A SOCIODEMOGRAPHIC AND PSYCHOSOCIAL PROFILE OF INJURY TYPOLOGY AMONGST NOVA SCOTIAN ADOLESCENTS

by

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Submitted in partial fulfillment of the requirements
for the degree of Master of Science

at

Dalhousie University
Halifax, Nova Scotia
February 2018

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Abstract

Background: Injuries lead to a high rate of both mortality and morbidity, and have been the leading cause of death amongst Canadian children and youth for several years. The literature surrounding patterns of adolescent injuries is small for many reasons, including a lack of good descriptive data and lack of research funds directed to this issue. Studies of adolescent injury have looked at associations between certain demographic and behavioural factors and the incidence of injury. For example, they have concluded that injuries are linked with socioeconomic status and that among poorer students, engagement in high-risk activities leads to injury, while among wealthier students, injury often stems from engaging in sports and recreational activities. Despite this work, there is a lack of understanding of whether specific injury patterns exist in adolescents and whether there are subgroups of adolescents who have a higher likelihood of experiencing specific types of injuries, those who sustain multiple types of injuries, and those who do not get injured at all. This project aims to address this topic through the creation of an injury typology among Nova Scotia adolescents.
Objectives: 1. Determine if patterns exist across mechanisms of injury among Nova Scotian high school students. 2. Determine if there are individual demographic and psychosocial characteristics that are associated with any injury subgroups identified in the first objective.
Methods: Using data from the Health Behaviour Supplement of the 2010-2011 Youth Smoking Survey, a cluster analysis was performed to address the first objective. Separate multivariable logistic regression models were applied, with sociodemographic, psychosocial, risk taking behaviour, and individual school factors as covariates to evaluate cluster membership.
Results: Six heterogeneous clusters were identified reflective of injury patterns. They were named (1) Poly Injury; (2) Roughnecks; (3) Sport-Oriented only; (4) Scrappers; (5) Bleeding-Oriented only; and (6) Injury Free. Being an Aboriginal student, engaging in risk taking behaviours, experiencing depressive symptoms, and lower school connectedness were associated with membership to the Poly Injury cluster. Males, Aboriginal students, engaging in some risky behaviours, and having higher grades were associated with being in the Roughnecks cluster. Females, Asian students, being a risk taker, and non-athletes had a negative relationship with the Sport-Oriented cluster. Engaging in some risk taking behaviours was negatively associated with the Scrappers group, while having good grades and involvement in sports were positively associated. Aboriginal students, those who engaged in risky sexual behaviours, and those engaged in athletics were negatively associated with membership to the Bleeding-Oriented group. Finally, Aboriginal students, those who drink, and those engaged in athletics were less likely to within the Injury Free cluster.
Future Implications: The clusters identified contribute to our understanding of adolescent involvement in injury and related injury patterns. Results will help guide injury prevention and control strategies in schools and communities by targeting specific types of adolescents who may be more prone to certain injury events.

List of Abbreviations Used

ANOVA	Analysis of Variance
CES-D	Centers for Epidemiological Studies Depression
CSTADS	Canadian Student Tobacco, Alcohol, and Drug Survey
HBS	Health Behaviour Supplement
OR	Odds Ratio
PHAC	Public Health Agency of Canada
PYLL	Potential Years of Life Lost
WHO	World Health Organization
YSS	Youth Smoking Survey

Acknowledgements

I would like to dedicate this thesis to my parents and brother. Their support, whether it was via phone calls or sending dog photos to alleviate my stress, gave me the strength and confidence to take on every obstacle head on. I would like to thank my supervisor, Dr. Mark Asbridge, and my committee members Dr. Leslie Anne Campbell and Dr. Gabriela Ilie. Without their expertise, encouragement, and patience this thesis would not have become a reality. Finally, I must thank all of my classmates. Late nights in the library, early morning classes, and post defence debriefs would not have been the same without all of you by my side. I know I have made many friends that will last a lifetime. Thank you.

Chapter One - Introduction

1.1 Introduction

Nova Scotia is the province with the highest rate of unintentional injuries in Canada (1). Throughout the country, injuries have been reported as the leading cause of death and disability amongst adolescents, among which 15-19 year olds have the highest risk of injury-related deaths (2). Despite this, there has been little research exploring these injury patterns among adolescents. This thesis examines the epidemiology of different injury mechanisms experienced by Nova Scotian adolescents, aged 14-18 years, who participated in the 2010-2011 Health Behaviour supplement (HBS) of the National Youth Smoking Survey (YSS). The primary aim of this thesis is to provide an injury typology for high school youth, while investigating key sociodemographic and psychosocial indicators associated with these injury patterns.

1.1.1 Research Objectives

This thesis has two main objectives:

1: To create a Nova Scotian adolescent injury typology based on the patterns that exist in the 2010-2011 Health Behaviour supplement of the Youth Smoking Survey using cluster analysis.

2: To determine if there is an association between sociodemographic, psychosocial, risk taking behaviour, and individual school factors and the observed injury patterns uncovered in objective one.

1.1.2 Study Rationale

Injuries are of growing concern amongst youth. Unintentional injuries are the leading cause of death and disability with approximately 950,000 adolescents and children succumbing to their injuries each year worldwide (3). When discussing injuries people often describe the situation as an accident. The term accident, however, gives the sense that the injury was unavoidable and that it happened purely by chance. This view of random inevitability does not allow for the opportunity for prevention, which is one of the core principles of public health. To identify opportunities to reduce the burden of adolescent injuries, potential injury patterns and associated indicators must be further examined and understood. In the injury literature, injuries are often classified as unintentional or intentional; however, there is little research on how mechanisms of injuries group together within and between individuals.

The HBS of the Youth Smoking Survey offers an excellent opportunity to explore a range of injury mechanisms experienced by adolescents residing in Nova Scotia. This project investigates the possibility that clusters of injury mechanisms exist among Nova Scotian youth, demonstrating unique injury patterns experienced by young people. These clusters may characterize injury groupings based on intentionality (intentional versus unintentional), those based on violence and harm, those from sport or recreation, or perhaps some other unique combinations. This raises important questions about the nature of individual injury patterns – do a small subset of youth experience multiple injuries across a range of mechanisms, or do unique subgroups exist? This study is unique in that it is the first study in Canada that used cluster analysis to determine patterns of injury mechanisms.

In addition, there is a need to investigate the sociodemographic and psychosocial characteristics of the participants who engaged in the various injury subgroups. Are they unique populations, with distinct characteristics? Are certain behaviours strongly associated with specific injury patterns, and less clearly linked with others? What indicators are linked with having experienced multiple injuries (and mechanisms)? The HBS includes several questions on sociodemographic and psychosocial indicators such as academic history, drug use, sexual risk behaviours, and mental health. These variables provide important insight to potential correlates for adolescent injury patterns.

Pickett and colleagues studied Canadian adolescents and found that supportive environments decreased the likelihood of students engaging in risk behaviours and subsequently reducing their risk of sustaining injuries (4). From their findings, Pickett and colleagues declared that future studies need to explore whether there are specific types of youth who have a higher likelihood of experiencing specific injuries, those whose sustain multiple types of injuries, and even those who do not experience injuries at all (4). This project aims to create an injury typology to explore this issue in greater depth. The injury typology describes both the kinds and dispersion of injuries amongst a sample of Nova Scotian high school students. The project also identifies characteristics that differentiate subjects in each injury cluster. The outcomes of this research may contribute to implementation and improvement of existing preventative measures by targeting specific types of adolescents who may be more prone to specific types of injury events.

1.1.3 Thesis Overview

This thesis begins with a review of the relevant published literature in Chapter Two. Topics discussed include injury definitions, injury rates among adolescents, the cost of injury in Canada and in Nova Scotia, and will review previous research on injury typologies. After the literature review, Chapter Three outlines research methods employed in the thesis, which include a description of the data, measures and covariates, and an explanation of the cluster analysis procedure. The results of the analysis are described in Chapters Four and Five, while Chapter Six engages in a discussion of the findings along with a short conclusion section.

Chapter Two – Literature Review

The following chapter provides a discussion of the relevant evidence concerning injury among Canadian adolescents. This thesis is directed at the experiences of Nova Scotian adolescents (14-18 years of age); therefore, the literature reviewed includes not only injury broadly, but also focuses specifically on the experiences of this age group in this region. Furthermore, this chapter outlines previous research conducted on injury typologies and any correlates that have been identified in relation to injury patterns.

2.1 Injury

The World Health Organization (WHO) defines injury as 'the physical damage that results when the human body/ human tissue is subject to intolerable levels of energy'. Events that cause injury include: road traffic collisions, violence, sexual abuse, self-harm, near drowning, falls, and episodes at the workplace, home, and during sports or recreational activities (5). Injuries are often viewed as accidental, giving the impression that they are unplanned and unavoidable occurrences (6). However, previous research has expanded our knowledge of mechanisms and severity of injuries allowing for prevention strategies to be put in place, such as helmet or seatbelt use. Unfortunately, even with the implementation of these strategies, around the world more than five million people are killed due to injuries each year (7). No country is immune to the effects with injuries accounting for 9% of global mortality each year (8).

2.1.1 Incidence of Injuries among Adolescents

Around 950,000 adolescents aged 18 years old and younger die each year worldwide due to injuries, 90% of which were unintentional (road traffic incidents, drowning, burns, falls, and poisoning) (9). The same study found that low and middle-income countries had the highest rates of injury-related deaths. Across Canada, injuries are the leading cause of death and disability among adolescents (2). Between 1994 and 2003, approximately 390 Canadian children aged 14 and under died due to injuries (10). Those aged 15 to 19 years have the highest risk of injury-related deaths (2). Around 76% of all adolescent deaths and 17% of all adolescent hospitalizations are due to injuries (11).

