In Dublin, Ireland, a survey was circulated among young adults in the region. The primary objectives were to determine the rate of bicycle and helmet use rates among young adults during their commute to school, and during their recreational time. The secondary objective was to investigate into the reasons why young adult cyclists do not use helmets. Responses were collected anonymously, and had two halves to investigate the primary objectives (see chapter 2).

The responses to certain questions were collapsed for the statistical analysis. The duration of commute to university for young adults was collapsed into two responses - Under 20 minutes and Over 20 minutes. Frequency of commute to the university campus and frequency of helmet use during school commute and recreational time was also consolidated into two answers - Always/Often and Rarely/On Occasion/Sometimes. χ^2 - tests and Fisher Exact tests were used to determine whether there were different bicycle and helmet use rates between three predefined age groups - 19 years and below, between 20 and 22 years old, and 23 years and older. P-values less than 0.05 were considered statistically significant. Descriptive statistics were used to convey the collected reasons for why young adults do not use helmets. All statistical analyses were conducted using the Statistical Analysis Software (SAS 9.4 for Windows).

FINDINGS

The survey was completed by 222 respondents, of which three did not consent. Among the 219 participants who completed the form in its entirety, 47 (22%) were 23 years old or older, 107 (49%) were between 20 and 22 years old, and 65 (30%) were 19 years old or younger. There was no difference in the percentage of student cyclists across the three cohorts (p=0.9231); 63% of the youngest cohort identified as student cyclists, while 61% and 60% of the older cohorts similarly self-identified. A vast majority of the commuters, regardless of age, reported a school commute under 20 minutes in duration (p=0.6350) - 96%, 92% and 90% reported this duration of commute, from the oldest to youngest cohort, respectively. Frequency of school commute was under 50% across all three groups (p=0.7247), with 49% of those 19 years and under reporting frequency bicycle commute, 45% for 20 and 22 year olds, and 39% for those 23 years and older. There seems to be a negative correlation trend between age and frequency of helmet use (p=0.1734); the youngest cohort used helmets frequently at a rate of 29%, while 11% of the oldest group frequently used helmets. All age groups agreed that it is safer to wear a helmet when riding a bicycle (p=0.2633), with 98%, 100% and 96% of young adults from the youngest to older cohorts, respectively, acknowledging so (see Table 1).

86%, 92% and 85% of young adults (aged 19 years and above, between 20 and 22 years old, and over 22 years old, respectively) identified themselves as cyclists during their recreational time (p=0.3867). Among recreational cyclists, older young adults also reported lower helmet use rates (p=0.2636), with those below 19 years old reporting frequent use of 30%, 16% of adults aged 20 to 22 years old frequently using helmets, and 13% of young adults above 22 years of age regularly using a helmet. 4%, 2% and 3% of young adults, from the youngest to older cohort respectively, did not believe that helmet use is safer than lack of helmet use (p=0.8433) (see Table 2).

Table 1. Demographics of cyclists to university

	≤ 19 years old	**20-22 years old**	**≥ 23 years old**	***p*-value**
Cyclist/Non-Cyclist				0.9231
Cyclist	41 (63%)	65 (61%)	28 (60%)	
Non-Cyclist	24 (37%)	42 (39%)	19 (40%)	
Duration				0.6350
Under 20 min	37 (90%)	60 (92%)	27 (96%)	
Over 20 min	4 (10%)	5 (8%)	1 (4%)	
Frequency of commute				0.7247
Always/Often	20 (49%)	29 (45%)	11 (39%)	
Rarely/On Occasion/Sometimes	21 (51%)	36 (55%)	17 (61%)	
Frequency of helmet use				0.1734
Always/Often	12 (29%)	13 (20%)	3 (11%)	
Rarely/On Occasion/Sometimes	29 (71%)	52 (80%)	25 (89%)	
Is it safer to wear a helmet?				0.2633
Yes	40 (98%)	65 (100%)	27 (96%)	
No	1 (2%)	0 (0%)	1 (4%)	

Table 2. Demographics of recreational cyclists

	≤ 19 years old	**20-22 years old**	**≥ 23 years old**	***p*-value**
Cyclist/Non-Cyclist				0.3867
Cyclist	56 (86%)	98 (92%)	40 (85%)	
Non-Cyclist	9 (14%)	9 (8%)	7 (15%)	
Frequency of helmet use				0.2636
Always/Often	14 (30%)	16 (16%)	5 (13%)	
Rarely/On Occasion/Sometimes	42 (70%)	82 (84%)	35 (88%)	
Is it safer to wear a helmet?				0.8433
Yes	54 (96%)	96 (98%)	39 (98%)	
No	2 (4%)	2 (2%)	1 (3%)	

The most common reason for not using a helmet among young adults below 19 years of age during their commute to school was inconvenience (45%), followed by the fact they do not own one (30%), it is a short commute (10%) and other reasons (15%) (i.e., “I’m a good biker”). Those between 20 and 22 years of age also most commonly cited inconvenience

(43%); other reasons included that they do not own a helmet (31%), it makes their head sweaty (7%), the commute is a short distance (4%), and other reasons (14%). Two reasons were cited equally-frequently (35% each) for young adults 23 years and older - the fact they do not own one and that it is inconvenient. The short commute distance (20%), the fact helmets make a head sweaty (5%) and other reasons (5%) were successively-frequent excuses (see Table 3).

Table 3. Reasons for not wearing a helmet - school commute

Reasons	≤ 19 years old	20-22 years old	≥ 23 years old	Reasons
"Short distance"	2 (10%)	1 (4%)	4 (20%)	"Short distance"
"Inconvenience"	9 (45%)	12 (43%)	7 (35%)	"Inconvenience"
"Do not own one"	6 (30%)	9 (31%)	7 (35%)	"Do not own one"
"It makes my head sweaty"	0 (0%)	2 (7%)	1 (5%)	"It makes my head sweaty"
Other*	3 (15%)	4 (14%)	1 (5%)	Other*

*Other: "I'm a good biker."

Among recreational cyclists, 41, 51, 21 reasons were provided by those 19 years and below, between 20 and 22 years old, and 23 years and older, respectively. The least common excuse by the youngest cohorts were its uncomfortable nature (12%) and that it messes up their hair (12%). More common reasons were the fact they do not own a helmet (17%), it is inconvenient (24%) and that they do not want to look weird (27%). In the next age cohort (between 20 and 22 years old), the most common reasons were its uncomfortable nature (27%), they do not own one (20%), it messes up hair (16%), they do not want to look weird (14%) and its inconvenience (6%). The most commonly-cited excuses provided by those 23 years and older were inconvenience (38%) and that they do not want to look weird (24%), followed by the fact they do not own one (19%), its uncomfortable nature (10%) and that it messes up their hair (5%) (see Table 4).

Table 4. Reasons for not wearing a helmet - recreational cycling

Reasons	≤ 19 years old	20-22 years old	≥ 23 years old
"Uncomfortable"	5 (12%)	14 (27%)	2 (10%)
"Do not own one"	7 (17%)	10 (20%)	4 (19%)
"I don't want to look weird"	11 (27%)	7 (14%)	5 (24%)
"Messes up my hair"	5 (12%)	8 (16%)	1 (5%)
Reasons	≤ 19 years old	20-22 years old	≥ 23 years old
"Inconvenience"	10 (24%)	3 (6%)	8 (38%)
Other*	3 (7%)	9 (18%)	1 (5%)

*Other: "Personal choice," "I'm a good rider."

DISCUSSION

The proportion of young adults who identify themselves as student and recreational cyclists is astronomically higher than any prior study in current literature (4-12). The high bicycle use rates in Dublin, compared to North American settlements, may be a result of the different cultural backgrounds as well as different infrastructure in terms of transportation. North American settlements are extremely vehicle-centric, and bicycles may not be as heavily emphasized and used when compared to Ireland.

Most of the bicycle commutes to campus have short duration times, similar to that reported by Chow et al. about young adults in New York State (12). This may be explained by the highly-developed and utilized public transit system, which would be the better alternative for long commutes to campus as opposed to a bicycle. The availability of effective transportation alternatives may also explain the low frequency of commute, as opposed to other studies carried out in North America; during adverse conditions, cyclists may more quickly switch from relying on a bicycle to other transportation methods.

Disappointingly, the frequency of helmet use is lower than any studies carried out in North America (4-12). This lower helmet-use rate could be due to different cultural, climate and environmental upbringings; Irish culture and households may less emphasize the use of helmets while

cycling. However, it is important to note that almost all of the young adult population do recognize it is safer to wear a helmet as opposed to not using a helmet, when cycling.

One reason for lack of helmet use uncovered in this study, but not previously discovered in other papers, was the fact that wearing a helmet would make the rider look weird. This reason may also help to explain the lower helmet use - it is less common for cyclists to use helmets, and hence using helmets are not a societal-norm.

As with any survey study, response/sampling bias may linger. The rather-large sample size hopefully reduced the influence of confounding variables. Additionally, different statistical tests were employed during certain parts of the analysis to account for smaller sampling sizes.

This study conducted in Dublin, Ireland, revealed distinctly different results from those carried out in North America. A much larger proportion of young adults identified themselves as cyclists, while many report that they have short commute times to university. Helmet wearing rates are remarkably lower than previously-reported literature, and may be accounted for by different cultural environments - using a helmet may not be a cultural-norm. Future studies should investigate whether these different cultural norms permeate in other regions outside of North America.

ACKNOWLEDGMENT

We would like to thank all of those who participated in the questionnaire.

REFERENCES

[1] Thompson RC, Rivara RP, Thompson DC. A case control study of the effectiveness of bicycle safety helmets. N Engl J Med 1989;320:1361-7.

[2] Thompson DC, Thompson RS, Rivara P, Wolf M. A case control of the effectiveness of bicycle safety helmets in preventing facial injuries. Am J Public Health 1990;80(12):1471-4.

[3] Sacks JJ, Holmgreen P, Smith SM, Sosin DM. Bicycle-associated head injuries and deaths in the United States from 1984 through 1988. How many are preventable? JAMA 1991;266(21):3016-8.

[4] Borean M, Ho S, Hollenberg D, Anpalagan T, Rzepka A, Viehweger J, et al. Helmet use of adolescents in Markham, Canada. Int J Adolesc Med Health 2017, in press.

[5] Anpalagan T, Borean M, Chen L, Viehweger J, Hollenberg D, Rzepka A, et al. Helmet use of adolescents in Toronto, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[6] Chow R, Hollenberg D, Pintilie A, Midroni C, Cumner S. Helmet use of adolescent cyclists at Crescent School in Toronto, Canada. Int J Adolesc Med Health 2016 Mar 12. Doi: 10.1515/ijamh-2015-0123.

[7] Anpalagan T, Hollenberg D, Borean M, Rzepka A, Chow R. Helmet use of young adults in London, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[8] Viehweger J, Borean M, Tang M, Hollenberg D, Anpalagan T, Rzepka A, et al. Helmet use of young adults in St. Catherines, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[9] Anpalagan T, Duarte N, Borean M, Anpalagan J, Camilleri R, Hollenberg D, et al. Helmet use of young adults in Waterloo, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[10] Chow R, Borean M, Hollenberg D, Song K, Liu J, Young T, et al. Helmet use of young adults in Montreal, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[11] Chow R, Rzepka A, Borean M, Parekh R, Hollenberg D, Anpalagan T, et al. Helmet use of young adults in Saskatoon, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[12] Chow R, Borean M, Hollenberg D, Ganguli N, Freedman Z, Kang R, et al. Helmet use of young adults in New York State, United States of America. Int J Child Health Hum Dev 2018;11(1), in press.

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Chapter 19

HELMET USE OF YOUNG ADULTS IN CALIFORNIA, UNITED STATES OF AMERICA

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A recently-published study surveyed bicycle and helmet use in New York State, USA, and reported helmet use rates in excess of 54% in the young adult population, which was notably higher compared to prior studies. It would be interesting to determine whether this observation propagates in other states of the USA. The aim of this project was to study helmet and bicycle use of young adults in the State of California, of the United States of America. The circulated anonymous questionnaire had two portions - the first half looked to investigate bicycle and helmet use of young adults who commute to university, while the second half looked to investigate the proportion of young adults who identify themselves as recreational

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cyclists and regular helmet users. Among the young adults in California, there was a much lower proportion of individuals who identify themselves as cyclists, which may be due to the car-culture. A high proportion of the population used bicycles for short commutes, and many cyclists rarely commuted, which also reflects the car-culture. The helmet use in the State of California was much lower than the young adults in New York State, USA; these rates however were in-line with prior studies.

