BICYCLE AND HELMET USE FACTORS IN AN ADOLESCENT POPULATION IN WINNIPEG

BY

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A Thesis
Submitted to the Faculty of Graduate Studies
in Partial Fulfilment of the Requirements
for the Degree of

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ABSTRACT

More than 100 Canadians, half of them children under the age of 15, die every year because of bicycle injuries. Head injuries cause 75% of these deaths. Research has shown that bicycle helmets can reduce the risk of serious head injury by up to 85 percent. Although the use of bicycle helmets has been increased by promotional interventions, the level of helmet use remains low among adolescents, varying from seven to 17 percent.

The purpose of this study was to describe bicycle and helmet use in an adolescent population in Winnipeg and to assess the factors related to helmet use. The proportion of adolescents in Winnipeg exposed to the risks associated with bicycle riding was determined partially by a direct observation study of cyclists commuting to school and from an analysis of data from a cross-sectional self-administered questionnaire.

The prevalence of bicycle use in Winnipeg adolescents commuting to school by direct observation was 8.4 percent (95% CI 8.0-8.8). Of the 274 bicycle riders, 12.8% (95% CI 8.6 - 17.0) were observed wearing helmets. The self-reported questionnaire found that 67.4% of students rode their bicycles in the 30 days preceding the survey. Helmet use in the last 30 days was reported by 14.5% of cyclists.

Ownership of bicycle helmets was found to be 43.6% and varied between grade groups and subregions of Winnipeg. Helmet ownership is higher in middle to high income subregions of Winnipeg, and lower in a low income subregion

($p<0.0001$). Helmet ownership is significantly higher in grades 7-9 than in grades 10-12 ($p<0.001$). Among adolescent helmet owners, only 21% reported always wearing their helmets. The major impediment to helmet use was discomfort, followed by lack of perceived need. The strongest predictor of helmet use was a positive belief in helmet effectiveness.

This observational study provides information to help focus health promotion activities to promote bicycle safety helmets and enhance bicycle safety in Manitoba. Consideration should be given to the development of graphic and more realistic educational strategies to increase helmet use. Public policy requiring the use of mandatory helmets has a high potential for increasing helmet use and encouraging adolescent helmet owners to wear their helmets.

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LIST OF ABBREVIATIONS

BHSI	Bicycle Helmet Safety Institute
CAA	Canadian Automobile Association
CCA	Canadian Cycling Association
CBHC	Canadian Bike Helmet Coalition
CBIC	Canadian Brain Injury Coalition
CHIRPP	Canadian Hospitals Injury Reporting and Prevention Program
CI	Confidence Interval
IM-PACT	Injuries Manitoba - Prevention of Adolescent and Childhood Trauma
MCA	Manitoba Cycling Association
MCHPE	Manitoba Center of Health Policy and Evaluation
MMWR	Morbidity and Mortality Weekly Report
MPI	Manitoba Public Insurance
NPHS	National Population Health Survey
P	Probability
S1 -S4	Grade 9 - Grade 12 (WSD No. 1)
TBI	Traumatic Brain Injury
WHO	World Health Organization
WSD	Winnipeg School Division
YRBSS	Youth Risk Behaviour Surveillance System

CHAPTER 1: INTRODUCTION

Bicycle riding is a popular outdoor activity enjoyed by all age groups. Millions of Canadians ride bicycles for pleasure, for commuting, and as a form of exercise. More than one-third of the population aged 10 and up reported bicycling as a common form of physical recreation in 1988 (1). In 1994/95, data from the National Population Health Survey (NPHS) determined that 1.85 million Canadian adolescents (aged 12-19) were bicycle riders (2). With the popularity in bicycling, bicycle crashes are responsible for a substantial number of injuries in bicyclists, particularly head injuries (3-5). Since bicycle use is highest in the younger population, the consequence of injuries can most often affect this group.

During the three years, 1988, 1989, and 1990, 171 children and youth under the age of 19 years died because of bicycle injuries in Canada (6). Using Statistics Canada data, the Canadian Institute of Child Health reports that these deaths accounted for 3% of all injury deaths for children and youth. The proportion of all deaths due to cycling injuries was 1 percent (6). The epidemiological literature reports that head injury is the most common cause of death and serious injury in bicycle-related crashes (3,5,7-8). An estimated 33% of the children who survive a serious bicycle related head injury have a permanent disability as a result (9). Research shows that 10% of all visits to pediatric emergency rooms are the result of bicycle incidents (10).

Bicycle injuries are recognized as a significant and costly public health problem in Manitoba. Bicycling was the cause of 146 injury admissions and two injury deaths in 1996 (11). Of the 12 injury deaths reported in 1996 for 10-14 year olds in Manitoba, motor vehicles accounted for 24% of the deaths and bicycling was the cause in 17 percent. Bicycle injuries are also an important cause of injury hospitalizations in school aged children in Manitoba. Of the 146 injury admissions, 28 (19%) were in 5 -9 year olds, 45 (31%) occurred in children aged 10 -14, and 12 (8%) occurred in 15 -19 year olds. In a broad range of injury causes for children aged 10 -14, falls were the single leading cause of injury hospitalizations (22%), followed by sports (10%), violence to self (10%), violence by others (8%), bicycling (7%), and motor vehicles (4%) (11).

In the last decade, increasing attention has been given to the prevention of bicycle injuries. From the earliest stages of bicycle crash analysis, attention was concentrated on head protection and the prevention of head injuries (12). The serious problem of head injuries to bicyclists involved in crashes can be prevented or their severity reduced through the use of a simple bicycle helmet (13-15). Research has shown that wearing an approved helmet reduces the risk of head injury by 85%, and of brain injury by 88% (13). An American national health objective for the year 2000, presented in a document titled "Healthy People 2000", calls for increasing the use of helmets among bicyclists to 50 percent (16). Good cycling skills, improving the cycling infrastructure with more bicycle lanes and paths, and safe cycling programs are also recognized measures in the prevention of bicycle injuries.

Encouraging the use of bicycle helmets to reduce the risks of head injury in cyclists has been a challenge to health promotion. A recent survey concluded that few Canadian cyclists wear helmets, and that the level of helmet use is lowest among adolescents cyclists. National data collected in 1994/95 reported that the helmet use rate was 58% in children aged 12 and younger. In the population aged 12 and older, the overall helmet use rate was reported to be 19 percent. At ages 12-14, 16% of cyclists always wore a helmet, but by ages 15-19, the percentage was just 8 percent (2). In Manitoba, the helmet use rate among the adolescent population in 1996 was observed to be as low as 7 percent (17).

Behaviours like bicycle helmet use have an impact on the health status of adolescents and the adults they will become. Adolescence has been described as a critical stage in human development between childhood and adulthood, and as a group one of the largest under-serviced populations (18). Reducing unintentional injuries among adolescents depends on our ability to identify, measure, and reduce high-risk behaviours (19). Promotion of helmet use in adolescents is particularly important because studies have shown that about 85% of adolescents own a bicycle (20). Adolescents are at higher risk of bicycle-related head injuries because few adolescents wear safety helmets. To develop policies and programs to help prevent unintentional bicycle injuries, health and education officials need data on the determinants of bicycle and helmet use behaviours. Major factors leading to teenagers not wanting to wear helmets in Australia were appearance and comfort (21). Studies focusing on the determinants of adolescent helmet use in Canada are scarce.

The major reason for teenagers not wearing a helmet in the recent

Canadian study was not owning one, followed by discomfort (2). Based on direct observations of helmet use between neighbourhoods in Manitoba, cost, availability, and attitudes were suggested barriers explaining the difference in helmet use rates for all age groups (17). The analysis of the recent national study and the Manitoba study could not report usage rates among helmet owners. An important research question left unanswered is what percentage of adolescent cyclists own a helmet, and what percentage wear their helmet.

A wide variety of educational approaches have been used to promote the use of bicycle helmets. Awareness programs, discount coupons for helmets, pamphlets, posters, school assemblies, educational guides and many other school and community based activities have focused on bicycle safety and helmet use. In Canada, heightened awareness among elementary school-aged children through educational means has demonstrated variable success in helmet use from 7% to 36 percent (22). The relative difficulty in implementing educational programs, their potentially great cost, and their limited success in greatly increasing helmet use, have led to the introduction of mandatory helmet laws as a strategy of many governmental jurisdictions (23).

The provinces of Ontario, British Columbia, New Brunswick and Nova Scotia have recently legislated mandatory bicycle helmets. Helmet legislation has been recommended in Manitoba by the Manitoba Safety Council (24), by Injuries Manitoba -Prevention of Childhood and Adolescent Trauma (IM-PACT) (25), and by the College of Physicians and Surgeons of Manitoba (26). Attitudes toward legislating helmet use are often controversial. Planned health promotion activities are necessary for the successful introduction of a bicycle safety helmet law. Information on bicycle and helmet use among adolescents in Winnipeg, and an understanding of the underlying factors associated with helmet use, is important data to the promotion and carrying out of bicycle helmet legislation.

1.0 Purpose and Objectives

This thesis was undertaken to describe bicycle and helmet use factors of adolescents between the ages of 11 and 18 from urban and suburban families of lower, middle, and upper socioeconomic subregions in Winnipeg. The description of bicycle and helmet use includes demographic data on the respondents, an examination of cycling exposure, and data on behavioural factors. The last component of the study explores anticipated support for mandatory helmet use and helmet legislation. Attitudes toward helmet use and bicycle safety among the adolescent population are important considerations in a study examining bicycle and helmet use in Winnipeg. The encouragement of bicycle use as an environmentally safe, friendly, and healthy form of recreation and transportation is important to the development of safe cycling programs. The research objectives of the study are:

1) To describe bicycle and helmet use in an adolescent population in Winnipeg.
2) To identify demographic, behavioural, and attitudinal factors associated with adolescent bicycle helmet use.

CHAPTER 2: BACKGROUND AND RELEVANT LITERATURE

2.0 Prevalence of Bicycle Use

Bicycle riding is among the most popular activities engaged in by individuals in developed countries. Worldwide bicycle sales have grown more rapidly than car sales over the last 20 years. The number of new bicycles produced is now three times the number of new cars (12). In 1988, more than one-third (40%) of the Canadian population aged 10 and over reported bicycling as a common form of physical recreation. Bicycling is most popular in the younger age groups and declines as Canadians age, from approximately 88% at age 10-14 years to less than 40% at age 45-64 years (1). A belief that physical activity improves individual well-being and the quality of life of our communities may be a factor in the popularity of cycling. The most popular forms of physical recreation, walking, gardening, swimming, and bicycling, all have several features in common: low cost, casual scheduling, proximity to home, and little need for supervision or training (1). Bicycling has become an integral part of active living. Recent increased interest in fitness and sports may also be related to an increase in bicycling (27).

In 1994, Statistics Canada began data collection for the National Population Health Survey (NPHS), a household survey designed to measure the health status of Canadians and to expand knowledge of health determinants (28). Data on bicycle use in Canada was collected from a Health Canada-sponsored supplement to Statistics Canada's 1994/95 NPHS. The sample size of the supplement was 13,400 with a response rate of 90.6% (2). In 1994/95, 62% of parents with a child aged 12 and younger reported that their child rode a bicycle or tricycle in the last 3 months. Rates of bicycle use among teenagers were similar with 62% at ages 12-14 and 49% at ages 15-19. Teenage boys were more likely than young women to be cyclists. Bicycle use was less common at older ages than among children and teenagers. National statistics in the United States have reported higher percentages of bicycle use. Bicycle use among students in grades 9 -12 in a nationwide survey in the United States in 1993 reported that 75.3% of students had ridden a bicycle during the 12 months preceding the survey (29). Seasonal bicycle use in Canada may have resulted in lower reported use of bicycles.

One population-based study on bicycling exposure in school-age children in Toronto, reported that 85.0% of children in the sample of 832 households owned a bicycle (30). Cycling information was obtained through a random-digit dialing telephone survey conducted in the second half of 1991. The targeted population consisted of the parents of at least one child aged five to 17 years. Ownership did not vary much across sex and age strata. The median bicycling season for children was from May to October. More than half of the children in each group spent at least 100 hours per year riding their bicycles, with boys spending more hours than girls. The authors of the study reported that children's bicycling exposure may be inversely associated with parental socioeconomic status. The median riding hours for children whose parents' educational levels were high school or less, colleges/university, and postgraduate were 184, 154, and 132, respectively (P<.001) (30). The study was limited by the reliability of parents' estimates of bicycling exposure.

In many countries, bicycle riding is a common form of school transport for many students. Data from the Institute of Transport Economics in Norway suggest that as many as 35% of Norwegian children aged 7-14 ride their bicycles to school (31). The prevalence of bicycle use for commuting to school in Canada is not readily available in the scientific and prevention literature. Bicycle riding is a common activity among adolescents, and may also be prevalent as a means of transportation in commuting to school. Additional studies on the ownership and patterns of bicycle use in Canada are important.

The benefits of physical recreation associated with bicycle use and an active lifestyle are well known. A health problem associated with physical activity is the risk of injuries. In 1988, the Canadian Fitness and Lifestyle Research Institute reported that 12% of Canadians sustained sports injuries in the previous year (1). The epidemiology of injuries with adolescents is important to an understanding of the scope of the public health problem of adolescent bicycle injuries.

2.1 Adolescent Injuries

Injury is a major source of morbidity and mortality among adolescents. In 1993, 70% of the 1553 deaths that occurred among Canadian children and youth aged 10 to 19 were attributable to injury (32). A review of general epidemiological patterns of injury among adolescents aged 10 through 14 and 15 through 19 years in the United States indicated that injuries are responsible for 57% and 79% of all deaths respectively. Sports and recreational activities are the leading sources of nonfatal injury among adolescents (33).

In an examination of non-fatal childhood injuries seen in the Emergency Department of the Children's Hospital of Eastern Ontario, falls and sports-related accidents were the leading causes of injury in 1088 (37.7%) and 560 (19.4%) of the cases respectively (34). Of the 560 sports-related injuries, 399 (71.2%) of the cases involved children aged 11 to 17 years old. The chances of being admitted to a hospital were six times higher among the boys than among the girls. Similarly, the trend of hospitalizations for sport injuries by age and sex in Manitoba in 1991 showed that 81% of hospitalizations for sports-related injuries occurred in males (35). Generally, more males are involved in sports, and engage in more risk taking behaviours. In Campbell's 1988 Well-Being Survey (1), Canadian males were more likely than females to be active in every age group, and males were more active when intensity was part of the definition of physical recreation. One recreational activity that contributes substantially to the injury problem among adolescents is bicycling (33).

2.1.0 Terminology Issues in Studies of Adolescent Bicycle Injuries

Terminology issues arise in the review of the epidemiological literature on bicycling injuries among adolescents. Characterizing both the population at risk and the outcomes is often difficult. Neither adolescence nor injury is defined uniformly in the literature.

Adolescence is the transitional period between puberty and adulthood in human development, extending mainly over the teen years (36). The literature often refers to all individuals' under age 19 as children. The terms adolescents and teenagers are used interchangeably. For the purposes of this study, students aged between 11 and 18 years and in grades seven to grade 12 were considered as adolescents.

Injuries can be intentional or unintentional in origin. Bicycle related head injury is an unintentional injury (35). Because head injury can affect the brain, this condition is also called brain injury. In some studies head and brain injuries are differentiated. In a study on bicycle helmet effectiveness, a "head injury" is defined as an injury to those areas of the head that a helmet might be expected to protect, the forehead, scalp, ears, skull, brain, and brain stem. "Brain injuries" are defined as present when a patient has a concussion or more serious brain dysfunction (13). A term often used in the literature is a "minor head injury," or an "unseen injury." A "minor head injury" is defined as the temporary disruption of brain functioning due to an insult to the head, but not judged serious enough to require formal rehabilitation (37). Currently, the term "brain injury" is preferred to "head injury" and has been adopted by the Canadian Brain Injury Coalition (CBIC) (38). Individuals working in the field of brain injuries feel the term brain injury results in less confusion in the public's perception of a head injury. Head injury is a less specific term than brain injury and may include superficial injuries that have not affected the brain. The terminology of "head injury" is used in the survey instrument and in this thesis report unless the citation of the data from the literature are specifically restricted to brain injury. It was felt by the researcher that the adolescent participants would be more familiar with the term "head injury."

2.1.1 Epidemiology of Bicycle Injuries

Bicycle related deaths and injuries are most often reported by Accident Reporting Systems. Canadian and Provincial Traffic Collision Statistics Reports are limited to those that involve motor vehicles. Not all bicycle crashes are reported as cyclists are not aware that they should be reported. A 1984 report in Australia estimated that only one in 30 bicycle crashes are reported to police (39). Hospital Separation Records have data on bicycle injury hospitalizations and Vital Statistics Agencies collect data on bicycle injury deaths.

One national initiative in injury surveillance is the Canadian Hospitals Injury Reporting and Prevention Program (CHIRPP). CHIRPP is an emergency room-based computerized injury surveillance program that contains information on emergency room visits to ten pediatric and five general hospitals in Canada. The mandate of CHIRPP includes the systematic collection and distribution of data necessary for investigating the causes and nature of childhood injuries that present for emergency and in-hospital care (40). The Children's Hospital in Winnipeg is one of the 15 hospitals participating in CHIRPP. Injury statistics, reported by CHIRPP includes data that do not involve motor vehicles, but only includes children seen at the participating hospitals. Severely injured and mortality victims can be missed in the CHIRPP database. Because of the above limitations, the incidence of injuries to cyclists can be under reported by CHIRPP data. A Manitoba Injury Data Report (11) recently compiled by Manitoba health in collaboration with IM-PACT on "Injury Deaths and Hospitalizations Province-wide and by Regions: 1996 and trends" is the first province-wide data report addressing injury in Manitoba, and will be discussed in this review.

Health Canada, March 1996, reports that during the three years 1988 to 1990, 171 children and youth died because of a cycling mishap. These deaths accounted for 3% of all injury deaths for children and adolescents. The proportion of all deaths due to cycling injuries was 1 percent (6). Three-quarters of these children were males and over one-third were preteens and young teenagers age 10 to 14. Far more children are hospitalized due to cycling mishaps than are killed. School-age children have the highest rates of hospitalization due to cycling injuries. In the three years, 1988 to 1990, 11,753 children and youth, aged zero to 19 years were hospitalized because of cycling injuries. Of the 11,573 children hospitalized, 39% were 10 to 14 years old, and 16% were 15 to 19 years old. The rate of hospitalization due to cycling injuries over the three years, was twice as high for males than it was for females (6).

Bicycle crashes are reported as a common cause of head injuries (3-4, 8, 41-43). In Ontario, a retrospective study on fatal bicycle related trauma on 212 people between 1985 and 1991, reported that more than 75 percent of the cases involved head injury (42). Of these fatalities, 32 percent of the deaths involved bicyclists less than 15 years of age. In the United States, the frequency of head injuries has been reported to be highest among cases aged 16 years or less.

Among 173 fatally injured bicyclists in Florida, the head and neck were the regions most seriously injured in 86% of cases. The frequency of non survivable injury was highest among the cases aged 16 years or less (43). Similarly, in a descriptive study of pediatric bicycle trauma cases admitted to the Children's Hospital Medical Center in Cincinnati between 1983 and 1987, the most common injury necessitating admission to hospital was a head injury (49%) (4).

According to the Morbidity and Mortality Weekly Report (7), a thousand persons a year die of injuries caused by bicycle crashes and 550,000 persons are treated in emergency departments in the United States. Head injuries account for 62 percent of bicycle related deaths, 33 percent of bicycle related emergency departments visits, and 67 percent of bicycle related hospital admissions. The proportion of total head injuries caused by cycling is important in epidemiological studies. Data from the National Electronic Injury Surveillance System in the United States report that each year from 1989 through 1992, Traumatic Brain Injury (TBI) was involved in an average of 247 (64%) deaths and 13,180 years of potential life lost before 65 years of age. Bicycling was the fourth leading cause of TBI-associated death among children and adolescents younger than 15 years, accounting for 6% of all TBI-associated deaths among these age groups (3).

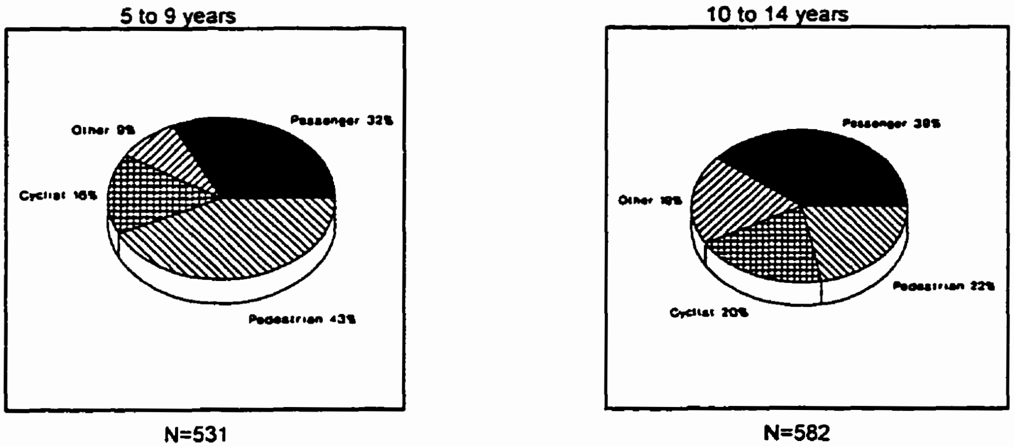
Bicycling injuries are a significant cause of childhood morbidity and mortality in Manitoba. In the province of Manitoba with 1.1 million residents, 92 children and adolescents aged zero to 19 years of age were hospitalized in 1996 for bicycling injuries (11). Bicycling is the leading cause-specific injury for males aged 10 -14 in Manitoba. Thirty-six percent of all male bicycle injury admissions occurred in males aged 10 to 14. Other high cause-specific injury admissions for this age group were off-road vehicles (28.6%), sports (22.5%), and fire (16.0%). Two cycling fatalities occurred in 1996, both in male children aged 10 to 14, a death rate of 4.75 per 10,000 for this age group (11). Bicycle injury data recorded at the Children's hospital in Winnipeg was obtained from the CHIRPP database for 1996 (40). CHIRPP data records whether a patient was admitted, required significant treatment, minor treatment, no treatment, or left before being seen. In 1996, a total of 272 bicycle injury cases aged three to 19 presented to the Winnipeg Children's Hospital Emergency department and were part of the CHIRPP database. Of the 272 cases, 22 (8.1%) were admitted for a minor head injury, three (1.1%) suffered a concussion, and six (2.2%) had dental injuries. Young adolescents had the highest rate of bicycle injuries and admissions. Of the 272 cases, 120 cases (44%) were aged 10 to 14 and 43 cases (53.5%) of this age group were admitted to the hospital. Only 17 cases (6.25%) were aged 15 to 19. Older adolescents may have been seen at other hospitals in Winnipeg other than the Children's Hospital, and would have not been included in the CHIRP database. The numbers of bicycle injuries and deaths in Manitoba, especially in young male adolescents aged 10 to 14 is a significant public health concern. Delineating the most important risk factors associated with bicycle injuries and fatalities with adolescents is important.

2.1.2 Causes of Adolescent Bicycle Injuries

Bicycle injuries can occur when bicycles are in collision with another bicycle, a car, a pedestrian or another object. Injuries also occur when the cyclist gets clothing or body parts entangled with the wheel or when they fall from the bike without being in a collision. Most of the bicycle related head injuries and deaths are caused by collisions with motor vehicles. It is well documented in the literature that bicycle events involving collisions with motor vehicles result in more severe injuries (3, 43-46). Higher impact forces and in many cases multiple impacts (to the car and to the ground) are the main reasons for the severe head injuries sustained in crashes with motor vehicles (46). One study in Canada reported that approximately 90% of deaths from a bicycle related head injury result from collisions with motor vehicles (42).

According to the 1996 Canadian Motor Vehicle Traffic Collision Statistics, a total of 59 or 1.9% of all fatalities victims were bicyclists (47). In the Manitoba 1994 Traffic Collision Statistics Report (48), "motor vehicles to bicycle" collisions accounted for 406 or 2.9% of the total non-fatal collision victims, and for three or 2.5 percent of the total collision fatalities. In 1995, the number of "motor vehicles to bicycle" collisions in Manitoba had decreased to 343 or 1.1% of all collision types, and accounted for two or 2.7% of the total collision fatalities (49).

CHART 2.1. Distribution of deaths attributed to motor vehicles Canada, 1986-1990 (5-year total)



Source: Canadian Institute of Child Health, 1994 (50)

Cycling mishaps with motor vehicles account for a substantial proportion of deaths in Canadian children (50). In the distribution of deaths attributed to motor vehicles in Canada between 1986-1990, shown in CHART 2.1, 16% of all injury deaths for children aged 5-9 years and 20% for those aged 10-14 years involved cycling. Data from Sosin's study (3) on pediatric head injuries and deaths from bicycling in the United States are similar to Canadian data. Collisions with motor vehicles on public streets accounted for 92% of the deaths associated with traumatic brain injury (TBI). The TBI- associated bicycle-related death rate was greatest for the 10 to 14-year-old age groups (3).

The authors of a retrospective study on bicyclist and environmental factors associated with fatal trauma cases in Ontario concluded that serious injury from bicycle crashes was multi-factorial (42). Some factors considered were the sharing of transportation routes with motorists, few bicyclists use protective equipment such as helmets, the speed attained by cyclists, and adverse road and environmental conditions. In motor vehicle and bicycle collisions, bicyclist error was determined to be the main cause of the crash in 66% of the cases and motorist error was the main cause in 41% of the cases (42). Excluding collisions with motor vehicles, common causes of a non fatal bicycle related head injuries include falls, striking fixed objects, and collisions with other bicycles (5). In the description of childhood bicycle injuries in Kingston, Ontario, more than 75% of them involved children aged five to 14. More than three quarters of the events resulted from a loss of control on the part of the cyclist (51).

A second study on risk factors associated with bicycling injuries was undertaken in the Kingston, Ontario region (52). A population-based descriptive analysis of all bicycle-related injuries that presented over a one-year period to the only two emergency departments serving the 125,000 people in the Kingston region suggested that lack of familiarity with a bicycle, and not necessarily lack of bicycling experience might contribute to bicycling injuries. Sixty percent of children who had suffered bicycling injuries indicated they were injured on bicycles they had been riding for less than one year, even though most of these children were experienced bicycle riders. Selbst et al.(45) reported similar findings in an earlier study. They found that 54% of the children in their study had been riding their bicycle for only six months or less before the injury event, 49% of all bicycles were less than one year old, and 24% were known to be in need of repair. Similarly, Cushman et al.,1990, (53) reported that in 63% of their injury cases, the bicycles were less than two years old, and in 74%, the bicycle had been repaired the same year as the injury event.

Riding a bicycle has been described as a significant developmental achievement for children (54). Generally, the bicycle is first purchased and used as a developmental toy. As the child becomes older, the bicycle assumes a role of transportation for trips to school, extracurricular activities, and chores or errands. Adolescents tend to cycle further from home and on major arterioles with increased traffic density. Agran & Winn (54) reported that those using the bicycle for transportation or for a purposeful trip were more commonly 10 to 14 years of age, riding on multilane streets, and riding alone. The authors suggest that the degree to which an adolescent is equipped to ride safely in the traffic environment is questionable. Whenever an adolescent is riding on the street, he/she is legally regarded as a vehicle driver and must follow the same rules of the road as motor vehicle drivers. This implies that the adolescent is not only knowledgeable regarding the vehicle code, but has the cognitive, behaviourial, and motor skills required of a motor vehicle driver (54).