The body of research pertaining to injury patterns in children and adolescents is somewhat limited. This may be due to a lack of good descriptive data, the idea that injuries are due to chance rather than a foreseeable reason, a lack of coordination amongst agencies to address injury prevention in a consistent fashion, inadequate funding put towards preventative efforts, and a lack of interest and concern from political entities (9).

2.1.2 Incidence of Injuries in Canada

Injuries are a growing concern across Canada, with an estimated 427 people across the country injured each hour (12). Between 2009 and 2010, approximately 4.27 million Canadians experienced an injury that was serious enough to affect their daily lives (13). That is around 15% of the Canadian population, representing an approximately 2% increase since 2001 (13). In terms of the population in 2007, 15,064 Canadians were killed due to injuries, which was 6% of all fatalities that year (13). Injury has been the leading cause of death in young Canadians for many years

as well as a common cause of admission to hospitals, impairment, and disability for children, adolescents, and seniors.

Beyond an important cause of mortality, injury is also a prominent source of premature mortality and disability. Potential Years of Life Lost (PYLL) is a measure of the estimated number of years someone would have lived if they had not had a premature death. The PYLL in Canada for injuries in 2012 was 179, 894, approximately 58% higher than PYLL due to suicides (14). The primary source of hospital admissions in all Canadians is injuries. Over the course of a year, around 250,000 Canadians were hospitalized because of injuries they had sustained (15). In 2009/10 unintentional injuries were the third leading cause of hospitalizations for Canadians aged 1-4 as well as 15-19 (after respiratory system diseases and infectious diseases, and digestive system diseases and mental disorders respectively). They were the second leading cause of hospitalizations in ages 5-9 and 10-14 after respiratory system diseases and digestive system diseases respectively (16).

The Canadian government has acknowledged the burden that injuries place on our society and has strategized prevention programs. In 2011, the Public Health Agency of Canada (PHAC) implemented the Active and Safe Injury Prevention Initiative to reduce injuries sustained by children engaged in sports and recreational activities (17). However, as sports injuries remain a public health concern and are often underreported, this work is nowhere near complete (18).

2.1.3 Economic Burden of Injuries in Canada

Parachute Canada, a leading injury focused Non-Governmental Organization, has compiled information on the economic burden of injuries across the country in the Cost of Injury in Canada 2015 Report (12). In 2010, injuries cost the Canadian economy $26.8 billion, with $15.9 billion of which was spent directly on health care. This is an increase of 35% since 2004. At this rate the economic burden would increase to $75 billion by 2035 (12). Injuries have cost Canadians more than heart disease and stroke at $20.9 billion (12).

Canadians have already invested in injury prevention methods that in turn help to reduce the economic burden. For example, for every dollar spent on a child safety seat the Canadian population saved $42 that would have been spent on health care costs (12). The idea is that injuries are preventable and we can save monetary losses incurred not only by direct medical costs but indirect ones as well, which include loss of productivity and reduction in work capabilities.

In 2010, transport incidents across all ages accounted for 2,260 deaths, 28,350 hospitalizations, and cost the Canadian economy $4,289 million (12). Canada hopes to boast the "safest roads in the world"; yet, to do so interventions must be put in place to enforce road safety laws (19). The evaluation of the National Safety Camera Program revealed that the gains earned from prevented injuries outweighed the cost of enforcement four-fold (20). Further interventions such as speed cameras have the potential to save Canadians $11.4 billion over the course of 25 years (12).

Another example of how injury prevention strategies can save Canadians money is the promotion of helmet use. Bicycle helmets have already been proven to

have a positive effect on the prevention of traumatic brain injuries, facial injuries, and fatal injuries (12). Helmet use is also being promoted, and at times enforced, for other sports including skiing, snowboarding, and skating (21). Parachute Canada has forecasted that injuries reduced due to helmet use over a 25-year period can save Canadians an estimated $5.5 billion in incurred costs as well as reduce hospitalizations by 76,000 (12).

2.1.4 Incidence and Cost of Injuries in Nova Scotia Asolescents

For children and adolescents in Nova Scotia, the leading cause of death and hospital admissions is injury (22). The burden is so severe that it eclipses the combined death toll of young Nova Scotians due to all other causes. It is estimated that every week in the province a child dies due to injury (22). Between the fiscal years 1995 and 2004 there were 19,046 children, adolescents, and young adults (0 to 25 years of age) admitted to hospitals across Nova Scotia due to injuries (23). Over the course of three years, 2001-2004, there were 582 deaths amongst young Nova Scotians aged 0 to 25 years, 56% of which resulted from injuries (23).

Not only does injury affect the emotional state of the province, it takes a toll on the Nova Scotia economy as well (23). It is estimated that injuries cost the province $518 million every year (23). In 2010, Nova Scotia had the highest health care costs incurred due to injuries in the entire country at $579 per capita compared to the national average of $467 per capita (12).

2.1.5 Correlates of Injury

Haddon's Matrix provides a framework for understanding how an injury event occurs and can be prevented (24). In 1968, William Haddon presented a table

that could be used to comprehend the origin of injuries (25). The cells in the table represent the collection of risk or protective factors involved in an injury event (25,26). The matrix is separated into three rows: pre-event, during the event, and post-event (24). The rows serve as phases in the event of injury where an alteration may have affected the outcome. Before the event of injury is where primary prevention can be implemented, secondary prevention during the event, and tertiary prevention post injury event (24). Haddon's Matrix is also divided into four columns: host or the person(s) affected, agent or vehicle, physical environment, and social environment (Table 2.3.1) (24).

The matrix can be used to determine prevention practices for a multitude of injuries (26). When an injury or event is identified the rows and columns of the table can be filled out. Each cell can then be filled with prevention approaches for the corresponding interacting factors and phase. Haddon's Matrix supplies this thesis with a framework that presents the complexities of injuries, such as the interactive and predictive nature of injury events, which shall help with the interpretation of this thesis' results.

Several risk and protective factors for adolescent injuries have been identified, drawing on social-environmental, family, lifestyle, biological and psychosocial indicators (27). The causal pathways of injuries are often complex and may include the location in which an injury is sustained. The environment in which an injury occurs may play a role in predicting where injuries are more likely to take place. The General Social Survey, administered in 1993, found that 52% of injuries incurred by children took place at the child's home (28). Commercially inclined

locales such as malls, restaurants, and sporting facilities were the second most likely location of injuries in the same study at 28%. The National Population Health Survey, completed during the fiscal year 1994 to 1995, found that when accounting for age, Canadian children tended to sustain more injuries at home or at sporting facilities, while older adolescents were more likely to be injured in the streets (28). The environments in which injuries occur likely reflect the amount of time spent by children and adolescents at said locations (29,30).

Injury correlates may be observed at a societal level, which can include factors such as cultural practices or socioeconomic status. Traditions as well as cultural views can impact and at times cause injuries. In Sub-Saharan Africa, for example, fire and smoke are often believed to ward off evil spirits as well as be an effective treatment for upper respiratory infections. Consequently, burns are quite a common injury in this population (31). Adolescent injuries are also impacted by socioeconomic status. Adolescents who come from wealthy families are more likely to be able to afford to participate in sports, leading to a higher percentage of sporting injuries (32). Conversely, an association exists between financial deficits and violence-related injuries and hospitalizations (33).

Factors at the community level may consist of safety precautions that the community has put in place. Advancements in traffic safety and emergency services have been known to reduce deaths by injuries (34). One precaution that is becoming more common is the implementation of bike lanes. Bikes lanes have been known to reduce injuries, especially segregated lanes (i.e. a physical barrier between cars and cyclists) (35). Safety concerns and prevention strategies in the workplace would

also fall under the community level. Nurses often sustain injuries when lifting patients and heavy objects; therefore, some hospitals have introduced mechanical lifting devices, which have shown to reduce muscle strains (36).

One level down from community is the family level of factors. Factors may include the care and supervision that a child is receiving or the feeling of a support system. Canadian adolescents who receive support from their families and their schools partook in fewer risk-taking behaviours such as smoking, drinking, reduced seatbelt use, marijuana or other drug use, or non-use of condoms during sexual intercourse, which in turn lowered their likelihood of experiencing injuries (4).

This thesis will focus primarily on factors at the individual level such as personal characteristics including, sex, age, ethnicity, as well as engagement in risk taking behaviours, and involvement in sports, and psychosocial measures such as mental health, academic achievement, self-esteem, and school connectedness. Several studies have identified differences between sociodemographic factors such as age and sex when addressing injuries (37,38). Parachute Canada states that males were more likely to be injured during a transport incident compared to females, surpassing them in fatalities, hospitalizations, emergency room treatments, and disabilities (12). Males were also more likely to be killed or hospitalized due to violence. Conversely, females between the ages of 15 and 19 years were 2.6 times more likely to require hospitalization, 2.6 times more likely to sustain permanent or partial disability, and twice as likely to be permanently disabled due to suicide and self-inflicted injuries than their male counterparts (12).

In the years 2009 and 2010, 4.27 million Canadians aged 12 years or older sustained injuries that were severe enough to inhibit their daily lives (13). During that same year adolescents aged 12 to 19 years had the greatest likelihood of being injured with 27% experiencing injuries of some form when compared to adults, 14%, and seniors, 9%, indicating that age may influence proneness to injuries (13). When looking at injuries incurred during sports, children aged 13 to 17 years were more likely to experience overuse injuries affecting the soft tissue, while 5 to 12 year olds had a higher likelihood of sustaining traumatic injuries (39).