INTRODUCTION

A recently-published study surveyed bicycle and helmet use in New York State, USA, and reported helmet use rates in excess of 54% in the young adult population (1). The paper by Chow et al. (1) is part of a series of studies conducted by a group based out of London, Canada. This study, the first conducted by the group in the United States, observed notably higher helmet use rates compared to prior studies.

Four prior studies among the Canadian adolescent population reported mediocre helmet use rates (2-5). Chow et al. (2) noted a range of 58% to 88% for Grade 7 through 12 students; Borean et al. (3) reported helmet use at a rate of 55% to 74% for the age cohort. Two more studies conducted in public high schools in Canada reported helmet-use between 38% and 61% for Grade 9 to 12 students (4-5). The helmet use of young adults in New York State was higher than the vast majority of recent studies documenting helmet use in the Canadian adolescent population, which is surprising given studies conducted among young adults.

Studies in the young adult population observed a positive correlation with respect to helmet use and age, with young adults who just passed through adolescence having the lowest helmet use rates. Published literature in the Province of Ontario, Canada, reported helmet-use rates below 44% (6-9). Two survey studies among the population of the Canadian Province of Quebec and the Province of Saskatchewan noted slightly higher rates, but still lower than the adolescent population (10-11). Irish young adults had an extremely low helmet use rates (12).

It is remarkable that the young adults in New York State, USA, use helmets more regularly than young adults in Canada and Ireland, according to the literature, as well as Canadian adolescents. It would be interesting to determine whether this observation propagates in other states of the USA. The aim of this study was to study helmet and bicycle use of young adults in the State of California, of the United States of America.

OUR PROJECT

The questionnaire circulated to young adults in California, USA, had two portions - the first half looked to investigate bicycle and helmet use of young adults who commute to university, while the second half looked to investigate the proportion of young adults who identify themselves as recreational cyclists and regular helmet users (see chapter 2). The survey was promoted as an anonymous questionnaire.

The results were collapsed into three age groups - 19 years old and below, between 20 and 22 years old, and 23 years old and above. Descriptive statistics were used to report the reasons provided by young adults for not using helmets regularly. Frequency of commute and helmet use were collapsed into Always/Often and Rarely/On Occasion/Sometimes for the statistical analysis; duration of commute was also consolidated into two responses - Under 20 min and Over 20 min. Fisher-Exact tests were carried out to determine whether there was a difference in response between the three age cohorts. P-values less than 0.05 were deemed statistically significant. All analyses were conducted using the Statistical Analysis Software (SAS Version 9.4 for Windows).

WHAT WE FOUND

The survey was completed by 220 consenting young adults, of whom 72 were 19 years old or younger, 87 were between the ages of 20 and 22 years old, and 61 aged 23 years or older. 21%, 16% and 13% of the three

cohorts, respectively, identified themselves as cyclists who commute to university (p=0.5105). There was no difference in the proportion of cyclists who had a commute under 20 minutes in duration - 87% of those 19 years and younger reported a commute less than 20 minutes, while 86% and 88% of those between 20 and 22 years old, and above 22 years old, respectively, similarly reported a short commute (p=0.9999). The vast majority of university cyclists do not cycle regularly (p=0.3244) - 80%, 71% and 100% of the youngest, middle and oldest cohort, respectively, did not frequently cycle. The three groups had similar helmet use of 13% (for those 19 years and below), 14% (for those between 20 and 22 years old), and 13% (for those 23 years old and above) (p=0.9999). All cohorts equally acknowledge that it is safer for cyclists to use helmets, with 100%, 93% and 100% from the oldest to youngest cohort in agreement with the safety benefits (p=0.5946) (see Table 1).

Table 1. Demographics of cyclists to university

	≤ 19 years old	**20-22 years old**	**≥ 23 years old**	***p*-value**
Cyclist/Non-Cyclist				0.5105
Cyclist	15 (21%)	14 (16%)	8 (13%)	
Non-Cyclist	57 (79%)	73 (84%)	53 (87%)	
Duration				0.9999
Under 20 min	13 (87%)	12 (86%)	7 (88%)	
Over 20 min	2 (13%)	2 (14%)	1 (13%)	
Frequency of commute				0.3244
Always/Often	3 (20%)	4 (29%)	0 (0%)	
Rarely/On Occasion/Sometimes	12 (80%)	10 (71%)	8 (100%)	
Frequency of helmet use				0.9999
Always/Often	2 (13%)	2 (14%)	1 (13%)	
Rarely/On Occasion/Sometimes	13 (87%)	12 (86%)	7 (88%)	
Is it safer to wear a helmet?				0.5946
Yes	15 (100%)	13 (93%)	8 (100%)	
No	0 (0%)	1 (7%)	0 (0%)	

Approximately similar proportion of young adults self-reported themselves as recreational cyclists (p=0.8600). 35% of those 19 years and

below, 34% of those between 20 and 22 years old, and 38% of those 23 years old and above, completed the form signifying they cycle during their recreational time. There seems to be a positive correlation between helmet use and age, which was statistically insignificant due to the rather-small sample size (p=0.5759); helmet use charted upward from 36% to 52%. As with the student cyclists, the majority of recreational cyclists similarly reported that helmets were safer as opposed to the alternative (lack of helmet) (p=0.9999) (see Table 2).

Table 2. Demographics of recreational cyclists

	≤ 19 years old	**20-22 years old**	**≥ 23 years old**	***p*-value**
Cyclist/Non-Cyclist				0.8600
Cyclist	25 (35%)	30 (34%)	23 (38%)	
Non-Cyclist	47 (65%)	47 (66%)	38 (62%)	
Frequency of helmet use				0.5759
Always/Often	9 (36%)	14 (47%)	12 (52%)	
Rarely/On Occasion/Sometimes	16 (54%)	16 (53%)	11 (48%)	
Is it safer to wear a helmet?				0.9999
Yes	25 (100%)	29 (97%)	23 (100%)	
No	0 (0%)	1 (3%)	0 (0%)	

Twelve reasons, thirteen reasons, and twelve reasons were offered from young adults aged 19 years and below, between 20 and 22 years old, and older than 22 years old, respectively. The most common excuse cited by the youngest cohort was inconvenience (42%), followed by the fact they do not own one (33%), it is difficult to store (17%) and other reasons (8%). There were two regularly-cited reasons - inconvenience (31%) and short distance (31%) - amongst the cohort with young adults between age 20 and 22 years old. Other reasons from this group included difficulty of storage (15%), helmets look lame (15%) and that they do not own one (8%). Inconvenience, difficult to store and other reasons accounted for 75% of reasons provided by the oldest cohort (25% each), while the remaining proportion was split evenly (8% for each) across the reasons of short

distance, lack of ownership and the belief that helmets look lame (see Table 3).

Table 3. Reasons for not wearing a helmet - school commute

Reasons	≤ 19 years old	20-22 years old	≥ 23 years old
"Inconvenience"	5 (42%)	4 (31%)	3 (25%)
"Difficult to store"	2 (17%)	2 (15%)	3 (25%)
"Do not own one"	4 (33%)	1 (8%)	1 (8%)
"Short distance"	0 (0%)	4 (31%)	1 (8%)
"Look lame"	0 (0%)	2 (15%)	1 (8%)
Other*	1 (8%)	0 (0%)	3 (25%)

*Other: "Lazy."

Of the 60 reasons provided for not using a helmet while recreationally cycling, 18, 22, and 20 of the youngest to oldest cohort provided reasons. 44% of those 19 years and younger cited that they were a good rider and hence did not need a helmet; 17% noted short distance as the reason, 11% cited inconvenience and 6% reported it was too hot to use a helmet. In those between 20 and 22 years old, the most common reason (50%) was that the young adults are good cyclists, followed by inconvenience (23%), it's too hot to wear one (18%) and that they cycle a short distance (9%). Among those 23 years and older, 35% of them believe that their strong cycling ability meant they did not need a helmet; 20%, 20%, 15% and 10% of them reported short distance, inconvenience, temperature and other reasons, respectively (see Table 4).

Table 4. Reasons for not wearing a helmet - recreational cycling

Reasons	≤ 19 years old	20-22 years old	≥ 23 years old
"I'm a good rider"	8 (44%)	11 (50%)	7 (35%)
"Short distance"	3 (17%)	2 (9%)	4 (20%)
"Inconvenient"	2 (11%)	5 (23%)	4 (20%)
"Too hot to wear one"	1 (6%)	4 (18%)	3 (15%)
Other*	4 (22%)	0 (0%)	2 (10%)

*Other: General disregard for safety.

DISCUSSION

Young adults in California who identified themselves as cyclists to university had the lowest helmet use than any other prior studies (6-12). Among recreational cyclists, however, the helmet use was similar to those previously reported in literature (6-11).

A noticeably low proportion of young adults cycled to school and even during their recreational time. This lower percentage may be a result of cultural and environmental factors - California's car-culture may promote vehicle use over bicycle use. California, however, lacks a prominent well-developed subway system that could serve as an alternative to bicycle use (1, 7, 12). The car-culture effect, which reduces bicycle use, seems to overcome the lack of a subway system, which would increase bicycle use.

The high proportion of young adults who had a short duration of the bicycle commute to university may also be a result of the car-culture. Cars were used by young adults for long commutes, while bicycles were only used for short commutes. It is important to note, however, that the commute to school was not frequent at all; cars seem to be a much more favourable alternative and may be used much more commonly (hence reducing the frequency of cycling).

This study was not without limitations. The somewhat small sample size of cyclists led to trends being observed (lack of significant p-values) rather than definitive differences between the cohorts. As with any survey study, there also exists the possibility of a response/sampling bias.

Among the young adults in California, there was a much lower proportion of individuals who identify themselves as cyclists, which may be due to the car-culture. A high proportion of the population used bicycles for short commutes, and many cyclists rarely commuted, which also reflects the car-culture. The helmet use in the State of California was much lower than the young adults in New York State, USA; these rates however were in-line with prior studies.

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REFERENCES

[1] Chow R, Borean M, Hollenberg D, Ganguli N, Freedman Z, Kang R, et al. Helmet use of young adults in New York State, United States of America. Int J Child Health Hum Dev 2018;11(1), in press.

[2] Chow R, Hollenberg D, Pintilie A, Midroni C, Cumner S. Helmet use of adolescent cyclists at Crescent School in Toronto, Canada. Int J Adolesc Med Health 2016 Mar 12. Doi: 10.1515/ijamh-2015-0123.

[3] Borean M, Trasente V, Rzepka A, Viggiani D, Viotto D, Hollenberg D, et al. Helmet use of adolescents at De La Salle College Oaklands in Toronto, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[4] Anpalagan T, Borean M, Chen L, Viehweger J, Hollenberg D, Rzepka A, et al. Helmet use of adolescents in Toronto, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[5] Borean M, Ho S, Hollenberg D, Anpalagan T, Rzepka A, Viehweger J, et al. Helmet use of adolescents in Markham, Canada. Int J Adolesc Med Health 2017;in press.

[6] Anpalagan T, Hollenberg D, Borean M, Rzepka A, Chow R. Helmet use of young adults in London, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[7] Chow R, Borean M, Hollenberg D, Ho C, Ng W, Guo W, et al. Helmet use of young adults in Toronto, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[8] Viehweger J, Borean M, Tang M, Hollenberg D, Anpalagan T, Rzepka A, et al. Helmet use of young adults in St. Catherines, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[9] Anpalagan T, Duarte N, Borean M, Anpalagan J, Camilleri R, Hollenberg D, et al. Helmet use of young adults in Waterloo, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[10] Chow R, Borean M, Hollenberg D, Song K, Liu J, Young T, et al. Helmet use of young adults in Montreal, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[11] Chow R, Rzepka A, Borean M, Parekh R, Hollenberg D, Anpalagan T, et al. Helmet use of young adults in Saskatoon, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[12] Chow R, Hollenberg D, Borean M, Goh S, Anpalagan T, Rzepka A, et al. Helmet use of young adults in Dublin, Ireland. Int J Child Health Hum Dev 2018;11(1), in press.