A study examining the incidence of bicycle related injuries among school age children in Norway concluded that bicycle related injuries occurring during travel to or from school are a significant contributor to the total incidence of bicycle related injuries (31). Data were obtained from a comprehensive prospective injury registration system to identify bicycle-related injuries occurring from 1990-1993 to children aged 10 to 15. The results showed that of 352 children, 108 (30%) were injured while cycling to or from school. Among children injured while cycling to school, rates were highest for older bicycle riders (4.7 v 3.1/1000 for children 13 -15 and 10 -12, respectively, $p<0.05$) and for boys compared to girls (4.8 v 2.9/1000, respectively, $p<0.01$).

A case-control study identified bicycle-riding circumstances and injuries in school-aged children aged 7 to 18 years in the Chicago area (55). Logistic regression identified 3 independent riding risk factors. Riding slowly was the strongest independent risk factor for bicycle injury identified in this study. Distance from home further than 3/4 mile, and riding only on the sidewalk were also identified as risk factors. These factors are not the typical factors. The authors commented that perhaps slow riding and riding on sidewalks identifies less proficient riders who are more apt to fall off their bicycles. It has been stated that children are more vulnerable to bicycle accidents related to their inexperience and ignorance (56). Whatever the cause of the bicycle injury, head injuries from bicycle crashes may result in physical, behavioural, and cognitive disabilities, as well as death.

2.1.3 Effects and Economic Consequences

The psychological and economic consequences that can be suffered by injured cycling victims and family of injured cyclists are difficult to assess. Among survivors of nonfatal brain injuries, the effects of the injury have been described as profound, disabling, and long lasting (7). It has been estimated that the lifetime cost for a head injured Canadian child including intensive care, long term hospital costs, and lifetime care and support at home to be about $1 million to $1.5 million (57). Persons with minor head injuries may experience persistent neurologic symptoms as headaches, dizziness, increased irritability and emotional instability (56). A study to determine the disabilities caused by bicycle-related injuries concluded that bicycle-related injuries cause significant short and long term disabilities among children. An examination of hospital records of 372 children aged 2 to 15 years included physical examinations and personal interviews with care givers. Cognitive or behaviour changes were noted in 31.2% of the cases. Many noted changes in school performance (worse in 20.7%), behaviour (13.4%) and sleep, particularly nightmares (34.1%) (58).

The burden of bicycle related injuries on individuals and on our health care system is obvious. Many persons with brain injuries in the past were inappropriately placed in hospitals, psychiatric institutes, nursing homes, and correctional institutions (59). Advances in rehabilitation for survivors of brain injury are improving the quality of life and independence for brain injured victims. However, primary prevention of brain injuries is essential. Reducing the number of bicycle injuries and deaths is a current public health concern in Manitoba, and throughout North America.

2.2 Bicycle Injury Prevention

As reviewed in the scientific literature, bicycle injury rates are especially high in children and in males. What has been done to reduce the toll of bicycle injuries and deaths? Children under 15 years of age have often been identified as the primary target group for bicycle related brain injury prevention programs

(60). Inadequate cycling skills and the use of safety helmets are two elements most often addressed in bicycle safety.

The prevention of bicycle injuries is best considered in terms of Haddon's matrix (61), which considers the host, vector, and environment in pre-event, event, and post event phases. Haddon's matrix with the example of the prevention of bicycle injuries is illustrated in APPENDIX A. Education is usually the first and most commonly used strategy to implement an active intervention. Bicycle helmets are an intervention aimed at minimizing the biomechanical exchange of energy which results at the time of the injury event. Safety helmets are widely recommended safety equipment for all cyclists. Other strategies are also useful in preventing bicycle related injuries. Bicycle factors related to visibility and fit, proper road design and maintenance, and providing an improved socio-cultural environment for cyclists are also applicable to Haddon's matrix of prevention. Changes in the environment can decrease the frequency of events leading to injury (62). Bicycle paths that separate bicycles from motor vehicles can lessen the frequency of bicycle-automobile collisions. However, the use of multiple strategies does not eliminate the need for bicycle helmets. Protection in the form of helmet use is generally regarded as the best secondary prevention intervention designed to protect the head from injury (13).

Helmet design and construction are based on known mechanisms of brain injury (12). In the event of a bicycle crash, they absorb the blow that would otherwise hit the skull. Safety standards for cycle helmets are necessary and helmets for use in Canada must be approved by the Canadian Standards

Association (CSA), the American National Standards Institute (ANSI), or the Snell Memorial Foundation (Snell) (57). Most bicycle injury prevention strategies involve helmet promotion as an intervention in their campaign. A risk reduction objective addressing the prevention of cycling injuries presented in a document titled "Healthy People 2000" calls for increasing the use of helmets among bicyclists to 50% by the year 2000 (16). In the United States, 70% of local health departments use "Healthy People 2000" as a framework to put prevention into action (16).

2.2.0 Bicycle Helmet Effectiveness

A solid body of scientific evidence over the past 10 years indicates that wearing a bicycle helmet is the most readily implemented measure available to reduce bicycle-related head injuries (12). Several well-documented studies on the effectiveness of bicycle helmets have concluded that the risk of head injury in bicycle crashes is reduced among cyclists wearing a helmet (13-15, 63). The most compelling evidence was produced in a case control study in 1989 in Seattle. In the analysis of 235 cases of head injuries to cyclists, the author's concluded that riders who do not wear helmets appear to be at a 6.6 times greater risk of head injury and an 8.3 times greater risk of brain injury than riders who wear helmets (13). A second prospective case-control study by Thompson et al, 1996, (63) included 3200 injured cyclists treated in emergency departments between March, 1992 and August, 1994 in Seattle, Washington. Risk of head injury in helmeted vs unhelmeted cyclists was adjusted for age and indicated a protective effect of 69% to 74% for helmets for three different categories of head injury, any head injury, brain injury, or severe brain injury. Adjusted odds ratios for each of four age groups (<6 years, 6-12 years, 13 -19 years, and $\geq$ 20 years) indicated similar levels of helmet protection by age (OR range, 0.27-0.40). A case control study including 445 children and their care givers in Australia, reported similar findings that wearing a helmet reduced the risk of head injury by 63% (95% CI 34% to 80%) and the loss of consciousness by 86 percent (CI 62% to 95%) (14).

A study in Sweden analyzed 321 fatal and non-fatal head and face injuries of unhelmeted bicyclists to assess the injury-reducing potential of bicycle helmet use (46). Brain contusions, most often to the frontal and temporal lobes, were the most common cause of fatal injury, followed by subdural hematomas. In the non-fatal injury group, abrasions/lacerations were the most common type of injury, followed by cerebral concussions and superficial contusions. The researchers concluded that if all types of injuries to bicyclists are taken into account, a helmet might have had an injury reducing effect in two of every five fatal cases and in one of every five non-fatal cases (46).

Bicycle helmet use and serious head injury among injured child bicyclists in Canada from 1990-1994 are shown in TABLE 2.1 (64). The proportion of hospital admissions are lower among bicycle helmet users than among those not wearing helmets. The proportion of serious head injuries is also lower among injured bicycle helmet users, 1.4% compared to 3.9% for unhelmeted riders.

These findings on helmet use and protection against head injury among

TABLE 2.1. Bicycle helmet use, hospital admission and serious head injury

Year		Helmet use	Hospital admissions		Serious head injuries	
		Number	Number	(%)	Number	(%)
1990	Helmets	58	1	(1.7%)	0	
	Others	2,089	130	(6.2%)	51	(2.4%)
1991	Helmets	107	4	(3.7%)	0	
	Others	3,277	265	(8.1%)	121	(3.7%)
1992	Helmets	310	22	(7.1%)	8	(2.6%)
	Others	3,049	349	(11.4%)	172	(5.6%)
1993	Helmets	651	50	(7.7%)	10	(1.5%)
	Others	3,506	357	(10.2%)	148	(4.2%)
1994	Helmets	1,064	65	(6.1%)	12	(1.1%)
	Other	3,634	327	(9.0%)	119	(3.3%)
All years	Helmets	2,190	142	(6.6%)	30	(1.4%)
	Others	15,555	1,428	(9.2%)	611	(3.9%)

Source: CHIRPP News, 1995 (64)

cyclists are consistent. The effectiveness of bicycle helmets in preventing head injuries is often not questioned. Increased helmet use can reduce the incidence of head injury, by that reducing the number of cyclists who are killed of disabled. However, some researchers have concluded that even if helmet use increases, serious and fatal injuries will remain a health care problem (42). Age-specific factors for bicycle related injuries were identified in a study in Ontario. For example, in youths 11-19 years, bicycling errors were a common factor associated with injuries. The research suggested that the finding provided merit for recommending that young cyclists complete training courses and obtain a license before being allowed to ride in traffic (42). Good cycling skills as well as wearing a bicycle helmet are important in controlling injuries.

Incorrect use of helmets is an important factor in the effectiveness of helmets and the incidence of head injuries. Serious head injuries have been found to occur when the helmet comes off a rider's head, or the head is struck below the rim of the helmet (12). A retrospective review of head injury cases to helmeted cyclists in Australia indicated that at least 15% of helmets were lost on impact in bike-car collisions (65). A properly fitted and worn helmet is essential to effectiveness. Some organizations and individuals will argue that bicycle helmets are ineffective in highway collisions with vehicles at high speeds. In a case-control study in Seattle, helmets were equally effective in crashes involving motor vehicles and those not involving motor vehicles (63). Helmets have also proven their worth in sports like hockey and football. Although helmets are effective in preventing head injuries, voluntary use of helmets among adolescents is still low in most parts of Canada.

2.2.1 Prevalence of Bicycle Helmet Use

Studies have demonstrated wide variability in helmet use. Some countries, such as Australia have implemented helmet legislation and have been able to dramatically increase helmet use to a reported high of 83 percent (12). In other areas without legislation, there has been poor compliance with helmet use despite intensive safety campaigns. The use of helmets has been shown to vary between provinces, communities, ages, and gender in Canada. The most recent report from the 1994/95 NPHS data demonstrated variation in bicycle helmet use by the population 12 and older across regions in Canada. Usage rates were highest in Ontario (20%) and British Columbia (27%), possibly reflecting the introduction of provincial legislation in Ontario and impending legislation in British Columbia. The lowest rate of helmet use was found in the Prairies (12%) (2). The data also revealed that Canadian teenagers were the most resistant to helmet use with 15% of cyclists aged 12 -14 wearing helmets, and 8% of cyclists aged 15-19 wearing helmets.

Early surveys in the United States indicated that bicycle helmet use in many regions of North America was infrequent among adolescents commuting to school. The results of a direct observation study by Weiss in 1986 on bicycle helmet use by children in Tuscan, Arizona, found that only a small percentage (less than 2%) of school-aged bicyclists wear helmets while commuting to and from school (66). The study was repeated in 1990 and there was no significant increase in the percentage of students who used helmets at the middle schools (0% both years) or the high schools (1.85% vs 1.45%) (67). The city in which the research was performed had no formal public, private, city-wide or school district-wide programs for promoting bicycle helmet use. A nationwide youth risk behaviour surveillance study (YRBSS) in 1993 reported that 75.3% of students in the United States had ridden a bicycle during the 12 months preceding the survey. Of these students, 92.8% rarely or never wore a bicycle helmet (29).

Recent studies reporting helmet ownership and use have reported higher helmet use rates but continue to show wide variation. A study by Sacks et al.,1996, (60) on bicycle helmet use among American children in 1994 determined that of bicyclists aged 5 to14, 50.2% own a helmet and 25.0% reportedly always wore their helmet when cycling. The methodology of the study was a national telephone survey of 5238 randomly dialed households with adult respondents reporting data on bicycle helmet ownership and helmet use. A similar telephone survey was conducted with parents of at least one child aged 5 to 17 among 707 children in Metropolitan Toronto to examine bicycle helmet ownership and use (68). The ownership rate was 22% and use rate 12%, lower than the national U.S. study which used a younger child population and included states with helmet legislation. In Canada, according to the NPHS data, 58% of Canadian parents reported that their child aged 12 and younger who rode a bicycle or tricycle always wore a helmet in 1994/95 (2). A limitation in the collection of the data in the above surveys is the rate of bicycle helmet ownership and use was based on parental report. Adult proxy reporting has not been validated. It has been suggested that parents report higher values for helmet ownership and use than self-reports by children (60). It has also been expressed that no individuals can report feelings, opinions, or knowledge for some other person. There are many behaviours or experiences that usually can only be reported accurately by self-reporters (69). In a survey related to bicycle helmet use, it is likely that adults may know more accurately about helmet ownership than use, especially when an older child rides unsupervised.

In many studies, bicycle helmet use has been found to be lower among young people than among adults. In a study on bicycle helmet use among Maryland children, the baseline rate for adult cyclists was 57% compared to 9%

for children (70). The authors suggested that helmet use was part of mature cycling behaviour. In a prospective analysis of injury severity among 116 helmeted and 168 non helmeted bicyclists involved in collisions with motor vehicles in Arizona, the authors found that children were much less likely to have been using a helmet than adults [10/60 (16.7%) vs.105/186 (56.5%); p<0.0001] (71). The likelihood of helmet use increased with age.

A Manitoba direct observation helmet use study (17) during the summer of 1996 established the local helmet use rate in Manitoba at 21.3% (95% CI 19.7 - 22.8). For all ages combined, the prevalence of helmet use in males (18.9%) was significantly lower than in females (26.3%). The helmet use rate of adolescents aged 12 to 15 was lowest at 7.3% (95% CI 4.9 to 9.7), and at 8.3% for 16 to 19 year olds (95% CI 4.6 to 12) (17). The Manitoba data on adolescent helmet use with 12 to 15 year olds is lower than national data which reported helmet use to be 15% in a slightly younger age group of 12 to 14 year olds in 1994/95. Adolescent age can be difficult to determine correctly by direct observation. Further studies focused on adolescent helmet use are important. The use of cycling helmets has showed an upward trend in some regions of Canada. An observational survey to determine the prevalence rates of helmet use by cyclists in Ottawa in September 1991 showed that the use of bicycle helmets had increased from 10.7% in 1988 to 32.2% in 1992 (72). In 1997, a helmet survey was conducted by the Safety Education office of the Ministry of Transportation in New Brunswick (73). A total of 210 cyclists were observed with an overall helmet usage rate of 49%. New Brunswick enacted bicycle helmet legislation in 1995. Increasing helmet use to a maximum is important in preventive strategies in reducing head injuries from cycling. Approaches to increasing helmet use include educational strategies, community-based programs, and bicycle helmet legislation. Education is the most common and popular strategy used to persuade cyclists to change their behaviour to reduce the risk of injury.

2.2.2 Educational Strategies to Promote Bicycle Helmets

There has been a wide variety of educational approaches to promote the use of bicycle helmets and safe cycling. Classroom instruction, promotion of helmets within physicians' offices, community campaigns, rodeos, and the use of media promotional efforts have been used to communicate safe cycling. Most evaluations of educational programs based on multiple intervention strategies involving school-based and community activities report an increase in helmet use over time (22, 74-77). A summary of studies evaluating educational strategies to increase helmet use is shown in TABLE 2.2. Data on estimates of helmet use are usually collected through questionnaires or direct observations.

As shown in TABLE 2.2, time is an important variable in bicycle helmet acquisition, and long-term programs accelerate the process of adopting helmet use behaviour. When results are collected after a shorter intervention time, the increase in helmet use is not as significant. A study on bicycle helmet use among 5-14 year old children and the impact of a community education program

TABLE 2.2. Summary of studies evaluating educational/intervention strategies to promote helmet use

Location (Reference	**Design of study***	**Program-type (age-group)**	**Intervention**	**Helmet-use rate (year evaluated) Pre-program**	**Helmet-use rate (year evaluated) Post-program**
Barrie, Ontario (77)	Randomized clinical trial	Awareness program (Kindergarten to grade 8)	Control school	0% (1988)	0% (1989)
			Education-only school	0% (1988)	0% (1989)
			Education plus subsidy school	0% (1988)	22% (1989)
East York, Ontario (22)	Prospective controlled trial	School-based bicycle helmet promotion (5 - 14 years)	High-income control area	4% (1990)	15% (1991)
			High-income intervention area	4% (1990)	36% (1991)
			Low-income control area	3% (1990)	13% (1991)
			Low-income intervention area	1% (1990)	7% (1991)
Goderich, Ontario (78)	Questionnaire (teachers)	Community campaign and school-based program (5-14 year olds)	Education and helmet subsidy	0.75% (Sept 1991)	11% (April 1992)
			After rodeo	0.75% (1991)	12.8% (June 1992)
			After cycling fatality		51.8% (April 1993)
Seattle, Washington (75)	Direct observation of helmet use	Community-wide bicycle helmet campaign (5 - 12 year olds)		5.5% (1987)	40.2% ('92)
Quebec (74)	Prospective controlled trial	School-based education campaign (8 - 12 year olds)	Control group (poor SE level)	4.1% (1991)	15.2% ('93)
			Study group (poor SE level)	3.1% ('91)	25.8% ('93)
			Control group (Average-rich)	2.8% ('91)	11.8% ('93)
			Study group (average-rich)	10.9% ('91)	33.7% ('93)

*All studies used direct observation of cyclists in their design.

in Goderich, Ontario resulted in an observed helmet use increase from 0.75 percent to only 12.8 percent after nine months (78). The low helmet use rate was tragically underscored by a cycling fatality in Goderich. In September 1992, a tragic event occurred when a 9-year-old boy not wearing his helmet rode his bicycle through a stop sign one block from his home, was hit by a car, and died the next day from head injuries (78). This cycling fatality in Goderich was associated with a dramatic increase in helmet use to more than 50 percent. A study in Quebec that assessed the effectiveness of a 4-year program of bicycle helmet promotion that targeted eight thousand elementary school children showed that helmet use increased from 3.1% in 1991 to 25.8% in 1993 in a poor municipality, and from 10.9% to 33.7% in an average-rich municipality (74). As a result of a bicycle helmet educational campaign and discount coupon offer in Seattle, helmet use among school-aged children increased from 5.5% in 1987 to 40.2% in 1992 (75). A limitation to the Seattle study is that secular trends in helmet use over a four to five year time span are not controlled for, and thus intervention trends are difficult to distinguish from secular trends.

A prospective controlled trial in Ontario evaluated the effectiveness of a school based promotion program in children aged 5 to 14 years, while controlling for secular trends in two high income and two low income schools (22). In the high income study area, observed helmet use rose from 4% to 36% in comparison to an increase from 4% to 15% in the control area. In the low income study area, there was an increase from 1% to 7%. The low income control area had a larger increase from 3% to 13%. A secular trend identified was a national discount coupon offer administered in offices of primary care physicians. The authors concluded that the program was successful in children of high income families, but not as successful in children of low income families.

The example of the four-year program design in Quebec included intervention strategies focused on persuasive communication and community organization to promote bicycle helmet use in children aged 8 to 12 (79). Standard educational activities included posters, pamphlets, association games, and role playing to encourage changes in attitudes and values with regard to helmets. Community-based activities focused on facilitating helmet acquisition by increasing helmet availability by offering discount coupons and helmets as prizes. In total, more than 200 schools and 250 agencies participated in the program each year with 12,214 posters, 319,944 pamphlets, 4,965 educational guides, and 72,672 discount coupons, and over 4600 bicycle helmets were given out free to children (79). The cost of the program over the 4 years involved considerable time, effort, and expense, which was not included as part of the program evaluation.

Educational strategies have the advantage of introducing safe cycling knowledge, but have had limited success in increasing helmet use rates. Many educational efforts require a continuing effort of individuals and organizations, are generally targeted only at elementary school children and have a gradual plateauing effect. In a case study in Seattle, one of the two fatally injured students had recently participated in a bicycle education program emphasizing helmet use and yet died without a helmet from a cycling injury (80). Educational programs focused on adolescent bicyclists have not been described in the literature. Researchers and authors have concluded that strategies such as legislation are necessary to achieve helmet use by the majority of bicycle riders (70, 77, 81). Laws mandating helmet use have been promoted as a preventive strategy to enforce the message of an educational campaign requiring people to act on their knowledge.

2.2.3 Legislative Strategies to Promote Bicycle Helmet Use

In recent years, emphasis has shifted from a focus on strictly educational campaigns to legislation mandating helmet use. The components of bicycle helmet legislation should include ages covered, helmet standards, locations where riders must wear helmets, and enforcement provisions (7). Current legislation varies widely between provinces, states, and countries.

Australia was the first country in the world to make wearing helmets for pedal cyclists compulsory by instituting helmet legislation in July of 1990 in the state of Victoria (12). Howard County, Maryland became the first jurisdiction in the United States to mandate bicycle helmet use by adopting a law requiring all bicyclists on county roads to wear an approved helmet in 1990 (70). The law was later amended to require helmets only for persons younger than 16 years of age. Enforcement involved the police sending warning letters to parents of unhelmeted children and issuing a citation after the third offence. The law provided for fines ranging from $25. to $100. that could be waived if a helmet were purchased (70). States with helmet laws of some kind now include more than one-third of the U.S. population (82).

TABLE 2.3. Summary of Provincial Helmet Legislation in Canada, 1998*

Province	Legislation
British Columbia	Law introduced September 1996 (all ages)
Alberta	No provincial legislation (discussions underway)
Saskatchewan	No provincial legislation
Manitoba	Legislation for children younger than 6 in rear bicycle carriers
Ontario	Law introduced October 1995 (children less than 18 years)
Quebec	No provincial legislation
Nova Scotia	Law introduced July 1997
New Brunswick	Law introduced December 1995
Prince Edward Island	Law currently at 2nd reading
Newfoundland	No provincial legislation (discussions underway)
Northwest Territories	No provincial legislation

* Information on legislation was obtained from Safe Kids Canada, 1998 (73).

A summary of current helmet legislation in Canada is shown in TABLE 2.3. Ontario passed the first mandatory helmet law for cyclists of all ages that took effect October 1, 1995. With a change in government and public outcry, Ontario has since amended the legislation to apply only to those under the age of 18 years. It has been suggested that the law in Ontario will be challenging to enforce because determining the age of the child will be difficult and because parents, as potential role models, are exempt (83). Four provinces currently have helmet legislation in place, and other provinces are in the process of introducing helmet legislation (73). It has been stated that by the year 2000, bicycle helmet use will probably be mandatory nationwide (84). However, provinces like Manitoba continue to oppose the introduction of bicycle helmet legislation, and prefer the education route.

The Canadian Automobile Association (CAA), representing four million motorists and travelers, recommends that all provincial governments should enact regulations that would require mandatory use of bicycle helmets for all cyclists (85). In Manitoba, organizations such as the Injury Prevention and Control Coalition, the College of Physicians and Surgeons, IM-PACT, and the Manitoba Safety Council have submitted recommendations in favour of mandatory helmets for all Manitoba cyclists. Public support and attitudes toward helmet legislation have been controversial. The effect of preventive strategies on increasing helmet use and decreasing head injuries has been evaluated.

2.3.4 The Effects of Preventive Strategies to Increase Helmet Use

A comprehensive review on the effectiveness of bicycle helmets was prepared by Dr. Michael Henderson for the Motor Accidents Authority of New South Wales, Australia in 1995 (12). The review included evaluations of the effect of the first law requiring wearing of an approved safety helmet by all bicyclists in Victoria, Australia on the use of helmets, the use of bicycles and the effect of the law on head injuries. Before legislation, because of media campaigns, public subsidies, and educational programs, the average helmet wearing rates for bicyclists in Victoria had increased from 5% in 1982/83 to 36% in 1989/90 (12). After legislation was introduced in 1990, helmet wearing rates showed a 37% increase for all age groups. A high baseline helmet use rate before legislation of 36% resulted in a helmet use rate of 73% post legislation. Follow-up studies showed that wearing rates continued to increase to around 83% in Melbourne by the middle of 1992 (12). Concurrent with the increase in helmet use, declines were reported both in the number of compensation claims filed with the Transport Accident Commission, and the number of cyclists with injuries who were admitted to public hospitals. Based on comparisons of claims during 1989 -1990 and 1990-1991, the number of cyclists killed or hospitalized with head injuries declined by 51%, and the number with similarly severe injuries other than to the head decreased by 24% (86). The findings in Australia suggest a substantial effect of the law on helmet use and on decreasing bicycle injuries.

Henderson states that the reduction in injuries was achieved through a reduction in the number of bicyclists involved in crashes plus a reduction in the risk of head injury to bicyclists involved in crashes. Others have argued that the decrease in cycling with teenagers because of legislation contributed to the reduction in the number of cyclists involved in crashes, and thus a reduction in the number of head injuries. Observational surveys on bicycle use in Melbourne following legislation showed a 36% decrease in bicycle use by children in May-June 1991 compared with May-June of 1990. The largest decrease (44%) occurred among 12-17-year-olds (86). The decline in cycling with adolescents was an obvious negative response to legislation, but the long term effects of legislation on cycling prevalence with this group are not available in the literature.

The effects of legislation on helmet use are shown in TABLE 2.4 (7). An American study compared helmet use in three Maryland school districts using three different approaches to promote helmet use by cyclists (70). Helmet use rates were determined by observation and only children were included in the studies in Maryland. Pre law and post law helmet use was observed in Howard County and two control counties: Montgomery that sponsored a community education program, and Baltimore county that had no helmet activities. Legislation resulted in the largest increase in helmet use, from 4% to 47 percent.

TABLE 2.4. Evaluation of legislation and community programs to increase the use of bicycle helmets.

			Helmet-use rates	
Location	**Years evaluated**	**Program type**	**Pre-program**	**Post-Program**
Victoria, Australia	March 1983-March 1990	Community campaign	6%	36%
Victoria, Australia	March 1990-March 1991	Helmet legislation introduced	36%	73%
Howard County, Maryland	1990-1991	Helmet legislation and community campaign	4%	47%
Montgomery County, Maryland	1990-1991	Community campaign	8%	19%
Baltimore County, Maryland	1990-1991	No specific helmet promotion activities	19%	4%

Source: MMWR. February 17, 1995 (7)

In the state of Georgia, a multi cluster random-digit-dialing telephone survey evaluated the effect of a state helmet law on reported bicycle helmet ownership and use. Reported helmet ownership increased from 39% before the law took effect to 57% after the law (+46%, P=.06). Reported helmet use increased from 33% before to 52% after the law (+58%, p<.05) (87). The authors concluded that the law appeared important in increasing reported helmet ownership and use.

Telephone surveys are often criticized for producing inflated results for helmet ownership and use. A study in Oregon was designed using four pre law and post law helmet use surveys: (1) statewide observations, reported use on the day of the survey increased from 25.8% to 76.0%, (2) middle school observations, use increased from 20.4% to 56.1%, (3) classroom self-report surveys, "always" use of helmets increased from 14.7% to 39.4%, and (4) a statewide adult telephone survey, "always" helmet use increased from 38.6% to 65.7 percent (88). Although use estimates differed, the authors concluded that all the helmet surveys showed similar degrees of pre law and post law change.