Several studies have explored any possible correlation between one's ethnicity and likelihood of sustaining an injury. One study found that when compared to white participants, nonwhites had a higher incidence of injury with 62.4% of the population sustaining an injury (40). Another study in Alberta followed children over a ten-year period to compare injuries sustained by Aboriginal and non-Aboriginal participants. They found that although both the mortality rate for both populations declined over the ten years, throughout the study and for all of the mechanisms of injury Aboriginal adolescents had consistently higher mortality rates (41).

Lifestyle choices such as engagement in risk taking behaviours and participating in sports have been known to affect injuries sustained by adolescents as well. Risk taking behaviours have been known to lead to injuries among adolescents. A study performed in six African countries found a positive correlation between risk taking and rate of adolescent injuries (42). Analysis involving multivariate regression models showed a higher likelihood for loneliness, hunger,

truancy, depression, smoking, and drug use in the same study (42). A Canadian study found a positive relationship between social risk-taking (drunkenness) and injuries obtained while fighting (33).

During the fiscal year of 2009-2010, 66% of the injuries sustained by young Canadians were linked to sports (13). Over the years there has been a societal movement to increase participation in sports amongst children and adolescents. This increase in organized sports has been paralleled by an augmentation in the prevalence of injuries due to sports sustained by the younger population (43–45). It should be noted that the environment surrounding sports tends to promote aggressive behaviour that often lead to injuries (46). Therefore, it is important to consider a subject's involvement in sports when examining injury patterns.

Finally, psychosocial factors may affect injuries at the individual level. Studies have shown a positive correlation between non-suicidal self-injury and depression and other mental disorders in adolescents, with females exhibiting higher rates for suicide and self-harm related injuries (37,47). Furthermore, both suicidal and non-suicidal self-inflicted injuries recurred in adolescents who were receiving treatment for depression (48,49). Academic failure has also been shown to act as a risk factor to street fighting and violence among adolescents, while higher grades act as a protective factor (50,51).

A national Canadian study found that self-esteem negatively correlated with depressive symptoms among Aboriginal adolescents (52). When a child experiences higher self-esteem they are less likely to engage in risk taking behavior such as substance use and risky sexual behaviour, which may ultimately lead to a decrease

in injuries (53). Similarly, school connectedness has been shown to act as a protective factor for risk taking behaviours, leads to fewer depressive symptoms, and reduces transport injuries (54).

It is possible to take the aforementioned correlates and situate them in Haddon's Matrix to create a framework. The YSS and HBS do not offer sufficient temporal information to complete the "Event" and "Post-event" rows; however, as seen in Table 2.3.2, it is possible to focus on the "Pre-event".

2.2 Patterns of Injuries

Currently the studies that make up the field of adolescent injury focus on associations between certain demographic or behavioural variables and the incidence of injury events. However, there is a lack of literature addressing how involvement in various injuries group together. Do patterns exist in injury involvement? Are injuries obtained while playing sports, and are the adolescents that obtain them, inherently different from those who experience injuries related to violence? Do people who have one type of injury usually sustain other types of injuries?

There have been two studies performed in Sweden regarding injury patterns in schools. The first studied surveillance data on school injuries, including both oral (jaw bone, teeth, and gums) and bodily injuries, and performed multivariate techniques to achieve a broader perspective (55). Over the course of one year, 1260 school-injury reports were gathered in one Swedish county's hospital outpatient emergency departments, healthcare centers, and dental clinics. They outlined five injury groups (lower limb/falling; head and oral; transportation/other equipment;

ball/puck; struck by object handled by another), with the hope of improving safety policies (55). Unfortunately, the usefulness of the study is diminished by the scarcity of information as to the reason for the occurrence of injuries, lack of similar injury categories, and no investigation into individual characteristics of the injured students, which can all lead to more specific and effective intervention practices.

The second study performed in Sweden examined the distribution of injuries students sustained during recesses (56). Seventy-nine schools participated, their students were 7 to 18 years of age and of the 1,094 injuries that were reported, 320 of them occurred during recess. Researchers identified four categories of injuries established by which part of the body had been injured and the primary mechanism (head injuries from collisions or blow; head or lower-limb injuries from surface while running; sprains or strains to upper or lower limbs; and wounds from collisions or falls involving other pupils when running) (56). However, when compared to an earlier phase of the study, the 79 schools that participated did not present an accurate representation of Swedish schools with regards to ergonomic conditions, ventilation, climate, as well as a lack of satisfaction with school curriculum, which may have led to biases in the distributions and ratios of injuries. Furthermore, the categories were not fully homogenous and observed clusters may have been affected by the difficulty to estimate the number and distribution of injuries not accounted for in the register.

Both Swedish studies used factor analysis to group the variables together. By doing so they grouped injuries together to identify common themes. Rather than grouping variables, this thesis combines students together, identifying if groups of

students exist defined by the kinds of injuries they experience. The results will shed light on potential injury patterns defined by the type of injuries that are experienced by the formed groups, whether groups of injury prone adolescents exist, and the existence of associated factors associated with being a part of each group. This project is also the first to identify clusters that form naturally in the data, unlike previous research using the HBS dataset that used predefined groups such as violence-related injury, transport-related injury, and unintentional injury (57).

To date, there have been no studies examining typologies of injury drawing on a broad range of mechanisms (e.g. violence, transportation, self-harm, falls, etc.) experienced by adults. There have, however, been studies focusing on specific mechanisms (assault injuries, motorcycle collisions) (58,59). One paper that examined possible injury typologies among assault injuries suggested that a matrix that accounts for severity, anatomical location, and type (tear, bruising, abrasions, fractures) be used for classifying injuries sustained during intimate partner and sexual violence (58). The study that examined fatal motorcycle collisions on the other hand produced injury profiles across Australia and New Zealand (59). Researchers performed logistic regression analysis in order to see if there were any relationships between anatomical location of the injury and whether the cyclist collided with the barrier in an upright or sliding position (59). While injury profiles were similar in both forms of collision, cyclists who slid into the barrier sustained more thoracic and pelvic injuries (59). This study focuses on injury patterns across mechanisms in adolescents; therefore, future research must address the gap in injury patterns among adults.

2.3 Haddon's Matrix Tables

Table 2.1 – Haddon's Matrix Car Collision Example

	HOST	**AGENT/VEHICLE**	**PHYSICAL ENVIRONMENT**	**SOCIAL ENVIRONMENT**
Pre-event	Alcohol use, education, risk taking behaviour, medications	Brake systems, tire quality, speed capability	Road design, roadside infrastructure, road maintenance	Incentives (insurance), public attitude towards driving
Event	Seatbelt use, age, sex, bone density	Speed of impact, vehicle size, airbag	Speed limits, guard rails, median barriers	Laws concerning use of safety equipment
Post-Event	Age, sex, medications, preexisting medical conditions	Alert systems, non-collapsible vehicles	First aid kit, emergency calls	Communication network, emergency services response, transport network

Table 2.2 – Thesis Haddon's Matrix

	HOST	**AGENT/VEHICLE**	**PHYSICAL ENVIRONMENT**	**SOCIAL ENVIRONMENT**
Pre-event	Age, sex, ethnicity, self-esteem, depression, smoking status, drinking behavior, cannabis use, sexual risk behavior, academic achievement		Involvement in sports	School connectedness, socioeconomic status, absenteeism

Chapter Three – Research Methods

The following chapter provides an overview of the research methods used in this project. A description of the data source and sample selection is provided, followed by a detailed explanation of the measures used and analytic techniques applied.

3.1 Overview

Each objective will be addressed in a separate section of the thesis employing distinct methods; however, both sets of analyses employed the same data – the 2010-2011 HBS of the YSS. To address the first objective, a cluster analysis was performed to identify any patterns by mechanism of injury. For the second objective, regression analyses were used to identify sociodemographic and psychosocial correlates for the injury clusters produced as part of objective one.

3.2 Data Source

Secondary data from the 2010-2011 Health Behaviour supplement of the Youth Smoking Survey was employed. The YSS, now the Canadian Student Tobacco, Alcohol, and Drugs Survey (CSTADS), is distributed across Canada every two years. The HBS was added one time to the YSS in 2010-2011 to examine injuries, sexual health, and depressive symptoms. The HBS was distributed to high school students across Nova Scotia, Canada. Nova Scotia, a primarily English-speaking province, has the largest population in Atlantic Canada. Out of the ten high schools in Nova Scotia that participated in the YSS, eight agreed to partake in the HBS. All students from grades 9-12 (ages 14-18) could participate in the survey, of which 57%, or 2,989 students, provided completed questionnaires(57). Both the consent of the parents

and the students were required to take part. Questionnaires were distributed and completed between November 2010 and May 2011. The Research Ethics Boards of the University of Waterloo, Dalhousie University, and participating school boards provided approval for both the YSS and the HBS.

3.3 Measures

3.3.1 Dependent Measures

In determining patterns of adolescent injury, the dependent variable was the *adolescent injury checklist*. This item was originally created in Australia to measure the prevalence of injury in adolescents across a range of injury mechanisms. The checklist also included whether the injury required medical attention and whether substance use was involved in the injury. Some of the wording of the Australian checklist was altered to reflect Canadian dialect and word use. The checklist outlines self-reported mechanisms of injury using 17 items. The mechanisms included in the checklist were chosen based on common means of injury amongst adolescents (the checklist can be seen in full in Appendix A). Students were asked to recall injuries from the previous 6 months and check off specific situations that resulted in injury; for example, “By a BB gun, pellet gun or regular gun?”, “While driving a car, truck or bus?”, “By being in a physical fight with someone?”. Students answered either “yes” or “no” and all responses will remain dichotomized (1/0). Asbridge and colleagues conducted a study using the checklist and computed a Kuder-Richardson 20 coefficient of 0.79 for the 17-item scale, which agreed with the alpha coefficients conducted by an Australian and a US study, 0.76 and 0.68 respectively (54,57,60). Therefore, internal reliability was similar in multiple applications of the checklist.