SECTION SIX: ANALYSIS OF HELMET USE

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Chapter 20

BICYCLE AND HELMET USE OF YOUNG ADULTS AND ADOLESCENTS: A META-ANALYSIS

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Multiple studies have been recently published, determined to scientifically document bicycle and helmet use in the adolescent and young adult population; these studies have not been systematically compared against each other though. The aim of this meta-analysis is to compile all the data from recent literature and compare the helmet use rates of adolescents and young adults in different regions. A literature search was conducted in many databases, such as Ovid MEDLINE and OLDMEDLINE, Embase Classic and Embase, PsycINFO. Relevant studies were screened to determine whether it reported bicycle and helmet use in adolescent and young adult populations. Additional data from three unpublished studies of the Bicycle Safety and Awareness Club – an independent all-girls school Mississauga, Canada; a school in Singapore; young adults in Vancouver, British Columbia, Canada – was also collected. A total of seventeen published studies were included in the meta-analysis, of which four of these studies were conducted in the

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adolescent population, and the other thirteen were carried out in the young adult population. There exists a U-shaped pattern between helmet use and age, as adolescents progress to young adulthood. Those residing in Canada and the United States use bicycles and helmets at a similar rate, which is different than those outside of North America (Ireland and Singapore). This may be a result of differing legislation around helmet use, and also different cultural factors. Local community advocacy programs should also be established to help increase helmet use. These programs can look into solutions to help rectify the barriers for helmet use, such as providing better locker space for student cyclists to store their helmets, and making helmets more fashionable and acceptable by the community.

INTRODUCTION

Head injuries comprise one-third of bicycle injuries treated in emergency departments in the United States (1-5). This comes as no surprise as helmet-use rates have been reported to be low (5). Children, in particularly, are more prone to these types of injuries – they are much more likely to be involved in a bicycle-related injury (1) and as a result are a commonly-treated cohort, as a result (3).

Multiple studies (6-7) have been recently published, determined to scientifically document bicycle and helmet use in the adolescent and young adult population. The first of the bunch, published by Chow et al. (6) reported a negative correlation between age and helmet use among adolescent males in Toronto, Ontario, Canada; helmet use decreased from 96% to 76% to 59% for Grade 7 to 12 students. Borean et al. also noted a similar trend, with helmet use falling from 88% to 58% for adolescent cyclists in Toronto, Ontario, Canada (7).

Since then, many studies have been carried out (8-11). Many have been published, and the Bicycle Safety and Awareness Club also has some unpublished data; these studies have not been systematically compared against each other though. The aim of this meta-analysis is to compile all the data from recent literature and compare the helmet use rates of adolescents and young adults in different regions.

LITERATURE SEARCH

A literature search was conducted in many databases, such as Ovid MEDLINE and OLDMEDLINE, Embase Classic and Embase, PsycINFO. Relevant studies were screened to determine whether it reported bicycle and helmet use in adolescent and young adult populations. Additional data from three unpublished studies of the Bicycle Safety & Awareness Club – an independent all-girls school Mississauga, Canada; a school in Singapore; young adults in Vancouver, British Columbia, Canada – was also collected.

The extracted endpoints were: bicycle use when commuting to school, duration of school commute, frequency of school commute, frequency of helmet use during school commute, knowledge of legislation/safety, bicycle use during recreational time, and frequency of helmet use during recreational time. These endpoints were compiled into a table and summed to produce a weighted average for each endpoint. The endpoints were produced for six age cohorts – three cohorts of adolescents (Grade 7 and 8 students, Grade 9 and 10 students, Grade 11 and 12 students) and three cohorts of young adults (aged 19 years and below, between 20 and 22 years old, and 23 years old and above).

For the studies conducted in the adolescent population, weighted averages were produced for independent-school studies in Canada, public high school studies in Canada, and a Singapore high school study. The studies conducted in the young adult population yielded weighted averages for each endpoint for: the Canadian Province of Ontario, Province of Quebec, Province of Saskatchewan, Province of Nova Scotia, Province of British Columbia, State of New York in the United States, State of California in the United States, and Outside of North America. These numerous weighted averages ultimately yielded three averages based on region – Canada, United States, and Outside of North America.

Singapore lacks bicycle legislation; the question in the Singapore questionnaire for the adolescents was a True/False question regarding whether it is safer or not as safe for helmet use. The data was merged with the data for Canadian adolescents regarding bicycle legislation. In two

studies (12-13), they only had two age cohorts for young adults – 19 years and below, and 20 years and above. The data for the oldest cohort was added to the middle cohort of this meta-analysis; the authors remarked that they had no responses from young adults older than 22 years old.

FINDINGS

A total of seventeen published studies (6-22) were included in the meta-analysis, as well as data from three unpublished studies conducted by the Bicycle Safety and Awareness Club. Four of these studies were conducted in the adolescent population, and the other thirteen were carried out in the young adult population.

Grade 7-8 adolescents

Two published (6, 10) and one unpublished study reported about the Grade 7-8 adolescent population; all of these studies reported on adolescents who attend independent high schools. The proportion of school cyclists ranged from 8% to 46%, with the weighted average being 33%. 89% of student cyclists reported that their duration was under 20 minutes (range = 80% to 100%). The three data sets reported frequency of commute ranging from 0% to 80%; overall, 25% frequently cycled. Frequency of helmet use was determined to be 93% from the three studies, which varied from 50% to 96%. 87% of this population was educated about the bicycle legislation (see Table 1).

86% of Grade 7-8 adolescents identified themselves as recreational cyclists (range = 73% to 92%). While 15% of this population did not regularly use a helmet, with the range from the three data sets spanning from 12% to 26%. 14% were not aware of the bicycle legislation mandating helmet use, for which the proportion of uneducated cyclists spanned from 5% to 37% (see Table 2).

Grade 9-10 adolescents

Four published and one unpublished study studied Grade 9-10 adolescents. Two (6, 10) and two (7, 9) of the published studies examined adolescents who attend independent and public schools, respectively. 29% of adolescents in independent schools and 18% of those in public school noted that they cycle to school – the conglomerate rate was 26%. 86% of this population had commute times of less than 20 minutes; 86% for adolescents in independent schools and 85% for those in public school. 100% of public school adolescents and 84% of independent school subjects rarely commuted to school; 87%, overall, did not commute frequently. 66% used helmets frequently; 70% and 46% of independent and public school adolescents, respectively. A higher proportion of independent school adolescents (96%) were aware of the law compared to public school adolescents (85%); the overall rate was 94% (see Table 3).

17% (13% for independent school, 26% for public school) noted that they did not use a bicycle during their recreational time. 60% of independent school and 55% of public school adolescents use their helmets regularly, leading to 59% regularly using a helmet. 14% were uneducated of the legislation – 14% and 13% of independent and public school adolescents, respectively, were unaware of the law (see Table 4).

Grade 11-12 adolescents

Two published studies (6, 10) and one unpublished study surveyed adolescents attending independent school, two published studies (7, 9) reported about adolescents in public school, and one unpublished paper examined adolescents in Singapore. No Singaporean adolescents reported they used a bicycle to commute to school, whereas 24% of independent and public school students used a bicycle. 36% had school commutes in excess of 20 minutes; 37% of independent school and 35% of public school adolescents reported this commute length. 15% and 10% of public and independent school adolescents frequently commuted to school;

overall, 12% regularly commuted using a bike. While 79% were aware of the legislation (75% for independent school, 83% for public school), only 53% used a helmet regularly (57% for independent school and 48% for public school) (see Table 5).

33%, 68% and 80% of Singaporean, public school and independent school adolescents identified themselves as recreational cyclists; 73% of adolescents were recreational cyclists. Of those three populations, 0%, 43% and 57% regularly used a helmet, respectively. 80%, 81% and 100% of independent school, public school and Singaporean adolescents are educated of legislation, or aware that helmets are a safer alternative than not wearing a helmet (see Table 6).

Young adults aged 19 years old and younger

Seven studies (11-17) were carried out in the Canadian Province of Ontario, while one study was carried out in each of the Provinces of Quebec (18), Saskatchewan (19), Nova Scotia (20), and British Columbia (unpublished). Three studies were conducted outside of Canada – one in the State of New York (8), one in the State of California (21), and one in Ireland (22). 22% of Canadian young adults noted that they use a bicycle to commute to school (21% for Ontario, 26% for Quebec, 22% for Saskatchewan, 22% for Nova Scotia and 20% for British Columbia), and 78% noted that it was a short commute under 20 minutes (82% for Ontario, 39% for Quebec, 68% for Saskatchewan, 81% for Nova Scotia and 100% for British Columbia). 29% of Ontario, 22% of Quebec, 21% of Saskatchewan, 63% of Nova Scotia and 50% of British Columbia young adults noted that they frequently commute to university; overall, 30% regularly commuted using a bicycle to campus. 42% of Canadian young adults regularly use a helmet, with the provinces ranging from 25% (Nova Scotia) to 63% (Saskatchewan); 94% acknowledged that there were safety benefits affiliated with wearing a helmet (range = 91% for Quebec to 100%) (see Table 7).

Outside of Canada, 15% of American young adults (14% for the State of New York, 21% for the State of California) self-identified themselves as a cyclist commuting to university. 95% of young adults had a commute time less than 20 minutes, where 98% of young adults the State of New York and 87% of the State of California concurred with this line of answer. 25% frequently commuted using a bike (26% for New York State, 20% for California); 52% regularly use a helmet (64% for the State of New York, 13% for the State of California); all young adults recognized that using a helmet was safer than not using one. For young adults in Ireland, 63% used a bicycle to commute to campus, 90% had commutes less than 20 minutes, 49% frequently commuted using a bike, 29% frequently used a helmet, and 98% recognized the safety benefits. Overall, 22% identified themselves as a student-cyclist, with the vast majority (82%) reporting short commutes. 31% regularly commuted and 43% regularly used a helmet; 95% recognized that a helmet was an effective protective device (see Table 7).

69% of Canadian young adults cycled during their recreational time, with rates ranging from 60% (British Columbia) to 76% (Nova Scotia). While 98% recognized the safety benefits of helmets (range = 95% - 100%), only 45% used a helmet regularly (range = 22% to 69%). 64% and 86% of American and Irish young adults use a bike during their free time; 57% and 30%, respectively, relatively use a helmet; 99% and 96% acknowledged the safety benefits of a helmet. Overall, 60% used a bicycle during their recreational time, of which 47% regularly use a helmet and 98% are aware of the safety benefits a helmet offers (see Table 8).

Young adults between 20 and 22 years old

40% of Canadian young adults commute to school using a bike; 37% of those in Ontario did so, while 61% of those in Quebec, 33% of Saskatchewan, 61% of Nova Scotia, and 100% of British Columbia also reported so. 78% noted that they had a short commute (ranging from 36% for Quebec to 100% for British Columbia); 32% conducted the commute regularly (ranging from 9% for Saskatchewan to 100% for British

Columbia); 47% regularly used a helmet (ranging from 0% for British Columbia to 71% for Nova Scotia); 99% were aware that helmet use was safer for young adults (ranging from 98% for Ontario to 100% in other provinces). 97% of American young adults noted that helmets were safe, with 93% and 98% of young adults in the State of California and the State of New York, respectively, reporting so. 21% of American young adults (23% for New York, 16% for California) used a bicycle to commute to campus, 95% had short commutes (97% for New York, 86% for California), 33% commuted regularly (34% for New York, 29% of California), and 59% regularly used a helmet (69% for New York, and 14% for California). Outside of North America, in Ireland, 61% noted that they commute to campus via a bicycle, 8% had commutes in excess of 20 minutes, 55% did not regularly commute, 80% did not frequently use a helmet, and 100% acknowledged helmets were effective safety equipment. Overall, 36% of young adults used a bicycle to commute to school, 83% had short commutes, 34% frequently commuted, 45% frequently used a helmet, and 99% were aware of the safety benefits (see Table 9).

Of the Canadian young adults surveyed across the studies, 64% noted that they were recreational cyclists, with the proportion varying by province between 60% for Ontario and 85% for Saskatchewan. American and Irish young adults similarly recorded this answer at a rate of 53% and 92%, respectively. 47% of Canadians regularly use a helmet (range = 21% to 72%), while 61% of Americans (range = 47% to 64%) and 16% of Irish young adults also self-reported this response. 97%, 98% and 98%, respectively, acknowledged the safety benefits of a helmet. Overall, 63%, 47% and 98% of young adults noted that they were recreational cyclists, they used a helmet regularly, and that a helmet was a safe equipment, respectively (see Table 10).