Helmet legislation plus a bicycle safety education program for children under the age of 16 in Ohio, resulted in the highest use of bicycle helmets by self-report (67.6%) and direct observation (85%) in the United States (89). The setting for the study was in four predominately white, upper-middle class suburbs of Cleveland, Ohio, and thus may not represent the general population of students in the public schools. In a multiracial population in New York, the overall use of helmets only increased from 4.7% to 13.9% after a bicycle helmet campaign and legislation (90).

The above studies demonstrate that mandatory helmet laws may have an important role in increasing helmet use toward the year 2000 objective of 50% helmet use. However, the passage of a law does not ensure compliance with it. In a study in Maryland, some children, especially teenagers continued to ride bicycles unhelmeted in the presence of the law (70). In the Australian review, helmet compliance was higher with adults (12). In Melbourne, Australia, fewer than 25% of students always wore a helmet when they rode a bicycle, despite compulsory helmet wearing legislation (21). Bicyclists choose not to wear helmets for reasons such as infringement of rights, lack of enforcement, and financial barriers (70). Efforts at multiple levels are crucial to new public health legislation. Published literature providing evidence of the effectiveness of helmet laws in the Canadian context is relatively scarce. Helmet use rates and the reasons for low helmet use rates in provinces with and without legislation are important to investigate.

2.3 Determinants of helmet use

Regional and socioeconomic variations between bicycle and helmet use in Canada exists. The NHPS showed that children and adult bicycle helmet use was lower in rural (10%) than in urban areas (18%)(2). In provinces that had legislation introduced or impending, the percentage of cyclists who stated not owning a helmet as a reason for not wearing one was low. The authors suggested that legislation may be a factor in the acquisition of helmets. Among adults, helmet use was associated with high income. The helmet use rate was 28% for cyclists in the highest income households, compared with 6% for those in households with the lowest incomes. Patterns were similar for education, with helmet use ranging from 29% for cyclists with a university degree to 9% for those who had not graduated from high school (2). Other studies have similarly reported helmet use to be highest among those in higher socioeconomic situations (17, 68, 71, 89). In a direct observation helmet use study in Manitoba (17), a fourfold difference in helmet use was observed between the highest (30.5%) and lowest (7.8%) income neighbourhoods. Based on the observations, cost, availability, and attitudes were suggested barriers explaining the difference in helmet use rates between neighbourhoods. A limitation to the study conducted in Manitoba is that it could not report on helmet ownership rates between neighbourhoods.

The three most prevalent reasons for non ownership of helmets as reported by parents of third graders in a study in Seattle were: never thought about purchasing (51%), helmet costs too much (29%), and children would not wear a helmet (20%) (91). A study assessing the attitudes of parents and children toward bicycle helmet ownership and use concluded that parental rules are associated with bicycle helmet use in children (92). Similar findings were found in a study looking at correlates of children's bicycle helmet use in two elementary schools in Georgia (93). Logistic regression showed that sibling ownership, parental helmet use, and lower parental perceived social barriers to helmet use were independently associated with children's reported helmet use and with parental intent for the child to use a helmet.

One study on factors related to helmet use among children aged 5-17 in Metropolitan Toronto, reported that parental helmet use had the most significant impact on child helmet ownership and use (68). When parents owned and used a helmet, 93% of their children had a helmet and more than 80% of them always wore it. The study further demonstrated that children with a previous bicycle injury were four times more likely to own a helmet than children without a history of injury, but injury had no impact on helmet use (68). In contrast, a study describing bicycle helmet use patterns among children younger than 15 years of age in the United States in 1991 suggested that helmet use was higher for children who had bicycle injuries in the past (94). However, the limitation of many of the above studies is that helmet use is based on a parental report. Data on reasons for the low reported use of helmets in adolescents may be more reliable if adolescents' self-report the information.

2.3.0 Barriers to Helmet Use in Adolescents

Barriers to helmet use are important to explore and report to guide helmet promotion activities. In a cross sectional survey of children aged seven to 13 years in the Netherlands, children who wore helmets perceived negative reactions from their social environment (20). Wearing a bicycle helmet was also described as inconvenient, time-consuming and uncomfortable. The results of focus groups with fourth, fifth, and sixth graders in the Boston area showed similar findings, that children were concerned that helmet use would invite derision from their peers. However, the results also showed that children respected other children who wore helmets (95).

A self-administered questionnaire with eight to 12-year-old children in Quebec was undertaken to identify factors related to expressed intention to use a bicycle helmet such as perception of risk and normative beliefs related to perceived approval of friends and parents (96). Although significantly associated with intentions to wear bicycle helmets, perception of risk and habitual safety-related behaviour were not identified as important predictors of stated intentions to wear helmets. In contrast with other studies, by children's own report, concerns about appearance or lack of use by friends were the least important reasons for nonuse among helmet owners in the study. Behavioural beliefs were the strongest predictors of the expressed intention to use a bicycle helmet. The authors suggested that the most effective messages that health planners can provide preadolescents to influence them to use helmets are that helmet use is fun and attractive, helmets provide a new look and a sporting image, and friends approve of and value this behaviour (96). The design of the study with a self-administered questionnaires given to pre-adolescents aged 8-12 may be a limitation to the reliability of the data. Most studies on barriers to wearing bicycle safety helmets have explored factors in children and adolescents younger than 14 years of age.

In the Health Canada-sponsored supplement to the NPHS, respondents aged 12 and older who did not wear a helmet all the time were asked the main reason for not doing so. The leading reason for not wearing helmets among teenagers aged 12-19 was lack of a helmet. This reason was more common among girls than boys (44% versus 36%) and increased with age. Discomfort was the second most noted reason for not wearing helmets. The third most popular reason was fear of ridicule, and girls were more likely than boys to cite fear of ridicule (2). Helmet ownership was not measured in the NPHS supplement. An examination of factors related to helmet ownership and use that is focused on adolescents is important to an understanding of barriers to helmet use.

2.3.1 Attitudes to Helmet Use and Mandatory Helmet Legislation

Adding to existing barriers to bicycle use, mandatory bicycle helmet laws are often added as a reason why bicycle riders chose not to wear helmets. Cycling associations have stated that mandatory bicycle helmet laws may discourage bicycling (97). Data on exposure to cycling is often not available. No reported evidence in the United States and Canada exists that mandatory bicycle helmet laws reduce bicycle use. Observational studies in Australia are reported to have shown reductions of 30% to 50% in the number of bicyclists after passage of mandatory bicycle helmet laws (86). The reported decrease in cycling in Australia was mainly among teenagers, while adult cycling increased.

The effectiveness of helmet laws in encouraging helmet use in adolescents is questionable. A survey of 1240 students, aged 13 -17 years, from 14 secondary schools in Melbourne, Australia was conducted in September 1993 to examine teenagers' attitudes toward helmet wearing after the introduction of compulsory helmet wearing legislation (21). Sixty-five percent of teenagers reported that they owned a helmet but only one third wore a helmet the last time they rode a bicycle. Fewer than 25% of students always wore a helmet when they rode a bicycle, despite compulsory helmet wearing legislation having been established for three years. Only 15% of teenagers cited the possibility of receiving a fine or enforcement of the mandatory helmet wearing law as a reason for wearing a bicycle helmet. The results suggest that teenagers do not believe that the helmet legislation had affected their behaviour. The large increases in helmet use in this age group after the law suggests that legislation acted indirectly, by getting their parents to insist on them wearing helmets (21).

Legislation requiring bicycle helmet use by all children has been found to have strong support from the public in Canada. A prospective roadside survey of cyclists in a Northern Ontario community, Sudbury, was carried out with 472 respondents in 1992 to find out the attitudes toward and perceptions of helmet use and possible legislation in Ontario (98). Awareness of the protective effects of helmets was displayed by 92% of the respondents. Regarding potential helmet legislation, 81% (95% CI: 75-86) of respondents older than 16 years of age agreed with the institution of mandatory helmet legislation for cyclists under the age of 16, and 57% (95% CI: 50-64) agreed with its institution for all cyclists. Helmet owners were more in favour of legislation than nonowners, and this was significant in those less than 16 ($p=0.03$) and in cyclists overall ($p=0.0001$).

Similar results were obtained with a random-digit-dialing telephone survey conducted in Toronto in 1991 on parental attitudes toward helmet legislation for child cyclists (68). Approximately 80% of responding parents were in favour of the suggested legislation, with some variation in support. Parents with teenaged children (aged 15-17 years), were least in favour of legislation.

Support for helmet legislation among adolescents has been documented in Britain. A British study in 1993 investigated the relationship between attitudes to cycle helmets and helmet use in 655 cyclists aged 14-18 years in secondary schools (99). Most teenagers sampled believed in the efficacy of cycle helmets and thought they ought to wear one, but only 18% of the sample wore a helmet on every cycle journey. When asked about legislation to enforce helmet use, 55% of the entire sample felt that helmet wearing 'should be made law' (99). Only 6% of non wearers said they would stop cycling if helmet wearing became compulsory. Support is an essential prerequisite before a safety law that requires individuals to modify their behaviour is introduced and enforced. Studies describing support for mandatory helmet laws and attitudes toward helmet legislation are important to the introduction and success of bicycle injury prevention strategies like helmet legislation in Manitoba.

2.4 Current Initiatives in Bicycle Injury Control

2.4.0 International Initiatives

In 1991, the World Health Organization (WHO) Helmet Initiative was created to promote the use of bicycle helmets world wide. The initiative has adopted four strategies to promote universal helmet use: 1) Collect and distribute better data. 2) Develop a generic program to promote the use of helmets. 3) Evaluate legislative approaches to assist in the promotion of helmets. 4) Encourage international collaboration for the promotion of helmets (100). The helmet initiative serves to stimulate public health agencies to address injury control issues and to promote effective interventions.

2.4.1 Canadian Initiatives

The Canadian Bike Helmet Coalition (CBHC) is a multi-disciplinary organization founded in 1992 to promote helmet use nationwide. The goal is to develop neighbourhood helmet promotion projects available for implementation throughout Canada (57). The CBHC has a guide on "how to organize a community project, bike helmets for children," that offers advice and videos to organizers of community campaigns. Safe Kids Canada (1993), a charitable organization whose purpose is to increase the public's understanding that unintentional, preventable injuries are the leading threat to children, works actively on children's bicycle safety (101). One of the leading bicycle injury prevention efforts has been the promotion of mandatory use of bicycle helmets.

Can-Bike, associated with the Canadian Cycling Association (CCA) (102), offers safe cycling courses that cover every aspect of bicycling, from a basic introduction to skills using bicycles as a mode of transportation.

2.4.2 Local Initiatives

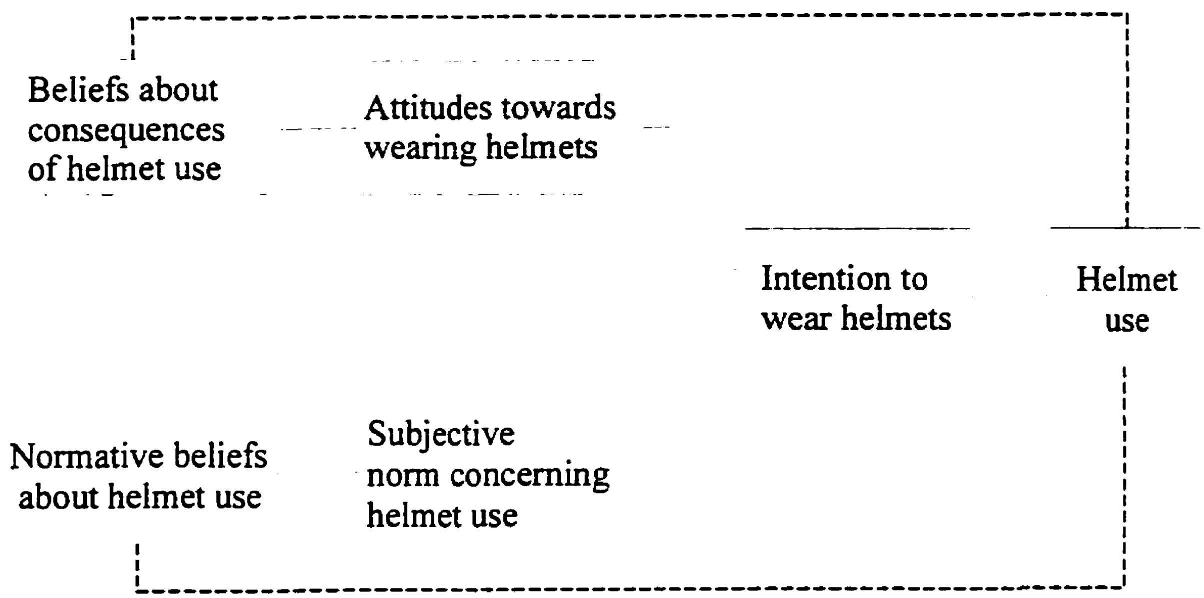
In Manitoba, recent public health attention has given an important focus to the prevention of cycling injuries, and the promotion of a safe and healthy cycling culture. IM-PACT and the Cycling Health and Safety Committee of Manitoba are using a province-wide multimedia and community education campaign to promote bicycle helmets for all ages, with an emphasis on learning the rules of the road in the spring and summer of 1998 (10). Manitoba Public Insurance (MPI) developed a "RoadWise Cycle Safely Program" in 1997 supported by the Cycling Health and Safety Committee of Manitoba. The five lesson safety program offers a kit, video and instructor's manual with handbooks and sticker sheets. The "Cycle Safely" instructor guide is designed to teach children how to be safe and responsible cyclists, and is available to schools across the province and to community groups (103). The Manitoba Cycling Association and local bicycle shops also offer safety courses for cyclists. Although these initiatives have the potential to increase helmet use rates, the distribution of health promotion activities is still limited. The MPI cycle safely program focuses on children in the elementary school years, and requires implementation by the schools. School compliance with the safety program will vary throughout the province. The low rate of helmet use by adolescents is often not specifically addressed by junior and senior high schools in Manitoba. Policy and legislative changes to increase bicycle safety in Manitoba have been recommended. Additional data focused on bicycle and helmet use in Winnipeg adolescents would be beneficial to current and future promotions of effective interventions with bicycle safety in Manitoba.

2.5 Theoretical and Conceptual Framework for Helmet Use

The focus of this study is on the bicyclist and the use of a helmet. The theoretical framework for this research study is constructed around two models. The first framework is Haddon's (61) phase factor matrix (APPENDIX A). Bicycle injuries are a common and important part of adolescent trauma. Adolescent bicycle injuries are caused by a variety of factors, including the bicyclist, environmental circumstances, and the bicycles themselves, as illustrated in Haddon's "phase factor matrix" in Appendix A. The use of a bicycle helmet can be considered as a primary (pre-event) and secondary intervention (the event stage) in injury prevention. As documented in the literature, bicycle riders who do not wear helmets are several times more likely to sustain head injuries than riders who do (13). An assumption, when doing research into determinants of behaviour is that the respondents are familiar with the "pros" and "cons" of the behaviour. In this study, it was assumed that most adolescents would be acquainted with safety helmets through other sports, the media, the press, and educational programs.

Figure 1

Conceptual Framework for Determinants of Helmet Use:



Source: Fishbein and Ajzen, 1975

FIGURE 2.1.

Fishbein and Ajzen's model of planned behaviour was used as a second framework for the study (104). The variables related to helmet use include demographic, behavioural, and attitudinal factors. A conceptual framework for the determinants of helmet use was adapted from the Fishbein and Ajzen model (FIGURE 2.1). The model is applicable to an adolescent study population because of the known low use of bicycle helmets. The low helmet use rate may be related to an increased desire by adolescents to conform to peer pressures, which peak around 12 or 13 years of age. The model uses "a theory of reasoned action" which states that individuals consider the implications of their actions before they decide to engage or not engage in a given behaviour (105). In the conceptual framework, a distinction is made between beliefs, attitudes, intentions, and behaviours. According to the conceptual framework, a person's intentions depend on certain beliefs. Some beliefs influence a person's attitude toward the behaviour. Attitude is thus viewed as one major determinant of a person's intention to wear a bicycle helmet. Behaviour is considered a function of two categories of factors; normative beliefs about what significant others expect one to do and beliefs related to the consequences of the behaviour.

The Ajzen-Fishbein conceptual framework provides an understanding to the definition and measurement of helmet use behaviour. The first step involves the measurement of the behaviour of interest, which is helmet use in this study. Examining the factors that determine the behavioural intention is the second step. Factors related to bicycle use and attitudes to safety are important variables. External variables, as demographics affect the behaviour indirectly and provide insight into the factors determining adolescent beliefs and by that increase our understanding of helmet use.

CHAPTER 3: METHODS

3.0 Design of the Study

The study used a combined method of research. Two types of cross-sectional observational surveys are used in a model of a dominant - less dominant design. Creswell describes the dominant - less dominant design as a study presented within a single dominant paradigm with one small component of the overall study drawn from the alternative paradigm (106). The first observation survey method used in the study is a less dominant qualitative method of an unobtrusive direct observation of students cycling to and from schools. The second observation survey method involves a quantitative collection of data in a self-report survey from the same school population in Winnipeg, and is the dominant model of the design.

3.0.1 Rationale for the Design

The purpose of combining the methods with two types of observational surveys is developmental, in which the less-dominant direct observation survey is used to help inform the dominant self-report survey. One objective of the qualitative observations of students cycling to and from schools is to determine the helmet use rate among adolescents commuting to and from school. An advantage to using a community based site like a school is that it is both more efficient in locating adolescent riders and more cost effective (107). The behaviours observed, use or non use of helmets were simple and only included a small sample size of 274 students commuting to five schools. The direct observations were supplemented with structured, quantitative observations to find contradictions and to add scope and breadth to the study.

The self-administered survey design allowed for a rapid turn around in data collection, and was an economical design. Self-administered procedures are thought to be best because the respondent does not have to admit directly to an interviewer a negatively valued behaviour (68). The researcher directly carried out the survey in classrooms and was thus able to exercise quality control with respect to ensuring a high response rate to the survey. Control over the completeness and accuracy of responses in a self-reported survey can be a problem. Respondents can also have a potential tendency to over report "healthy behaviours" about the way they behave (108). The title of the survey questionnaire, "Bicycle Riding Survey" was designed partially to mask the safety objective of the proposed study to allow for greater reliability of the answers. Self-reported use has been found to achieve higher helmet use rates than through direct observation of cyclists (88). In this study, direct observations of helmet use in students commuting to and from school was used to validate reported use of helmets in the questionnaire survey.

3.1 The Instrument

3.1.0 Direct Observation Study

The setting for the direct observation of bicyclists was the school grounds of the selected schools in the sampling frame of the study. Standard observing techniques of counting the number of bicyclists commuting to school, and the number of bicyclists wearing helmets provided a measurement of bicycle and helmet wearing rates. An observation tally form was used at each school designed to record the number of cyclists, the gender of the cyclist, and the use or non use of a helmet (APPENDIX B).

3.1.1 Development of the Survey Instrument

The survey instrument used in this study consisted of 20 developmentally appropriate questions (APPENDIX C). The survey included five components, demographic descriptors, cycling exposure, helmet behaviour, determinants of helmet use, and attitudes to bicycle safety.

Five of the 20 survey items were adapted from the Youth Risk Behaviour Surveillance System (YRBSS) questionnaire (109). The YRBSS monitors six categories of priority health risk behaviours among youth and young adults: behaviours that contribute to unintentional and intentional injuries, tobacco use, alcohol and other drug use, sexual behaviours, dietary behaviours, and physical activity. The questionnaire developed by the Centers for Disease Control and

Prevention includes 75 items that measure priority risk behaviours in youth. The questionnaire allowed copying, modification, and administration without permission (109). The survey items copied from the YRBSS questionnaire were items on cycling exposure, use of helmets, and demographic factors related to age, grade, and sex. Some modifications of the questions developed by YRBSS were necessary for a study in Winnipeg. To provide a current measure of riding bicycles and helmet behaviours, a "30-day" recall period was used rather than the "past 12 months", related to a shorter cycling season in Manitoba.

The YRBSS was designed to focus primarily on risk behaviour. Additional multiple-choice and categorical questions were developed and added to the survey instrument to measure factors related to the use and non use of bicycles, the use and non use of helmets, the type of injuries sustained with cycling, and attitudes to mandatory laws for helmet use. A thorough exploration of the available literature on bicycle and helmet use was used as background information to the development of the new survey questions and response categories.

Increasingly, researchers are using focus groups and "think-aloud" interviews with subjects to help in the development of survey questions. An unpublished focus group study with Manitoba students conducted by IM-PACT in May of 1997 explored reasons why adolescent cyclists chose not to wear helmets (25). The study was carried out in 4 schools in Manitoba (3 in Winnipeg, 1 in rural Manitoba) with students in grades 7 & 8, and one school used grade 9 students. The size of the focus groups ranged from 10 to 17 students, with the focus group discussions using 12 questions which were recorded and later transcribed to a typed format. No specific question addressed why students did not wear helmets. Questions related to "how do you feel about wearing a bike helmet" and "how do you think someone looks when they are wearing a helmet" uncovered potential reasons for non helmet use. The reasons related to parents not encouraging helmets, helmets are uncomfortable, helmets were not "cool", helmets were "dorky" looking, and peer derision were included in the survey responses.

In formatting and writing the questionnaire, the appropriate guidelines to questionnaire construction as developed by Woodward (1983) (110) and Bourque & Clark (1992) (111) were followed. Closed-ended questions were used primarily to avoid incomplete, vague, or hard to code answers, and to make the task of doing the survey easy. A major objective of the survey was to avoid unanswered questions. According to Bourque and Clark (111), closed-ended questions result in much more efficient data collection, processing and analysis. All close-ended questions clarified that single answers were wanted. No residual "other" category was provided. Respondents were expected to choose the single category that was closest to the desired response. "Don't know" was not included in most questions, as it is felt that their existence in a list of alternatives encourages respondents to use them when other answers are more appropriate (111). Two questions related to attitude; "do you think there should be a law for all cyclists to wear helmets" and "if there was a law requiring cyclists to wear helmets, what would you do," included a "not sure" response to avoid the questions left unanswered.

The questionnaire was designed to follow a logical sequence and was laid out in a way that was clear and uncluttered starting with questions related to bicycle use and ending with questions related to helmet use. The last question of the survey instrument was open-ended. The purpose of the open-ended question was to provide more in-depth qualitative data on how students believed they could be convinced to wear bicycle helmets. A target guideline for the length of time required to complete the questionnaire was approximately 15 minutes. According to Woodward (110), formats that are easy to follow and pleasing to the eye make completing the questionnaire less of a chore, and affect the accuracy of the responses given. In this study of adolescents aged 12 to 18 approximately, an accurate report of helmet use was an expected goal.

3.1.2 Establishing Validity of the Survey Instrument

Validity is defined as "the extent to which any measuring instrument measures what it is intended to measure" (112). In this research study, the research instrument was partially constructed from the YRBSS questionnaire and included several new untested questions. The YRBSS was the first surveillance system in the United States to monitor behaviours at the national, state, and local levels over time. National school-based YRBSS surveys were successfully conducted in 1990, 1991, and 1993 (109) to measure adolescent behaviours related to unintentional injuries. When one modifies an instrument, the original validity may be distorted, and it becomes important to reestablish validity (106). Establishing validity of the questionnaire required a pilot study to validate the survey instrument in relation to the objectives of the observation study. A pretest and pilot study of the data collection form were completed prior to implementation of the survey.

Informal pretesting of the initial questionnaire was done with ten neighborhood adolescents aged 12 to 16 years. An objective of the survey instrument was to obtain accurate complete data. The possible lack of good reading skills by the respondents was a recognized disadvantage of a self-administered questionnaire. The survey questions were comprehensible to all students in the informal pretest. The readability of the questionnaire was also assessed by a school teacher, and was improved based on the teacher's suggestions. One problem identified in the pretest was the possibility of student unfamiliarity with postal codes. The problem was addressed by having Winnipeg's postal code directory available in the classroom.

Following the informal pretest, a pilot test of the questionnaire was done with twenty-five boy scouts, aged 11 to 14 in a South Winnipeg group. An experienced data collector conducted the pilot test with the objective of providing the most useful feedback to the instrument. The data collector for the pilot test was instructed to be particularly sensitive to things that did not work or to content that was being missed by the data collection instrument. The respondents were asked for responses to how well they understood the instrument and on how easily they could complete the survey. The pilot test of the survey established further validity of the instrument related to the completion of all questions and clarity of information. The completion of the survey instrument took less than 10 minutes. Having pencils available to ensure a high response rate was a determined need of the survey. Following the pilot test of the survey and consultation with the thesis committee members, some questions were reorganized to improve the flow of the questionnaire. Five new questions were added to the survey instrument to provide additional data on factors related to bicycle and helmet use, cycling injuries, and suggestions to encourage helmet use.

3.2 The Population and the Sample

3.2.0 Defining the Population

The target population chosen for this study was an adolescent student population in a defined urban geographic area of Winnipeg School Division (WSD) No.1 in Central Winnipeg, and a suburban geographic area of Assiniboine South School Division No.3 in South West Winnipeg. The school divisions were purposefully selected to represent a diverse socioeconomic spectrum of students. The age of the adolescent target population is approximately 12 to 18, the typical age for grades seven to 12 (Senior 4). The Winnipeg School Division has 79 schools (113). Data are available from the school division on the total population of students for age and sex. The division has seven junior-senior high schools that include grades seven to S4. The total student enrollment in grades seven to S4 is approximately 10,000. The student population in the WSD No.1 is a heterogenous population with varied socioeconomic background. The Assiniboine South School Division has 16 schools, more representative of a suburban school population, with a less varied socioeconomic background. The total enrollment in grades seven to grade 12 is 3108 students (114). The sampling frame for the two school divisions included approximately 13,100 students.

3.2.1 Selecting the Sample

A sample of adolescent students was selected using a two-stage strategy, first using a stratified selection of schools, and then selecting students from within those schools. The sample frame includes all the students in grades seven to 12 in WSD No. 1 and Assiniboine South School Division No.3. Initial observations of bicycle racks in junior high and senior high schools in the two divisions were conducted in early September to see if students cycled to the schools prior to a stratified selection of the schools. Some inquiries were also made with school principals regarding cycling to schools. In total, 12 schools were observed. An inquiry at four of the schools determined that bicycle use was discouraged at the schools because of thefts of bicycles. Schools with less than 10 bicycles on the grounds during the initial site visits were excluded.

Using a stratified sample of schools in the division produced a sample that was more likely to reflect the different socioeconomic populations than a simple random sample. In a stratification sampling technique, the population is first divided into subgroups of one or more characteristics thought to affect the outcome. The schools in WSD No.1 are stratified by district of the city, south, north, central, and the inner city. Some degree of stratification was accomplished by selecting schools from different districts. Four of seven schools were selected in the first stage of the study, two schools in the south district, one in the north district, and one in the central district. In the south district, it was desirable to select two schools, a junior high (7-8) and a senior high (S1-S4) which each had a high observation of bicycles on racks. Schools in the inner city were not included in the initial observation of schools, as cycling in the inner city was unlikely. Although cycling to school was also not prevalent in the school in the north district, the importance of including a school in a lower socioeconomic subregion of Winnipeg was considered in the selection of schools. One school selected in the central district was deleted from the study as the principal felt that implementing the study in the classrooms directly would be difficult for the researcher. Three schools were selected in Assiniboine South School Division No.3 based on cycling prevalence at the schools and the inclusion of more suburban school populations. In total, six schools were selected for the combined observational study.