3.3.2 Independent Variables

Depression has been shown to have a positive association with the occurrence of adolescent injuries, as previously discussed in section 2.1.5. To include depressive symptoms and risk of depression in our analysis we used an abridged version of the Centers for Epidemiological Studies Depression (CES-D) Scale, which consisted of 8 items assessing depressive symptoms, that was included in the HBS. Each question pertained to how students felt in the previous week. The questions were as follows: "I felt sad", "I felt depressed", "I thought my life had been a failure", "I felt fearful", "my sleep was restless", "I felt lonely", "I had crying spells", and "I felt that I could not shake off the blues even with help from my family and friends". Students chose answers from a 4-point Likert-type scale with the extremes being rarely/never to very often. Their answers were tabulated to give an overall depression score. Students could score anywhere between 0 and 24, with 24 being the highest level of depressive symptoms. A score of 7 was used as a cut point dichotomizing the score making a student who received 7 or higher defined as having a higher risk of being depressed, as was previously used by Asbridge and colleagues (57). This reduced version of the CES-D scale has previously been used to evaluate depressive symptoms and risk of depression in adolescents (60,61). The results achieved using the 8-item scale correspond with rates of depressive symptoms in adolescents obtained with the full 20-item CES-D scale and a 12-item version (62,63). Asbridge and colleagues calculated a Cronbach's alpha of 0.91 (57). Although it seems improbable to get an accurate estimate of a person's mental health by only looking at depressive symptoms from the previous week, the test-

retest reliability of the CES-D has been evaluated and showed moderate to strong correlations when redone after three and six months (64,65).

Covariates from the Youth Smoking Survey were also included to assess intra-cluster correlation. The covariates examined have been evaluated in previous studies and shown to have a relationship with injuries. Sociodemographic variables that were analyzed include: sex, student grade, how much money the student spends each week, and ethnicity. Sex was considered as previous studies have shown that boys are more likely to experience injuries related to transportation incidents and violence, while girls are more likely to engage in self-harm and suicidal ideation (12). Students were asked if they are female or male and the variable was coded as 1 = males and 0 = female.

Age has also been known to affect the types of injuries children and adolescents sustain, with adolescents more often experiencing soft tissue injuries while younger children experience injuries of a more traumatic nature (39). Participants in the YSS were asked what grade they were in as a proxy of age; they ranged between grades 6 and 12. Only students who selected grades 9, 10, 11, and 12 were included as they were the only grades to receive the HBS.

Similarly, a proxy was needed for socioeconomic status, measured here by students' weekly spending habits. Low socioeconomic status appears to be a risk factor for injury (28,31). The YSS asked students to declare how much money they are given each week to spend or save; this includes money received as an allowance as well as earned at a job. Students had 8 options: zero, $1-$5, $6-$10, $11-$20, $21-$40, $41-$100, more than $100, or "I do not know how much money I get each

week". For this study, students were grouped into three categories, spends less than $40, more than $40, or unknown. These cut points have been previously used by Asbridge and colleagues (57).

Students were asked to identify their ethnicity from the following options: White, Black, Asian, Aboriginal (First Nations, Métis, Inuit), Latin American/ Hispanic, and Other. Ethnicity has been shown to be associated with injuries, with Aboriginal adolescents, as well as nonwhites in general having a higher likelihood of injury (40,41).

Risk taking indicators including smoking habits, drinking behaviour, use of cannabis, and sexual risk behaviours, have all been shown to increase the risk of injuries among adolescents (31,42,50,51). Students were asked to respond yes or no to the question "Are you a smoker?" Those who responded yes included both occasional and daily smokers. Students were also asked to identify their drinking behaviour over the past 12 months; responses were separated into four categories: consumed ≥ 5 drinks on one occasion at least 12 times throughout the previous year, consumed ≥ 5 drinks on one occasion less than 12 times throughout the previous year, did not consume ≥ 5 drinks on one occasion in the last 12 months, and did not consume any alcohol over the course of the year. Students also identified if they had used cannabis in the previous year. Responses were grouped into the following three categories: frequent cannabis use within the previous year (at least 12 times), infrequent cannabis use (fewer than 12 times), and no cannabis use. The final risk behaviour that was examined was sexual risk behaviour, measured with the question of number of sexual partners in the past year. More

partners place individuals at higher risk; as such, students were placed into three categories: have multiple sexual partners, one sexual partner, or sexually inactive. These categories have been previously used by Asbridge et al (57).

Finally, school attendance, performance indicators, self-esteem, and school attachment will also be considered. Students were asked to comment on their absenteeism, and responses were grouped into one of the following three categories: missed 3 classes or more, 1 or 2 classes, did not miss any school. The grades that a student typically receives have also been shown to influence adolescent injuries rates with higher academic achievement acting as a protective factor, while lower achievements increase risk of injuries (50,51). The YSS asked students to pick one out of five options that best describes their marks during the past year: above 85%, 70-84%, 60- 69%, 50-59%, and below 50%. In this study, students' grade averages were dichotomized into ≥ 70% vs. ≤ 70% to isolate good grades. Finally, adolescents are more likely to sustain injuries when they participate in sports (13,43–45). Therefore, students were asked to answer yes or no if they participate in intramural or school team sports.

Higher self-esteem has been shown to act as a protective factor with regards to injuries among adolescents. In the YSS students were asked to respond to these three questions regarding self-esteem: 1) In general, I like the way I am, 2) When I do something, I do it well, and 3) I like the way I look. The responses were given on a 5-point Likert Scale coded 0 through 4 i.e., true, mostly true, sometimes true/sometimes false, mostly false and false, and can be combined to give an overall self-esteem score out of 12. A score was calculated for school attachment. School

connectedness was measured using 6 questions. Students were asked to agree or disagree with the following statements: 1) I feel close to people at my school, 2) I feel I am part of my school, 3) I am happy to be at my school, 4) I feel the teachers in my school treat me fairly, 5) I feel safe at my school, and 6) Getting good grades is important to me. Students answered with a 4-point Likert Scale ranging from strongly agree to strongly disagree, giving an overall score out of 24. Previous studies have shown that school connectedness may act as a protective factor for risk taking behaviours, which in turn decreases the likelihood of sustaining an injury.

3.4 Cluster Analysis

In determining whether injury patterns exist among adolescents, a cluster analysis was performed. Cluster analysis is a descriptive and non-inferential operation, and has often been referred to as a heuristic device for assessing patterns in the data (66). Rather than a measurement of data, cluster analysis is used to delve into and examine the arrangement of the data to focus on subjects rather than measures, unlike factor analysis. The goal of a cluster analysis is to identify any patterns that exist amongst respondents and form mutually exclusive clusters (66). When classifying clusters, the aim is to maximize both within cluster homogeneity and between cluster heterogeneity (67). In other words, subjects within a cluster should be as similar as possible while remaining markedly different from those found in neighbouring clusters. Cluster analysis can be used to shed light on patterns that are hidden in a large data set such as taxonomic descriptions (66,68). Although there are several different methods of cluster analysis, they all have the same purpose to explore the structure of the data (68). The two most frequently

used methods are hierarchical and partition clustering; the former is used in this study.

3.4.1 Hierarchical Clustering

Hierarchical clustering is a stepwise iterative process that can be either agglomerative or divisive; agglomerative clustering was used (68). The process of hierarchical clustering creates a dendrogram, which is a visual representation of the clusters and how closely the data points group together around a centroid (69).

Agglomerative hierarchical clustering consists of four key steps. First, the proximity matrix must be computed to determine which two data points of clusters are most similar and should therefore be combined at each step of clustering (70). Once the two closest clusters have been identified they are merged together and the proximity matrix must be updated. The process continues to merge the two closest clusters, updating the proximity matrix until only one cluster is left. When using agglomerative cluster analysis, the distance between each cluster and the newly formed cluster must be calculated at each step (70).

Each form of hierarchical cluster analysis uses the same core algorithm; however, they differ in how they analyze inter-cluster similarity, also known as cluster linkage (68). Single linkage, complete linkage, and average linkage use a proximity matrix as an input. On the other hand, centroid linkage and Ward's method use raw data. Ward's method is used for the hierarchical cluster analysis.

3.4.2 Ward's Method

This study uses Ward's method as it is appropriate for clustering binary variables, in this case clustering students based on their yes/no responses to the

injury checklist (71). Ward's method, also known as the minimum sum of squares, is computed using raw data as an input; in this case the students based on their responses from the injury checklist. Ward's method is based on the error sum of squares criterion and measures distances using Euclidean distances (68). The error sum of squares equation is as follows:

$$SSE = \sum_{i=1}^{n} (x_i - \bar{x})^2$$

where n is the number of observations, x_i is the value of the i^{th} observation, and $\bar{x}$ is the mean of all the observations.

STATA was used to conduct the analyses for this thesis. To determine the distance between a cluster and one that was just formed, STATA uses the Lance & Williams recurrence formula:

$$d_{k(ij)} = \alpha_i d_{ki} + \alpha_j d_{kj} + \beta d_{ij} + \gamma \left| d_{ki} - d_{kj} \right|$$

where d_{ij} is the distance between groups *I* and *j*. Every cluster linkage approach has values that correlate to parameter values α_i, α_j, β, and γ.

Euclidean distance measures are very sensitive to variability; therefore, all injury measures were standardized (z-transformed). A dendrogram is produced which visually showcased the clusters, where the y-axis represents the distance at which the groups come together, while the subjects are distributed along the x-axis in such a way that the groups don't overlap (69). The number of clusters is determined by examining the horizontal bars on the dendrogram, which represent the dissimilarity of variables. When clusters are fused together that is visually represented by the splitting of one vertical line into two vertical lines. The position

of said split on the y-axis gives the dissimilarity between the two clusters. Clusters are therefore identified at the vertical splits with the lowest dissimilarity.