Table 1. Bicycle and helmet use of (grade 7-8) adolescents, to school

Study	School Cyclist		Duration		Frequency of Commute		Frequency of Helmet Use		Educated of Legislation	
	Cyclist	Non-Cyclist	Under 20 Min	Over 20 Min	Always/ Often	Rarely/On Occasion/ Sometimes	Always/ Often	Rarely/On Occasion/ Sometimes	Educated	Uneducated
Chow et al. 2016 (6)	46 (46%)	55 (54%)	41 (89%)	5 (12%)	9 (20%)	37 (80%)	44 (96%)	2 (4%)	41 (89%)	5 (11%)
Borean et al. 2018 (10)	5 (14%)	32 (85%)	4 (80%)	1 (20%)	4 (80%)	1 (20%)	4 (80%)	1 (20%)	4 (80%)	1 (20%)
Not Published	2 (8%)	22 (92%)	2 (100%)	0 (0%)	0 (0%)	2 (100%)	1 (50%)	1 (50%)	1 (50%)	1 (50%)
Independent School	*53 (33%)*	*109 (67%)*	*47 (89%)*	*6 (11%)*	*13 (25%)*	*40 (75%)*	*49 (93%)*	*4 (7%)*	*46 (87%)*	*7 (13%)*
Total	53 (33%)	109 (67%)	47 (89%)	6 (11%)	13 (25%)	40 (75%)	49 (93%)	4 (7%)	46 (87%)	7 (13%)

Table 2. Bicycle and helmet use of (grade 7-8) adolescents, during recreational time

Study	Recreational Cyclist		Frequency of Helmet Use		Educated of Legislation	
	Cyclist	Non-Cyclist	Always/Often	Rarely/On Occasion/Sometimes	Educated	Uneducated
Chow et al. 2016 (6)	93 (92%)	8 (8%)	82 (88%)	11 (12%)	85 (91%)	8 (9%)
Borean et al. 2018 (10)	27 (73%)	10 (27%)	20 (74%)	7 (26%)	17 (63%)	10 (37%)
Not Published	19 (79%)	5 (21%)	16 (84%)	3 (16%)	18 (95%)	1 (5%)
Independent School	*139 (86%)*	*23 (14%)*	*118 (85%)*	*21 (15%)*	*120 (86%)*	*19 (14%)*
Total	139 (86%)	23 (14%)	118 (85%)	21 (15%)	120 (86%)	19 (14%)

Table 3. Bicycle and helmet use of (grade 9-10) adolescents, to school

Study	School Cyclist		Duration		Frequency of Commute		Frequency of Helmet Use		Educated of Legislation	
	Cyclist	Non-Cyclist	Under 20 Min	Over 20 Min	Always/ Often	Rarely/On Occasion/ Sometimes	Always/ Often	Rarely/On Occasion/ Sometimes	Educated	Uneducated
Chow et al. 2016 (6)	45 (46%)	53 (54%)	39 (87%)	6 (13%)	6 (13%)	39 (87%)	34 (76%)	11 (24%)	44 (98%)	1 (2%)
Borean et al. 2018 (10)	8 (11%)	63 (89%)	7 (88%)	1 (13%)	2 (25%)	6 (75%)	5 (63%)	3 (38%)	7 (88%)	1 (13%)
Not Published	4 (15%)	23 (85%	3 (75%)	1 (25%)	1 (25%)	3 (75%)	1 (25%)	3 (75%)	4 (100%)	0 (0%)
Independent School	*57 (29%)*	*139 (71%)*	*49 (86%)*	*8 (14%)*	*9 (16%)*	*48 (84%)*	*40 (70%)*	*17 (30%)*	*55 (96%)*	*2 (4%)*
Borean et al. 2017 (7)	7 (26%)	20 (74%)	7 (100%)	0 (0%)	0 (0%)	7 (100%)	1 (14%)	6 (86%)	6 (86%)	1 (14%)
Anpalagan et al. 2018 (9)	6 (13%)	41 (87%)	4 (67%)	2 (33%)	0 (0%)	6 (100%)	5 (83%)	1 (17%)	5 (83%)	1 (17%)
Public School	*13 (18%)*	*61 (82%)*	*11 (85%)*	*2 (15%)*	*0 (0%)*	*13 (100%)*	*6 (46%)*	*7 (54%)*	*11 (85%)*	*2 (15%)*
Total	70 (26%)	200 (75%)	60 (86%)	10 (14%)	9 (13%)	61 (87%)	46 (66%)	24 (34%)	66 (94%)	4 (6%)

Table 4. Bicycle and helmet use of (grade 9-10) adolescents, during recreational time

Study	Recreational Cyclist		Frequency of Helmet Use		Educated of Legislation	
	Cyclist	Non-Cyclist	Always/Often	Rarely/On Occasion/Sometimes	Educated	Uneducated
Chow et al. 2016 (6)	88 (89%)	11 (11%)	53 (60%)	35 (40%)	80 (91%)	8 (9%)
Borean et al. 2018 (10)	58 (82%)	13 (18%)	38 (66%)	20 (34%)	45 (78%)	13 (22%)
Not Published	25 (93%)	2 (7%)	12 (48%)	13 (52%)	22 (88%)	3 (12%)
Independent School	*171 (87%)*	*26 (13%)*	*103 (60%)*	*68 (40%)*	*147 (86%)*	*24 (14%)*
Borean et al. 2017 (7)	17 (63%)	10 (37%)	7 (41%)	10 (59%)	16 (94%)	1 (6%)
Anpalagan et al. 2018 (9)	38 (81%)	9 (19%)	23 (61%)	15 (39%)	32 (84%)	6 (16%)
Public School	*55 (74%)*	*19 (26%)*	*30 (55%)*	*25 (45%)*	*48 (87%)*	*7 (13%)*
Total	226 (83%)	45 (17%)	133 (59%)	93 (41%)	195 (86%)	31 (14%)

Table 5. Bicycle and helmet use of (grade 11-12) adolescents, to school

Study	School Cyclist		Duration		Frequency of Commute		Frequency of Helmet Use		Educated of Legislation	
	Cyclist	Non-Cyclist	Under 20 Min	Over 20 Min	Always/ Often	Rarely/On Occasion/ Sometimes	Always/ Often	Rarely/On Occasion/ Sometimes	Educated	Uneducated
Chow et al. 2016 (6)	29 (51%)	28 (49%)	20 (69%)	9 (31%)	4 (14%)	25 (86%)	17 (59%)	12 (41%)	23 (79%)	6 (21%)
Borean et al. 2018 (10)	20 (16%)	106 (84%)	10 (50%)	10 (50%)	0 (0%)	20 (100%)	11 (55%)	9 (45%)	14 (70%)	6 (30%)
Not Published	2 (7%)	26 (93%)	2 (100%)	0 (0%)	1 (50%)	1 (50%)	1 (50%)	1 (50%)	1 (50%)	1 (50%)
Independent School	*51 (24%)*	*160 (76%)*	*32 (63%)*	*19 (37%)*	*5 (10%)*	*46 (90%)*	*29 (57%)*	*22 (43%)*	*38 (75%)*	*13 (25%)*
Borean et al. 2017 (7)	27 (23%)	90 (77%)	20 (74%)	7 (26%)	4 (15%)	23 (85%)	8 (30%)	19 (70%)	24 (89%)	3 (11%)
Anpalagan et al. 2018 (9)	21 (27%)	58 (73%)	11 (52%)	10 (48%)	3 (14%)	18 (86%)	15 (71%)	6 (29%)	16 (76%)	5 (24%)
Public School	*48 (24%)*	*148 (76%)*	*31 (65%)*	*17 (35%)*	*7 (15%)*	*41 (85%)*	*23 (48%)*	*25 (52%)*	*40 (83%)*	*8 (17%)*
Not published - Singapore	0 (0%)	12 (100%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Outside of Canada	*0 (0%)*	*12 (100%)*	*0 (0%)*	*0 (0%)*	*0 (0%)*	*0 (0%)*	*0 (0%)*	*0 (0%)*	*0 (0%)*	*0 (0%)*
Total	99 (24%)	321 (76%)	63 (64%)	36 (36%)	12 (12%)	87 (89%)	52 (53%)	47 (47%)	78 (79%)	21 (21%)

Table 6. Bicycle and helmet use of (grade 11-12) adolescents, during recreational time

Study	Recreational Cyclist		Frequency of Helmet Use		Educated of Legislation	
	Cyclist	Non-Cyclist	Always/Often	Rarely/On Occasion/Sometimes	Educated	Uneducated
Chow et al. 2016 (6)	45 (79%)	12 (21%)	26 (58%)	19 (42%)	37 (82%)	8 (18%)
Borean et al. 2018 (10)	104 (83%)	22 (17%)	57 (55%)	47 (45%)	82 (79%)	22 (21%)
Not Published	20 (71%)	8 (29%)	14 (70%)	6 (30%)	16 (80%)	4 (20%)
Independent School	*169 (80%)*	*42 (20%)*	*97 (57%)*	*72 (43%)*	*135 (80%)*	*34 (20%)*
Borean et al. 2017 (7)	78 (67%)	39 (33%)	30 (38%)	48 (62%)	65 (83%)	13 (17%)
Anpalagan et al. 2018 (9)	56 (71%)	23 (29%)	28 (50%)	28 (50%)	44 (79%)	12 (21%)
Public School	*134 (68%)*	*62 (32%)*	*58 (43%)*	*76 (57%)*	*109 (81%)*	*25 (19%)*
Not published - Singapore	4 (33%)	8 (66%)	0 (0%)	4 (100%)	4 (100%)	0 (0%)
Outside of Canada	*4 (33%)*	*8 (66%)*	*0 (0%)*	*4 (100%)*	*4 (100%)*	*0 (0%)*
Total	297 (73%)	112 (27%)	155 (52%)	152 (48%)	248 (84%)	59 (16%)

Table 7. Bicycle and helmet use of (19 year olds and below) young adults, to university

Study	School Cyclist		Duration		Frequency of Commute		Frequency of Helmet Use		Educated of Legislation	
	Cyclist	Non-Cyclist	Under 20 Min	Over 20 Min	Always/ Often	Rarely/On Occasion/ Sometimes	Always/ Often	Rarely/On Occasion/ Sometimes	Educated	Uneducated
Anpalagan et al. 2018 (11)	63 (25%)	194 (75%)	45 (71%)	18 (29%)	14 (22%)	49 (78%)	24 (38%)	39 (62%)	58 (92%)	5 (8%)
Anpalagan et al. 2018 (14)	53 (20%)	213 (80%)	48 (91%)	5 (91%)	20 (38%)	33 (62%)	19 (36%)	34 (64%)	50 (94%)	3 (6%)
Anpalagan et al. 2018 (12)	17 (21%)	64 (79%)	16 (94%)	1 (6%)	6 (35%)	11 (65%)	6 (35%)	11 (65%)	17 (100%)	0 (0%)
Chow et al. 2018 (15)	36 (19%)	149 (81%)	25 (69%)	11 (31%)	7 (19%)	29 (81%)	20 (56%)	16 (44%)	33 (92%)	3 (8%)
Rzepka et al. 2018 (13)	6 (9%)	64 (91%)	6 (100%)	0 (0%)	6 (100%)	0 (0%)	2 (33%)	4 (66%)	6 (100%)	0 (0%)
Viehweger et al. 2018 (16)	3 (7%)	43 (93%)	3 (100%)	0 (0%)	1 (33%)	2 (67%)	1 (33%)	2 (67%)	1 (33%)	2 (67%)
Viehweger et al. 2018 (17)	31 (36%)	54 (64%)	29 (94%)	2 (6%)	6 (19%)	25 (81%)	11 (35%)	20 (65%)	30 (97%)	1 (3%)
Province of Ontario	*209 (21%)*	*781 (79%)*	*172 (82%)*	*37 (18%)*	*60 (29%)*	*149 (71%)*	*83 (40%)*	*126 (60%)*	*195 (93%)*	*14 (7%)*
Chow et al. 2018 (18)	23 (26%)	64 (74%)	9 (39%)	14 (61%)	5 (22%)	18 (78%)	11 (48%)	12 (52%)	21 (91%)	2 (9%)
Province of Quebec	*23 (26%)*	*64 (74%)*	*9 (39%)*	*14 (61%)*	*5 (22%)*	*18 (78%)*	*11 (48%)*	*12 (52%)*	*21 (91%)*	*2 (9%)*

Table 7. (Continued)