3.2.2 Determining the Sample Size

The participants in the direct observational study would include all students riding bicycles to the selected schools. School populations were determined by contacting the school principals. The approximate school population to be surveyed in the direct observation study was 4995. The schools were identified by an identification number (ID) from 1 to 6. The break down by individual school population is shown in TABLE 3.1.

TABLE 3.1. Schools sample population

School ID	Level	Grade	Enrollment No.
1	High school	10-12	1000
2	Junior high	7-9	504
3	High	10-12	800
4	Junior high	7-8	391
5	High	9-12	1200
6	Junior high and high	7-12	1100
Total			4995

In determining the sample size for the number of participants in the cross-sectional classroom survey, considering the analysis plan was important. The key components of the analysis plan in this study were the grades, or grade groups within the total population for which separate estimates might be required, with some estimate of the student population that will fall into those subgroups. The sample size required is dependent on how rare the phenomenon of interest is, and is determined by estimating a proportion (115). Based on the literature reviewed, the proportion of 7% helmet use among adolescents in Manitoba (17) and a standard deviation of + or - 5% was used to determine the sample size required. The sample size necessary was 100 students per subgroup. Using a two-stage strategy of sampling by first selecting the schools, then randomly selecting classrooms with a representative proportion of students in each grade would yield an overall sample size of 600 students (100 per grade). To ensure a sample size that was sufficiently large rather than too small, 827 students were included in the self-reported survey.

The selection of classrooms for the self-report survey was carried out by the school principals, as the timing of the survey implementation had to coincide with convenient classroom curriculum within each school. Minimal disruption of school classes was a priority of the researcher in obtaining cooperation of the selected schools. In School 6, the number of classrooms selected exceeded the selection in other schools to ensure a comparable representation of a lower socioeconomic subregion in the sample population. The school principals ensured the researcher that the students in classrooms followed a basic random assignment to classrooms.

3.3 Ethical Considerations

3.3.0 Human Subjects Approval

One of the most important considerations in biomedical research is treatment of human subjects (116). A proposal for doing research on human subjects was sent to the Human Subjects Committee of the Faculty of Medicine at the University of Manitoba. Approval of the study was received on October 1, 1997 and is included in APPENDIX D.

3.3.1 Institutional Approval

The process of negotiating access to doing research in schools required a formal application to the Winnipeg School Division No. 1, Research, Planning and Technology Department. In the Assiniboine South School Division No. 3, a letter of request for permission to conduct research was sent to the Superintendent of Education. Approval for conducting research in the selected schools was received from the two school divisions in September 1997, with approval to contact the principals of the selected schools directly for their involvement and approval. In accepting the research project, the Research Review Committee, WSD No. 1, requested that a copy of the research results be sent to them upon completion of the study. The school principals were directly contacted by the researcher and informed of the purpose of the study, and of the data collection procedures. All the principals had an opportunity to review the survey instrument, and indicated that an informed consent of the participants was unnecessary related to the random classrooms, anonymous survey, innocuous questions, and no pictures of students would be involved. Upon approval by the school principals, a letter was sent to each school requesting participation of classrooms with a scheduled date for implementation of the cross-sectional survey.

3.4 Data Collection

3.4.0 Direct Observation Method

In the direct observation study of cyclists, the researcher was the primary and only observer for all schools. The direct observations for the five selected schools were carried out on September 23, 24, and 26, 1997. Direct observations were omitted from School 6, as the initial observation of the bicycle rack and inquiry with the principal verified that a very small number of students cycled to the school daily. The observed use of bicycles by the student population was thought to be accurate as the weather was ideal for cycling. Temperatures on all three days averaged 18 degrees Celsius. Direct observation methods are unobtrusive in nature. The observer was positioned near the entrance of the school in direct view of the bicycle racks where students locked their bicycles. At all the schools, students were only observed in the bike storage area as they locked or unlocked their bikes. If a student locked their bike at a different location, they were not included in the direct observation study of helmet use. The additional or remaining bicycles on the storage racks were included in the bicycle use count, but were excluded in the helmet use counts.

The observations at the high schools were done in the mornings between 8:00 and 9:15 A.M., as students arrived at the school. The observations at the junior-high schools were carried out between the hours of 3:15 and 4:30 P.M., as students left the schools on bicycles. The number of students riding a bicycle, the gender of the cyclist and the number of cyclists who were wearing a helmet were recorded on the tally form. Other interesting observations related to activities around the bicycle racks, crowding, storage of helmets, and some unsafe bicycle riding practices were also noted on the tally forms. Schools and students were not given advance notice of the date of the observation survey to better conduct a reliable observation of cyclists commuting to and from schools.

3.4.1 Implementation of the Self-report Survey

The survey questionnaire was group administered in the classrooms during regular class periods on October 7, 8, and 10, 1997. The cooperation and assistance of the principals and classroom teachers allowed the researcher to directly implement the survey with 36 classrooms, including the distribution and return of the surveys in sealed envelopes. A short orientation to the survey questionnaire method, ensuring each participant had a pencil, and clarification of completing all questions were mentioned. Students at all schools were directly informed that participation in the survey was voluntary and that they could withdraw at any time during the data collection procedures. The respondents selected answers to close-ended questions by circling one response to each question, as specified in a parenthesis for each item on the questionnaire. The last question required writing an answer.

In all classrooms, two probes were used by the researcher to clarify the information recorded. In question No.7 (Appendix C), "If you did not ride your bicycle to school today, what is the most important reason for not cycling," students were told they could add one additional choice; h) "distance was too close." In question No.15, students were given instructions to circle more than one answer for types of injuries if applicable. A postal code directory for Winnipeg was available for students who were unfamiliar with their postal code. In school six, the implementation of the survey was carried out with four to five classrooms in a school theater to allow for more expedient implementation of more surveys required in the school. Use of the postal-code directory to assist students in a theater setting was difficult and not implemented. As a result, the surveys at school six had a higher rate of incomplete or possibly incorrect data on postal codes.

The time taken to complete the survey in each classroom or theater was approximately 15 minutes. The total time taken for implementation of 827 surveys in six schools was 15 hours, over the three scheduled days. The questionnaires were reviewed as soon as possible after completion in the classroom and numbered sequentially. Each questionnaire was identified by a school I.D. number (1 to 6) in the top right-hand corner. The big strength of a group-administered survey is the high rate of response (69). In the implementation of this bicycle riding survey, the rate of participation was 100%, with no voluntary withdrawals or refusals to participate. The only limits on participation stemmed from absenteeism on the day of the survey.

3.4.2 Ethical Considerations in Implementation of the Survey

Information obtained in the self-administered questionnaire was confidential. Students recorded their responses directly on the questionnaire and were requested to not write their names on the survey forms. Classroom teachers were requested to not view the surveys upon completion by the respondents. The researcher also did not view the answers to the questions in the classroom. The survey forms were returned to the researcher and placed in a sealed envelope in each classroom. Information from the survey forms was transferred to a computer upon completion of all the surveys.

3.4.3 Criticisms of the Survey Instrument

Criticism of the survey instrument falls into two main areas, omissions in content and errors detected after completion of the survey. Some of the questions lacked response categories which resulted in some lost data. Although ownership of helmets was measured in the survey instrument, whether students had ever worn a helmet was not included in the data. Parental use of helmets was also not included as part of the survey data. A question added to the survey on injuries sustained during cycling was limited to providing information only on the nature of the injury. Specification if the injury occurred in the past year would have added important information to the adolescent rate of injuries. Additional questions would have provided further data. A void in the survey instrument is a lack of data on the influence of educational or promotional interventions on helmet use. Information from respondents on previous participation in bicycle safety programs was not collected in the survey instrument. A limitation to getting this information from the schools was that in junior and senior high schools, the students in grades seven and nine or 10, would have recently enrolled from different feeder schools. In Winnipeg, programs were not operated in schools by Manitoba Public Insurance in the past five years, and thus school bicycle safety programs were unlikely.

Some errors were detected at the initial implementation of the survey. In the survey question regarding reasons for not cycling, "distance was too close", was inadvertently omitted in the final draft of the survey. In many situations students live too close to school to cycle. This error was identified in the first school, and a probe was used by the researcher to add one response category to the question, which may have affected the responses to the item.

3.4.4 Data Entry and Storage

Prior to data-entry, the collected data for the open-ended question was summarized into categories. Twelve categories were developed from the individual responses on ways to convince students to wear helmets into a code frame to assist in content analysis: 1) consequences; 2) law; 3) education, videos; 4) more stylish helmets; 5) cannot do anything; 6) not sure; 7) no response; 8) incentives; 9) more comfortable helmets; 10) helmets do not work; 11) parents responsibility; 12) less expensive helmet.

Data entry for 19 of the survey items was completed by an experienced data entry operator to a computerized file. It was felt that a full time data entry person would make fewer errors. Problems with the data were brought to the attention of the researcher. At the time of data entry, three surveys were deleted because of obvious inaccurate or incomplete entry of data. The instructions in the survey requested only one response for each question, except for the question on previous types of injuries sustained with cycling, where a probe was given in the classrooms to encourage students to circle more than one response when applicable. In several survey questions two answers were circled. Two numeric columns were created for the questions which had more than one response on the survey to allow for a second response.

All questions were coded with a unique number assigned to each possible response for data entry. The survey item related to postal codes was not initially entered by the data entry personnel as it was uncertain if the statistical program used would accept alphabets. The postal codes were entered at a later time by the researcher. As a result, the researcher and data entry operator independently examined the data for consistency, completeness, and clarity. A high degree of inter coder reliability was achieved resulting in confidence that the data set contained few coding errors. In the examination of postal code data, it was obvious that many postal codes were not recorded on the survey forms, most notably in school six where use of a postal code directory was unavailable to most students. In the column collecting data on postal codes, a missing response was coded as 99 to have complete data for this variable.

An American Standard Code for Information Interchange file (ASCII) was created for storage of the records. A total of 824 records were entered. The ASCII file was imported to a statistical system for windows, Number Cruncher Statistical Systems 97 (NCSS 97) (117), in preparation for analysis. Variable labels and value labels for all data were created by the researcher to provide the necessary information for statistical analysis, displays, and printouts of results.

3.5 Analysis

3.5.0 An Overview of the Analysis

The proportion of adolescents in Winnipeg exposed to the risks associated with bicycle riding were determined partially by the direct observation survey and from an analysis of data from the self-administered questionnaire. The analysis of the direct observation survey includes a description of the survey results related to bicycle and helmet use observed for each school. The prevalence rates of bicycle use and helmet use in commuting to school are expressed as simple percentages, and were computed manually for each school. A proportion of the sample responding in a certain way is an estimate of the true population proportion and needs confidence limits fitted to it to make it a meaningful comment on the wider population (115). Confidence intervals (CI) accompany the estimated values of bicycle and helmet use. A confidence interval is the range of values, consistent with the data, that is believed to encompass the actual or "true" population value (116).

NCSS 97 (117) was used to compute the statistical analysis for the questionnaire. The analysis plan of the questionnaire survey data for this thesis included (a) screening of the data, (b) describing the variables, (c) testing for significance between variables, and (d) a logistic regression model. The reliability of adolescent reports of helmet use was tested manually by examining the correlation between self-report and direct observations of cycling to school using Chi-squared analysis.

3.5.1 Screening of the Data

Survey data in the cross-sectional study were screened for appropriate range of values, outliers, and missing values using NCSS 97. The data file included 824 cases, and 30 variables. All variables were also checked for coding within appropriate value limits, allowing for the detection of incorrect data entry producing results obviously in error. Outliers and code values outside of the possible range of values on each variable were screened, cross referenced with the original survey forms, and established that the values were true outliers. The variable "age," had six codes that were outside of the age code values of 11 to 18. The six cases were deleted from the data file.

Both cases and variables were examined for missing values. Missing values are shown in TABLE 3.2 (APPENDIX E). Missing data (no answer recorded) was less than 1.0% for most variables. The variable on the most important reason for wearing a helmet had the largest percentage of missing values (5.5%). Two items on the survey, the variable postal code, and the last item on the survey collecting data on ways to convince students to wear bicycle helmets included a coded value of "no response."

The survey was designed so that consistent numeric codes were used for common response options like "did not ride a bicycle in the last 30 days" which simplified data analysis and allowed for cross reference of some of the data. In some cases, assumptions could be made about how the data were missing. Bourque and Clark (111) consider the fact that data may be missing because respondents only partially complete what seems to them to be a repetitive questionnaire. When responses to only one or two items are missing in a scale that contains repetitive items, Bourque and Clark (111) recommend imputing the values for those items. For example, two questions (# 6 and # 7, Appendix C) had a response "rode my bicycle today," coded as "1". If one of those questions had a missing response, the missing value was imputed for those questions. The missing response of "rode my bicycle today" was imputed for six of the cases. Four questions (# 8,11,12, and 13, Appendix C) all asked for the same first response of "did not ride a bicycle in the past 30 days," coded as "1." Data imputation for missing values for these questions occurred in 10 cases with missing values. Although statistics can be biased once missing values are replaced, the extent of the bias in this case is very minor.

Although the survey instructions specified one response for 18 of the questions, some respondents circled more than one response to certain questions. The variables with more than one response are shown in Appendix

E. For most variables, the number of second responses was less than 1.0% and of little significance to the data analysis. The variable related to bicycle use had the greatest percentage (3.2%) of second responses. In rows with more than one response for an item, the common sense approach was to randomly pick one of the two responses (118). Second responses were asked for and included in the data analysis for the variable injury.

3.5.2 Describing the Variables

Univariate description of the variables was completed prior to analysis. The variables are listed in TABLE 3.2, Appendix E. For simplification and use in comparison with other studies, operational definitions were established for the variables. An operational definition is one that describes a variable in observable terms (116). Transformation of some of the variables created new more meaningful measures for analysis.

The variable containing grade value was grouped as grades 7-9 and grades 10-12, a grouping that allowed comparison with a local study and a national study on helmet use. To prevent oversimplification and allow important data to be included in this study in Winnipeg, a second grouping of grade values was transformed into three groups, grades 7-8, 9-10, and 11-12.

Information on postal codes initially included 32 different postal codes. The 32 postal codes were grouped into subregions of Winnipeg as defined by the Manitoba Center of Health Policy and Evaluation (MCHPE) (119). The city is grouped into nine Winnipeg subregions based on 1986 family incomes by postal code. The nine subregions are illustrated in a SAS graph map in APPENDIX F (119). Survey respondents resided primarily in three subregions of Winnipeg, the Outer Core, South Central, and South West. Thirty-two (3.91%) of the 747 respondents with data on postal codes resided in several other subregions and were classified in a fourth subregion under "other," as the numbers were too small to create new subregion categories.

Variables related to bicycle and helmet use factors were transformed to permit categorical analysis. The frequency of bicycle use in the last 30 days was transformed into a "times cycle" group with two categories, < than 10 times, and > than 10 times. The five categories for reasons for using bicycles were grouped into two more meaningful categories, commuting and recreational use. The dependent variable related to helmet use combined responses to create a helmet use category, and a helmet non use category. Wearing helmets "never, rarely, and sometimes" was considered as non use of helmets. The responses of "most of the time and always" were considered as helmet use.

The variable injury included seven response categories related to type of injury. For simplification, five of the responses (broken arm/leg, minor head injury, dental injury, admission injury, and other injuries) were combined into one category "injury." Three categories were included in a new injury variable; no previous bicycle injury, minor abrasions, and previous bicycle injury. The last variable to be grouped was on "ways to convince students to use helmets." The initial code frame of 12 categories was regrouped into nine categories.

A descriptive analysis is provided for all variables, and is displayed in tables and charts. The categorical variables are described simply by stating the number and/or percentile of individuals falling into each category. The variable on injuries provided more than one response in some cases. A separate table was generated to include the total number of injuries reported for the sample. In many cases, students also provided more than one way they felt adolescents could be convinced to wear bicycle helmets. Of 741 cases with responses to the question, 97 second statements and 10 third statements were given. To allow for all the data to be included, the percentile for the total number of suggestions given to the survey question are presented. The data for the open-ended question in the survey is further explored using qualitative analysis in the text.

3.5.3 Testing for Significance

To test for significant differences between variables, the non normally distributed data was analyzed with a non parametric statistical test. A widely used general test for whether a statistically significant relationship exists between two categorical variables is the chi-square test (115). The relationship between the explanatory variables and the dependent variables was examined in the analysis using the Chi-square test. A commonly chosen significance level is a probability (P) value=0.05. A P value of 0.05 tells us there is a 5% chance that the observed difference could arise by chance if the null hypothesis of no relationship is true. As several statistical analyzes were performed on the same data, it is more likely that some P values could wrongly be accepted as suggesting a relationship. To compensate for this multiple testing problem, the alpha level of 0.05 was adjusted to a more conservative alpha of 0.01.

In this study, the primary dependent variable represents whether adolescents used bicycle helmets. A second dependent variable examined was helmet ownership. The explanatory variables included grade groups, gender, area of residence, bicycle use today, bicycle use frequency, reasons for bicycle use, previous bicycle injury, and belief in helmet effectiveness. The variables most strongly associated with helmet use and helmet ownership were included in two separate logistic regression models.

3.5.4 Logistic Regression

Regression analysis is an area of statistics that attempts to predict or estimate the value of a response variable from the known values of one or more explanatory variables (116). The variables related to helmet use include demographic, behavioural, and attitudinal factors. The dichotomous structure of the dependent variables and the importance of examining the impact of demographic, behavioural, and attitudinal factors on the likelihood of helmet use and ownership motivated the selection of a logistic regression model.

Variables significantly associated ($p= 0.01$) with helmet use and helmet ownership were entered into logistic regression equations to assess which variables best predicted helmet ownership and helmet use outcomes.

CHAPTER 4: RESULTS

4.0 An Overview of the Results

The presentations of the results of the direct observation survey are summarized first, followed by the results of the classroom self-report survey. Results are summarized in tables with further explanation in the text. As charts and bar graphs are central to the description of the results, they are included in the body of the paper.

4.1 Direct Observation Survey Results

4.1.0 Bicycle Use

A total of 327 bicycles were observed at five different schools in a defined geographic area of Winnipeg. The results are summarized in TABLE 4.1. The overall prevalence of bicycle use by students commuting to school was 8.4% (95% CI 8.0% - 8.8%). Bicycle use was most prevalent in school two (27.4%) and in school four (16.1%), which were junior high schools in middle and high income sub-regions. The direct observation of bicycle use included students observed arriving or leaving the bicycle storage area, as well as bicycles present on the storage racks when the researcher arrived or left the school site.

Some additional observations of interest were recorded on the tally forms. At school one, where cycling was least prevalent (2.1%), only one bike rack at the entrance to the school was used to capacity. Additional bike stands toward the side and back entrance of the school were not used. At the other four schools, the bike racks were all used to capacity. At school two, about 20 bikes were also locked to a chain length fence around the entrance of the school. Only school four provided a locked bike compound for storage of bicycles during school hours. At school five, one vandalized bicycle was observed on the racks. At the same school, one adult took his bicycle into the school for storage.

TABLE 4.1. Bicycle use by students commuting to school according to school*

School ID code (Level)	Student population	Bicycle use N	(%)	95% CI (%)
1(High, 10-12)	1000	21	(2.1)	(1.2 - 3.0)
2 (Junior high, 7-9)	504	138	(27.4)	(23.7 - 31.1)
3 (High, 10-12)	800	29	(3.6)	(2.3 - 4.9)
4 (Junior high, 7-8)	391	63	(16.1)	(12.4 - 19.8)
5 (High, 9-12)	1200	76	(6.3)	(4.9 - 7.7)
TOTAL	3895	327	(8.4)	(8.0 - 8.8)

*Direct Observation of students riding bicycles and bicycles on racks

4.1.1 Helmet Use

The results of the direct observation of helmet use in bicycle riders commuting to school are shown in TABLE 4.2. Of the 274 bicycle riders observed riding, 12.8% (95% CI 8.6% - 17.0%) wore helmets commuting to and from school. A junior high school in Winnipeg School division No.1 had the highest observed helmet use rate of 40 percent (95% CI 27.1% - 52.9%). In a second junior high school (school 4) in Assiniboine South School division, out of 109 students, only one student was observed wearing a helmet. Three helmets were observed on the handlebars of the bicycles at this school, and were not included in the helmet use count. The number of student cyclists (274) included in the helmet use direct observation surveys only included the students observed arriving or leaving the school grounds on their bicycles. Besides observations of helmet use, some unsafe bicycle use was noted on the tally form. At school two, five students were observed riding double. Three students carried large musical instruments on the front handle bars of the bicycle. Several bicycle riders were observed crossing a major thoroughfare to get to the bicycle storage area, rather than using an intersection with controlled lights at a nearby corner.

TABLE 4.2. Bicycle helmet use by students according to school*

School ID code (Level)	Student bicyclists	Helmet use N (%)	95% CI (%)
1 (High, 10-12)	16	0 (0)	
2 (Junior high, 7-9)	109	1 (0.9)	(0.0 - 2.7)
3 (High, 10-12)	25	2 (8.0)	(2.6 - 18.6)
4 (Junior high, 7-8)	55	22 (40.0)	(27.1 - 52.9)
5 (High, 9-12)	69	10 (14.5)	(6.2 - 22.8)
Total	274	35 (12.8)	(8.6 - 17.0)

* Direct observation of students commuting to school

4.2 Self-report Survey Results

4.2.0 Sample Demographics

The demographic characteristics of the sample population are shown in TABLE 4.3. The total number of students participating in the survey was 827.

TABLE 4.3. Demographic characteristics of sample population*

School	Number	Percent
1 (High, 10-12)	73	8.9
2 (Junior high, 7-9)	132	16.1
3 (High, 10-12)	130	15.9
4 (Junior high, 7-8)	142	17.4
5 (High, 9-12)	103	12.6
6 (Junior high, High, 7-12)	238	29.1
Total	818	100.0
Gender		
Female	385	47.4
Male	428	52.6
Total	813	100.0
Grade		
7th	169	20.7
8th	160	19.3
9th	106	12.9
10th	138	16.9
11th	149	18.2
12th	92	11.3
Ungraded	3	0.4
Total	817	100.0
Sub- region group		
Outer core	210	25.7
South Central	180	22.0
South West	325	39.7
Other	32	3.9
Unknown	71	8.7
Total	818	100.0

*Totals differ because of missing data

The response rate to the survey was 100%, with no students refusing to participate. Screening of the data resulted in a total of nine surveys being deleted from the data set. The total number of survey respondents included in the results was 818. Nearly equal numbers of males (52.6%) and females (47.4%) completed the questionnaire in the schools. Grades seven to 12 are represented in the sample population. Grades 7-9 included 435 (53.3%) of the respondents and grades 10-12 included 382 (46.8%) of the survey respondents. Three students were in an ungraded category, and were later included in the grade 10-12 group. The totals for the demographic characteristics of the sample differ because of missing data for the gender and grade variable.

The socio-demographic profile of the sample population was defined using postal code and income information provided by the Manitoba Center for Health Policy and Evaluation (MCHPE) (119). Based on the 1991 census data, family income values of all Winnipeg families were divided into five urban income quintiles (119). The income ranges for the five urban income quintiles based on the 1991 census are:

Quintile 1: $ 0 - 30,163 (U1)(Low)
Quintile 2: $ 30,164 - 36,643 (U2)
Quintile 3: $ 36,644 - 44,613 (U3)
Quintile 4: $ 44,614 - 54,289 (U4)
Quintile 5: $ 54,290 - (U5) (High)

The sub-regions identified by postal codes are displayed in CHART 4.1. Three subregions of Winnipeg were represented in the sample, with the largest percentage (43.5%) residing in South West Winnipeg. A fourth category was defined as other and included 32 (4.3%) of the respondents. The Outer Core subregion contains approximately 40% of families in U1 (Low) and 43% in U2. The South Central region has approximately 23% in U3, 17% in U4, and 33% in U5 (High). The South West subregion of Winnipeg is represented by the highest income range based on census data, with 22% in U4 and 56% in U5 (118). Using the income quintiles as guidelines, the socio-demographic profiles of the subregions were defined as low income for the Outer Core subregion, medium income for the South Central subregion, and medium to high income for the South West subregion (CHART 4.1).

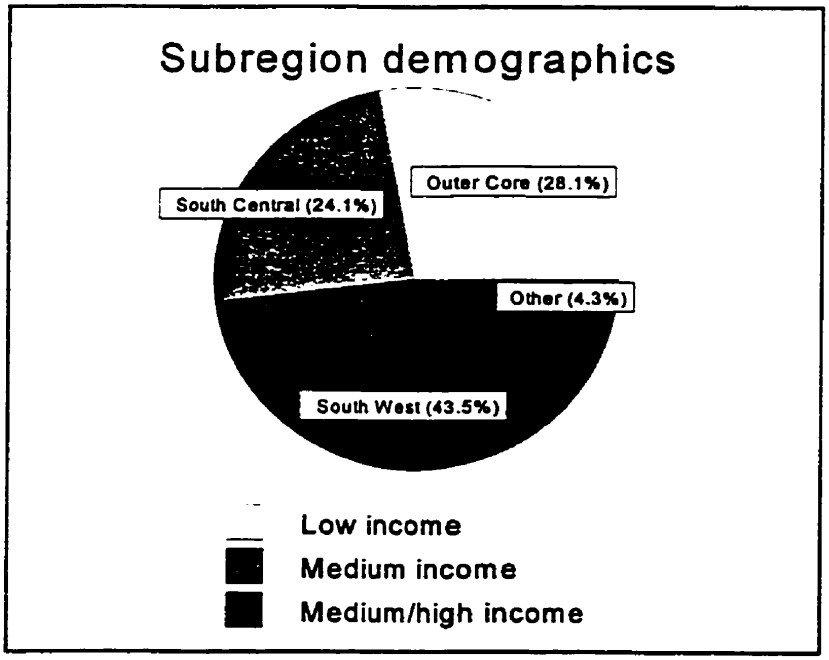


CHART 4.1

4.2.1 Bicycle Use

The survey assessed the riding exposure of adolescents from responses to two questions, "how many times did you ride a bicycle in the last 30 days" and "did you ride a bicycle to school today." As shown in TABLE 4.4, 12.4% of students cycled to school on the day of the survey. More males (17.8%) than females (6.5%) used their bicycles commuting to school on the day of the survey. Of 811 survey respondents, 67.4% of adolescents reported that they rode their bicycles in the last 30 days. The estimated median riding times in the last month for adolescents was 20 or more times. More than one third of these adolescents, 37.7% rode their bicycles more than 20 times in the last 30 days. The percentage of males who cycled 20 plus times (46.3%), was much higher than the percentage of female respondents (24.9%). In this adolescent sample, a higher percentage (59.7%) reported using their bicycle for commuting which included commuting to school and to friends, than for recreational use (40.3%). Recreational use included cycling on trails for fun, casual cycling, and cycling for sport or fitness.