It is important to note that clustering analyses will generate factions even when none exist; therefore, clustering must be validated (70). In this study, an ANOVA test is produced automatically when the cluster analysis is run. The ANOVA table is used to provide internal validity of the final cluster structure by evaluating the inter-cluster heterogeneity. A greater *F* value signifies a larger heterogeneity, while a small *F* value represents less heterogeneity. Additionally, an ANOVA of other covariates not included in the cluster analysis will be examined across clusters to provide external validity to the cluster structure.

The proportions and means of the independent variables in each cluster will be calculated to glean more information on which students were in each cluster. The Bonferroni correction will be performed to account for the potential of incorrectly rejecting a true null hypothesis when comparing proportions and means between clusters.

3.5 Logistic Regression

For the second objective, a series of regression analyses are performed to model key sociodemographic and psychosocial indicators as related to membership to specific injury clusters (as created in objective one). Each cluster was analyzed separately to identify correlates within each grouping. The outcome variable in this study was binary (whether a student was in a specific cluster or the Injury Free cluster); therefore, logistic regression was used to determine if exposure variables are associated with the absence or presence of the outcome. Multivariable logistic

regression models were used to explore characteristics that differentiate subgroups, such as sociodemographic, risk taking, and individual school attendance and performance indicators, as well as elevated depressive symptoms from the CES-D scale.

To determine if the outcome is affected, logistic regression creates a model with a sequence of the values of the exposure variables. The logistic regression model explains the variation in the probability of the binary outcome with the following function:

$$P(y|x) = \frac{1}{1 + e^{-(\alpha+\beta x)}}$$

where $P(y|x)$ represents the probability (P) of the binary outcome (y) for a given value of x. In the interest of calculating an odds ratio, the probability must then be transformed using the logit transformation. The logit transformation, when applied to a probability, removes the upper bond and transforms the probability into odds. In this thesis, p was the probability of being in a specific cluster and 1-p was the probability of being in the Injury Free cluster. The odds can be calculated from the ratio of $p/(1\text{-}p)$, while the log odds are obtained after a logit transformation and can be denoted as:

$$logit(p) = log_e\left(\frac{1}{1-p}\right)$$

The odds ratio will then be determined by comparing correlates for factions across a variety of covariables. In this case, $L_1 = \text{logit}(p_1)$ was estimated for one faction (membership in a specific cluster) and $L_2 = \text{logit}\ (p_2)$ was estimated to the other faction (being in the Injury Free cluster) across a number of exposure variables,

such as sex, age, socioeconomic status, etc. This will give the following equation for the log of the odds ratio:

$$L_1 - L_2 = logit(p_1) - logit(p_2) = log\left(\frac{p_1}{1-p_1}\right) - log\left(\frac{p_2}{1-p_2}\right)$$

$$= log\left[\left(\frac{p_1}{1-p_1}\right)/log\left(\frac{p_2}{1-p_2}\right)\right]$$

If the odds ratio is equal to 1 there is no difference between factions; therefore, the correlate in question is not associated with the outcome. When the OR is > 1 the outcome is more likely in one faction than the other, while an OR < 1 indicates the outcome is less likely in one faction compared to the other (72).

Unadjusted logistic regression models were performed for each covariable. As many of the variables have been shown to be correlated with each other (i.e. school connectedness and risk taking behaviours) adjusted models were used to account for confounding (54). Full models were run, as all variables were known to be related to injury. Separate adjusted logistic regressions were performed using the outcome variable of cluster membership vs. non-membership, the results of which can be seen in Appendix B.

3.6 Tables

Table 3.1 – Dependent Variables Included In Analysis

Variable	Survey response categories	Categories and codes for analysis
Were you injured by being in a physical fight with someone?	Yes No	1 = yes 0 = no
Were you injured by a BB gun, pellet gun or regular gun?	Yes No	1 = yes 0 = no
Were you injured by being hit by something like a rock or glass?	Yes No	1 = yes 0 = no
Were you injured by nearly drowning?	Yes No	1 = yes 0 = no
Were you injured by falling?	Yes No	1 = yes 0 = no
Were you injured by being burned by fire, chemicals, electricity, or hot liquid?	Yes No	1 = yes 0 = no
Were you injured by an animal or serious insect bite?	Yes No	1 = yes 0 = no
Were you injured while riding in a car, truck or bus?	Yes No	1 = yes 0 = no
Were you injured while riding a bicycle, skateboard or rollerblades?	Yes No	1 = yes 0 = no
Were you injured while riding a motorcycle, moped, snowmobile, all-terrain vehical (ATV)?	Yes No	1 = yes 0 = no
Were you injured by a team sport, athletic activity or exercise?	Yes No	1 = yes 0 = no
Were you injured by being hit by a moving vehicle while walking?	Yes No	1 = yes 0 = no
Were you injured by accidentally drinking or eating a dangerous substance?	Yes No	1 = yes 0 = no
Were you injured by being physically attacked?	Yes No	1 = yes 0 = no
Were you injured by being stabbed?	Yes No	1 = yes 0 = no
Were you injured while driving a car, truck, or bus?	Yes No	1 = yes 0 = no
Were you injured by getting cut, bruised, bleeding?	Yes No	1 = yes 0 = no

Table 3.2 – Independent Variables Included In Analysis

Variable	Survey response categories	Categories and codes for analysis
Depression	Abridged version of the CES-D consisting of 8 items each of which can be answered with a 4-point Likert-type scale. An overall depression score is tabulated ranging from 0 to 24.	0= lower risk of depression (score lower than 7) 1= higher risk of depression (score of 7 or higher)
Sex	• Male • Female	0= male 1= female
Age (measured by student's grade)	• Grade 6 • Grade 7 • Grade 8 • Grade 9 • Grade 10 • Grade 11 • Grade 12	1= grade 9 2= grade 10 3= grade 11 4= grade 12
Socioeconomic status (measured by students' weekly spending habits)	• Zero • $1-$5 • $6-$10 • $11-$20 • $21-$40 • $41-$100 • More than $100 • I do not know how much money I get each week	1= unknown 2= spends less than $40 3= spends more than $40
Smoking status (Are you a smoker?)	• No • Yes	0= no 1= yes
Drinking behaviour (In the last 12 months, how often did you have 5 drinks of alcohol or more on one occasion?)	• I have never done this • I did not have 5 or more drinks on one occasion in the last 12 months • Less than once a month • Once a month • 2 to 3 times a month • Once a week • 2 to 5 times a week • Daily or almost daily • I do not know	1= did not consume any alcohol over the course of the year 2= did not consume ≥ 5 drinks on one occasion in the last 12 months 3= consumed ≥ 5 drinks on one occasion less than 12 times throughout the previous year 4= consumed ≥ 5 drinks on one occasion at least 12 times throughout the previous year

Variable	Survey response categories	Categories and codes for analysis
Cannabis use (In the last 12 months, how often did you use marijuana or cannabis?)	• I have never used marijuana • I have used marijuana but not in the last 12 months • Less than once a month • Once a month • 2 or 3 times a month • Once a week • 2 or 3 times a week • 4 to 6 times a week • Every day • I do not know	1= no cannabis use 2= infrequent cannabis use 3= frequent cannabis use within the previous year (at least 12 times)
Sexual risk behaviour (In the past 12 months, I have had sex with:)	• 0 people • 1 person • 2 people • 3 people • 4 or more people • Not applicable (I have never had sex)	1= sexually inactive 2= one sexual partner 3= multiple sexual partners
Absenteeism (In the last 4 weeks, how many classes did you skip when you were not supposed to?)	• 0 classes • 1 or 2 classes • 3 to 5 classes • 6 to 10 classes • 11 to 20 classes • More than 20 classes	1= did not miss any school 2= 1 or 2 classes 3= missed 3 classes or more
Academic achievement (Which best describes your marks during the past year?)	• Mostly A's / above 85% / level 4 • Mostly A's and B's / 70-84% / level 3-4 • Mostly B's and C's / 60-69% / level 3 • Mostly C's / 50-59% / level 2 • Mostly letter grades below C's / below 50% / level 1	0= ≤ 70% 1= ≥ 70%
Involvement in sports (At your school, do you participate in intramural or school team sports?)	• No • Yes	0= no 1= yes

Variable	Survey response categories	Categories and codes for analysis
Ethnicity (How would you describe yourself?)	• White • Black • Asian • Aboriginal (First Nations, Métis, Inuit) • Latin American/ Hispanic • Other	1= White 2= Black 3= Asian 4= Aboriginal 5= Latin American/ Hispanic 6= Other
Self-esteem	Self-esteem was measured using 3 questions. Students were asked to respond to these questions: 1) In general, I like the way I am, 2) When I do something, I do it well, and 3) I like the way I look. The responses were given on a 5-point Likert Scale i.e., true, mostly true, sometimes true/sometimes false, mostly false and false.	Scores were calculated by adding students' responses to the 3 questions. Students could have a score of 0 to 12 with a lower score indicating higher self-esteem. Answers for each of the 3 questions were: 0= True 1= Mostly true 2= Sometimes true/ sometimes false 3= Mostly false 4= False
School connectedness	School connectedness was measured using 6 questions. Students were asked to agree or disagree with the following statements: 1) I feel close to people at my school, 2) I feel I am part of my school, 3) I am happy to be at my school, 4) I feel the teachers in my school treat me fairly, 5) I feel safe at my school, and 6) Getting good grades is important to me. Students answered with a 4-point Likert Scale ranging from strongly agree to strongly disagree.	Scores were calculated by adding students' responses to the 6 questions. Students could have a score of 6 to 24 with a lower score indicating higher school connectedness. Answers for each of the 6 questions were: 1= Strongly agree 2= Agree 3= Disagree 4= Strongly disagree

Chapter Four – Results: Objective One

Chapter Four provides results of the first objective, which identifies the presence of any existing clusters of mechanisms of injury among Nova Scotia high school students. First, the frequency of each mechanism of injury is presented; followed by a summary of demographic, risk behaviour, psychosocial, and school involvement covariates. Chapter Four concludes with a description of the identified clusters.