Study	School Cyclist		Duration		Frequency of Commute		Frequency of Helmet Use		Educated of Legislation	
	Cyclist	Non-Cyclist	Under 20 Min	Over 20 Min	Always/ Often	Rarely/On Occasion/ Sometimes	Always/ Often	Rarely/On Occasion/ Sometimes	Educated	Uneducated
Chow et al. 2018 (19)	19 (22%)	66 (78%)	13 (68%)	6 (32%)	4 (21%)	15 (79%)	7 (37%)	12 (63%)	19 (100%)	0 (0%)
Province of Saskatchewan	*19 (22%)*	*66 (78%)*	*13 (68%)*	*6 (32%)*	*4 (21%)*	*15 (79%)*	*7 (37%)*	*12 (63%)*	*19 (100%)*	*0 (0%)*
Hollenberg et al. 2018 (20)	16 (22%)	56 (78%)	13 (81%)	3 (19%)	10 (63%)	6 (38%)	12 (75%)	4 (25%)	16 (100%)	0 (0%)
Province of Nova Scotia	*16 (22%)*	*56 (78%)*	*13 (81%)*	*3 (19%)*	*10 (63%)*	*6 (38%)*	*12 (75%)*	*4 (25%)*	*16 (100%)*	*0 (0%)*
Not published - Vancouver	2 (20%)	8 (80%)	2 (100%)	0 (0%)	1 (50%)	1 (50%)	1 (50%)	1 (50%)	2 (100%)	0 (0%)
Province of British Columbia	*2 (20%)*	*8 (80%)*	*2 (100%)*	*0 (0%)*	*1 (50%)*	*1 (50%)*	*1 (50%)*	*1 (50%)*	*2 (100%)*	*0 (0%)*
Canada	*269 (22%)*	*975 (78%)*	*209 (78%)*	*60 (22%)*	*80 (30%)*	*189 (70%)*	*114 (42%)*	*155 (58%)*	*253 (94%)*	*16 (6%)*
Chow et al. 2018 (8)	50 (14%)	308 (86%)	49 (98%)	1 (2%)	13 (26%)	37 (74%)	32 (64%)	18 (36%)	50 (100%)	0 (0%)
State of New York	*50 (14%)*	*308 (86%)*	*49 (98%)*	*1 (2%)*	*13 (26%)*	*37 (74%)*	*32 (64%)*	*18 (36%)*	*50 (100%)*	*0 (0%)*
Chow et al. 2018 (21)	15 (21%)	57 (79%)	13 (87%)	2 (13%)	3 (20%)	12 (80%)	2 (13%)	13 (87%)	15 (100%)	0 (0%)

Study	School Cyclist		Duration		Frequency of Commute		Frequency of Helmet Use		Educated of Legislation	
	Cyclist	Non-Cyclist	Under 20 Min	Over 20 Min	Always/ Often	Rarely/On Occasion/ Sometimes	Always/ Often	Rarely/On Occasion/ Sometimes	Educated	Uneducated
State of California	*15 (21%)*	*57 (79%)*	*13 (87%)*	*2 (13%)*	*3 (20%)*	*12 (80%)*	*2 (13%)*	*13 (87%)*	*15 (100%)*	*0 (0%)*
United States of America	*65 (15%)*	*365 (85%)*	*62 (95%)*	*3 (5%)*	*16 (25%)*	*49 (75%)*	*34 (52%)*	*31 (48%)*	*65 (100%)*	*0 (0%)*
Chow et al. 2018 (22)	41 (63%)	24 (37%)	37 (90%)	4 (10%)	20 (49%)	21 (51%)	12 (29%)	29 (71%)	40 (98%)	1 (2%)
Outside of North America	*41 (63%)*	*24 (37%)*	*37 (90%)*	*4 (10%)*	*20 (49%)*	*21 (51%)*	*12 (29%)*	*29 (71%)*	*40 (98%)*	*1 (2%)*
Total	375 (22%)	1364 (78%)	308 (82%)	67 (18%)	116 (31%)	259 (69%)	160 (43%)	215 (57%)	358 (95%)	17 (5%)

Table 8. Bicycle and helmet use of (19 year olds and below) young adults, during recreational time

Study	Recreational Cyclist		Frequency of Helmet Use		Educated of Legislation	
	Cyclist	Non-Cyclist	Always/Often	Rarely/On Occasion/Sometimes	Educated	Uneducated
Anpalagan et al. 2018 (11)	171 (67%)	86 (33%)	75 (44%)	96 (56%)	164 (96%)	7 (4%)
Anpalagan et al. 2018 (14)	181 (68%)	87 (32%)	81 (45%)	100 (55%)	176 (97%)	5 (3%)
Anpalagan et al. 2018 (12)	60 (74%)	21 (26%)	33 (55%)	27 (45%)	60 (100%)	0 (0%)
Chow et al. 2018 (15)	136 (74%)	49 (26%)	46 (34%)	90 (66%)	132 (97%)	4 (3%)
Rzepka et al. 2018 (13)	49 (70%)	21 (30%)	21 (43%)	28 (57%)	49 (100%)	0 (0%)
Viehweger et al. 2018 (16)	33 (72%)	13 (28%)	8 (32%)	25 (64%)	33 (100%)	0 (0%)
Viehweger et al. 2018 (17)	53 (62%)	32 (38%)	32 (60%)	21 (40%)	53 (100%)	0 (0%)
Province of Ontario	683 (69%)	309 (31%)	296 (43%)	387 (57%)	667 (98%)	16 (2%)
Chow et al. 2018 (18)	63 (72%)	24 (28%)	35 (56%)	28 (44%)	60 (95%)	3 (5%)
Province of Quebec	63 (72%)	24 (28%)	35 (56%)	28 (44%)	60 (95%)	3 (5%)
Chow et al. 2018 (19)	54 (64%)	31 (36%)	12 (22%)	42 (78%)	54 (100%)	0 (0%)
Province of Saskatchewan	54 (64%)	31 (36%)	12 (22%)	42 (78%)	54 (100%)	0 (0%)

Study	Recreational Cyclist		Frequency of Helmet Use		Educated of Legislation	
	Cyclist	Non-Cyclist	Always/Often	Rarely/On Occasion/Sometimes	Educated	Uneducated
Hollenberg et al. 2018 (20)	55 (76%)	17 (24%)	38 (69%)	17 (31%)	55 (100%)	0 (0%)
Province of Nova Scotia	55 (76%)	17 (24%)	38 (69%)	17 (31%)	55 (100%)	0 (0%)
Not published - Vancouver	6 (60%)	4 (40%)	4 (67%)	2 (33%)	6 (100%)	0 (0%)
Province of British Columbia	6 (60%)	4 (40%)	4 (67%)	2 (33%)	6 (100%)	0 (0%)
Canada	861 (69%)	385 (31%)	385 (45%)	476 (55%)	842 (98%)	19 (2%)
Chow et al. 2018 (8)	251 (70%)	107 (30%)	147 (59%)	104 (41%)	247 (98%)	4 (2%)
State of New York	251 (70%)	107 (30%)	147 (59%)	104 (41%)	247 (98%)	4 (2%)
Chow et al. 2018 (21)	25 (35%)	47 (65%)	9 (36%)	16 (54%)	25 (100%)	0 (0%)
State of California	25 (35%)	47 (65%)	9 (36%)	16 (54%)	25 (100%)	0 (0%)
United States of America	276 (64%)	154 (36%)	156 (57%)	120 (43%)	272 (99%)	4 (1%)
Chow et al. 2018 (22)	56 (86%)	9 (14%)	14 (30%)	42 (70%)	54 (96%)	2 (4%)
Outside of North America	56 (86%)	9 (14%)	14 (30%)	42 (70%)	54 (96%)	2 (4%)
Total	1193 (69%)	548 (31%)	555 (47%)	638 (53%)	1168 (98%)	25 (2%)

Table 9. Bicycle and helmet use of (20 to 22 year old) young adults, to university

Study	School Cyclist		Duration		Frequency of Commute		Frequency of Helmet Use		Educated of Legislation	
	Cyclist	Non-Cyclist	Under 20 Min	Over 20 Min	Always/ Often	Rarely/On Occasion/ Sometimes	Always/ Often	Rarely/On Occasion/ Sometimes	Educated	Uneducated
Anpalagan et al. 2018 (11)	78 (39%)	121 (61%)	64 (82%)	14 (18%)	29 (37%)	49 (63%)	38 (49%)	40 (51%)	77 (99%)	1 (1%)
Anpalagan et al. 2018 (14)	55 (33%)	112 (67%)	51 (93%)	4 (7%)	11 (20%)	44 (80%)	27 (49%)	28 (51%)	54 (98%)	1 (2%)
Anpalagan et al. 2018 (12)	2 (33%)	4 (66%)	2 (100%)	0 (0%)	1 (50%)	1 (50%)	1 (50%)	1 (50%)	2 (100%)	0 (0%)
Chow et al. 2018 (15)	29 (34%)	56 (66%)	22 (76%)	7 (24%)	9 (31%)	20 (69%)	18 (62%)	11 (38%)	29 (100%)	0 (0%)
Rzepka et al. 2018 (13)	0 (0%)	6 (100%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Viehweger et al. 2018 (16)	6 (21%)	22 (79%)	5 (83%)	1 (17%)	3 (50%)	3 (50%)	1 (17%)	5 (83%)	4 (67%)	2 (33%)
Viehweger et al. 2018 (17)	26 (59%)	18 (41%)	26 (100%)	0 (0%)	11 (42%)	15 (58%)	5 (19%)	21 (81%)	26 (100%)	0 (0%)
Province of Ontario	*196 (37%)*	*339 (63%)*	*170 (87%)*	*26 (13%)*	*64 (33%)*	*132 (67%)*	*90 (46%)*	*106 (54%)*	*192 (98%)*	*4 (2%)*
Chow et al. 2018 (18)	33 (61%)	21 (39%)	12 (36%)	21 (64%)	8 (24%)	25 (76%)	13 (39%)	20 (61%)	33 (100%)	0 (0%)
Province of Quebec	*33 (61%)*	*21 (39%)*	*12 (36%)*	*21 (64%)*	*8 (24%)*	*25 (76%)*	*13 (39%)*	*20 (61%)*	*33 (100%)*	*0 (0%)*

Study	School Cyclist		Duration		Frequency of Commute		Frequency of Helmet Use		Educated of Legislation	
	Cyclist	Non-Cyclist	Under 20 Min	Over 20 Min	Always/ Often	Rarely/On Occasion/ Sometimes	Always/ Often	Rarely/On Occasion/ Sometimes	Educated	Uneducated
Chow et al. 2018 (19)	11 (33%)	22 (66%)	8 (73%)	3 (27%)	1 (9%)	10 (91%)	4 (36%)	7 (64%)	11 (100%)	0 (0%)
Province of Saskatchewan	*11 (33%)*	*22 (66%)*	*8 (73%)*	*3 (27%)*	*1 (9%)*	*10 (91%)*	*4 (36%)*	*7 (64%)*	*11 (100%)*	*0 (0%)*
Hollenberg et al. 2018 (20)	28 (61%)	18 (39%)	18 (64%)	10 (36%)	12 (43%)	16 (57%)	20 (71%)	8 (29%)	28 (100%)	0 (0%)
Province of Nova Scotia	*28 (61%)*	*18 (39%)*	*18 (64%)*	*10 (36%)*	*12 (43%)*	*16 (57%)*	*20 (71%)*	*8 (29%)*	*28 (100%)*	*0 (0%)*
Not published - Vancouver	1 (100%)	0 (0%)	1 (100%)	0 (0%)	1 (100%)	0 (0%)	0 (0%)	1 (100%)	1 (100%)	0 (0%)
Province of British Columbia	*1 (100%)*	*0 (0%)*	*1 (100%)*	*0 (0%)*	*1 (100%)*	*0 (0%)*	*0 (0%)*	*1 (100%)*	*1 (100%)*	*0 (0%)*
Canada	269 (40%)	400 (60%)	209 (78%)	60 (22%)	86 (32%)	183 (68%)	127 (47%)	142 (53%)	265 (99%)	4 (1%)
Chow et al. 2018 (8)	62 (23%)	212 (77%)	60 (97%)	2 (3%)	21 (34%)	41 (66%)	43 (69%)	19 (31%)	61 (98%)	1 (2%)
State of New York	*62 (23%)*	*212 (77%)*	*60 (97%)*	*2 (3%)*	*21 (34%)*	*41 (66%)*	*43 (69%)*	*19 (31%)*	*61 (98%)*	*1 (2%)*
Chow et al. 2018 (21)	14 (16%)	73 (84%)	12 (86%)	2 (14%)	4 (29%)	10 (71%)	2 (14%)	12 (86%)	13 (93%)	1 (7%)
State of California	*14 (16%)*	*73 (84%)*	*12 (86%)*	*2 (14%)*	*4 (29%)*	*10 (71%)*	*2 (14%)*	*12 (86%)*	*13 (93%)*	*1 (7%)*