TABLE 4.4. Bicycle use information*

Cycle Today	**Female n(%)**	**Male n(%)**	**Both**
Yes	25 (6.5)	76 (17.8)	101 (12.4)
No	360 (93.5)	352 (82.2)	712 (87.6)
Total	385	428	813
Cycle in Last 30 days			
Yes	221 (57.6)	326(76.3)	547 (67.4)
No	163 (42.4)	101 (23.7)	264 (32.6)
Total	384	427	811
Frequency of Cycling *(Last 30 days)*			
1 - 5 times	89 (40.3)	98 (30.1)	187 (34.2)
6 - 10 times	44 (19.9)	25 (7.7)	69 (12.6)
10 - 20 times	33 (14.9)	52 (16.0)	85 (15.5)
20 plus times	55 (24.9)	151(46.3)	206 (37.7)
Total	221	326	547
Reason for Bicycle Use *(Last 30 days)*			
Commuting	133 (60.5)	190 (59.2)	323 (59.7)
Recreational	87 (39.5)	131 (40.8)	218 (40.3)
Total	220	321	541

* Totals differ because of missing data

Reasons for not cycling are described in TABLE 4.5. Of the 87.6% of adolescents who did not to cycle to school on the day of the survey, 41.1% of the students reported "no interest" as the reason for not cycling. "Distance too far" (17.8%) was the second most frequently stated reason, and "no bike" (16.4%) was the third most frequent reason. Approximately 84% of adolescent students own bicycles in Winnipeg.

TABLE 4.5. Reasons for not cycling*

Reason	Number	Percent
No bicycle	115	16.4
No interest	288	41.1
Discouraged	22	3.1
Unsafe Route	15	2.1
Distance too far	125	17.8
Bad Weather	107	15.3
Distance too close & other reasons	29	4.1

*Students who did not cycle on day of survey

The reasons for not cycling by gender are shown in CHART 4.2. Males and females had some differences in the reasons stated for not cycling. More females than males reported "distance too far" and "lack of interest" as their reason for not cycling. "Distance was too close" was included in a category with other reasons written by students. Some responses written in by students included reasons related to the fact that their bicycle was recently stolen or in need of repair.

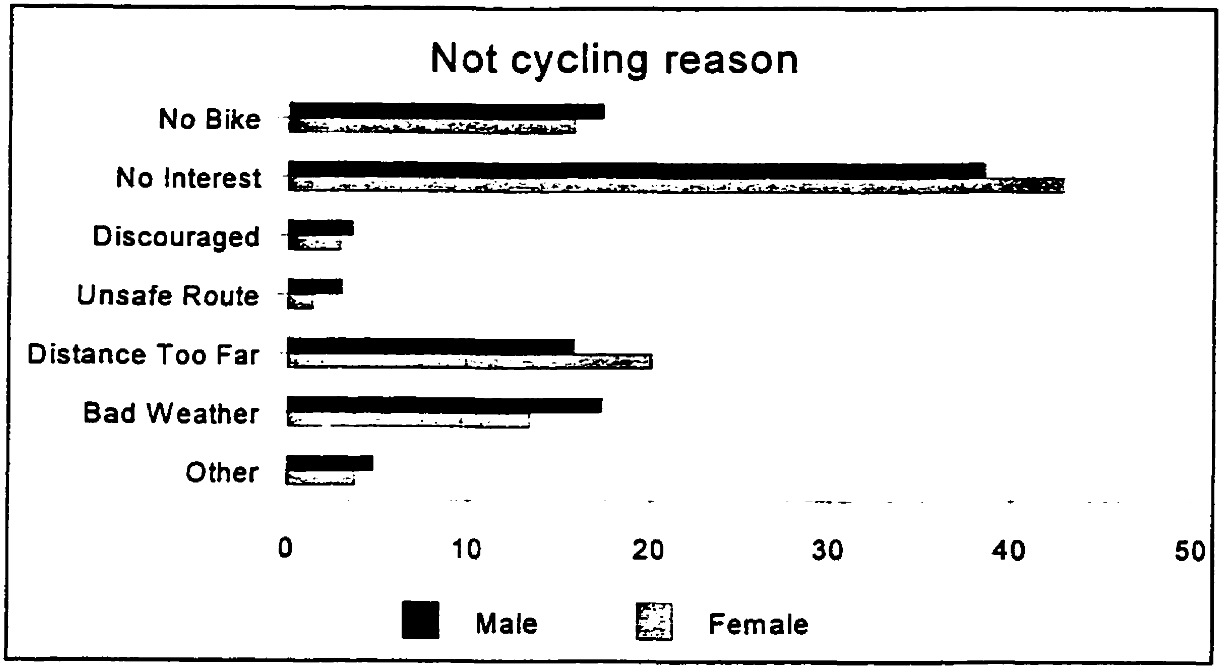


CHART 4.2.

TABLE 4.6 provides a profile of the bicycle riders in the adolescent sample. In grades 7-9, 80.0% of the respondents cycled in the last 30 days, compared with 53.4% of respondents in grades 10-12. More males (76.2%) than females (57.4%) cycled in the last 30 days. Cycling was prevalent in all subregions represented in the sample population of adolescents, with approximately 60% to 70% of adolescents using their bicycles in the last 30 days.

TABLE 4.6. A profile of bicycle riders (last 30 days)

Characteristics	Riders/sample size*	Percent of group
Grade		
7-9	348/435	80.1
10-12	205/382	53.7
Total	553/817	67.7
Gender		
Male	326/428	76.2
Female	221/385	57.4
Total	547/813	67.3
Sub-Region		
Outer Core	128/210	61.0
South Central	128/180	71.1
South West	230/325	70.8
Other	19/32	59.4
Unknown	48/71	67.6
Total	551/818	67.6

* Total sample size differs because of missing data

4.2.2 Helmet Ownership

A description of helmet ownership by grade group, gender, school and subregion for students who bicycled in the last 30 days is summarized in TABLE 4.7. Helmets are owned by 241 (43.6%) of 553 adolescent bicycle riders. The percentage of ownership is much higher in grades 7-9 (50.6%) than in grades 10-12 (31.7%). Helmet ownership is similar in males and females, 41.3% and 46.4% respectively. A wide variation in ownership was reported in the six schools. In school four, 73.7% of the 114 bicycle users in the school owned

TABLE 4.7. Bicycle helmet ownership by grade, gender, school, and subregion**

Characteristic	Yes n (%)	No n (%)	Total
Grade			
7-9	176 (50.6)	172 (49.4)	348
10-12	65 (31.7)	140 (68.3)	205
Total	241 (43.6)	312 (56.4)	553
Gender			
Male	135 (41.3)	192 (58.7)	327
Female	103 (46.4)	119 (53.6)	222
Total*	238 (43.4)	311 (56.6)	549*
School			
1(Grade 10-12)	10 (24.4)	31 (75.6)	41
2 (Grade 7-9)	67 (57.3)	50 (42.7)	117
3 (Grade 10-12)	28 (36.4)	49 (63.6)	77
4 (Grade 7-8)	84 (73.7)	30 (26.3)	114
5 (Grade 9-12)	27 (51.9)	25 (48.1)	52
6 (Grade 7-12)	25 (16.4)	127 (83.6)	152
Total	241 (43.6)	312 (56.4)	553
Subregion			
Outer Core	28 (21.9)	100 (78.1)	128
South Central	93 (72.7)	35 (27.3)	128
South West	104 (45.2)	126 (54.8)	230
Other	5 (26.3)	14 (73.7)	19
Unknown	11 (22.9)	37 (77.1)	48
Total	241 (43.6)	312 (56.4)	553

*Total differs because of missing data
** Adolescents who bicycled in the last 30 days

helmets. In school six, only 16.4% of 152 respondents owned helmets. The prevalence of helmet ownership shows similar variation among the four subregions of Winnipeg. Prevalence is highest in the South Central region (72.7%), followed by the South West region (45.2%), other (26.3%), and lowest in the Outer Core region (21.9%).

4.2.3 Helmet Use

Several descriptive observations can be made about helmet use in adolescents aged approximately 12 to 18 years. The reported prevalence of helmet use in students cycling to school on the day of the survey was 14.8%. The survey results describing adolescent helmet use in the last 30 days are presented in TABLE 4.8. Helmet use is defined as those respondents who reported that they wore helmets always or most of the time. The prevalence of helmet use in the survey sample was 14.5% for students who cycled in the last 30 days. The majority of students, 85.5%, sometimes, rarely, or never wore helmets, and were reported as helmet non users. Helmet use was higher in grades 7-9 (16.4%) compared with grades 10-12 (11.2%). Males reported higher helmet use (14.7%) than females (13.5%). As with helmet ownership, helmet use varied between schools. Helmet use was highest in school four (32.6%), a junior high school in a medium income subregion of Winnipeg. A suburban high school, school one, had the lowest reported helmet use (4.9%). A description of helmet use by subregions shows that helmet use is highest in the South Central subregion (29.5%) and lowest in the South West subregion and the Outer Core subregion (10.9%).

TABLE 4.8. Helmet use by grade, gender, school, and subregion*

Characteristic	Helmet Non use N (%) *(Sometimes, rarely, and never)*	Helmet Use N (%) *(Most of the time and always)*	Total
Grade			
7 - 9	291 (83.6)	57 (16.4)	348
10 - 12	182 (88.8)	23 (11.2)	205
Total	473 (85.5)	80 (14.5)	553
Gender			
Male	279 (85.3)	48 (14.7)	327
Female	192 (86.5)	30 (13.5)	222
Total**	471 (85.8)	78 (14.2)	549**
School (Grade)			
1 (10-12)	39 (95.1)	2 (4.9)	41
2 (7-9)	101 (86.3)	16 (13.7)	117
3 (10-12)	69 (89.3)	8 (10.4)	77
4 (7-8)	76 (68.4)	36 (31.6)	114
5 (9-12)	44 (84.6)	8 (15.4)	52
6 (7-12)	142 (93.4)	10 (6.6)	152
Total	473 (85.5)	80 (14.5)	553
Subregion			
Outer Core	114 (89.1)	14 (10.9)	128
South Central	90 (70.3)	38 (29.5)	128
South West	205 (89.1)	25 (10.9)	230
Other	16 (84.2)	3 (15.8)	19
Unknown	48 (100.0)	0 (0.0)	48
Total	473 (85.5)	80 (14.5)	553

* Adolescents who bicycled in the last 30 days
** Total differs because of missing data

The survey results describing adolescent helmet use among all bicycle riders and among riders who were helmet owners are presented in TABLE 4.9. Of the students who reported using their bicycles to commute to school, 14.8% reported wearing a helmet cycling to school on the day of the survey. For all bicycle riders who cycled in the last 30 days, 9.5% always wore a helmet. The highest percentage of adolescents, 72.9% reported never wearing a helmet when they cycled. The results in TABLE 4.9 show that not all the adolescents who owned helmets wore them. For the 238 bicycle riders who owned helmets, 45.4% of them never wore their helmet. Overall, only 31.9% of adolescents who owned helmets wore helmets always or most of the time. This included 21.0% who reported wearing their helmets always, and another 10.9% who wore them most of the time.

Bicycle riders were defined as those adolescents who reported using their bicycles between one and 20 plus times in the last 30 days. The information on helmet use presented in TABLE 4.9 includes some adolescents (2.6%) initially defined as cyclists, who later reported that they did not cycle in the last 30 days. A minor difference in the two responses may be related to some ambiguousness in the questions and the fact that no data are perfectly reliable.

TABLE 4.9. Helmet use information for students who cycled in the last 30 days

Helmet use Characteristic	Female N (%)	Male N (%)	Both N (%)
Rider owns helmet			
Yes	103 (46.4)	135 (41.3)	238 (43.4)
No	119 (53.6)	192 (58.7)	311 (56.6)
Total	222	327	549
Rider wore helmet today			
Yes	6 (40.0)	9 (60.0)	15 (14.8)
No	19 (22.1)	67 (77.9)	86 (85.2)
Total	25 (24.7)	76 (75.3)	101
Proportion of time spent wearing helmet *(all riders)**			
*(Did not cycle)**	4 (1.8)	10 (3.1)	14 (2.6)
Never	163 (73.4)	237 (72.5)	400 (72.9)
Rarely	16 (7.2)	19 (5.8)	35 (6.4)
Sometimes	9 (4.1)	13 (4.0)	22 (4.0)
Most of the Time	10 (4.5)	16 (4.9)	26 (4.7)
Always	20 (9.0)	32 (9.8)	52 (9.5)
Total	222	327	549
Proportion of time spent wearing helmet (*helmet owners*)			
(*Did not cycle*)*	0	3 (2.2)	3 (1.3)
Never	51 (49.5)	57 (42.2)	108 (45.4)
Rarely	13 (12.6)	18 (13.3)	31 (13.0)
Sometimes	9 (8.7)	11 (8.1)	20 (8.4)
Most of the Time	10 (9.7)	16 (11.9)	26 (10.9)
Always	20 (19.4)	30 (22.2)	50 (21.0)
Total	103	135	238

*Some students defined as cyclists reported not cycling in the last 30 days

4.2.4 Reasons for Helmet Use and Helmet Non Use

The survey collected data on the reasons why adolescents did or did not wear helmets. The initial results are presented in TABLE 4.10. Of the 14.5% of adolescents who wore helmets always or most of the time, safety precautions and the insistence of family members were said to be important reasons for wearing helmets. Of the 79 students who were helmet users, 43 (54.4%) students reported safety precautions as the most important reason for wearing helmets. The reason that "family members insist" on helmet use was given by 24 (30.4%) of the respondents. Of the 85.5% of adolescents who sometimes, rarely, or never wore helmets, the most important reason for not wearing helmets was that the "helmet is uncomfortable" (32%). The second most frequent reason was "helmets are not necessary" (27.3%) and the third most frequent reason was "helmets are unattractive" (16.9%). Answers given for the second most important reason for not wearing helmets are similar. The three most frequent reasons were, "helmet is uncomfortable" (28.2%), "helmets are unattractive" (20.1%), and "helmets are not necessary" (17.6%).

Reasons for not wearing helmets given by adolescents who owned and did not own helmets are illustrated in CHART 4.3. Non helmet owners reported "unnecessary," "not encouraged" and "too expensive" more frequently as reasons for not wearing helmets. Helmet owners more frequently judged helmets too uncomfortable and unattractive to wear. Peer pressure was more frequently reported as a reason for not wearing helmets in helmet owners.

TABLE 4.10. Helmet use patterns in adolescents

For the 14.5% of adolescents who always or most of the time wear helmets

Reasons for wearing helmets	n	Percent
Family members insist	24	30.4
Safety precautions	43	54.4
Previous bicycle injury	9	11.4
It looks cool	3	3.9
Total	79	

For the 85.5% of adolescents who sometimes, rarely, or never wear helmets

Most important reason for not wearing helmet	n	Percent
Helmet is uncomfortable	147	33.7
Friends make fun of helmets	43	9.9
Helmets are too expensive	25	5.7
Parents do not encourage helmets	26	6.0
Helmets are not necessary	119	27.2
Helmets are unattractive	77	17.6
Total	437	

2nd most important reason for not wearing helmet	n	Percent
Helmet is uncomfortable	118	27.0
Friends make fun of helmets	77	17.6
Helmets are too expensive	23	5.3
Parents do not encourage helmets	47	10.8
Helmets are not necessary	78	17.9
Helmets are unattractive	94	21.5
Total	437	

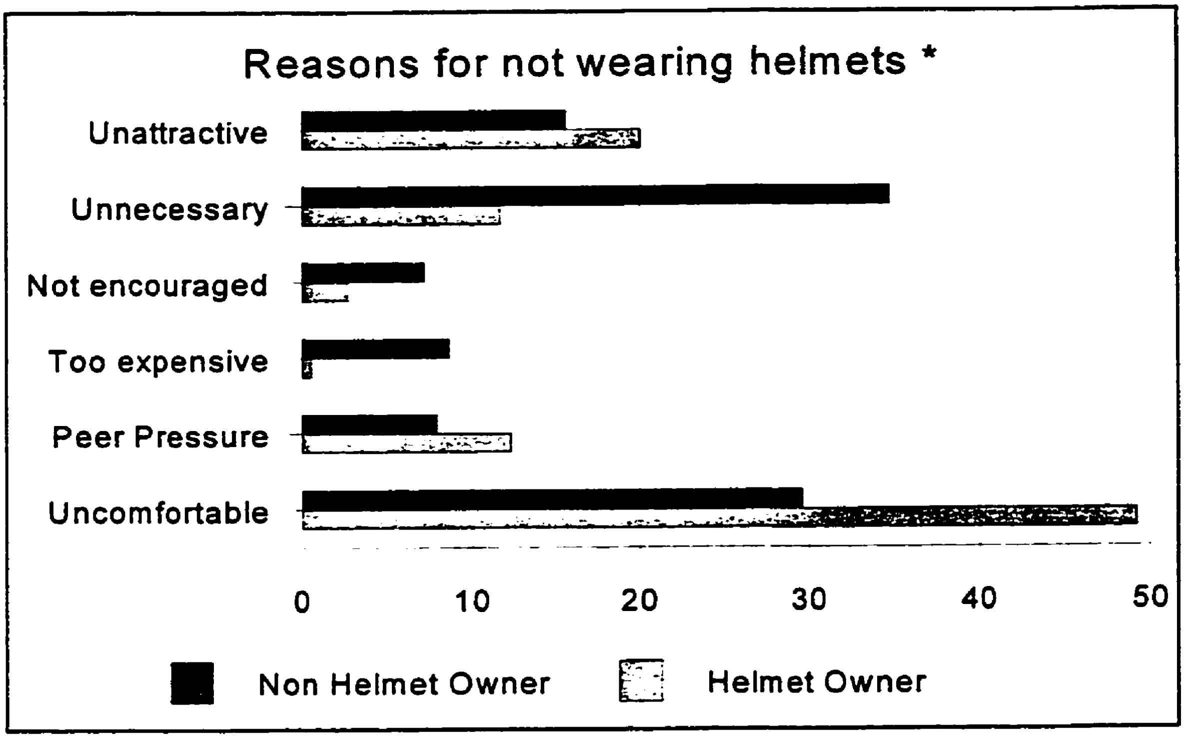


CHART 4.3.
*Values expressed in percentages

The reasons adolescent bicycle riders do not wear helmets by gender, grade group, and subregion are described in TABLE 4.11. More females than males find helmets unattractive, 27.4% and 11.9%, respectively. More males (33.7%) and adolescents in grades 10-12 (39.3%) indicate that the most important reason for not wearing helmets is that they are unnecessary, in comparison to females (16.8%) and students in grades 7-9 (19.0%). Not wearing helmets because they are uncomfortable is more prevalent as a reason in younger adolescents in grades 7-9 (41.6%) and in adolescents in the South Central subregion (51.7%). Peer pressure (friends make fun of helmets) was similar in both genders and grade groups. Peer pressure as a reason for not wearing helmets was higher in the Outer Core subregion (10.2%) and in the South West subregion (11.3%) than in the South Central subregion (4.6%). "Helmets are too expensive" was more prevalent as a reason among adolescents in grades 10-12 (8.1%) than in grades 7-9 (4.3%), and among adolescents in the South West subregion. A parent not encouraging helmets was generally represented least frequently as a reason for non use of helmets.

TABLE 4.11. Distribution of most important reason for not wearing helmets, adolescents, by gender, grade group and subregion (%)*

	Uncomfortable	Peer Pressure	Too Expensive	Parents do not encourage	Unnecessary	Unattractive
Gender						
Female	64 (34.8)	17 (9.5)	9 (5.0)	10 (5.6)	30 (16.8)	49 (27.4)
Male	87 (32.2)	28 (10.4)	17 (6.3)	15 (5.6)	91 (33.7)	32 (11.9)
Grade						
7-9	116 (41.6)	26 (9.3)	12 (4.3)	18 (6.5)	53 (19.0)	54 (19.4)
10-12	37 (21.4)	19 (11.0)	14 (8.1)	8 (4.6)	68 (39.3)	27 (15.6)
Sub-Region						
Outer Core	37 (34.3)	11 (10.2)	7 (6.5)	6 (5.6)	23 (21.3)	24 (22.2)
South Central	45 (51.7)	4 (4.6)	1 (1.1)	5 (5.7)	17 (19.5)	15 (17.2)
South West	52 (26.7)	22 (11.3)	14 (7.2)	14 (7.2)	61 (31.3)	32 (16.4)
Other	3	1	0	0	4	6

*Numbers represent adolescents who cycled/did not always wear a helmet

TABLE 4.12 indicates that 34.4% of adolescents feel that wearing a helmet is always important. The percentage of adolescents who report cycling in hazardous conditions and cycling in traffic as circumstances for when helmets are important is similar, 20.3% and 20.2% respectively. Gender differences in when students report it is important to wear a helmet are shown in CHART 4.4. More females (42.8%) than males (26.6%) report that wearing a helmet is always important. More males (23.3%) than females (17.1%) report helmet use is important when cycling in hazardous conditions. More than twice as many males (22.3%) as females (10.5%) report that wearing a helmet is never important.

TABLE 4.12. Percentage distribution of when students feel it is most important to wear a helmet*

Circumstances	Female n(%)	Male n(%)	Total n(%)
Cycling in traffic	78 (20.5)	83 (19.9)	161 (20.2)
A regular basis	20 (5.2)	18 (4.3)	38 (4.8)
Cycling long distances	15 (3.9)	12 (2.9)	27 (3.4)
In hazardous conditions	65 (17.1)	97 (23.3)	162 (20.3)
Never important	40 (10.5)	93 (22.3)	133 (16.7)
Always important	163 (42.8)	111 (26.6)	274 (34.3)
Total	381	414	795

*All students

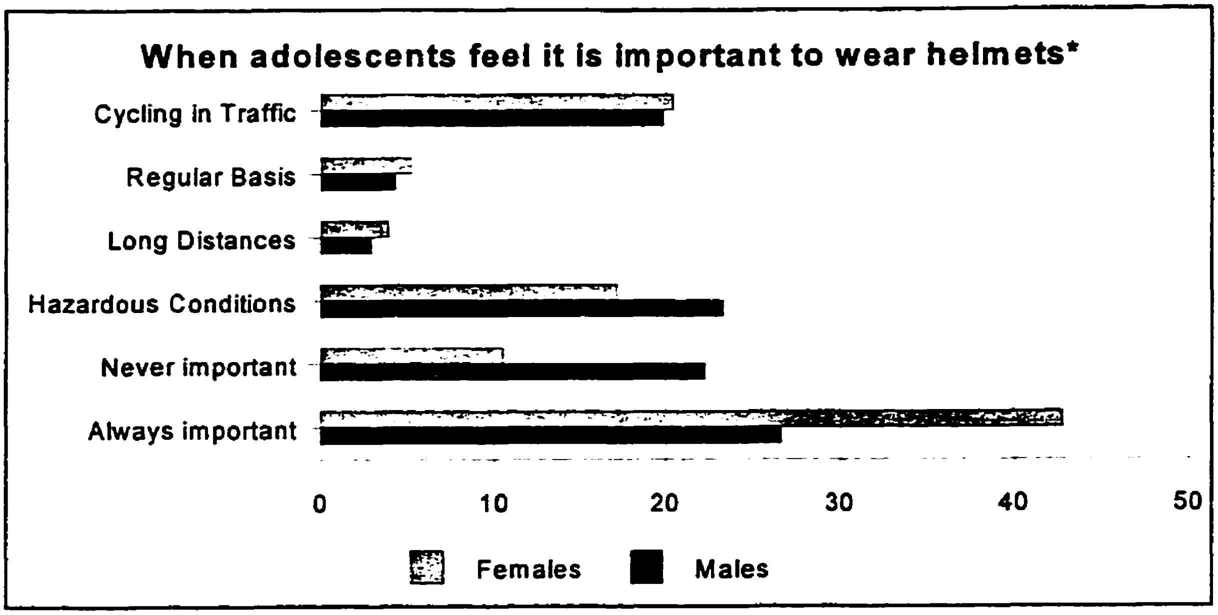


CHART 4.4.
*Values expressed as percentages

4.2.5 Previous Bicycle Injuries

The survey collected data on whether adolescents had a previous bicycle injury by the type of injury. Often, respondents reported more than one injury. TABLE 4.13 presents a percentage distribution of previous bicycle injuries by gender as reported by adolescents. Only one type of injury, logically decided as the more major reported per adolescent, is included in this table. More than half (64.6%) of the adolescents reported having an injury ranging from minor abrasions to an admission injury. The percentage of admission injuries was higher in males (6.3%) than in females (1.8%).

A total of 21 additional second injuries were included in the data. Four respondents reported multiple injuries and these responses were included in injury counts. A description of the percentage distribution of types of injury is shown in TABLE 4.14. Of the types of previous injuries listed in the response categories, minor abrasions were the most frequently reported type of injury (72.4%). A total of 34 (6.4%) of the adolescents had a previous bicycle injury requiring admission to a hospital. Minor head injuries were reported by 21 (3.9%) of the adolescents.

TABLE 4.13. Distribution of previous bicycle injury experience by gender

Previous Injury	Female N (%)	Male N (%)	Total*
No injury	145 (37.7)	149 (35.2)	294 (36.4)
Minor abrasion	199 (51.7)	183 (43.3)	382 (47.3)
Broken arm or leg	8 (2.1)	11 (2.6)	19 (2.4)
Minor head injury	5 (1.3)	14 (3.3)	19 (2.4)
Dental injury	4 (1.0)	5 (1.2)	9 (1.1)
Admission injury	7 (1.8)	27 (6.4)	34 (4.2)
Other injury	17 (4.4)	34 (8.0)	51 (6.3)
Total*	385	423	808

*Totals do not represent all injuries (only one injury response/adolescent included in data)

TABLE 4.14. Types of previous injuries*

Previous Injury	No. of times mentioned (%)
Minor abrasion	393 (72.4)
Broken arm or leg	24 (4.4)
Minor head injury	21 (3.9)
Dental injury	11 (2.0)
Admission injury	34 (6.3)
Other injury	60 (11.0)
Total	540

* All reported injuries included in n (%)

4.2.6 Attitudes to Helmet Effectiveness and Legislation

TABLE 4.15 summarizes the data on adolescent attitudes and perceptions of helmet effectiveness and the suggestion of mandatory helmet laws for cyclists. As shown in TABLE 4.15, 82.5% of adolescents believed that bicycle helmets prevented head injuries. However, only 17.5% of adolescents reported that there should be a law for all cyclists to wear helmets. Approximately one-third or 29.2% were not sure, and 53.4% reported that a law should not be required for cyclists to wear helmets. Adolescents had a more positive attitude regarding compliance with a helmet law. When asked "if a law were required for cyclists to wear helmets, what would you do," 35.9% reported they would wear a helmet, 23.5% would not wear a helmet, and 23.4% were not sure. Of the 809 respondents who answered this question, 140 (17.3%) said they would stop cycling.