4.1 Mechanism of Injury Frequencies

Table 4.1 presents an overview of the frequency of mechanisms of injury as captured by the Health Behaviour Supplement in 2010-2011. The table comprises the seventeen possible mechanisms of injury a student could have identified on the Adolescent Injury Checklist. As expected, most of the questions were answered no, indicating no injury occurred. Injuries that resulted in bleeding were the only ones that had a higher percentage of students answering yes rather than no, 1,743 out of 2,985 students. Falls and sports related injuries were also quite high with 1,001 and 1,095 students checking yes for each question respectively. Injuries sustained while nearly drowning had the lowest number of incidents, with 75 students checking yes.

4.2 Summary of Covariates

Table 4.2 summarizes the unweighted sociodemographic, risk behaviour, psychosocial, and school involvement covariates examined in this study. Of the 2,985 students that participated in the HBS, 53.3% were female and were evenly distributed across grades 10 through 12; grade 9 had the lowest number of students

with 204. Most of the students were white (84.0%), and received less than $40 a week (40.0%).

With regards to risk taking behaviours, only 474 students identified as smokers and among non-smokers only 7 were susceptible to smoking. The largest proportion of students were non-drinkers (39.0%); however, they were closely followed by frequent binge drinkers (35.5%). Frequent cannabis users made up 29.6% of respondents, while 18.6% were infrequent users and 51.9% did not use cannabis at all. Most students were sexually inactive (54.3%), while 26.2% had one sexual partner and 19.5% had multiple sexual partners.

High academic achievement, defined as an average of 70% or higher, was observed in 72.3% of students, while 43.0% engaged in some degree of truancy. Most of the students did not participate in sports (62.8%) and had lower depressive symptoms (76.4%). The mean self-esteem score was 8 out of 12 indicating that most of the students had lower self-esteem. Conversely, the mean school connectivity score was 12 out of 24; with 6 being the lowest possible score an average of 12 indicates that most of the students feel connected to the school.

4.3 Description of Clusters

Hierarchical clustering produced a total of six clusters in the HBS data. The number six was decided on using stopping rules and validated with silhouette coefficients. Figure 4.1 shows the silhouette widths of each cluster. Four clusters displayed the ideal score of 1.00 and the other two clusters had coefficients of 0.16 and -0.50, indicating the presence of intra-cluster homogeneity, with six clusters as a valid option. When evaluating the cluster stopping rule values generated by the

Duda-Hart test both six clusters and nine clusters had low pseudo *T*-squared values. Nine clusters were also deemed a valid option when the silhouette coefficients were produced; however, six clusters were chosen to ensure that clusters contained enough students to generate useful results for the regressions. The upper limit of the dendrogram (Figure 4.2) for the HBS dataset was produced and visually showcased the six clusters. The clusters were identified using the y-axis to determine the similarity between each horizontal line.

Table 4.3 presents the proportion of each mechanism of injury in each cluster. The clusters have been named based on the prevalence of mechanisms of injury observed in each cluster. The names are as follows: Poly Injured; Roughnecks; Sport-Oriented; Scrappers; Bleeding-Oriented; and Injury Free. As the name suggests students who were members of the Poly Injured group experienced one or more injuries from many of the mechanisms of injury. The difference between the Poly Injured cluster and the other groups was statistically significant (at a value of $p<0.05$) for each mechanism of injury except for bleeding and sports injuries. The Poly Injured cluster was the largest with 1272 members out of possible 2985 students. The 377 students who belonged to the Roughnecks cluster all experienced falls, most experienced bleeding (77.2%), and 49.2% were injured while participating in sports. The difference between the Roughnecks group and the other clusters was only statistically significant for falls. All members of the Sport-Oriented group were injured while playing sports and did not experience any other form of injury. They made up the smallest cluster with 167 students. Scrappers members were all injured only when playing sports and from an injury involving bleeding,

while Bleeding-Oriented members only sustained injuries that resulted in bleeding and had 176 and 282 students respectively. Finally, the 711 members of the Injury Free cluster did not experience any injuries of any form.

Tables 4.4, 4.5, and 4.6 further describe the clusters based on weighted sociodemographic, risk-taking behaviours, and psychosocial and school involvement factors respectively, and help to validate the heterogeneity of the cluster solution. The Roughnecks cluster was significantly more likely to be male relative to all other clusters, at 72% male compared to a population mean of 49%. The proportion of grade 10 students in the Poly Injured (31%), Roughnecks (29%), and Sport-Oriented (38%) clusters differed significantly from the population mean of 25%. For the proportion of students in grade 11 the difference between the population mean (26%) and the Poly Injured (32%), and Injury Free (32%) clusters were statistically significant. The Poly Injured (30%), Roughnecks (37%), Bleeding-Oriented (34%), and Injury Free (31%) clusters also differed significantly when compared to the population mean of 25% of students in grade 12. Among those in the Injury Free cluster, 6% of students were Asian, which differed significantly from the population mean (3%), as well as the Poly Injured (2%), Roughnecks (3%), and Sport-Oriented (1%) clusters. Finally, with regards to weekly spending habits, the proportion of the Injury Free cluster who did not know how much money they spend was 33%, which was statistically different when compared to the Poly Injured (24%), Roughnecks (23%), and Scrappers (22%) clusters. Conversely, 38% of the Poly Injured group spent more than $40 per week, which was significantly more than both the

population mean and the Injury Free cluster, which were 31% and 29% respectively.

The means of risky behaviours including smoking status, drinking behaviour, cannabis use, and number of sexual partners differed significantly across clusters. The Poly Injured group was significantly more likely to contain smokers with 23% when compared to the population mean of 14%, as well as the Roughnecks (10%), Sport-Oriented (6%), Scrappers (3%), Bleeding-Oriented (11%), and Injury Free (14%) clusters.

With regards to the proportion of non-drinkers the Poly Injured cluster (30%) differed significantly from the population mean (44%) as well as the Roughnecks (38%), the Sport-Oriented (51%), Bleeding-Oriented (42%), and Injury Free (50%) clusters. Furthermore, the proportion of non-drinkers was significantly higher in the Injury Free cluster when compared to the population mean, the Roughnecks, and the Scrappers. The proportion of infrequent binge drinkers was significantly higher among Scrappers at 26% when compared to the population mean at 16% and the Injury Free cluster at 15%. In the Poly Injured group, the proportion of frequent binge drinkers was significantly higher (45%) when compared to the population mean (33%), the Sport-Oriented (26%), the Scrappers (32%), the Bleeding-Oriented (29%), and the Injury Free (26%). On the other hand, the Injury Free cluster was significantly lower with regards to the proportion of frequent binge drinkers when compared to both the population mean and the Roughnecks.

Non-cannabis users made up 39% of the Poly Injured cluster, which was significantly lower than the proportion in the population mean (56%), the Roughnecks (59%), the Sport-Oriented (63%), the Scrappers (61%), Bleeding-Oriented (54%), and the Injury Free (62%) clusters. While non-users were significantly more common in the Injury Free cluster when it was compared to the population mean. The proportion of infrequent cannabis users among the Poly Injured cluster (21%) differed significantly from the population mean at 16%. Frequent cannabis users were more common in the Poly Injured cluster (40%) when compared to the population mean (28%), Roughnecks (25%), Sport-Oriented (21%), Scrappers (18%), Bleeding-Oriented (27%), and Injury Free (17%). Conversely, frequent users saw significantly lower proportions in both the Scrappers and Injury Free clusters when compared to the population mean.

There was a smaller proportion of sexually inactive students among the Poly Injured cluster (44%) when compared to the population mean (58%), Roughnecks (17%), Sport-Oriented (59%), Scrappers (62%), Bleeding-Oriented (61%), and Injury Free (63%). The Poly Injured group had a significantly higher proportion of students with multiple sexual partners (28%) when compared with the population mean (18%), Roughnecks (17%), Sport-Oriented (16%), Scrappers (10%), Bleeding-Oriented (13%), and Injury Free (14%). Conversely, the Scrappers had significantly fewer students engaging in sexually risky behaviour when compared to the population mean.

Finally, the means of all the psychosocial and school involvement covariates differed significantly across clusters, this includes absenteeism, academic

achievement, self-esteem, school connectedness, depression, and sports participation. The difference between the proportions of students who did not skip any classes in the Poly Injured group compared to other clusters as well as the population mean of 64% was statistically significant with 48.4% of students falling into said category. The Sport-Oriented cluster also differed significantly with regards to the proportion of students who did not engage in truancy (75%) when compared to the population mean, Roughnecks (60%), Bleeding-Oriented (58%), and Injury Free (64%). The Poly Injured cluster had a significantly higher proportion of students who skipped at least 3 classes (28%) when compared to the population mean (18%), Roughnecks (17%), Sport-Oriented (9%), Scrappers (13%), and the Injury Free (17%) clusters. Conversely, the Sport-Oriented cluster saw fewer frequent truants when compared to the population mean, Bleeding-Oriented (20%), and the Injury Free clusters.