Table 9. (Continued)

Study	School Cyclist		Duration		Frequency of Commute		Frequency of Helmet Use		Educated of Legislation	
	Cyclist	Non-Cyclist	Under 20 Min	Over 20 Min	Always/ Often	Rarely/On Occasion/ Sometimes	Always/ Often	Rarely/On Occasion/ Sometimes	Educated	Uneducated
United States of America	*76 (21%)*	*285 (79%)*	*72 (95%)*	*4 (5%)*	*25 (33%)*	*51 (67%)*	*45 (59%)*	*31 (41%)*	*74 (97%)*	*2 (3%)*
Chow et al. 2018 (22)	65 (61%)	42 (39%)	60 (92%)	5 (8%)	29 (45%)	36 (55%)	13 (20%)	52 (80%)	65 (100%)	0 (0%)
Outside of North America	*65 (61%)*	*42 (39%)*	*60 (92%)*	*5 (8%)*	*29 (45%)*	*36 (55%)*	*13 (20%)*	*52 (80%)*	*65 (100%)*	*0 (0%)*
Total	410 (36%)	727 (64%)	341 (83%)	69 (17%)	140 (34%)	270 (66%)	185 (45%)	225 (55%)	404 (99%)	6 (1%)

Table 10. Bicycle and helmet use of (20 to 22 year old) young adults, during recreational time

Study	Recreational Cyclist		Frequency of Helmet Use		Educated of Legislation	
	Cyclist	Non-Cyclist	Always/Often	Rarely/On Occasion/Sometimes	Educated	Uneducated
Anpalagan et al. 2018 (11)	98 (49%)	101 (51%)	55 (56%)	43 (44%)	97 (99%)	1 (1%)
Anpalagan et al. 2018 (14)	109 (65%)	59 (35%)	52 (48%)	57 (52%)	105 (96%)	4 (4%)
Anpalagan et al. 2018 (12)	4 (66%)	2 (33%)	2 (50%)	2 (50%)	4 (100%)	0 (0%)

Study	Recreational Cyclist		Frequency of Helmet Use		Educated of Legislation	
	Cyclist	Non-Cyclist	Always/Often	Rarely/On Occasion/Sometimes	Educated	Uneducated
Chow et al. 2018 (15)	64 (75%)	21 (25%)	28 (44%)	36 (56%)	62 (97%)	2 (3%)
Rzepka et al. 2018 (13)	4 (67%)	2 (33%)	0 (0%)	4 (100%)	4 (100%)	0 (0%)
Viehweger et al. 2018 (16)	20 (71%)	8 (29%)	3 (15%)	17 (85%)	18 (90%)	2 (10%)
Viehweger et al. 2018 (17)	25 (57%)	19 (43%)	8 (32%)	17 (68%)	25 (100%)	0 (0%)
Province of Ontario	324 (60%)	212 (40%)	148 (46%)	176 (54%)	315 (97%)	9 (3%)
Chow et al. 2018 (18)	42 (78%)	12 (22%)	23 (55%)	19 (45%)	41 (98%)	1 (2%)
Province of Quebec	42 (78%)	12 (22%)	23 (55%)	19 (45%)	41 (98%)	1 (2%)
Chow et al. 2018 (19)	28 (85%)	5 (15%)	6 (21%)	22 (79%)	27 (96%)	1 (4%)
Province of Saskatchewan	28 (85%)	5 (15%)	6 (21%)	22 (79%)	27 (96%)	1 (4%)
Hollenberg et al. 2018 (20)	32 (70%)	14 (30%)	23 (72%)	9 (28%)	32 (100%)	0 (0%)
Province of Nova Scotia	32 (70%)	14 (30%)	23 (72%)	9 (28%)	32 (100%)	0 (0%)
Canada	426 (64%)	243 (34%)	200 (47%)	226 (53%)	415 (97%)	11 (3%)

Table 10. (Continued)

Study	Recreational Cyclist		Frequency of Helmet Use		Educated of Legislation	
	Cyclist	Non-Cyclist	Always/Often	Rarely/On Occasion/Sometimes	Educated	Uneducated
Chow et al. 2018 (8)	157 (57%)	117 (43%)	101 (64%)	56 (36%)	155 (99%)	2 (1%)
State of New York	157 (57%)	117 (43%)	101 (64%)	56 (36%)	155 (99%)	2 (1%)
Chow et al. 2018 (21)	30 (34%)	47 (66%)	14 (47%)	16 (53%)	29 (97%)	1 (3%)
State of California	30 (34%)	47 (66%)	14 (47%)	16 (53%)	29 (97%)	1 (3%)
United States of America	187 (53%)	164 (47%)	115 (61%)	72 (39%)	184 (98%)	3 (2%)
Chow et al. 2018 (22)	98 (92%)	9 (8%)	16 (16%)	82 (84%)	96 (98%)	2 (2%)
Outside of North America	98 (92%)	9 (8%)	16 (16%)	82 (84%)	96 (98%)	2 (2%)
Total	711 (63%)	416 (37%)	331 (47%)	380 (53%)	695 (98%)	16 (2%)

Table 11. Bicycle and helmet use of (23 year olds and above) young adults, to university

Study	School Cyclist		Duration		Frequency of Commute		Frequency of Helmet Use		Educated of Legislation	
	Cyclist	Non-Cyclist	**Under 20 Min**	**Over 20 Min**	**Always/ Often**	**Rarely/On Occasion/ Sometimes**	**Always/ Often**	**Rarely/On Occasion/ Sometimes**	**Educated**	**Uneducated**
Anpalagan et al. 2018 (11)	12 (57%)	9 (43%)	11 (92%)	1 (8%)	4 (33%)	8 (66%)	8 (66%)	4 (33%)	9 (75%)	3 (25%)
Anpalagan et al. 2018 (14)	35 (73%)	13 (27%)	28 (80%)	7 (20%)	19 (54%)	16 (46%)	20 (57%)	15 (43%)	35 (100%)	0 (0%)
Chow et al. 2018 (15)	21 (31%)	67 (69%)	15 (71%)	6 (29%)	9 (43%)	12 (57%)	15 (71%)	6 (29%)	20 (95%)	1 (5%)
Viehweger et al. 2018 (16)	3 (60%)	2 (40%)	3 (100%)	0 (0%)	3 (100%)	0 (0%)	2 (67%)	1 (33%)	3 (100%)	0 (0%)
Viehweger et al. 2018 (17)	11 (85%)	2 (15%)	8 (73%)	3 (27%)	6 (55%)	5 (45%)	6 (55%)	5 (45%)	11 (100%)	0 (0%)
Province of Ontario	***82 (47%)***	***93 (53%)***	***65 (79%)***	***17 (21%)***	***41 (50%)***	***41 (50%)***	***51 (61%)***	***31 (39%)***	***78 (95%)***	***4 (5%)***
Chow et al. 2018 (18)	22 (76%)	7 (24%)	17 (77%)	5 (23%)	9 (41%)	13 (59%)	14 (65%)	8 (36%)	22 (100%)	0 (0%)
Province of Quebec	***22 (76%)***	***7 (24%)***	***17 (77%)***	***5 (23%)***	***9 (41%)***	***13 (59%)***	***14 (65%)***	***8 (36%)***	***22 (100%)***	***0 (0%)***
Chow et al. 2018 (19)	8 (53%)	7 (47%)	5 (63%)	3 (38%)	3 (38%)	5 (63%)	6 (75%)	2 (25%)	8 (100%)	0 (0%)
Province of Saskatchewan	***8 (53%)***	***7 (47%)***	***5 (63%)***	***3 (38%)***	***3 (38%)***	***5 (63%)***	***6 (75%)***	***2 (25%)***	***8 (100%)***	***0 (0%)***
Hollenberg et al. 2018 (20)	24 (73%)	9 (27%)	20 (83%)	4 (17%)	11 (46%)	13 (54%)	18 (75%)	6 (25%)	24 (100%)	0 (0%)

Table 11. (Continued)

Study	School Cyclist		Duration		Frequency of Commute		Frequency of Helmet Use		Educated of Legislation	
	Cyclist	Non-Cyclist	**Under 20 Min**	**Over 20 Min**	**Always/ Often**	**Rarely/On Occasion/ Sometimes**	**Always/ Often**	**Rarely/On Occasion/ Sometimes**	**Educated**	**Uneducated**
Province of Nova Scotia	***24 (73%)***	***9 (27%)***	***20 (83%)***	***4 (17%)***	***11 (46%)***	***13 (54%)***	***18 (75%)***	***6 (25%)***	***24 (100%)***	***0 (0%)***
Canada	***136 (54%)***	***116 (46%)***	***107 (79%)***	***29 (21%)***	***64 (47%)***	***72 (53%)***	***89 (65%)***	***47 (35%)***	***132 (97%)***	***4 (3%)***
Chow et al. 2018 (8)	27 (23%)	91 (77%)	25 (93%)	2 (7%)	7 (26%)	20 (74%)	21 (78%)	6 (22%)	27 (100%)	0 (0%)
State of New York	***27 (23%)***	***91 (77%)***	***25 (93%)***	***2 (7%)***	***7 (26%)***	***20 (74%)***	***21 (78%)***	***6 (22%)***	***27 (100%)***	***0 (0%)***
Chow et al. 2018 (21)	8 (13%)	53 (87%)	7 (88%)	1 (13%)	0 (0%)	8 (100%)	1 (13%)	7 (88%)	8 (100%)	0 (0%)
State of California	***8 (13%)***	***53 (87%)***	***7 (88%)***	***1 (13%)***	***0 (0%)***	***8 (100%)***	***1 (13%)***	***7 (88%)***	***8 (100%)***	***0 (0%)***
United States of America	***35 (20%)***	***144 (80%)***	***32 (91%)***	***3 (9%)***	***7 (20%)***	***28 (80%)***	***22 (63%)***	***13 (37%)***	***35 (100%)***	***0 (0%)***
Chow et al. 2018 (22)	28 (60%)	19 (40%)	27 (96%)	1 (4%)	11 (39%)	17 (61%)	3 (11%)	25 (89%)	27 (96%)	1 (4%)
Outside of North America	***28 (60%)***	***19 (40%)***	***27 (96%)***	***1 (4%)***	***11 (39%)***	***17 (61%)***	***3 (11%)***	***25 (89%)***	***27 (96%)***	***1 (4%)***
Total	**199 (42%)**	**279 (58%)**	**166 (83%)**	**33 (17%)**	**82 (41%)**	**117 (54%)**	**114 (57%)**	**85 (43%)**	**194 (97%)**	**5 (3%)**

Table 12. Bicycle and helmet use of (23 year olds and older) young adults, during recreational time

Study	Recreational Cyclist		Frequency of Helmet Use		Educated of Legislation	
	Cyclist	Non-Cyclist	Always/Often	Rarely/On Occasion/ Sometimes	Educated	Uneducated
Anpalagan et al. 2018 (11)	19 (90%)	2 (10%)	13 (68%)	6 (32%)	17 (89%)	2 (11%)
Anpalagan et al. 2018 (14)	38 (79%)	10 (21%)	27 (71%)	11 (29%)	38 (100%)	0 (0%)
Chow et al. 2018 (15)	65 (74%)	23 (26%)	34 (52%)	31 (48%)	63 (97%)	2 (3%)
Viehweger et al. 2018 (16)	5 (100%)	0 (0%)	4 (80%)	1 (20%)	5 (100%)	0 (0%)
Viehweger et al. 2018 (17)	10 (77%)	3 (23%)	7 (70%)	3 (30%)	10 (100%)	0 (0%)
Province of Ontario	137 (78%)	38 (22%)	85 (62%)	52 (38%)	133 (97%)	4 (3%)
Chow et al. 2018 (18)	25 (86%)	4 (14%)	17 (68%)	8 (32%)	25 (100%)	0 (0%)
Province of Quebec	25 (86%)	4 (14%)	17 (68%)	8 (32%)	25 (100%)	0 (0%)
Chow et al. 2018 (19)	12 (80%)	3 (20%)	5 (42%)	7 (58%)	12 (100%)	0 (0%)
Province of Saskatchewan	12 (80%)	3 (20%)	5 (42%)	7 (58%)	12 (100%)	0 (0%)
Hollenberg et al. 2018 (20)	26 (79%)	7 (21%)	20 (77%)	6 (23%)	25 (96%)	1 (4%)
Province of Nova Scotia	26 (79%)	7 (21%)	20 (77%)	6 (23%)	25 (96%)	1 (4%)