TABLE 4.15. Attitudes toward helmet use and legislation*

Question	Yes N (%)	No N (%)	Not Sure N (%)	
Do you think bicycle helmets prevent head injuries?	669 (82.5%)	142 (17.5%)		
Should there be a law for all cyclists to wear helmets?	142 (17.5%)	434 (53.4%)	237 (29.2%)	
	Wear helmet	**No helmet**	**Not sure**	**Stop Cycling**
If there was a law requiring cyclists to wear helmets, what would you do?	290 (35.9%)	190 (23.5%)	189 (23.4%)	140 (17.3%)

*Number and % represent all questionnaire respondents

4.2.7 Convincing Students to Wear Bicycle Helmets - Quantitative Results

The quantitative results of the survey item on suggestions for ways to convince students to wear helmets are summarized in TABLE 4.16.

TABLE 4.16. Adolescents' suggestions for ways to convince students to wear helmets*

Suggestion	No. Times Mentioned	Percentage
Education	226	30.7
Law	118	16.1
More stylish helmets	126	17.1
Incentives	41	5.6
More comfortable	27	3.7
Cannot do anything	159	21.6
Other	38	5.2
Total	735	

*All suggestions included in N (%)

Some form of education was the most frequent response given by students for ways to convince students to wear helmets (30.7%). The suggestions of education included school presentations, assemblies, speakers, videos, media, commercials, posters, and courses. Approximately one-fifth (21.6%) of the adolescents suggested that convincing adolescents to wear helmets was not possible. More stylish helmets (17.1%) and use of a helmet law (16.1%) were the third and fourth most frequent suggestions.

TABLE 4.17. Adolescents' suggestions for ways to convince students to wear helmets by gender*

Suggestions	Males N (%)	Females N (%)	Total N (%)
Education	84 (19.6)	99 (26.7)	183 (22.5)
Law	49 (11.4)	58 (15.1)	107 (13.2)
More stylish helmets	53 (12.4)	59 (15.3)	112 (13.8)
Incentives	22 (5.1)	9 (2.3)	31 (5.1)
More ccmfortable	11 (2.1)	6 (2.6)	17 (2.1)
Cannot do anything	90 (21.0)	69 (17.9)	159 (19.6)
Other	15 (3.5)	9 (2.3)	24 (3.0)
Not sure	60 (14.0)	43 (11.2)	103 (12.7)
No response	44 (10.3)	33 (8.6)	77 (9.5)
Total	428	385	813

*Only first suggestion included in N (%)

Adolescents' suggestions for ways to convince students to wear helmets are further described by gender in TABLE 4.17. About 12.7% of the adolescents were not sure of what could be done, and 9.5% did not respond to the open-ended question. More females (26.7%) than males (19.6%) felt education was important in encouraging helmet use. More females (15.1%) also felt that a helmet law was necessary for convincing students to wear helmets than males (11.4%). A higher percentage of males (21.0%) than females (17.9%) suggest that convincing adolescents to wear helmets is impossible.

4.2.8 Convincing Students to Wear Bicycle Helmets - Qualitative data

The last question of the self-report survey was open-ended and involves a qualitative analysis besides the quantitative summary presented in TABLES 4.16 and 4.17. Students were given a statement "we know that bicycle helmets prevent head injuries" and were asked for suggestions of what they thought needed to be done to convince students their age to wear helmets. Many students thought and wrote serious comments providing practical suggestions and took the opportunity to provide opinions to the survey.

The adolescents in the survey presented very realistic and effective strategies related to the importance of education in encouraging helmet use. The educational emphasis was on the need for graphic examples of consequences of bicycle crashes. The importance of realistic life stories and seeing victims in bicycle crashes were foremost in many comments. Opinions were also presented on past education efforts. Some examples of students' comments are:

> Have very graphic commercials on TV showing the consequences of not wearing helmets.
>
> Presentations, and spokespersons to make people realize that a helmet can save a life! Bring in people who have had incidents/accidents occur to them. Advertise it more! Just like those drinking and driving commercials! It can be deadly! But not only for the safety but the awareness of drivers.
>
> There needs to be a television commercial so graphic using people instead of a watermelon, because to the best of my knowledge I have NEVER seen a cycling accident, only smashed fruit.

Other students felt that convincing students to wear helmets was impossible or felt they should not be convinced to do anything. Students' antipathy and negative attitudes toward helmets were obvious in their remarks. Some respondents emphasized their strong feelings against helmets by vulgar language. Some common reasons given for their dislike of helmets were:

> You can't convince us to wear an ugly thing like that. As if I want helmet hair.

> I don't want to wear a helmet. I'm responsible and I don't need one. Nothing can be done.

> I know that it would take a lot of convincing to get students to wear helmets because they're not attractive at all and they don't really appeal to any other student I know. I'm not sure what anybody could do to get one to wear a helmet. Nothing helps... they're all ugly.

Helmets were criticized not only because of their appearance but because they were not well designed. Practical suggestions were given for improving their design. The idea of having helmets included in the collections of popular fashion designers was mentioned. One male student in grade eight sketched a design of a helmet that he thought would be more appealing to students (see FIGURE 4.2.).

> Helmets should be thinner and they should fit every head. My three helmets never fit me and it's hard to wear them because they slant or come loose.

> They should try and make them more comfortable and in more sizes because they're always too big or too small.

> Have the major brand names make helmets like Nike, Adidas, or Reebok design helmets.

FIGURE 4.2. Helmet design

Several students suggested that the majority of students will not wear a helmet until it is compulsory. A major barrier to helmet use evident in many comments was the negative criticism of other students.

> I think that a law should be passed requiring cyclists to wear a helmet, with a large sum of money fined if caught without one. Then I wouldn't have to feel uncomfortable about wearing a helmet around my friends. Those who refuse to wear a helmet can stop riding their bike.
>
> Most people make fun of you if you wear a helmet. If this didn't happen, I think more people would wear them.
>
> I think if they made a law I wouldn't be embarrassed to wear a helmet. I would wear one all the time.

Through taking an active part in the research questionnaire, the students provided valuable suggestions for increasing helmet use. Their beliefs and attitudes about peer group approval and comfort were important comments in their perceived use of helmets.

4.3 Variables in Relation to Helmet Ownership

Measures of association between variables were determined by cross tabulations of the data using Chi-squared analysis. If the Chi-squared values exceeded a critical value at P= 0.01, the null hypothesis of no relationship between the variables was accepted. Variables significantly associated with helmet ownership are presented in TABLE 4.18.

Significant differences in helmet ownership were present depending on age by grade group 7-9 and 10-12 (p=<0.0001), and depending on which subregion adolescents lived in (p=<0.0001). Significant differences in helmet ownership were also found depending on frequency of cycling (p=0.0004), cycling to school on the day of the survey (p=0.0002), and belief in helmet effectiveness (p=<0.0001). Males and females showed no significant differences in ownership of helmets (p=0.2355). Helmet use between students who used their bicycles for commuting and students who used their bicycles for recreation showed no significant differences (p=0.1789). Having a previous bicycle injury was insignificant to helmet ownership (p=0.2231).

TABLE 4.18. Variables in relation to bicycle helmet ownership

Characteristic	Number*	Own Helmet (%)*	Do not own Helmet (%)*	Probability p=0.01
Grade Group 1				
7 - 9	348	50.6	49.4	
10 - 12	205	31.7	68.3	<0.001
Gender				
Female	222	46.4	53.6	
Male	327	41.3	58.7	0.2355 (NS)
Sub-region				
Outer Core	128	21.9	78.1	
South Central	128	72.7	27.3	
South West	230	45.2	54.8	
Other	19	26.3	73.7	<0.0001
Bicycle Use				
Commuters	321	42.1	57.9	
Recreation	217	47.9	52.1	0.1789 (NS)
Times Cycle				
<10 time	259	35.5	64.5	
>10 times	292	50.3	49.7	0.0004
Today Cycle				
Yes	101	60.4	39.6	
No	452	39.8	60.2	0.0002
Previous Injury				
No Injury	182	38.5	61.5	
Minor Abrasion	276	46.0	54.0	
Injury	94	46.8	53.2	0.2231 (NS)
Belief in helmet effectiveness				
Yes	446	48.0	52.0	
No	103	26.2	73.8	<0.0001

**Number and % represent adolescents who cycled in the last 30 days NS -Not significant

4.4 Variables in Relation to Helmet Use

The central focus of the inferential analysis in this study is to determine the factors related to helmet use in adolescents. Use of helmets was analyzed to determine if differences existed by grade group, gender, and subregion of residence. Bicycle use behaviour, previous injuries, and a belief in helmet effectiveness were also included in the etiologic approach of determining the factors significant to helmet use. The results of the Chi-squared analysis are shown in TABLE 4.19. Demographic variables significantly related to helmet use ($P<0.01$) were age by grade group 2 ($p=0.0096$) and subregions ($p=<0.0001$). Belief in helmet effectiveness was significant to helmet use ($p=0.0019$). Whether students bicycled to school on the day of the survey, the number of times they used their bicycle in the last 30 days, what they used their bicycle for, and if they had a previous bicycle injury all tested not significant to helmet use.

4.5 Results of Logistic Regression

The logistic regression analysis examined the impact of the explanatory factors on the likelihood of helmet ownership and on the likelihood of helmet use. All the explanatory variables significantly associated with helmet use and helmet ownership, as shown in TABLE 4.18 and TABLE 4.19, were included in the logistic regression model as dichotomous variables (variables having two discrete categories). The regression definitions of the independent variables entered into the logistic regression model are provided in Table 4.20. The reference categories were represented by one category for each variable.

TABLE 4.19. Variables in relation to bicycle helmet use

Characteristics	No.*	Helmet Non use (%)*	Helmet Use (%)*	P (p=<0.01)
Grade Group 1				
7-9	348	83.6	16.4	
10-12	205	88.8	11.2	0.0957 (NS)
Grade Group 2				
7-8	273	81.0	19.0	
9-10	161	90.7	9.3	
11-12	119	89.1	10.9	0.0096
Gender				
Male	327	86.5	13.5	
Female	222	85.3	14.7	0.7011 (NS)
Subregion				
Outer core	128	89.1	10.9	
South Central	128	70.3	29.7	
South West	230	89.1	10.9	
Other	19	84.2	15.8	<0.0001
Today cycle				
Yes	101	84.2	15.8	
No	452	85.5	14.2	0.6639 (NS)
Times cycle				
<10 times	259	86.5	13.5	
>10 times	292	84.6	15.4	0.5280 (NS)
Bicycle Use Group				
Commuters	321	86.3	13.7	
Recreational	217	83.7	16.6	0.3566 (NS)
Previous bicycle injury				
No injury	182	87.4	12.6	
Minor abrasions	276	84.4	15.6	
Injury	94	85.1	14.5	0.6767 (NS)
Belief in effectiveness				
Yes	446	83.2	16.8	
No	103	95.1	4.9	0.0019

* No. and % represent adolescents who cycled in the last 30 days NS -Not Significant

TABLE 4.20. Independent variable definitions for logistic regression

Variable	Score
Rider characteristics	
Grade Group 1 - (7-9)	1 if rider was in grade 7-9, 0 otherwise
(10-12)	Reference category
Grade Group 2 - (7-8)	1 if rider was in grade 7-8, 0 otherwise
(11-12)	1 if rider was in grade 11-12, 0 otherwise
(9-10)	Reference category
Cycle today*	1 if rider cycled to school, 0 if otherwise
Frequency of cycling >10 times*	1 if rider cycled >10 times, 0 otherwise
Residence demographics	
South Central subregion	1 if rider lives in S. Central, 0 otherwise
South West subregion	1 if rider lives in S. West, 0 otherwise
Other subregion	1 if rider lives in other, 0 otherwise
Outer Core subregion	Reference category
Attitudes to cycling	
Belief in helmet effectiveness*	1 if rider believes helmets are effective, 0 otherwise

* The reference categories are represented by "otherwise"

The regression results for helmet ownership are presented in TABLE 4.21. The regression coefficient measures the log odds of helmet ownership when the explanatory variable takes the value 0. A standard error measures the log odds ratio attributable to a one unit increase in the value of the variable after the possible influence of the other variables on the probability of helmet ownership have been controlled for and eliminated. According to the regression results, helmet ownership was predicted by being in grades 7-9 (p=0.0024), cycling more than 10 times (p=0.0401), living in the South Central subregion (p=<0.0001) or the Southwest subregion of Winnipeg (p=<0.0001), and believing in the effectiveness of helmets (p=0.0003). Cycling to school on the day of the survey and living in an "other" subregion were not independent predictors of helmet ownership. The odds ratios (OR) and confidence intervals (CI) for helmet ownership are also shown in TABLE 4.21. Residing in the South Central subregion of Winnipeg was the strongest predictor of helmet ownership, OR=6.81 (CI 4.02 -11.55). Living in the South West subregion, OR=2.73 (CI 1.61 - 4.60), and a belief in helmet effectiveness, OR=2.61 (CI 1.55 - 4.41), were the second and third predictors of helmet ownership. Being in the younger grade group, grades 7-9, and cycling more than 10 times in the last 30 days were also significant factors predicting helmet ownership.

TABLE 4.21. Logistic regression results: Factors associated with helmet ownership

Variable	Regression Coefficient*	Standard Error**	Probability	Odds Ratio (with 95% CI)
Grade 7 - 9	0.6423	0.2123	0.0024	1.90 (1.25 - 2.28)
Cycle 10+ times	0.4079	0.1986	0.0401	1.50 (1.02 - 2.23)
South Central subregion	1.9189	0.2695	>0.0001	6.81 (4.02 - 11.55)
South West subregion	1.0030	0.2668	>0.0001	2.73 (1.61 - 4.60)
Belief in helmet effectiveness	0.9608	0.2669	0.0003	2.61(1.55 - 4.41)

*Represents the log odds ratio **Represents the standard error of the log odds ratio

Regression results for factors associated with helmet use are presented in TABLE 4.22. Residing in the South Central subregion of Winnipeg (p= <0.0001), being in grade 7-8 (p=0.0340), and having a positive belief in the effectiveness of bicycle helmets (p=0.0089) were the only three factors that affected the likelihood of helmet use. Being in grades 9-10, grades 11-12, residing in the Outer Core subregion, the South West subregion, or the "other" subregion did not predict helmet use in adolescents. The odds of helmet use were highest if the respondent believed in helmet effectiveness, OR =3.54 (CI 1.37 - 9.15). The second best predictor of helmet use in this study was residing in the South Central subregion, OR=2.97 (CI 1.77 - 5.00). The odds of helmet use if an adolescent was in grades 7-8 was 1.76 (CI 1.04 - 2.98).

TABLE 4.22. Logistic regression results: Factors associated with helmet use

Variable	Regression Coefficient*	Standard Error**	Probability	Odds Ratio (with 95% CI)
Grade 7 - 8	0.5676	0.2678	0.0340	1.76 (1.04 - 2.98)
South Central subregion	1.0889	0.2654	<0.0001	2.97 (1.77-5.00)
Belief in helmet effectiveness	1.2650	0.4839	0.0089	3.54 (1.37 - 9.15)

* Represents the log odds ratio **Represents the standard error of log odds ratio

4.6 Reliability of Results

Reliability concerns the extent to which any measuring procedure yields the same results on repeated trials (112). The form of data collection in the surveys involved students in secondary public schools in the sampling frame answering self-administered questions and direct observations of students cycling to school. Reliability of survey designs can be questioned related to the reliance on self-reporting of data by adolescents. The responses to not cycling in the last 30 days, which was repeated in several questions, produced a few responses for some cases that were not consistent.

The Chi-squared measure is a reasonable measure of agreement or disagreement between observed values of a qualitative variable and the expected values of a variable (115). In this study, checking the agreement between the helmet use results from the direct observation survey and the helmet use results observed in the self-report survey was a practical method of investigating the reliability of the self-reported data. In a 2x2 contingency table categorizing helmet use as either "yes" or "no," the association between the direct observation results and the self-report survey is highly insignificant (Chi-square= 0.2169 with 1df, NS). The analysis of the simple 2 x 2 table used Yates correction, as the degrees of freedom equal one. The calculated value of 0.2169 is much smaller than the 0.05 critical value of 3.84, indicating a very high measure of agreement between the observed results and the self-reported results. The reliance of self-reporting by adolescent students in this study was highly positive. The validity of the results is indicated by their consistency with national data on helmet use.

CHAPTER 5: DISCUSSION

An overview of bicycle and helmet use factors in the scientific literature can be summarized as follows. Cycling is a popular recreational activity in Canada. Epidemiological data reveal that children and adolescent cyclists are extremely vulnerable to bicycle crashes and head injuries. Recent injury studies show that bicycle helmets can reduce the likelihood and severity of head injuries substantially. Because bicycle helmets reduce the risk of head injury, a goal of many prevention strategies is to increase the number of bicyclists who wear helmets. Existing data suggested that helmet use rates were low, especially in adolescents. According to studies from the 1990's in various geographic locations in Canada, helmet use among adolescents ranged from about 7% to 17 percent. Lack of awareness, discomfort, peer pressure and high cost are the frequently cited barriers to use of helmets. An increasing trend in provincial bicycle helmet laws in Canada and a positive attitude in Manitoba to increasing bicycle safety in recent years is encouraging.

The objective of this study was to describe bicycle and helmet use in adolescents in Winnipeg and to gain insight into the determinants of helmet use. Many results are consistent with results from other studies. A published report, using data from the Health Canada sponsored supplement to Statistics Canada's 1994/95 NPHS, examined the use of bicycles and bicycle helmets by Canadians and explored attitudes toward helmet use and the status of helmet legislation in Canada (2). The major results of this recent national survey will be discussed in some detail, due to the similarity of the study to the survey undertaken in Winnipeg. Some notable similarities and differences in bicycle and helmet use were observed between this study and the national study.

The description of bicycle use in an adolescent population in Winnipeg shows that approximately 85% of adolescents aged 12 to 18 own bicycles and most of these adolescents' cycle. Of the total sample population, 67.4% of the adolescents cycled in the last 30 days. Bicycle use is more prevalent in younger adolescents and in males. Of the students in grades 7-9 (aged 12 to 14 approximately), 79.8% were defined as bicycle users, and 53.4% of adolescents in grades 10-12 (aged 15 -19) were bicycle users. Of the male respondents, 76.2% cycled in the last 30 days compared with only 57.4% of females. The finding of a decline in cycling with older adolescents and in females who cycled is similar to the findings in the national survey. Nationally, 62% of Canadian teenagers aged 12-14 cycled with a decline to 49% at ages 15-19. Bicycle use was higher in males than females (2). In comparison to the national data, a higher percentage of adolescents cycled in the last 30 days in Winnipeg. The authors of the report on "factors associated with bicycle helmet use" mention that the use of bicycles by the adolescent population may be underestimated in the NHPS data (2). The NHPS asked about bicycle use "in the past three months." If the interview occurred in the winter or early spring, adolescent respondents who rode bicycles in more favorable weather would not have been recorded as cyclists. Data on cycling exposure "in the last 30 days" was collected in the first week of October in Winnipeg and gives an accurate estimate of seasonal bicycle use in the adolescent population.

Most adolescent cyclists in Winnipeg were commuters that would most likely involve cycling in traffic with automobiles. The percentage of cyclists who cycled to school on the day of the direct observation survey was 8.4%, and 12.4% on the day of the self-report survey. In one junior high school (grades 7-9) in the South West subregion of Winnipeg, more than one quarter of the student population commuted to school by bicycle. The high prevalence of bicycle use is a positive finding to environmental and adolescent health. This school also provided the most bike racks for storage of bicycles on the school grounds. Only one junior high school in the South Central subregion had a locked bike compound for storage of bikes during school hours. The prevalence of bicycle use to this school by direct observation was 16 percent. In four schools, the observations of very crowded storage areas for bicycles may be an indication that even more students would cycle if they had a secure place to store their bicycle. If the school divisions took more initiative in providing larger and more secure bicycle compounds at their schools, more students would be encouraged to use their bicycles and hopefully become less dependent on automobile use for getting to school.

A higher percentage of students cycled to the junior high schools and in the more affluent subregions of Winnipeg. These results are similar to results of a study in Toronto. Field interventions conducted in Metropolitan Toronto suggest that in affluent areas a larger proportion of children cycle to school (68).

The reason for less bicycle use in the poorer neighbourhoods may be related to not owning bicycles and to a problem with vandalism of bicycles. A discussion with the principal at one school verified that bicycle use was discouraged because of vandalism. The survey results also indicate that most cyclists used their bicycle more than 20 times in the last 30 days. The results show that a bicycle is an important and popular means of transportation for adolescents in Winnipeg. Similarly, a study by Seijts in the Netherlands (20) reported that the bicycle is a first important means of transportation and recreation. In the Netherlands, roads are separated from cycling tracks and facilities are favorable for cyclists. In a city like Winnipeg, this is rarely the case. Five of the six schools in the study population were on a major thoroughfare with high traffic volume, which would require students to cycle in hazardous situations. Only school one was on a neighborhood street in a suburb with less traffic.

A frequent reason given for not cycling to school was no interest. In approximately 17% of the cases, students said the distance was too far, and 16% had no bicycle. Many students, 107 (15.3%) indicated that bad weather was the reason for not cycling to school. Although the temperatures were seasonally warm during the day, the earlier morning temperatures were cool. A greater number of students may cycle to school in May and June in Winnipeg.

Helmet use among adolescents in Winnipeg is low. The results of the direct observation survey indicate that 12.8% of adolescent cyclists wear helmets while commuting to and from school. A slightly higher percentage was found in the self-report survey at 14.8% of students who reported wearing a helmet cycling to school on the day of the survey. The direct observation rates are higher for Winnipeg adolescents than a previous helmet use rate from a Manitoba study in 1996. A direct observation study on urban and rural patterns of bicycle helmet use in Manitoba in 1996 established the helmet use rates for adolescents aged 12 to 15 to be only 7.3%, and only slightly higher in the older adolescent aged 16 to 19 at 8.3 percent (17). The difference between the two studies in prevalence rates may be explained by the reported differences in urban and rural patterns of helmet use. Overall, the Manitoba study reported urban helmet use (22.9%) to be much higher than rural use (8.9%). It is also possible that more cyclists would wear helmets commuting to school than on a casual cycle, and would thus reflect a higher helmet use rate than for general use. However, the prevalence of helmet use among adolescents who cycled in the last 30 days in Winnipeg is 14.5%, which is almost identical to 14.8% who reported wearing helmets cycling to school on the day of the survey. A possible secular trend in increased helmet use in Winnipeg adolescents a year later is encouragement. In the last year, IM-PACT and a bicycle safety committee had been promoting bicycle helmet use through a media campaign. In direct observation studies estimating the age of the cyclist is often difficult. The direct observation of cyclists commuting to school in this study provides an accurate assessment of age according to school level.

The results of the self-report survey of 14.5% helmet use is slightly higher than the observed use of 12.8 percent. The self-report results are similar to a recent U.S. national study describing helmet use patterns of children younger than 15 years of age. Of all the child riders, about 15% were reported to have used their helmets all or more than half the time when riding to school (94).

Bicycle helmet use in students commuting to school is higher in some Canadian cities. The rate of helmet use in secondary students commuting to school in Ottawa in 1991 was 17% (72), compared with only 12.4% of adolescent cyclists wearing helmets cycling to school in Winnipeg in 1997. Higher helmet use rates among students in Ottawa in 1991 may be related to the community wide efforts to promote helmet use. A city like Ottawa has a cycling culture with a well-developed network of bicycle paths and a large active cycling population. A current issue in Winnipeg is the lack of safe cycling routes. Other results between the two studies are similar. In Ottawa, the results from individual schools reflected a strong socioeconomic trend, from 0% helmet use in a school in a high-density public housing area to 68% in upper income professional neighbourhoods. Similarly in Winnipeg, the direct observation of helmet use varied from 0% in a South West suburb of Winnipeg to 40% in South Central Winnipeg. Both regions represented middle to high income areas (119). The difference in helmet use between two subregions in a similar socioeconomic profile indicates that other demographic variables other than income may be important to helmet use.

The prevalence of helmet use described by grade (age) and gender is similar to national data on helmet use, by a self-report method. In grades 7-9, aged approximately 12-14, 16.7% of cyclists wore helmets in Winnipeg. In grades 10-12, aged approximately 15-19, the prevalence of helmet use declined to 11.4%. Helmet use was also higher in females, than males. The national study made similar observations with a decline in helmet use in older adolescents. At ages 12-14, 16% of cyclists in Canada always wore a helmet. At ages 15-19, the percentage was just 8 percent (2). The higher percentage of helmet use in the older adolescent in Winnipeg may be related to slight differences in methodology of self-report. In the national figures, only those respondents who reported "always" wearing their helmets were considered helmet users. In the current survey, respondents who reported "always and most of the time" were defined as helmet users. A recent report by Ni et al. (88) suggest that restricting the definition of helmet use to those who always wear a helmet may better emulate community studies in which cyclists are observed on the roads. The analysis of the NPHS data is limited in not being able to report usage rates among helmet owners. The self-report survey in this research project asked a direct question about helmet ownership, and provided an analysis of helmet use among helmet owners.

Of the adolescents who cycled in the last 30 days, 43.4% owned helmets. Bicycle helmet ownership was higher in females than males. Bicycle helmet ownership by adolescents varies across the three defined subregions, the schools, and by grade. The highest bicycle helmet ownership was reported in a junior high school (grade 7-8) at 73.2 percent. The lowest reported helmet ownership was 16.4% in a combined junior high and high school. Helmet ownership was higher in the younger grade group, grades 7-9 than in grades 10-12. This finding may be an indication that parents no longer feel that purchasing their older adolescent a bicycle helmet is important once they have outgrown it. In a description of bicycle helmet ownership by subregion, helmet ownership is highest in the South Central subregion (medium income) and lowest in the Outer Core subregion (low income). The differences in the ownership between regions may be directly related to socioeconomic factors and the priority of helmet purchase. The Outer Core subregion has the lowest income as available from census data. The higher bicycle helmet ownership in the South Central subregion in comparison to the South West subregion, two similarly defined income areas, is indicative that other social factors other than income are also important to helmet ownership.

A disturbing and important finding in this study is that the majority of helmet owners do not wear their helmets. Overall, 43.4% of adolescent cyclists reported owning a helmet. Of the helmet owners, only 21.3% reported always wearing their helmet. Almost half (46.6%) of helmet owners never wore their helmets. Other studies have reported helmet use to be higher among helmet owners. Bicycle helmet ownership and use among 707 children aged five to 17 was documented in a study in Toronto in 1991. The Toronto survey showed that about 22% of child cyclists owned a helmet. Of these, 54% were reported to wear helmets all the time (68). A survey in August of 1992 with five to 14 year olds in Chicago reported helmet ownership at 28% and helmet use at 45% (92). The higher rates of helmet use among the helmet owners in Toronto and Chicago could be related to reporting bias. Use of parental reports in both surveys may have produced inflated numbers for helmet use by children. It is likely that parents are more familiar with helmet ownership than helmet use of their children, especially with the older adolescent. In Sudbury, a roadside survey with respondents (median age 19.1) found 30% of the cases owned helmets and 66% claimed to wear their helmet "all the time" (98). Helmet use among helmet owners was much higher in the Sudbury study than reported with adolescents in Winnipeg. The difference in helmet use rates among helmet owners in the two cities is most likely related to an older age study population in the Sudbury study.