The proportion of students who achieved an average of 70% or above differed significantly for the Poly Injured (66%), Roughnecks (82%), Sport-Oriented (87%), and Scrappers (89%) clusters when they were compared with the population mean of 74%. There were significantly fewer students with high grades in the Poly Injured group when compared to the Roughnecks, Sport-Oriented, and Scrappers, while there were more in the Sport-Oriented and Scrappers when they were compared to the Bleeding-Oriented (72%) and Injury Free (71%). The Roughnecks also had significantly more students with higher academic achievement when compared to the Injury Free group.

The mean self-esteem scores of the Poly Injured (8.5), Sport-Oriented (9.8), Scrappers (9.6), and Injury Free (9.1) clusters differed significantly when compared to the population mean of 8.8. The Sport-Oriented cluster members had significantly higher self-esteem scores than members of the Poly Injured, Roughnecks (8.5), Bleeding-Oriented (8.4), and Injury Free clusters. Similarly, the Scrappers and the Injury Free members had significantly higher self-esteem scores than the Poly Injured, Roughnecks, and Bleeding-Oriented clusters; however, the Injury Free students had significantly lower self-esteem scores than those in the Sport-Oriented group. Higher self-esteem scores corresponded to lower self-esteem; therefore, although there were significant differences between clusters the aforementioned scores indicate that most students experienced lower self-esteem.

The mean school connectedness score of the Poly Injured (12.5), Sport-Oriented (10.9), Scrappers (10.7), and Injury Free (11.3) clusters differed significantly to the population mean score of 11.9. Both the Poly Injured and the Bleeding-Oriented (12.4) students had significantly higher school connectedness scores than students in the Roughnecks (11.7), Sport-Oriented, Scrappers, and Injury Free groups. However, Roughnecks had a higher score than both the Sport-Oriented students and Scrappers. Higher school connectedness scores corresponded with lower school connectedness.

The proportion of students who displayed depressive symptoms was significantly higher in the Poly Injured cluster with 28% when compared to the population mean of 21%, as well as the proportion in the Sport-Oriented (12%), Scrappers (16%), and Injury Free (17%) clusters. Conversely, the proportion of

students with depressive symptoms was significantly smaller in the Sport-Oriented group when compared to both the population mean and the Roughnecks (22%).

Finally, both the Sport-Oriented and Scrappers had significantly higher proportions of athletes (70% and 74% respectively) when compared to the population mean of 38%, as well as the Poly Injured (36%), Roughnecks (39%), Bleeding-Oriented (19%), and Injury Free (29%) clusters. Conversely, the Bleeding-Oriented and Injury Free groups contained significantly fewer students who participated in sports when compared to the population mean, as well as members of the Poly Injured and Roughnecks groups.

4.4 Chapter Summary

The first objective aimed to identify existing clusters of mechanisms of injury within the HBS dataset. In summary, six clusters were identified and were named Poly Injury; Roughnecks; Sport-Oriented; Scrappers; Bleeding-Oriented; and Injury Free. The Poly Injury group differed significantly from other clusters for all mechanisms of injury except for injuries that resulted in bleeding as well as those sustained while playing sports. In general students who belonged to the Poly Injured group had higher weekly spending habits, and engaged in many risky behaviours including smoking, binge drinking, cannabis use, and risky sex. There were more truants and students with lower averages in that cluster; members had higher self-esteem, lower school connectedness, more depressive symptoms, and participated in fewer sports. Roughnecks were mostly males, had higher grades, and higher self-esteem. The Sport-Oriented cluster contained fewer students who engaged in risky behaviours such as smoking and binge drinking. The cluster also

had fewer truants, students with high averages, lower self-esteem scores, higher school connectedness scores, and high participation in sports. The Scrappers also had fewer students who exhibited risky behaviours including smoking, cannabis use, and risky sex; however, there were more students who engaged in infrequent binge drinking. Scrappers also tended to have higher grades, lower self-esteem, higher school connectedness, and had the highest proportion of students who participated in sports. Those in the Bleeding-Oriented cluster generally had higher self-esteem, lower school connectedness, and very few participated in sports. Finally, the Injury Free group had the highest proportion of Asian students and tended to have mostly students who did not engage in risky behaviours such as drinking and cannabis use. They also had lower self-esteem and engaged in fewer sports. It should be noted that although there were significant differences between groups with regards to self-esteem scores all groups had medians that indicated that many students exhibited lower self-esteem.

The fact that there were statistically significant differences not only between each cluster and the population mean for certain variables but also between the clusters themselves validated the heterogeneity of the clusters. Therefore, the six clusters that were identified each contained students that were not only similar to members of the same cluster, but were also statistically different from students in neighbouring clusters.

4.5 Figures

Figure 4.1 – Silhouettes of Six Clusters

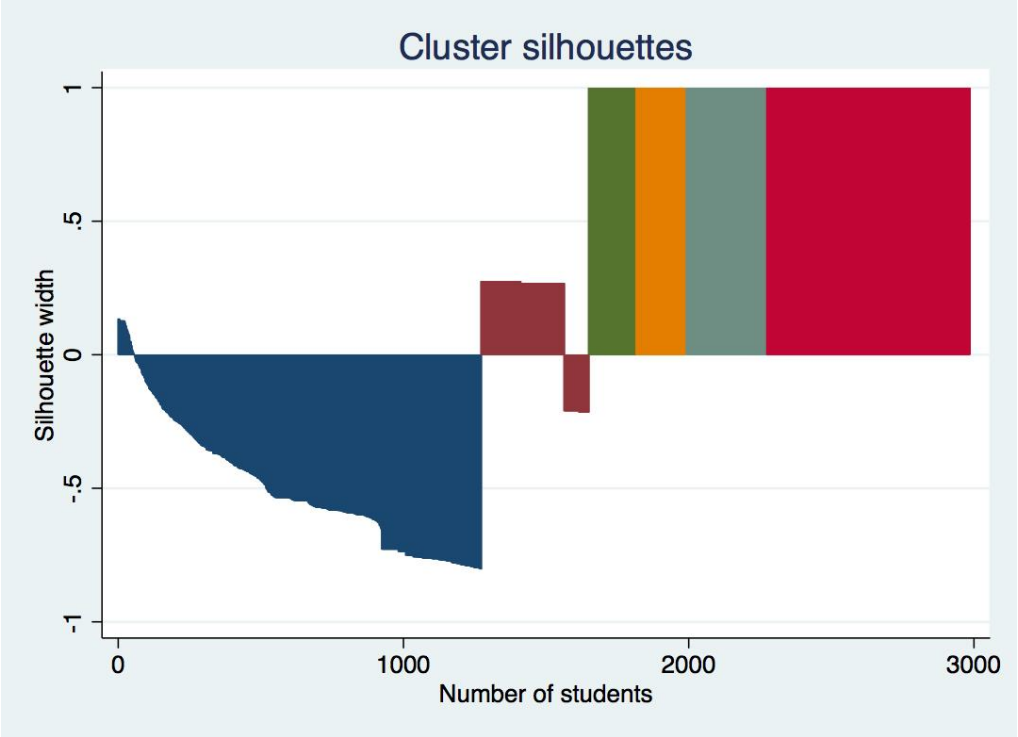
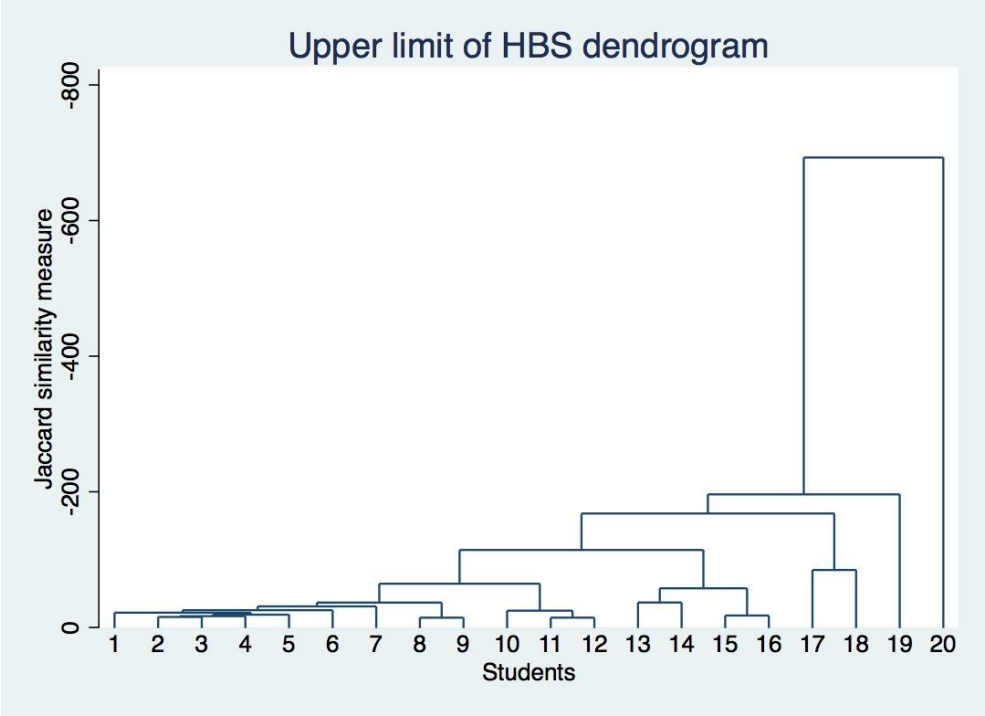