Table 12. (Continued)

Study	Recreational Cyclist		Frequency of Helmet Use		Educated of Legislation	
	Cyclist	Non-Cyclist	Always/Often	Rarely/On Occasion/ Sometimes	Educated	Uneducated
Not published - Vancouver	1 (50%)	1 (50%)	0 (0%)	1 (100%)	1 (100%)	0 (0%)
Province of British Columbia	1 (50%)	1 (50%)	0 (0%)	1 (100%)	1 (100%)	0 (0%)
Canada	201 (79%)	53 (21%)	127 (63%)	74 (37%)	196 (98%)	5 (2%)
Chow et al. 2018 (8)	73 (62%)	45 (38%)	51 (70%)	22 (30%)	73 (100%)	0 (0%)
State of New York	73 (62%)	45 (38%)	51 (70%)	22 (30%)	73 (100%)	0 (0%)
Chow et al. 2018 (21)	23 (38%)	38 (62%)	12 (52%)	11 (48%)	23 (100%)	0 (0%)
State of California	23 (38%)	38 (62%)	12 (52%)	11 (48%)	23 (100%)	0 (0%)
United States of America	96 (54%)	83 (46%)	63 (66%)	33 (34%)	96 (100%)	0 (0%)
Chow et al. 2018 (22)	40 (85%)	7 (15%)	5 (13%)	35 (88%)	39 (98%)	1 (3%)
Outside of North America	40 (85%)	7 (15%)	5 (13%)	35 (88%)	39 (98%)	1 (3%)
Total	337 (70%)	143 (30%)	195 (58%)	142 (42%)	331 (98%)	6 (2%)

Young adults 23 years old and above

Five studies (11, 14-17) studied young adults in Ontario as opposed to seven in the prior two cohorts of young adults. 54% Canadian young adults commuted to school using a bicycle (range = 47% to 76%), while 20% of American young adults (range = 13% to 23%) and 60% of Irish young adults similarly reported so. 79% (range = 63% to 83%), 91% (range = 88% to 93%), and 96% respectively had a short commute of less than 20 minutes. Canadian young adults commuted the most regularly, with 47% reporting so; 39% of Irish and 20% of American young adults also brought about this conclusion. Only 11% of Irish young adults regularly used a helmet, compared to 65% for Canadians and 63% for Americans. 97%, 100% and 96% of Canadians, Americans and Irish young adults reported that they were aware of the safety benefits offered by helmets. Overall, 42% used a bicycle to commute to school, 83% had short commutes, 41% frequently commuted to school, 57% regularly used a helmet and 97% were aware of the safety benefits (see Table 11).

79% of Canadian young adults reported that they were recreational cyclists, with the Province of British Columbia having the lowest proportion (50%) and the Province of Quebec having the highest proportion (86%). A smaller proportion of Americans (54%) and a larger proportion of Irish young adults (85%) identified themselves as recreational cyclists. 63%, 66% and 13% regularly use a helmet, respectively, while 98%, 100% and 98% believe that helmet use is effective. Overall, 70% are recreational cyclists, 58% regularly use a helmet, and 98% acknowledge that bicycle helmets are effective protective equipment (see Table 12).

DISCUSSION

This is the first meta-analysis to comprehensively analyze bicycle and helmet use of adolescents and young adults of recently-published literature.

This meta-analysis also incorporates three data sets that were not published, introducing more data to the scientific community.

All but one age group (Grade 7 to 8 adolescents) had the same observation – a larger proportion of the population was aware of the helmet's safety benefits/legislation than compared to helmet use. The older adolescents and young adults are actively deciding not to use a helmet. For the youngest group of adolescents, their good adherence to helmet use may be due to their psychological stage of development in which they still idolize and adhere to their parents' requests and fear punishment/ legislation.

The discrepancy between helmet use and knowledge of safety benefits may be resolved using several approaches. An extension of the legislation for all ages, not just children under the age of 18 years old, may help a little bit with increasing helmet-use; however, data from the oldest adolescent cohort show that there is a disregard of the law. Better enforcement of bicycle legislation coupled with an extension of the legislation may increase helmet use. Local community advocacy programs should also be established to help increase helmet use. These programs do not need to focus on the safety benefits of helmets, as almost all of the population are aware of these advantages; instead, they should look into solutions to encourage helmet use. All the included published studies listed reasons for why adolescents and young adults do not use helmets (6-22). Community programs can look into solutions to help rectify these barriers, such as providing better locker space for student cyclists to store their helmets, and making helmets more fashionable and acceptable by the community.

The meta-analysis data led to conclusions in-line with the published studies – helmet use decreases as adolescents age, and helmet use increases as young adults age. There seems to be a U-shaped pattern, with helmet use rates bottoming out for adolescents in Grade 11 and 12, and young adults below 19 years of age. The data also suggests that, generally, the populations of Canada and United States yield similar statistics, which is different compared to those outside of North America. This may be explained by cultural environments – Canada and United States share

similar cultural atmospheres, which differ from those outside of North America (Ireland, Singapore).

In conclusion, there exists a U-shaped pattern between helmet use and age, as adolescents progress to young adulthood. Those residing in Canada and the United States use bicycles and helmets at a similar rate, which is different than those outside of North America (Ireland and Singapore). This may be a result of differing legislation around helmet use, and also different cultural factors. Local community advocacy programs should also be established to help increase helmet use. These programs can look into solutions to help rectify the barriers for helmet use, such as providing better locker space for student cyclists to store their helmets, and making helmets more fashionable and acceptable by the community.

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REFERENCES

[1] Baker SP, Li G, Fowler G, Dannenberg AL. Injuries to bicyclists: A national perspective. Baltimore, MD: The Johns Hopkins Injury Prevention Center, 1993.

[2] Friede AM, Azzara CV, Gallagher SS, Guyer B. The epidemiology of injuries to bicycle riders. Pediatr Clin North Am 1985;32:141–51.

[3] Sacks JJ, Holmgreen P, Smith SM, Sosin DM. Bicycle-associated head injuries and deaths in the United States from 1984 through 1988. How many are preventable? JAMA 1991;266:3016–8.

[4] Selbst SM, Alexander D, Ruddy R. Bicycle-related injuries. Am J Dis Child 1987;141:140–4.

[5] Thompson RS, Rivara RP, Thompson DC. A case control study of the effectiveness of bicycle safety helmets. N Engl J Med 1989;320:1361–7.

[6] Chow R, Hollenberg D, Pintilie A, Midroni C, Cumner S. Helmet use of adolescent cyclists at Crescent School in Toronto, Canada. Int J Adolesc Med Health 2016 Mar 12. Doi: 10.1515/ijamh-2015-0123.

[7] Borean M, Ho S, Hollenberg D, Anpalagan T, Rzepka A, Viehweger J, et al. Helmet use of adolescents in Markham, Canada. Int J Adolesc Med Health 2017, in press.

[8] Chow R, Borean M, Hollenberg D, Ganguli N, Freedman Z, Kang R, et al. Helmet use of young adults in New York State, United States of America. Int J Child Health Hum Dev 2018;11(1), in press.

[9] Anpalagan T, Borean M, Chen L, Viehweger J, Hollenberg D, Rzepka A, et al. Helmet use of adolescents in Toronto, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[10] Borean M, Trasente V, Rzepka A, Viggiani D, Viotto D, Hollenberg D, et al. Helmet use of adolescents at De La Salle College Oaklands in Toronto, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[11] Anpalagan T, Hollenberg D, Borean M, Rzepka A, Chow R. Helmet use of young adults in London, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[12] Anpalagan T, Panigrahi I, Borean M, Hollenberg D, Rzepka A, Viehweger J et al. Helmet use of young adults in Hamilton, Canada. Int J Child Health Hum Dev 2018;11(1); in press.

[13] Rzepka A, Borean M, Hollenberg D, Chan Z, Binns A, Weise E, et al. Helmet use of young adults in Guelph, Canada. Int J Child Health Hum Dev 2018;11(1); in press.

[14] Anpalagan T, Duarte N, Borean M, Anpalagan J, Camilleri R, Hollenberg D, et al. Helmet use of young adults in Waterloo, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[15] Chow R, Borean M, Hollenberg D, Ho C, Ng W, Guo W, et al. Helmet use of young adults in Toronto, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[16] Viehweger J, Borean M, Tang M, Hollenberg D, Anpalagan T, Rzepka A, et al. Helmet use of young adults in St. Catherines, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[17] Viehweger J, Borean M, Midroni L, Midroni C, Hollenberg D, Anpalagan T et al. Helmet use of young adults in Kingston, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[18] Chow R, Borean M, Hollenberg D, Song K, Liu J, Young T, et al. Helmet use of young adults in Montreal, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[19] Chow R, Rzepka A, Borean M, Parekh R, Hollenberg D, Anpalagan T, et al. Helmet use of young adults in Saskatoon, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[20] Hollenberg D, Ferguson T, Borean M, Anpalagan T, Rzepka A, Viehweger J, et al. Helmet use of young adults in Halifax, Canada. Int J Child Health Hum Dev 2018;11(1), in press.

[21] Chow R, Borean M, Murai A, Menon G, Hollenberg D, Anpalagan T, et al. Helmet use of young adults in California, United States of America. Int J Child Health Hum Dev 2018;11(1): in press.

[22] Chow R, Hollenberg D, Borean M, Goh S, Anpalagan T, Rzepka A, et al. Helmet use of young adults in Dublin, Ireland. Int J Child Health Hum Dev 2018;11(1), in press.

SECTION SEVEN: ACKNOWLEDGMENTS

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Chapter 21

ABOUT THE EDITORS

Ronald Chow, BMSc(C), is the Founder and President of the Bicycle Safety and Awareness Club headquartered in London, Ontario, Canada. At the young age of 18 years old, he already has over 100 peer-reviewed publications to his name. He was the recipient of the Ontario Lieutenant Governor's Community Volunteer Award for volunteerism in his community, the Chancellor's Scholarship from Queen's University for excellent academic ability and leadership skills, the George Eastman Young Leaders Award from the University of Rochester for astounding leadership and extensive extracurricular activities, and the Future of Western Award from the University of Western Ontario as the most accomplished first-year university student leader in the areas of academics, student government, athletics and philanthropy. Email: rchow48@uwo.ca

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Disabilities, Ministry of Social Affairs and Social Services, Jerusalem, the founder and director of the National Institute of Child Health and Human Development in Israel. Numerous publications in the field of pediatrics, child health and human development, rehabilitation, intellectual disability, disability, health, welfare, abuse, advocacy, quality of life and prevention. Received the Peter Sabroe Child Award for outstanding work on behalf of Danish Children in 1985 and the International LEGO-Prize ("The Children's Nobel Prize") for an extraordinary contribution towards improvement in child welfare and well-being in 1987. Email: jmerrick@zahav.net.il

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Chapter 22

ABOUT THE BICYCLE SAFETY AND AWARENESS CLUB, LONDON, ONTARIO, CANADA

The Bicycle Safety and Awareness Club (BSAC) is a student-run organization headquartered in London, Ontario, Canada. It was established in 2016, and has affiliated members located in Canada, United States and other countries. The aim of BSAC is to educate, advocate and promote bicycle safety among university students and the young adult population in the local community. Advocating and educating about safe cycling practices are centrally-managed by the operations team at headquarters in London, Canada.

The research arm of BSAC operates independently of the operations team. It draws on resources available to BSAC as needed to investigate and evaluate current cycling practices in communities. This book, for example, is a culmination of the research work conducted by BSAC's research team.

With the knowledge uncovered by the research arm, the operations team acts accordingly to cater its advocacy/education programs towards the local communities. BSAC coordinately works towards building a safer and better community for student and young adult cyclists.

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Chapter 23

ABOUT THE NATIONAL INSTITUTE OF CHILD HEALTH AND HUMAN DEVELOPMENT IN ISRAEL

The National Institute of Child Health and Human Development (NICHD) in Israel was established in 1998 as a virtual institute under the auspices of the Medical Director, Ministry of Social Affairs and Social Services in order to function as the research arm for the Office of the Medical Director. In 1998 the National Council for Child Health and Pediatrics, Ministry of Health and in 1999 the Director General and Deputy Director General of the Ministry of Health endorsed the establishment of the NICHD.