A positive finding in the current study is that helmet ownership is higher in Winnipeg adolescents than reported in other studies. Higher helmet ownership found in some regions of Winnipeg may be related to an encouraging secular trend. In the national study, the leading reason for not wearing a helmet for all ages was not owning one. The authors of the report on the national data suggest that the cost of helmets may be a barrier to use. A substantial share of children (52%) in low income households did not have a helmet (2). Similarly in Winnipeg, fewer adolescents (21.9%) owned helmets in the Outer Core subregion (low income) in comparison to a medium income subregion (72.7%) and a medium-high income subregion (45.2%). Low helmet ownership in the Outer Core subregion is a concern. Further studies on ways to increase helmet ownership in poorer subregions of Winnipeg are important. However, the issue that 68% of adolescent helmet owners in Winnipeg do not usually wear their helmet raises added concerns. Convincing or helping parents to purchase helmets is only a partial solution, because many adolescents will be unwilling to wear them. The issue revolves around how best to get adolescents to wear helmets.

The leading most important reason for not wearing a helmet among cyclists in this study was that a helmet is uncomfortable. The second reason was a lack of perceived needs, and the third reason was that helmets are unattractive. Helmet owners and nonowners reported some differences in reasons for not wearing helmets. Almost 50% of helmet owners do not wear helmets because they are uncomfortable. The second and third most important reasons are that helmets are unattractive and that friends make fun of helmets. The most frequently reported reason among non helmet owners is lack of perceived needs, followed by helmets are uncomfortable, and helmets are unattractive. It is more likely that helmet owners would describe helmets as uncomfortable as a reason for not wearing them. The fact that helmet nonowners also state "uncomfortable" as the second most frequent reason is indicative that they have previously worn a bicycle helmet or they are making their decision based on helmets used in other sports as hockey or ringette.

The reasons for not wearing helmets in Winnipeg are similar to findings in an Australian study. Major factors leading to teenagers aged 13 -17 in Melbourne not wanting to wear a helmet were appearance and comfort (21). The concerns about the comfort and attractiveness of helmets suggest that the design of helmets may be a factor in their use. Helmet designs have changed in recent years from the bland, heavy, utilitarian shapes to lighter, streamlined, and more colorful models. More guidance and time taken in purchasing a bicycle helmet may be important to finding a comfortable and attractive helmet, and increasing helmet use.

The leading reason for not wearing a helmet in the national study was not owning a helmet. This reason was not included in the Winnipeg study, and thus cannot be compared. Discomfort was ranked second as a reason for not wearing helmets, and "other" ranked third. Unfortunately, "other" does not provide good data to be used in a study of determinants of helmet use. In both the current study and the national study, lack of perceived need was more prevalent in males than females, and particulary in males aged 15-19. Fear of ridicule was a more important deterrent to helmet use for 12-14 year-olds and in females {2). In Winnipeg adolescents, peer pressure was more prevalent as a reason among males and among adolescents in grades 10-12. The differences are small, and may be related to the small numbers in some groups.

A study of barriers to wearing bicycle safety helmets in the Netherlands among children suggested that negative social pressure will be much higher in an environment where social norms about wearing bicycle safety helmets are variable and unfavorable (20). This suggestion is true in the current study. Adolescents in the South West subregion had the lowest prevalence of helmet use and reported peer pressure more frequently as a reason for not wearing a helmet. Lack of perceived need was the most frequent reason reported for not wearing helmets in the South West subregion. In comparison, discomfort was the most frequent reason given for not wearing helmets in the Outer Core and the South Central subregions. It appears that a negative safe cycling attitude is more prevalent in the South West subregion of the Winnipeg study. The use of education in the schools to promote a positive attitude to safe cycling among adolescent cyclists and automobile drivers is an important element in the health education of adolescents. Many adolescents in grades 11 and 12 have driver's licenses. One student comment in the survey was as follows:

> Students my age do what they want, so the most effective way to convince them to wear a helmet is to educate them on the consequences which may occur if a helmet is not worn. Also educate drivers who feel cyclists should not be on the road and disregard their presence.

The prevalence of previous cycling injuries among adolescents in Winnipeg is high. A substantial number of students had at least one injury serious enough for them to remember. Sixty-three percent of adolescents in the survey reported one type of cycling injury, and 21(2.6%) of the students reported more than one injury. It is possible that a substantial number of slightly injured cyclists are not included in official registries. As a result, a large group of injured cyclists remains unnoticed, especially in adolescents. Of all injuries reported, 46.8% were minor abrasions, and probably did not require medical attention. The prevalence of injuries that required admission to a hospital was 6.3 percent. Four percent of the injuries involved a broken arm or leg, and 3.7% involved a minor head injury. Two percent of the previous injuries were dental injuries. The vulnerability of young cyclists to bicycle crashes and injuries in Winnipeg is evident. One student's comments summarize some adolescent cycling behaviours that could more easily result in bicycle crashes;

> Well, I ride my bike without my hands on my handlebars. My parents insist that I wear a helmet because of that reason.

Helmet use among cyclists with previous bicycle injuries is 15.4 percent. Among cyclists who have not had a previous injury, helmet use is lower at 12.7%, but the difference between the two groups in not significant at p=0.05. A Toronto study made similar observations. Five percent of children in the study were reported to have suffered a bicycle-related injury requiring treatment other than at home. Most of these children still did not wear a helmet. Among helmet owners, the proportion of children who did not use a helmet following a bicycle crash was greater than among their peers who had no previous injury (79% vs. 63%, p=0.02) (30). The authors suggest that common behavioural characteristics may have contributed both to the injuries and to resistance to wearing a helmet. A continued perceived lack of risk in spite of having previous bicycle injuries among most adolescents is obvious in this study. The direct observation of cyclists in this study included observations of students riding double and transporting large musical instruments on their handlebars. Research has indicated that bike borrowing and riding double are common factors in injury events (120). Instructions on bicycle safety and traffic laws continue to be important considerations in efforts to decrease the number of bicycle injuries in adolescents.

For the 14.5% of adolescents defined as helmet users, safety precautions and the insistence of family members were the two most important reasons for wearing helmets. A previous bicycle injury was only mentioned as a reason for wearing a helmet in nine cases (11.4%). Finch (21) reported similar findings in Australia, with both safety considerations and parental pressures as two important factors that influenced a teenager to wear a helmet. However, many students in the self-report survey commented on how they felt serious bicycle injuries were important motivators to using helmets. Some comments written by students are:

> Describe the experiences of other students our age that had an accident and how their life was affected by the accident.
>
> I think that they need to know about how many people die or get severely hurt by not wearing a helmet. My uncle fell off his bike and his helmet saved his life. Now I always wear a helmet.

This study showed that adolescents were strongly convinced about the effectiveness of bicycle safety helmets protecting against head injuries. Eighty-three percent believed bicycle helmets prevent head injuries. These findings are similar to a Northeastern Ontario roadside survey where awareness of the protective effects of helmets was shown by 92% of respondents over the age of 16 (98). The higher percentage in Ontario respondents is most likely related to more mature respondents, mean age of 19.7 years. The mean age of the Winnipeg respondents is 14.4 years. Although 83% of adolescents believe that helmets are effective in reducing head injuries, only 34.3% of Winnipeg adolescents believe that wearing a helmet is always important and 16.7% reported that wearing a helmet is never important. Approximately 40% of respondents feel that wearing helmets when cycling in traffic is important and in other hazardous conditions. The awareness of helmet effectiveness and the importance of wearing helmets does not seem to reflect on helmet use behaviour among adolescents in this study.

According to the 1994/95 NPHS data, provinces with legislation tend to have higher percentages of both helmet owners and users (2). The overall helmet use rate for the population aged 12 and older is higher in Ontario (20%) and British Columbia (27%). The Prairie provinces with no helmet legislation had the lowest overall helmet use rate of 12 percent. In the present study, owning and wearing a bicycle safety helmet was highly prevalent in one Winnipeg junior high school, 73.2% and 32.1% respectively. The findings suggest that high helmet ownership and use is spotty within the city. The fact that most adolescent helmet owners do not wear helmets reflects safety interventions that have failed in Winnipeg. The effects of education and helmet legislation in increasing helmet use has been documented in the literature. Post law helmet wearing surveys in Australia in 1992 found that helmet wearing rates were 77% in children, 59% in teenagers, and 84% in adults two years following the introduction of a helmet law (87). However, observational surveys of bicycle usage in Australia have shown that both the number of bicyclists and the amount of bicycle exposure time decreased after introduction of the law in teenagers

The attitudes of adolescents to helmet use and helmet laws are an important component of this present study. When asked the question "should there be a law for all cyclists to wear helmets", 17.5% of the respondents said "yes", 53.4% said "no", and 29.2% were "not sure". Much higher support for legislation was recently demonstrated in two other Canadian studies. Regarding potential helmet legislation in Ontario, 81% of respondents more than 16 years of age in a roadside survey in Sudbury agreed with the institution of mandatory helmet legislation for cyclists under the age of 16, and 57% agreed with its institution for all cyclists, whatever age (98). In Metropolitan Toronto, legislation requiring bicycle helmet use by all children in Ontario had strong support from the public. In 1991, a telephone survey of parents reported that 80.8% of responding parents were in favour of the suggested legislation. Parents of teenaged children aged 15-17 were one subgroup that did not support legislation in Toronto (68). The fact that most of the adolescents do not support legislation in Winnipeg is not an unusual finding, and is similar to a study with adolescents in Australia. A two-year community-based action research program in Australia used student observations, focus groups, a baseline survey, and student workshops to develop strategies for increasing bicycle helmet wearing in students. Students taking part in the baseline survey and workshops disagreed that helmet wearing should be compulsory. However, in later workshops and focus groups sessions, students said that compulsory helmet laws were the only sure of getting students to wear helmets (39).

Support for helmet legislation as to anticipated cycling behaviours in Winnipeg showed that 36% of cyclists would wear a helmet if there was a law requiring cyclists to wear helmets. An additional 23% were not sure if they would wear a helmet. A helmet law would more than double helmet use in the adolescent population from 14.5% to 36 per cent. If the 23% of adolescents who were not sure of their behaviour could be convinced to wear helmets, the potential for a helmet use rate of greater than 50% is encouraging. Most cycling organizations feel that many cyclists would stop cycling if helmets became mandatory. In this group of Winnipeg adolescents, only 17% reported that they would stop cycling. Some very strong comments were made by students in support of mandatory helmet legislation:

> I think you need to make a law because I had an accident and I'd be dead if I weren't wearing a helmet. I don't want anyone to get hurt. Make a law like in some places.

> I think there should be a law about it. When speeches are made about bicycle helmets at school, not many people listen. But if there was a law, I think more people would listen.

The above comment has been previously described as active and passive interventions. Dr. William Haddon (1980) described the term active to require much action on the part of individuals and the term passive to categorize those measures at the other extreme that require no individual action (61). Legislation is recognized as a passive intervention. Graitcer et al.(23) in a review of educational and legislative strategies to promote bicycle helmets in the United States recently concluded that changing behaviour, especially traffic behaviour, through education and training programs has had at best only limited success. They report that the need for passive interventions is a major reason that states have enacted laws requiring the use of injury intervention devices like safety belts, child seats, and motorcycle helmets instead of engaging in educational programs of limited usefulness (23). A bicycle helmet law is similar and will help protect cyclists despite his or her behaviour.

A study on teenagers' attitudes toward bicycle helmets three years after introduction of mandatory wearing in Australia, reported that 65% of teenagers owned a helmet but only one third wore a helmet the last time they rode a bicycle

(21). It appears that compulsory helmet wearing legislation is not sufficient to convince adolescents to wear helmets. Increasing helmet use in adolescents is a major challenge. The respondents of this study in Winnipeg suggested several ways that they considered students their age could be convinced to wear helmets. Seeing and understanding the consequences of bicycle crashes was mentioned repeatedly by students. One student commented that "experience really touches the heart of everyone, young or old, boy or girl." The suggestions of students are important for road safety educators and others involved in the prevention of bicycle injuries. The development of relevant educational materials for adolescents is critical. A criticism related to past educational efforts was, "Show graphic pictures of bicycle related head injuries. The smashed watermelon is not convincing enough." The most important determinant of helmet use identified by logistic regression was an adolescent belief in helmet effectiveness.

5.0 Limitations of the Study

Methods of data collection can influence the results. A limitation of the direct observation method in this study is that helmet use is only observed in cyclists commuting to or from school. An observation of adolescent cyclists at additional locations in Winnipeg would have given a broader direct observation helmet use rate, and would have allowed a comparison of helmet use rates to school with helmet use during recreational cycling. Also, compliance with correct helmet use was not obtained. Documenting helmet-wearing errors of cyclists would have been difficult, as the researcher was positioned a reasonable distance away from the cyclists to allow for an obscure observation of helmet use behaviour. In a study in Sudbury, only 49% of cyclists were wearing their helmets as recommended by the Canadian Standards Association (98). Incorrect helmet use with adolescents is an important consideration in future studies.

Estimating the age of the commuting cyclist correctly is problematic in direct observation methods. The schools selected for the cross-sectional surveys had different student populations inclusive of grades, and thus are not directly and easily comparable. In Winnipeg School Division No. 1, the junior-high school only included grades seven and eight. The senior high school included grades S1 to S4. In Assiniboine South School Division No. 3, the junior high school included grades 7, 8, and 9, and the two high schools included grades 10 to 12. Only one school was inclusive of grades 7 to 12 (S4).

Demographic characteristics of the survey respondents in relation to socioeconomic status may not be accurately described. The adolescents in the sample were grouped into three defined subregions of Winnipeg based on the first three digits of the postal codes. The subregion income categories were combined into three levels, low, medium, and medium-high income. It is possible that the survey respondents are not totally representative of the subregions as defined by income. The subregions are large and may encompass a variety of socioeconomic different neighbourhoods, so differences on a neighborhood basis would have been missed. The schools selected in the

South Central subregion, defined as a medium income subregion, may be more representative of a high income area. The educational level of the household was also not collected in the survey. In many situations, socio demographic characteristics of populations are best defined by education and income.

A number of biases are possible in self-report surveys. Although these findings are important, they need to be interpreted with some caution. First the results could be subject to some recall bias, because many survey questions required information on past behaviour. There also exists the possibility of some reporting bias associated with the fact that the survey responses were reported by adolescents. However, an examination of the direct observation helmet use prevalence (12.8%) and the self-report helmet use prevalence (14.5%) by chi-square analysis confirmed that no significant differences existed between the two methods of data collection for helmet use data.

Generalizability in quantitative methodology refers to the extent to which the study findings will be representative and can be generalized to similar circumstances and subjects (106). Unique patterns of bicycle and helmet use in urban areas like Winnipeg may not be totally applicable to rural and Northern populations of Manitoba. Thus, these study findings may not be easily generalized to all adolescent populations in Manitoba.

CHAPTER 6: CONCLUSIONS

6.0 Principal Findings

This observation study was undertaken to describe the level of bicycle and helmet use in an adolescent population in Winnipeg, and further to assess the factors thought to be related to helmet use in adolescent bicycle users. The major findings that resulted from this research study will be summarized. The data presented in this thesis report can be a useful tool in developing, implementing, and evaluating bicycle safety prevention strategies.

Bicycle riding is a common activity for adolescents in Winnipeg. The majority of adolescents use their bicycles for commuting that generally involves cycling with automobile traffic. Helmet use among Winnipeg adolescents is low with 14.5% of adolescents wearing helmets all or most of the time. The data demonstrated that helmet ownership is much higher than helmet use. Sixty-seven percent of 12 to 18 year olds ride bicycles in Winnipeg. About half these adolescents own helmets and about one quarter of helmet owners always wear helmets. Owner non use is an important area of bicycle helmet noncompliance. Helmet ownership is clearly a necessary but not a sufficient condition for helmet use. Promotion of helmet use in adolescents is particularly important because the results of this study show that approximately 85% of adolescents own a bicycle and only 14.5% wear safety helmets.

The major impediment to helmet use was discomfort, followed by lack of perceived need, the unattractive appearance of helmets, and peer pressure.

Barriers to ownership and use of helmets exist at all socioeconomic levels. The high frequency of adolescents reporting that helmets are uncomfortable as a reason for not wearing helmets in this present study may be an indication that education on proper fit and adjustments on helmets are important to increasing the helmet use rate among adolescents. The design of helmets may also be a factor causing helmets to be uncomfortable related to problems with heat and sweating.

Logistic regression analysis examined the impact of a number of factors on the likelihood of helmet use. According to the regression results, the strongest predictor of helmet use was a positive belief in helmet effectiveness. Helmet use is higher in one subregion of Winnipeg, but may not have been necessarily related to household income. The geographic location of adolescent residence affected the likelihood of helmet use for one subregion, the South Central subregion of Winnipeg. A second subregion, the South West subregion, with a similar or higher income was not significant to helmet use. Further studies on determinants of helmet use among a larger number of subregions in Winnipeg are warranted to determine additional demographic variables significant to helmet use.

Bicycle injury is a major threat to the health of adolescents in Manitoba and was responsible for two deaths in 1996 (11). The high prevalence of previous bicycle injuries in adolescents in this study supports the fact that children and adolescents are vulnerable to bicycle injuries. Besides the individual suffering injury represents, the cost to society is an important consideration. An undetermined cost of injuries in medical care and lost productivity is present. Among adolescents, most of the lost productivity would be school days. Because the injury problem is important for adolescent health, efforts to design effective preventive interventions are critical. Previous injuries with adolescent cyclists did not affect the likelihood of helmet use in this study.

Attitudes toward helmet use and injury prevention in adolescents remain a significant barrier to progress in the promotion of helmet use. Interventions directed at increasing helmet use in adolescents and reducing adolescent injury should not rely strictly on adult perspectives. This study provides a clearer understanding of how adolescents view bicycle injuries and its possible solutions, including responses to both voluntary and mandatory behavioural changes and changes in the design and marketing of bicycle helmets. Students wish to be made aware that bicycle injuries are frequent and that such injuries can result in serious consequences and death. The use of relevant and graphic education strategies is important to increasing helmet use. Schools present a opportune location to provide students with the environment to develop positive beliefs and attitudes to helmet use and safe cycling. The design, manufacture, and marketing of more comfortable and stylish helmets are also crucial to increasing helmet use in adolescents. Many students felt that the implementation of a provincial law requiring the use of helmets by all cyclists would increase helmet use rates among adolescents.

6.1 Significance of the Study

This study provides potentially useful information on the factors that must be addressed by programs seeking to increase bicycle helmet use by adolescents. The results of the study have important implications for efforts to improve bicycle safety and reduce adolescent injuries in Manitoba.

The popularity of bicycle use with adolescents is beneficial to the environment and to adolescent health. Further encouragement in using bicycles as a mode of transportation and recreational use is important. Injuries from bicycling are common, and sometimes unavoidable. Improving the environmental situation for cyclists with bicycle lanes, and the promotion of safe cycling skills are important and necessary components of programs to increase bicycle use and reduce the incidence of injuries. The use of bicycle helmets is an important component in safe cycling programs.

Despite a variety of promotional and media efforts to increase the use of bicycle helmets in Manitoba in the last two years, helmet wearing is still not typical behaviour among adolescent cyclists in Winnipeg. Achieving a helmet use rate in the 15% range is discouraging and unacceptable, if one considers the potential for serious head injury when 85% of the adolescent population continue to ride their bicycles unhelmeted. Data in this study provides health and road safety officials an opportunity to learn from adolescents about the determinants of bicycle helmet use and its potential solutions. The participants in the survey clearly understood the potential protective benefit of helmet use for reducing head injuries. This implies that educational efforts have heightened awareness of the problem of head injury and the fact that helmet use may reduce the extent of these injuries. Publicity on the benefits of helmet use in the news media and scientific press needs to continue. However, educational efforts alone have not caused adolescents to act upon this knowledge. Strategies to change this pattern are required in Manitoba.

The helmet ownership issue in this study is important as it represents the fact that almost 50% of parents of adolescents realized the importance of helmets and have purchased helmets for their adolescents. However, the noncompliance to wearing helmets among helmet owners in Winnipeg emphasizes that much work is still required to convince adolescents to wear helmets. A helmet purchased and not used is an indication of a safety intervention that has failed. Adolescents need to be reminded of the need to wear helmets on every bicycle excursion. Public policy requiring the use of mandatory helmets has the greatest potential to increase helmet use and can be most effective in brain injury reduction. The results of this study conclude that a helmet law could increase dramatically the number of adolescents that would wear helmets to approximately 50 percent. Increased public pressure for legislation is important.

An overwhelming public outcry occurs whenever a child or adolescent is killed by a preventable bicycle injury, yet efforts to improve safety programs are challenging. Prevention strategies like helmet legislation are often perceived as coercive. Resistence is often encountered from the public and cycling associations based on denying freedom of choice and discouraging cycling.

Researchers in injury prevention for adolescents have concluded that the most effective measures to reduce injury in adolescents are legislative and regulatory controls in road, sport, and workplace settings (121). Sometimes this may result in discouraging an activity, rather than making it safer. Munro et al. (121), further conclude that while the results reported from community-based approaches are encouraging, little evidence exists that purely educational measures reduce injury rates in the short term.

The adolescent years are very important to getting an education, choosing important preventive behaviours, and developing a sense of responsibility for one's own health. However, efforts to increase helmets should be generalized to all age groups to achieve the greatest benefit. Encouraging helmet use by adult bicyclists to prevent head injuries provides a role model for adolescents. Adolescent students are affected by role models and are very aware of who wears helmets. A comment written by one student is very important to the promotion of helmet use, "more adults riding should wear helmets, then maybe students might want to use them." Additional surveys and educational campaigns should be directed at adults in Manitoba to establish a reliable measure of support for helmet use and legislation.

Governments at all levels have an important role to play in developing policies that encourage people to make healthy decisions. Is the current trend of some Canadian governments legislating mandatory bicycle helmets diverting attention and resources away from other preventive measures? Is there a need for increased resources and initiatives to teach adolescents fundamental cycling rules? Would money be better spent on improving the cycling infrastructure? These questions and the politics of bicycle safety are important issues that continue to be debated, similar to previous debates on seatbelts and motorcycle helmets.

An improvement in the co-existence among all road users and thus improving the safety of the cycling environment in Winnipeg is important in bicycle injury control and prevention. Improving the cycling infrastructure within Winnipeg by having more cycling paths and bicycle lanes will encourage cycling as an environmentally friendly, safe, and alternative form of transportation. The provincial and municipal governments must be urged to enact legislation requiring helmet use by all bicyclists. Increasing helmet use and reducing the incidence of preventable death, disability, and injury from bicycle crashes will only be realized through a cooperative effort of all levels of government, voluntary organizations, corporate sectors, and individual citizens of Manitoba.

6.2 Summary and Recommendations

This thesis report on bicycle and helmet use has practical implications for the promotion of a healthy lifestyle and increasing bicycle helmet use among adolescents. The bicycle is an important means of transportation and recreation. However, the majority of adolescents who ride bicycles do not wear helmets. The low rate of helmet use by adolescents in Winnipeg suggests that educational efforts alone have been unsuccessful in bicycle helmet promotion in Winnipeg. The current trend toward the development of provincial helmet laws in Canada can be expected to increase the helmet use rate among adolescents. The following recommendations are based on the results of the study.

1. Mandatory helmet legislation as a strategy to increase helmet use and promote bicycle safety in Manitoba for all cyclists is clearly warranted.
2. Educational campaigns and safe cycling courses should be targeted at adolescents and the educational content should be focused on graphic, realistic consequences of bicycle crashes and the effectiveness of helmets in preventing head injuries.
3. Discussion with helmet manufacturers is warranted to encourage the redesigning and marketing of helmets to make them more comfortable and attractive to adolescents.
4. Parents who cycle should act as role models for adolescents.

REFERENCES

1. Stephens T, Craig CL. The Well-Being of Canadians. Highlights of the Campbell's Survey. Ottawa. Canadian Fitness and Lifestyle Research Institute, 1990.

2. Millar WJ, Pless IB. Factors associated with bicycle helmet use. Health Reports 1997; 9(2): 31-39. (Statistics Canada, Cat 82-003-XPB)

3. Sosin DM, Sacks JJ, Webb KW. Pediatric head injuries and deaths from bicycling in the United States. Pediatrics 1996; 98(5): 868-870.

4. McKenna PJ, Welsh DJ, Martin LW. Pediatric bicycle trauma. J Trauma 1991; 31 (3): 392-394.

5. Thompson DC, Thompson RS, Rivara FP. Incidence of bicycle related injuries in a defined population. AJPH 1990; 80(11): 1388 -1390.

6. Health Canada Information March 1996: Bicycle Injuries. Available online: www.hc-sc.gc.ca/hppb/cny/factsheets/bicycle/bike.htm. June 1998.

7. Centers for Disease Control and Prevention. Injury-control recommendations: Bicycle helmets. Morbid Mortal Wkly Rep 1995; 44(RR 1): 1-17.

8. Sacks JJ, Holmgreen P, Smith SM, Sosin DM. Bicycle-related head injuries and deaths: how many are preventable? JAMA 1991; 266(21): 3016-3018.

9. Nakayama DK, Gardner MJ, Rogers KD. Disability from bicycle-related injuries in children. J Trauma 1990; 30(11): 1390-1394.

10. Injuries Manitoba- Prevention of Adolescent and Childhood Trauma. Injury Facts Bicycles. Children's Hospital, Winnipeg, May 1997.

11. Manitoba Injury Data Resource. Injury Deaths and Hospitalizations Province-wide and by Regions: 1996 and trends. Epidemiology Unit, Manitoba Health, March 1998.

12. Henderson, M. The effectiveness of bicycle helmets: a review. New South Wales, Australia: Motor Vehicle Accidents Authority of New South Wales, 1995.

13. Thompson RS, Rivera FP, Thompson DC. A case control study of the effectiveness of bicycle safety helmets. N. Engl J Med 1989; 320: 1361-1367.

14. Thomas S, Acton C, Nixon J, Battistutta D, Pitt WR, Clark R. Effectiveness of bicycle helmets in preventing head injury in children: case-control study. BMJ 1994; 308: 173-176.

15. McDermott FT, Lane JC, Brazenor GA, Debney EA. The effectiveness of bicycle helmets: a study of 1710 casualties. J Trauma 1993; 34: 834-844.

16. Public Health Service: Healthy People 2000: national health promotion and disease prevention objectives. DHHS Publication no. (PHS) 91-50212. U.S. Government Printing Office, Washington, DC, 1991.

17. Harlos S, Warda L, Buchan, Klassen T, Koop V, Moffatt M. Urban and rural patterns of bicycle helmet use: Factors predicting usage. (In press) 1998.

18. McGinnis, J. Improving Adolescent Health: Research to Guide Action (Editorial). Public Health Reports 1993; 108(1): 1.

19. Waxweiler RJ, Hard Y, O'Carroll PW. Measuring adolescent behaviours related to unintentional injuries. Public Health Reports 1993; 108(1): 11-14.

20. Seijts HP, Kok G, Bouter L, Klip AJ. Barriers to wearing bicycle safety helmets in the Netherlands. Arch Pediatr Adoles Med 1995; 149: 174-180.

21. Finch C. Teenagers' attitudes towards bicycle helmets three years after the introduction of mandatory wearing. Injury Prevention 1996; 2: 126 -130.

22. Parkin PC, Spence LJ, Hu X, Kranz KE, Shortt LG, Wesson DE. Evaluation of a promotional strategy to increase bicycle helmet use by children. Pediatrics 1993; 91(4): 772-777.