Mission

The mission of a National Institute for Child Health and Human Development in Israel is to provide an academic focal point for the scholarly interdisciplinary study of child life, health, public health, welfare, disability, rehabilitation, intellectual disability and related aspects of human development. This mission includes research, teaching, clinical work, information and public service activities in the field of child health and human development.

Service and academic activities

Over the years many activities became focused in the south of Israel due to collaboration with various professionals at the Faculty of Health Sciences (FOHS) at the Ben Gurion University of the Negev (BGU). Since 2000 an affiliation with the Zusman Child Development Center at the Pediatric Division of Soroka University Medical Center has resulted in collaboration around the establishment of the Down Syndrome Clinic at that center. In 2002 a full course on "Disability" was established at the Recanati School for Allied Professions in the Community, FOHS, BGU and in 2005 collaboration was started with the Primary Care Unit of the faculty and disability became part of the master of public health course on "Children and society". In the academic year 2005-2006 a one semester course on "Aging with disability" was started as part of the master of science program in gerontology in our collaboration with the Center for Multidisciplinary Research in Aging. In 2010 collaborations with the Division of Pediatrics, Hadassah Hebrew University Medical Center, Jerusalem, Israel around the National Down Syndrome Center and teaching students and residents about intellectual and developmental disabilities as part of their training at this campus.

Research activities

The affiliated staff have over the years published work from projects and research activities in this national and international collaboration. In the year 2000 the International Journal of Adolescent Medicine and Health and in 2005 the International Journal on Disability and Human Development of De Gruyter Publishing House (Berlin and New York) were affiliated with the National Institute of Child Health and Human Development. From 2008 also the International Journal of Child Health and Human Development (Nova Science, New York), the International Journal of Child and Adolescent Health (Nova Science) and the Journal of Pain Management (Nova Science) affiliated and from 2009 the International

Public Health Journal (Nova Science) and Journal of Alternative Medicine Research (Nova Science). All peer-reviewed international journals.

National collaborations

Nationally the NICHD works in collaboration with the Faculty of Health Sciences, Ben Gurion University of the Negev; Department of Physical Therapy, Sackler School of Medicine, Tel Aviv University; Autism Center, Assaf HaRofeh Medical Center; National Rett and PKU Centers at Chaim Sheba Medical Center, Tel HaShomer; Department of Physiotherapy, Haifa University; Department of Education, Bar Ilan University, Ramat Gan, Faculty of Social Sciences and Health Sciences; College of Judea and Samaria in Ariel and in 2011 affiliation with Center for Pediatric Chronic Diseases and National Center for Down Syndrome, Department of Pediatrics, Hadassah Hebrew University Medical Center, Mount Scopus Campus, Jerusalem.

International collaborations

Internationally with the Department of Disability and Human Development, College of Applied Health Sciences, University of Illinois at Chicago; Strong Center for Developmental Disabilities, Golisano Children's Hospital at Strong, University of Rochester School of Medicine and Dentistry, New York; Centre on Intellectual Disabilities, University of Albany, New York; Centre for Chronic Disease Prevention and Control, Health Canada, Ottawa; Chandler Medical Center and Children’s Hospital, Kentucky Children’s Hospital, Section of Adolescent Medicine, University of Kentucky, Lexington; Chronic Disease Prevention and Control Research Center, Baylor College of Medicine, Houston, Texas; Division of Neuroscience, Department of Psychiatry, Columbia University, New York; Institute for the Study of Disadvantage and Disability, Atlanta; Center for Autism and Related Disorders, Department Psychiatry, Children’s Hospital

Boston, Boston; Department of Pediatric and Adolescent Medicine, Western Michigan University Homer Stryker MD School of Medicine, Kalamazoo, Michigan, United States; Department of Paediatrics, Child Health and Adolescent Medicine, Children's Hospital at Westmead, Westmead, Australia; International Centre for the Study of Occupational and Mental Health, Düsseldorf, Germany; Centre for Advanced Studies in Nursing, Department of General Practice and Primary Care, University of Aberdeen, Aberdeen, United Kingdom; Quality of Life Research Center, Copenhagen, Denmark; Nordic School of Public Health, Gottenburg, Sweden, Scandinavian Institute of Quality of Working Life, Oslo, Norway; The Department of Applied Social Sciences (APSS) of The Hong Kong Polytechnic University Hong Kong.

Targets

Our focus is on research, international collaborations, clinical work, teaching and policy in health, disability and human development and to establish the NICHD as a permanent institute in Israel in order to conduct model research and together with the four university schools of public health/medicine in Israel establish a national master and doctoral program in disability and human development at the institute to secure the next generation of professionals working in this often non-prestigious/low-status field of work.

Contact

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Chapter 24

ABOUT THE BOOK SERIES "PEDIATRICS, CHILD AND ADOLESCENT HEALTH"

Pediatrics, child and adolescent health is a book series with publications from a multidisciplinary group of researchers, practitioners and clinicians for an international professional forum interested in the broad spectrum of pediatric medicine, child health, adolescent health and human development.

- Merrick J, ed. Child and adolescent health yearbook 2011. New York: Nova Science, 2012.
- Merrick J, ed. Child and adolescent health yearbook 2012. New York: Nova Science, 2012.
- Roach RR, Greydanus DE, Patel DR, Homnick DN, Merrick J, eds. Tropical pediatrics: A public health concern of international proportions. New York: Nova Science, 2012.
- Merrick J, ed. Child health and human development yearbook 2011. New York: Nova Science, 2012.
- Merrick J, ed. Child health and human development yearbook 2012. New York: Nova Science, 2012.
- Shek DTL, Sun RCF, Merrick J, eds. Developmental issues in Chinese adolescents. New York: Nova Science, 2012.
- Shek DTL, Sun RCF, Merrick J, eds. Positive youth development: Theory, research and application. New York: Nova Science, 2012.

- Zachor DA, Merrick J, eds. Understanding autism spectrum disorder: Current research aspects. New York: Nova Science, 2012.
- Ma HK, Shek DTL, Merrick J, eds. Positive youth development: A new school curriculum to tackle adolescent developmental issues. New York: Nova Science, 2012.
- Wood D, Reiss JG, Ferris ME, Edwards LR, Merrick J, eds. Transition from pediatric to adult medical care. New York: Nova Science, 2012.
- Isenberg Y. Guidelines for the healthy integration of the ill child in the educational system: Experience from Israel. New York: Nova Science, 2013.
- Shek DTL, Sun RCF, Merrick J, eds. Chinese adolescent development: Economic disadvantages, parents and intrapersonal development. New York: Nova Science, 2013.
- Shek DTL, Sun RCF, Merrick J, eds. University and college students: Health and development issues for the leaders of tomorrow. New York: Nova Science, 2013.
- Shek DTL, Sun RCF, Merrick J, eds. Adolescence and behavior issues in a Chinese context. New York: Nova Science, 2013.
- Sun J, Buys N, Merrick J. Advances in preterm infant research. New York: Nova Science, 2013.
- Tsitsika A, Janikian M, Greydanus DE, Omar HA, Merrick J, eds. Internet addiction: A public health concern in adolescence. New York: Nova Science, 2013.
- Shek, DTL, Lee TY, Merrick J, eds. Promotion of holistic development of young people in Hong Kong. New York: Nova Science, 2013.
- Shek DTL, Ma C, Lu Y, Merrick J, eds. Human developmental research: Experience from research in Hong Kong. New York: Nova Science, 2013.
- Rubin IL, Merrick J, eds. Child health and human development: Social, economic and environmental factors. New York: Nova Science, 2013.
- Merrick J, ed. Chronic disease and disability in childhood. New York: Nova Science, 2013.
- Rubin IL, Merrick J, eds. Break the cycle of environmental health disparities: Maternal and child health aspects. New York: Nova Science, 2013.

- Rubin IL, Merrick J, eds. Environmental health disparities in children: Asthma, obesity and food. New York: Nova Science, 2013.
- Rubin IL, Merrick J, eds. Environmental health: Home, school and community. New York: Nova Science, 2013.
- Merrick J, Kandel I, Omar HA, eds. Children, violence and bullying: International perspectives. New York: Nova Science, 2013.
- Omar HA, Bowling CH, Merrick J, eds. Playing with fire: Children, adolescents and firesetting. New York: Nova Science, 2013.
- Merrick J, Tenenbaum A, Omar HA, eds. School, adolescence and health issues. New York: Nova Science, 2014.
- Merrick J, Tenenbaum A, Omar HA, eds. Adolescence and sexuality: International perspectives. New York: Nova Science, 2014.
- Diamond G, Arbel E. Adoption: The search for a new parenthood adoption. New York: Nova Science, 2014.
- Taylor MF, Pooley JA, Merrick J, eds. Adolescence: Places and spaces. New York: Nova Science, 2014.
- Greydanus DE, Feinberg AN, Merrick J, eds. Born into this world: Health issues. New York: Nova Science, 2014.
- Greydanus DE, Feinberg AN, Merrick J, eds. Caring for the newborn: A comprehensive guide for the clinician. New York: Nova Science, 2014.
- Rubin IL, Merrick J, eds. Environment and hope: Improving health, reducing AIDS and promoting food security in the world. New York: Nova Science, 2014.
- Greydanus DE, Feinberg AN, Merrick J, eds. Pediatric and adolescent dermatology: Some current issues. New York: Nova Science, 2014.
- Roach RR, Greydanus DE, Patel DR, Merrick J, eds. Tropical pediatrics: A public health concern of international proportions, Second edition. New York: Nova Science, 2015.
- Merrick J, ed. Child and adolescent health issues: A tribute to the pediatrician Donald E Greydanus. New York: Nova Science, 2015.
- Feinberg AN. A pediatric resident pocket guide: Making the most of morning reports. New York: Nova Science, 2015.

- Greydanus DE, Patel DR, Pratt HD, Calles Jr JL, Nazeer A, Merrick J, eds. Behavioral pediatrics, 4th edition. New York: Nova Science, 2015.
- Merrick J, ed. Disability, chronic disease and human development. New York: Nova Science, 2015.
- Hegamin-Younger C, Merrick J, eds. Caribbean adolescents: Some public health concerns. New York: Nova Science, 2015.
- Merrick J, ed. Adolescence and health: Some international perspectives. New York: Nova Science, 2015.
- Omar HA. Youth suicide prevention: Everybody's business. New York: Nova Science, 2015.
- Greydanus DE, Raj VMS, Merrick J, eds. Chronic disease and disability: The pediatric kidney. New York: Nova Science, 2015.
- Merrick J, ed. Children and childhood: Some international aspects. New York: Nova Science, 2016.
- Shek DTL, Lee TY, Merrick J, eds. Children and adolescents: Future challenges. New York: Nova Science, 2016.
- Shek DTL, Wu FKU, Leung JTY, Merrick J, eds. Adolescence: Positive youth development programs in Chinese communities. New York: Nova Science, 2016.
- Merrick J, Greydanus DE, eds. Sexuality: Some international aspects. New York: Nova Science, 2016.
- Harel-Fisch Y, Abdeen Z, Navot M. Growing up in the Middle East: The daily lives and well-being of Israeli and Palestinian youth. New York: Nova Science, 2016.
- Greydanus DE, Malhotra D, Merrick J, eds. Chronic disease and disability: The pediatric heart. New York: Nova Science, 2016.
- Greydanus DE, Kamboj MK, Merrick J, eds. Chronic disease and disability: The pediatric pancreas. New York: Nova Science, 2016.
- Kamboj MK, Greydanus DE, Merrick J, eds. Diabetes mellitus: Childhood and adolescence. New York: Nova Science, 2016.
- Greydanus DE, Palusci VJ, Merrick J, eds. Chronic disease and disability: Abuse and neglect in childhood and adolescence. New York: Nova Science, 2016.
- Greydanus DE, Calles JL Jr, Patel DR, Nazeer A, Merrick J, eds. Clinical aspects of psychopharmacology in childhood and adolescence, second ed. New York: Nova Science, 2016.
- Greydanus DE, Apple RW, White K, Merrick J, eds. Children and youth: Post-traumatic stress disorder and motor vehicle crashes. New York: Nova Science, 2017.

- Mazaba ML, Siziya S, Merrick J, eds. Suicide: A global view on suicidal ideation among adolescents. New York: Nova Science, 2017.

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