23. Graitcer PI, Kellermann AL, Christoffel T. A review of educational and legislative strategies to promote bicycle helmets. Injury Prevention 1995; 1: 129-132.

24. Manitoba Safety Council. Personnel contact. Winnipeg, Manitoba, June 1998.

25. Injuries Manitoba- Prevention of Adolescent and Childhood Trauma.- Personnel contact. Children's Hospital, Winnipeg, Manitoba, June 1998.

26. The College of Physicians and Surgeons of Manitoba. The Pediatric Death Review Committee Annual Report 1993.

27. Cohen GC. Cycling Injuries. Can Fam Physician 1993; 39: 628-632.

28. Tambay JL, Catlin G. Sample design of the National Population Health Survey. Health Reports 1995; 7(1): 29-38.

29. Kann L, Warren CW, Harris WA, Collins JL, et al. Youth risk behaviour surveillance- United States, 1993 in: CDC Surveillance Summaries, March 24, 1995, MMWR 1995; 44(no. SS-1): 1-35.

30. Hu X, Wesson DE, Chipman ML, Parkin PC. Bicycling exposure and severe injries in school-age children. Arch Pediatr Adolesc Med 1995; 149: 437-441.

31. Kopjar B, Wickizer TM. Cycling to school - a significant health risk? Injury Prevention 1995; 1: 238-241.

32. Wilkins K. Causes of death: how the sexes differ. Health Reports 1995; 7(2): 33-43 (Statistics Canada Cat 82-003).

33. Runyan CW. Gerkin EA. Epidemiology and prevention of adolescent injury. JAMA 1989; 262: 2273 -2279.

34. Shanon A, Bashaw B, Lewis J, Feldman W. Nonfatal childhood injuries: a survey at the Children's Hospital of Eastern Ontario. Can Med Assoc J 1992; 146(3): 361-365.

35. Injury Control in Manitoba. A report from the injury prevention and control coalition. March 1994. Winnipeg, Manitoba.

36. Webster's Dictionary - Thesaurus. Pamco Publishing company, Inc, New York, 1992.

37. Kraus JF, Fife D, Conroy C. Incidence, severity, and outcomes of brain injuries involving bicycles. Am J Public Health 1987; 77: 76-78.

38. Canadian Brain Injury Coalition. Personal contact, Diane Bastiaanssen. Winnipeg. June, 1998.

39. Stevenson T, Lennie J. Empowering school students in developing strategies to increase bicycle helmet wearing. Health Education Research 1992; 7(4): 555-566.

40. CHIRPP database for 1996. Injuries to Bicyclists. IM-PACT, Health Sciences Centre 1997.

41. Acton C, Thomas S, Nixon JW, Clark R, Pitt WR, Battistutta D. Children and bicycles: what is really happening? Studies of fatal and non-fatal bicycle injury. Injury Prevention 1995; 1: 86-91.

42. Rowe BH, Rowe AM, Bota GW. Bicyclist and environmental factors associated with fatal bicycle-related trauma in Ontario. Can Med Assoc J 1995; 152(1): 45-51.

43. Fife D, Davis J, Tate L, Wells JK, Harris SS, Williams AF. Fatal injuries to bicyclists: the experience of Dade County, Florida. J Trauma 1983; 23: 745-755.

44. Rivara FP, Thompson DC, Thompson RS. Epidemiology of bicycle injuries and risk factors for serious injury. Injury Prevention 1997; 3: 110 -114.

45. Selbst SM, Alexander D, Ruddy R. Bicycle-related injuries. Am J Dis child 1987; 141: 140-144.

46. Bjornstig U, Ostrom M, Eriksson A, Sonntag-Ostrom E. Head and face injuries in bicyclists with special reference to possible effects of helmet use. J of Trauma 1992; 33(6): 887-893.

47. Transport Canada. Traffic Collision Statistics in Canada, 1996 (TP 3322) Ottawa: Transport Canada, 1998.

48. Manitoba Highways and Transportation Traffic collision statistics report 1994. Winnipeg, 1995.

49. Manitoba Highways and Transportation Traffic collision statistics report 1995. Winnipeg, 1998.

50. Canadian Institute of Child Health. The Health of Canada's Children. 2nd ed. 1994.

51. Bienefeld M, Pickett W, Carr PA. A descriptive study of childhood injuries in Kingston, Ontario using data from a computerized injury surveillance system. Chronic Diseases in Canada 1996; 17(1): 21-27.

52. Schwartz HI, Brison RJ. Bicycle-related injuries in children: A study in two Ontario emergency departments, 1994. Chronic Diseases in Canada 1996; 17 (2): 56 -62.

53. Cushman R, Down J, MacMillan N, Waclawik H. Bicycle-related injuries: a survey in a pediatric emergency department. Can Med Assoc J 1990; 143 (2): 108-112.

54. Agran PF, Winn DG. The Bicycle: A developmental toy versus a vehicle. Pediatrics 1993; 91 (4): 752 -755.

55. Senturia YD, Morehead T, LeBailly S, et al. Bicycle-riding circumstances and injuries in school-aged children. Arch Pediatr Adolesc Med 1997; 151: 485-489.

56. Lapner M, Ivan LP. Bicycle injuries among children. Can Med Assoc J 1981; 125:132.

57. Canadian Bike Helmet Coalition: How to organize a community project - bike helmets for children. Ottawa 1995.

58. Nakayama DK, Pasieka KB. Gardner MJ. How bicycle-related injuries change bicycling practices in children. AM J Dis Child 1990; 144 (August): 928-929.

59. Newbigging T. The changing face of rehabilitation. Disability Today 1995; 5(1): 21-28.

60. Sacks JJ, Kresnow M, Houston B, Russell J. Bicycle helmet use among American children, 1994. Injury Prevention 1996; 2: 258-262.

61. Haddon W. Advances in the epidemiology of Injuries as a basis of public policy. Public Health Reports 1980; 95(5): 411-421.

62. Rivara FP. Epidemiology of Childhood Injuries. Am J Dis Child 1982; 136: 399-405.

63. Thompson DC, Rivara FP, Thompson RS. Effectiveness of bicycle safety helmets in preventing head injuries. JAMA 1996; 276(24): 1968-1973.

64. CHIRPP News. Bicycle helmet use and serious head injury among injured bicyclists. November 1995; page 4.

65. Grimard G, Nolan T, Carlin JB. Head injuries in helmeted child bicyclists. Injury Prevention 1995; 1:21-25.

66. Weiss BD. Bicycle helmet use by children. Pediatrics 1986; 77: 677-679.

67. Weiss BD. Trends in bicycle helmet use by children, 1985-1990. Pediatrics 1992; 89: 78-80.

68. Hu X, Wesson DE, Parkin CP, Chipman MI, Spence LJ. Current bicycle helmet ownership, use and related factors among school-aged children in Metropolitan Toronto. Can J pub Health 1994; 85(2): 121-124.

69. Fowler FJ. Survey Research Methods (Second Edition). Beverley Hills: Sage Publications, 1993.

70. Cote TR, Sacks JJ, Lambert-Huber DA, et al. Bicycle helmet use among Maryland children: effect of legislation and education. Pediatrics 1992; 89:76-78.

71. Spaite DW, Murphy M, Criss EA, Valenzuela TD, Meislin HW. A prospective analysis of injury severity among helmeted and nonhelmeted bicyclists involved in collisions with motor vehicles. J of Trauma 1991; 31(11): 1510-1516.

72. Cushman R, Pless R, Hope D, Jenkins C. Trends in bicycle helmet use in Ottawa from 1988 to 1991. Can Med Assoc J 1992; 91: 772-777.

73. Safe Kids Canada, Bike helmet legislation: A guide for injury prevention advocates (Draft Report), Toronto, Ontario, June 1998.

74. Farley C, Haddad S, Brown B. The effects of a 4 -year program promoting bicycle helmet use among children in Quebec. Am J of Public Health 1996; 86(1): 46-51.

75. Rivara FP, Thompson DC, Thompson RS, et al. The Seattle children's bicycle helmet campaign: Changes in helmet use and head injury admissions. Pediatrics 1994; 93: 567-569.

76. Dannenberg AL, Gielen AC, Bielenson PL, Wilson MH, Joffe A. Bicycle helmet laws and educational campaigns: and evaluation of strategies to increase children's helmet use. Am J Public Health 1993; 83: 667-674.

77. Morris BA, Trimble NE. Promotion of bicycle helmet use among schoolchildren: a randomized clinical trail. Can J Public Health 1991; 82: 92-94.

78. Rourke LL. Bicycle helmet use among school children. Impact of a community program and a cycling fatality. Can Fam Physician 1994; 40: 1116-1123.

79. Farley C, Otis J, Benoit M. Evaluation of a four-year bicycle helmet promotion campaign in Quebec aimed at children ages 8 to 12: Impact on attitudes, norms and behaviours. Can J of Public Health 1997; 88(1): 62-68.

80. Scheidt DC, Wilson MH, Sterns MS. Bicycle helmet law for children: a case study of activism in injury control. Pediatrics 1992; 89(6): 1248-1250.

81. Parkin PC, Hu X, Spence LJ, et al. Evaluation of a subsidy program to increase bicycle helmet use by children of low income families. Pediatrics 1995; 46(2): 283-287.

82. Bicycle Helmet Safety Institute. Mandatory Helmet Laws: A Summary. Online. Available: www.sph.emory.edu/Helmets/initiative.html. March 1998.

83. Minister of Public works and Government Services Canada. Building toward breakthroughs in injury control - a legislative perspective in the prevention of unintentional injuries among children and youth in Canada. Health Canada 1996; Cat.H39-384/1996 E.

84. Cushman R. Bicycle helmet promotion- Prototype for physician activism in injury prevention. Can Fam Physician 1994; 40: 1074-1075.

85. Canadian Automobile Association. 1997-98 Statement of Policy. Ottawa, Ontario 1998.

86. Vulcan AP, Cameron MH, Heiman L. Mandatory bicycle helmet use: Victoria, Australia. MMWR Morb Mortal Wkly Rep 1993; 42: 359-363.

87. Schieber RA, Kresnow M, Sacks JJ, Pledger EE, O'Neil JM, Toomey K. Effect of a state law on reported bicycle helmet ownership and use. Arch Pediatr Adolesc Med 1996; 150: 707-712.

88. 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.

89. Macknin ML, Vanderbrug Medendorp S. Association between bicycle helmet legislation, bicycle safety education, and use of bicycle helmets in children. Arch Pediatr Adolesc Med 1994; 148: 255-259.

90. 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): 41-44.

91. DiGuiseppe CG, Rivara FP, Koepsell TD, Polissar L. Bicycle helmet use by children: Evaluation of a community-wide helmet campaign. Journal of the American Medical Association 1989; 262(16): 2256-2261.

92. Millar PA, Binns Hj, Christoffel KK. Children's bicycle helmet attitudes and use. Association with parental roles. Arch Pediatr Adolesc Med 1996; 159(12): 1259-1264.

93. Pendergrast RA, Ashworth CS, DuRant CS, Litaker M. Correlates of children's bicycle helmet use and short-term failure of school-level interventions. Pediatrics 1992: 90(3): 354-358.

94. Rodgers GB. Bicycle helmet use patterns among children. Pediatrics 1996; 97: 166-173.

95. Howland J, Sargebt J, Weitsman M, et al. Barriers to bicycle helmet use among children. AJDC 1989; 143: 741-744.

96. Otis J, Lesage D, Godin G, Brown B, Farley C, Lambert J. Predicting and reinforcing children's intentions to wear protective helmets while bicycling. Pub Health Reports 1992; 107(3): 283-289.

97. Manitoba Cycling Association. Personnel contact. Winnipeg, June 1998.

98. Rowe BH, Thorsteinson K, Bota GW. Bicycle helmet use and complaince: A Northeastern Ontario roadside survey. Can J of Public Health 1995; 86 (1): 57-61.

99. Joshi MS, Beckett K, MacFarlane A. Cycle helmet wearing in teenagers - do health beliefs influence behaviour? Arch Dis Child 1994; 71(6): 536-539.

100. World Health Organization Helmet Initiative. Online. Available: www.emory.edu/WHO/initiative.html. June, 1988.

101. Safe Kids Canada. Personnel contact. Toronto, Ontario, June 1998.

102. Canadian Cycling Association. Personnel contact. Winnipeg, June 1998.

103. Manitoba Public Insurance, Road Safety Department. Road Wise Cycle Safely Instructor Guide. Cycle Safely 1997 edition. Winnipeg.

104. Fishbein M, and Ajzen I. Belief, attitude, intention and behaviour: an introduction to theory and research. Addison-Wesley, Co., Reading, MA, 1975.

105. Ajzen I, Fishbein M. Understanding Attitudes and Predicting Social Behaviour. Prentice-Hall Inc., Englewood Cliffs, New Jersey, 1980.

106. Creswell JW. Research Design: Qualitative and Quantitative Approaches. Sage Publications, 1994.

107. Becker LR, Mandell MB, Wood K, Schmidt ER, O'Hara F. A community based approach to bicycle use counts. Injury Prevention 1996; 2: 283-285.

108. Fink A, Kosecoff J. How to conduct surveys: A step-by-step guide. Newbury Park, CA. Sage Publications, 1985.

109. Centers for Disease Control and Prevention. Measuring the health behaviour of Adolescents: the Youth Risk Behaviour Surveillance System. In Public Health Reports. 1993; 108(supp 1): 60-66.

110. Woodward CA. and Chambers LW. Guide to Questionnaire Construction and Question Writing. The Can Public Health Assoc, Ottawa, Canada, 1983.

111. Bourque LB, Clark VA. Processing data - The survey example. Sage University Papers, Sage Publications. Beverly Hills, 1992.

112. Carmines EG, Zeller RA. Reliability and Validity Assessment. Sage University Papers, 07-017, Sage Publications. Beverly Hills 1979.

113. Winnipeg School Division No. 1. Your guide to WSD : 1996-1997. Winnipeg.

114. Assiniboine South School Division No.3. Personnel contact. September 1997.

115. Hassard TH. Understanding Biostatistics. Mosby -Year Book, Inc. St. Louis, Missouri 1991.

116. Lang TA, Secic M. How to Report Statistics in Medicine. American College of Physicians, Philadelphia, Pennsylvania, 1997.

117. HintzeJL. Quick Start & Self Help Manual -NCSS 97 Statistical System for windows. Kaysville, Utah, 1997.

118. Hassard TH. Personal contact. University of Manitoba, Biostatistical Consulting Unit. May 1998.

119. Manitoba Center for Health Policy and Evaluation. Personnel contact, Leonard MacWilliam, Winnipeg, June, 1998.

120. Waller JA. Bicycle ownership, use, and injury patterns among elementary schoolchildren. Injury Prevention 1995; 1: 256-261.

121. Munro J, Coleman P, Nicholl J, Harper R, Kent G, Wild D. Can we prevent accidental injury to adolescents? A systematic review of the evidence. Injury prevention 1995; 1: 249-255.

APPENDICES

APPENDIX A

Haddon's Phase-Factor Matrix:
as applied to the prevention of bicycle injuries

	Host (Cyclist Factors)	**Agent (Bicycle Factors)**	**Environment (Road, Traffic and Surroundings)**
Pre-Event (before a crash)	- education (rider training) - reflective clothing - cycling, attitude - helmet	- bicycle fit - maintenance - bicycle visibility - bicycle flag	- road design, bicycle paths - road maintenance - traffic flow - socio-cultural environment (legislation, attitudes)
Event (during a crash)	- helmet - protective equipment	- bicycle design	- direct hazards
Post-Event (after a crash)	- fitness - first aid		-emergency medical services

APPENDIX B

Bicycle Helmet Observation Study Tally Form

School ______________________________

Grades ______________________

Date ____________________________

Time __________________________

No Helmet		Helmet	
Male	Female	Male	Female

APPENDIX C

Bicycle Riding Survey

The purpose of this survey is to collect information on bicycle riding in Winnipeg for a Master's thesis at the University of Manitoba. Please do not write your name on the questionnaire.

Please answer all questions.

1. How old are you?

   ____

2. What is your sex? (*Circle one*)
   a. Female   b. Male

3. In what grade are you? (*Circle one*)
   a. 7th grade   b. 8th
   c. 9th (S1)   d. 10th (S2)
   e. 11th (S3)   f. 12th (S4)
   g. Ungraded or other

4. What is the postal code of where you live?

   ___ ___ ___ ___ ___ ___

5. During the past "30 days", how many times did you ride a bicycle? (*Circle one*)
   a. 0 times
   b. 1 to 5 times
   c. 6 to 10 times
   d. 10 to 20 times
   e. 20 or more times

6. Did you ride a bicycle to school today? (*Circle one*)
   a. Yes   b. No

7. If you did not ride your bicycle to school today, what is the **one most important reason** for not cycling? *(Circle one)*
   a. Rode my bicycle today
   b. Do not own a bike
   c. Did not want to cycle
   d. Cycling is discouraged by parents or school
   e. Unsafe bike route
   f. Distance is too far
   g. Weather was not good for cycling

8. During the past "30 days" when you rode your bicycle, what did you **most often use** your bicycle for? (*Circle one*)
   a. Did not ride a bicycle in the past "30 days"
   b. Commuting to school
   c. Cycling on trails for fun
   d. Casual cycling
   e. Sport or fitness
   f. Commuting to friends

9. Do you own a bicycle helmet? (*Circle one*)
   a. Yes b. No

10. If you rode your bicycle to school today, did you wear a bicycle helmet?
   (Circle one)
   a. Did not ride my bicycle to school today
   b. Yes
   c. No

11. When you rode a bicycle during the past "30 days", how often did you wear a helmet?
   (*Circle one*)
   a. Did not ride a bicycle in the past "30 days"
   b. Never wore a helmet
   c. Rarely wore a helmet
   d. Sometimes wore a helmet
   e. Most of the time wore a helmet
   f. Always wore a helmet.

12. During the past "30 days" when you rode your bicycle, what is the **one most important reason** for not wearing a bicycle helmet? (*Circle one*)
   a. Did not ride a bicycle in the past "30 days"
   b. Always wore a helmet
   c. Helmet is uncomfortable
   d. Friends make fun of helmets
   e. Helmets are too expensive
   f. Parents do not encourage me to wear a helmet
   g. Helmets are not necessary
   h. Helmets are unattractive

13. During the past "30 days" when you rode your bicycle, what was **the second most important reason** for not wearing a helmet? *(Circle one)*
   a. Did not ride a bicycle in the past "30 days"
   b. Always wore a helmet
   c. Helmet is uncomfortable
   d. Friends make fun of helmets
   e. Helmets are too expensive
   f. Parents do not encourage me to wear a helmet
   g. Helmets are not necessary
   h. Helmets are unattractive

14. What is the **most important reason** for wearing a helmet? (*Circle one*)
   a. Family members insist
   b. Following safety precautions
   c. Previous bicycle related injury requiring medical attention
   d. It looks cool
   e. Friends wear a helmet

15. If you had a previous cycling injury, what was the type of injury? *(Circle one)*
    a. Never had a cycling injury
    b. Minor abrasions (scrapes, cuts)
    c. Broken arm or leg treated without having to stay overnight in a hospital
    d. Minor head injury treated without having to stay overnight in a hospital
    e. Dental injury
    f. Injury requiring admission to hospital
    g. Some other type of injury

16. Under what circumstance do you feel it is **most important** to wear a bicycle helmet? *(Circle one)*
    a. When cycling in traffic
    b. When cycling on a regular basis
    c. When cycling long distances
    d. When cycling in hazardous conditions
    e. It is never important
    f. It is important to always wear a helmet

17. Do you think bicycle helmets prevent head injuries? (*Circle one*)
    a. Yes b. No

18. Do you think there should be a law for all cyclists to wear helmets? (*Circle one*)
    a. Yes
    b. No
    c. Not sure

19. If there was a law requiring cyclists to wear helmets, what would you do? *(Circle one)*
    a. I would cycle with a helmet
    b. I would cycle without a helmet
    c. I would stop cycling
    e. Not sure

20. We know that bicycle helmets prevent head injuries. What do you think needs to be done to convince students your age to wear helmets?

____

____

____

____

____

____

____

Thank-you for your cooperation.

APPENDIX D

UNIVERSITY OF MANITOBA

FACULTY COMMITTEE ON THE USE OF HUMAN SUBJECTS IN RESEARCH

NAME: Gladys L. Stewart

REFERENCE: E97:254
DATE: October 1 /97

YOUR PROJECT ENTITLED:

Protocol Title: **Bicyle and Helmet Use Factors in an Adolescent Population in Winnipeg**

Approval of Study

HAS BEEN APPROVED BY DR. G. GRAHAME ON BEHALF OF THE COMMITTEE:

October 1, 1997

COMMITTEE PROVISOS OR LIMITATIONS:

Approved as per your letter dated October 1, 1997

You may be asked at intervals for a status report. Any significant changes of the protocol should be reported to the Chairman for the Committee's consideration, in advance of implementation of such changes.

****THIS IS FOR THE ETHICS OF HUMAN USE ONLY. FOR THE LOGISTICS OF PERFORMING THE STUDY, APPROVAL SHOULD BE SOUGHT FROM THE RELEVANT INSTITUTION, IF REQUIRED.**

Sincerely yours,

THE UNIVERSITY OF MANITOBA

Gordon R. Grahame, M.D.,
Chairman,
Faculty Committee on the Use of
Human Subjects in Research

GRG/tk

Inquiries should be directed to Theresa Kennedy
Telephone: 789-3255 Fax: 789-3942
E-mail: kennedy@bldghsc.lan1.umanitoba.ca

APPENDIX E

TABLE 3.2. Univariate description of variables in self-report survey*

Variable	Range (of coded values)	Sample size count	Second Response (%,>1.0%)	Missing values (%,>1.0%)
Demographic				
School	5	818	0	0
Age	7 (11- 18)	816	0	2
Gender	1	813	0	5
Grade	6 (7-12)	817	0	1
Grade group 1	1 (7-9, 10-12)	817	NA	1
Grade group 2	2 (7-8, 9-10, 11-12)	817	NA	1
Subregion	4	818	0	0
Bicycle use factors				
Today cycle	1	818	0	0
Times cycle	4	816	0	2
Times cycle group	2	816	NA	2
Not cycling reason	7	803	7	15 (1.8%)
Bicycle use	5	811	26 (3.2%)	7
Bicycle use group	2	811	NA	7

Table 3.2

continued

Variable	Range (of coded values)	Sample size count	Second response (% >1.0%)	Missing values (% >1.0%)
Helmet factors				
Own helmet	1	818	0	0
Helmet today	2	817	0	1
Helmet use in the last 30 days	5	818	1	0
Helmet use group	2	818	NA	0
Why no helmet 1	8	800	11 (1.3%)	18 (2.2%)
Why no helmet 2	8	801	5	17 (2.1%)
Why helmet	5	773	7	45 (5.5%)
When helmet	6	803	6	15 (1.8%)
Injury	6	813	21 (2.6%)	5
Previous injury group	2	813	21 (2.6%)	5
Attitudinal factors				
Belief in helmet effectiveness	1	811	0	7
Support for helmet law	2	813	0	5
If law, what behaviour	3	809	0	9 (1.1%)
Convince use category	11	818	107 (13.1%)	0
Convince use group	8	818	107 (13.1%)	0

APPENDIX F Map of Winnipeg Sub-Regions

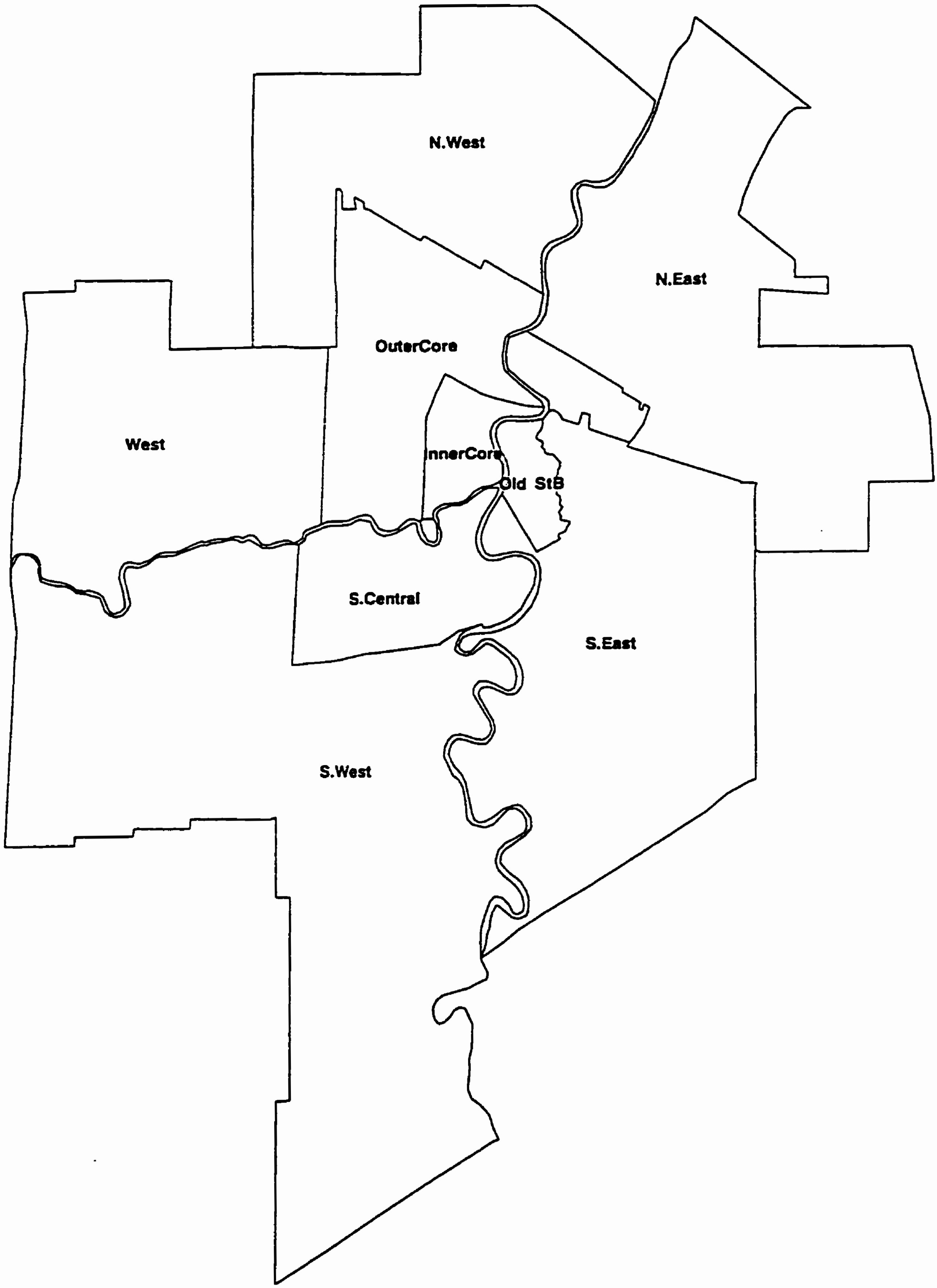


IMAGE EVALUATION TEST TARGET (QA-3)

150mm

6"

APPLIED IMAGE, Inc
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