Figure 4.2 Upper Portion of the Dendrogram Produced Using HBS Data



4.6 Tables

Table 4.1 – Frequency of Mechanisms of Injury Among Nova Scotian Adolescents

Mechanism of injury	**No** **N (%)**	**Yes** **N (%)**
Were you injured by being in a physical fight with someone?	2,634 (88.2)	351 (11.8)
Were you injured by a BB gun, pellet gun or regular gun?	2,742 (91.9)	243 (8.1)
Were you injured by being hit by something like a rock or glass?	2,689 (90.1)	296 (9.9)
Were you injured by nearly drowning?	2,910 (97.5)	75 (2.5)
Were you injured by falling?	1,984 (66.5)	1,001 (33.5)
Were you injured by being burned by fire, chemicals, electricity, or hot liquid?	2,413 (80.8)	572 (19.2)
Were you injured by an animal or serious insect bite?	2,743 (91.9)	242 (8.1)
Were you injured while riding in a car, truck or bus?	2,850 (95.5)	135 (4.5)
Were you injured while riding a bicycle, skateboard or rollerblades?	2,622 (87.8)	363 (12.2)
Were you injured while riding a motorcycle, moped, snowmobile, all-terrain vehicle (ATV)?	2,800 (93.8)	185 (6.2)
Were you injured by a team sport, athletic activity or exercise?	1,890 (63.3)	1,095 (36.7)
Were you injured by being hit by a moving vehicle while walking?	2,890 (96.8)	95 (3.2)
Were you injured by accidentally drinking or eating a dangerous substance?	2,876 (96.4)	109 (3.7)
Were you injured by being physically attacked?	2,768 (92.7)	217 (7.3)
Were you injured by being stabbed?	2,876 (96.4)	109 (3.7)
Were you injured while driving a car, truck, or bus?	2,866 (96.0)	119 (4.0)
Were you injured by getting cut, bruised, bleeding?	1,242 (41.6)	1,743 (58.4)

Table 4.2 – Frequency of Sociodemographic, Risk Behaviour, Psychosocial, and School Involvement Covariates Among Nova Scotian Adolescents

Covariate	Frequency N (%)
Sex	
Male	1,394 (46.7)
Female	1,591 (53.3)
Grade	
9	204 (6.8)
10	993 (33.3)
11	976 (32.7)
12	812 (27.2)
Weekly spending	
Unknown	806 (27.0)
< $40	1,193 (40.0)
≥ $40	986 (33.0)
Ethnicity	
White	2,508 (84.0)
Black	89 (3.0)
Asian	87 (2.9)
Aboriginal	152 (5.1)
Hispanic	36 (1.2)
Other	113 (3.8)
Smoking status	
No	2,511 (84.1)
Yes	474 (15.9)
Smoking susceptibility among non-smokers	
No	2,110 (84.0)
Yes	401 (16.0)
Drinking behaviour	
Non-drinker	1,164 (39.0)
Non binge drinker	219 (7.3)
Infrequent binge drinker	542 (18.2)
Frequent binge drinker	1,060 (35.5)
Cannabis use	
None	1,548 (51.9)
Infrequent user	554 (18.6)
Frequent user	883 (29.6)
Number of sexual partners	
None	1,622 (54.3)
One	782 (26.2)
Multiple	581 (19.5)
Absenteeism	
Did not skip	1,701 (57.0)
Skipped 1 or 2 classes	659 (22.1)
Skipped 3 or more classes	625 (20.9)

Covariate	Frequency N (%)
Academic achievement	
< 70%	828 (27.7)
≥ 70%	2,157 (72.3)
Participation in sports	
No	1,873 (62.8)
Yes	1,112 (37.3)
Depressive symptoms	
Low	2,279 (76.4)
High	706 (23.7)
Self-esteem score	
0	39 (1.3)
1	9 (0.3)
2	19 (0.6)
3	69 (2.3)
4	98 (3.3)
5	106 (3.6)
6	223 (7.5)
7	259 (8.7)
8	355 (11.9)
9	531 (17.8)
10	459 (15.4)
11	419 (14.0)
12	399 (13.4)
School connectedness score	
6	202 (6.8)
7	132 (4.4)
8	157 (5.3)
9	189 (6.3)
10	225 (7.5)
11	395 (13.2)
12	583 (19.5)
13	306 (10.3)
14	224 (7.5)
15	199 (6.7)
16	133 (4.5)
17	75 (2.5)
18	50 (1.7)
19	35 (1.2)
20	25 (0.8)
21	24 (0.8)
22	10 (0.3)
23	2 (0.1)
24	19 (0.6)

Table 4.3 – Proportion of Mechanisms of Injury Among Nova Scotian Adolescents Across Clusters

Mechanism of injury	Variable across clusters	Poly Injured (N = 1272)	Roughnecks (N = 377)	Sport-Oriented (N = 167)	Scrappers (N = 176)	Bleeding-Oriented (N = 282)	Injury Free (N = 711)	F statistic
Fight (% yes)	11.8 (10.3, 13.4)	**27.8 (25.3, 30.4)**	0.0	0.0	0.0	0.0	0.0	135.9*
Bleeding (% yes)	58.6 (55.9, 61.3)	78.5 (76.1, 80.7)	77.2 (72.5, 81.3)	0.0	100.0	100.0	0.0	986.4*
Gun (% yes)	8.2 (7.0, 9.6)	**19.2 (17.0, 21.5)**	0.0	0.0	0.0	0.0	0.0	84.4*
Hit (% yes)	9.5 (8.2, 10.9)	**22.7 (20.4, 25.1)**	0.0	0.0	0.0	0.0	0.0	101.1*
Drown (% yes)	2.6 (1.9, 3.5)	**5.7 (4.5, 7.1)**	0.0	0.0	0.0	0.0	0.0	22.9*
Fall (% yes)	33.2 (30.8, 35.8)	**47.9 (45.1, 50.8)**	**100.0**	0.0	0.0	0.0	0.0	667.3*
Burn (% yes)	19.1 (17.1, 21.4)	**44.8 (42.0, 47.7)**	0.0	0.0	0.0	0.0	0.0	291.8*
Bite (% yes)	7.75 (6.6, 9.1)	**18.41 (16.3, 20.7)**	0.0	0.0	0.0	0.0	0.0	78.7*
Driving (% yes)	3.6 (2.9, 4.5)	**9.4 (7.9, 11.2)**	0.0	0.0	0.0	0.0	0.0	32.3*

Mechanism of injury	Variable across clusters	Poly Injured (N = 1272)	Roughnecks (N = 377)	Sport-Oriented (N = 167)	Scrappers (N = 176)	Bleeding-Oriented (N = 282)	Injury Free (N = 711)	F statistic
Passenger (% yes)	5.0 (3.7, 6.8)	**10.8 (9.1, 12.7)**	0.0	0.0	0.0	0.0	0.0	47.0*
Bike (% yes)	12.5 (11.00, 14.2)	**29.3 (26.8, 32.0)**	0.0	0.0	0.0	0.0	0.0	147.2*
Motorcycle (% yes)	6.7 (5.2, 8.6)	**14.6 (12.7, 16.7)**	0.0	0.0	0.0	0.0	0.0	65.9*
Sports (% yes)	37.7 (35.2, 40.3)	45.1 (42.4, 48.0)	49.2 (43.9, 54.4)	100.0	100.0	0.0	0.0	448.6*
Pedestrian (% yes)	3.0 (2.3, 3.9)	**7.5 (6.1, 9.1)**	0.0	0.0	0.0	0.0	0.0	26.6*
Drink (% yes)	4.2 (2.9, 6.0)	**8.6 (7.1, 10.3)**	0.0	0.0	0.0	0.0	0.0	38.2*
Attack (%yes)	6.8 (5.7, 8.0)	**16.7 (14.7, 19.0**	0.0	0.0	0.0	0.0	0.0	66.6*
Stab (% yes)	3.5 (2.8, 4.5)	**8.5 (7.1, 10.2)**	0.0	0.	0.0	0.0	0.0	31.9*

* statistically significant with a *p*-value < 0.05. A Bonferroni test was performed to test the difference between clusters, numbers in bold were statistically significant with a *p*-value < 0.05.

Table 4.4 – Proportions of Sociodemographic Covariates Among Nova Scotian Adolescents Across Clusters– Comparing Between Individual Clusters as well as the Population

Independent variable	**Variable across clusters**	**Poly Injured (N = 1272)**	**Roughnecks (N = 377)**	**Sport-Oriented (N = 167)**	**Scrappers (N = 176)**	**Bleeding-Oriented (N = 282)**	**Injury Free (N = 711)**	**F statistic**
Sex								
(%male)	48.8 (46.1, 51.4)	44.2 (41.4, 47.1)	**71.8‡ (66.7, 76.4)**	48.5‡ (40.8, 56.4)	45.4‡ (38.0, 53.2)	48.6‡ (42.6, 54.7)	46.0‡ (42.2, 49.8)	19.1*
Grade								
(% grade 9)	24.1 (21.2, 27.7)	24.0 (19.7, 29.0)	22.7 (16.6, 30.3)	24.3 (12.7, 41.4)	20.7 (12.5, 32.2)	29.0 (18.8, 42.0)	24.6 (17.7, 33.2)	1.2
(% grade 10)	24.7 (22.8, 26.6)	25,2 (22.4, 28.2)	24.3 (19.7, 29.6)	31.5 (22.9, 41.7)	22.6 (16.2, 30.6)	20.6 (15.5, 26.9)	24.5 (20.8, 28.8)	
(% grade 11)	26.1 (24.1, 28.1)	26.7 (23.8, 29.8)	23.6 (18.8, 29.0)	21.1 (14.8, 29.1)	30.1 (22.2, 39.4)	25.6 (19.4, 33.1)	26.4 (22.3, 30.9)	
(% grade 12)	25.0 (23.1, 26.9)	24.4 (20.6, 28.7)	29.4 (24.4, 26.9)	23.1 (16.1, 32.1)	26.6 (19.8, 34.8)	24.7 (19.0, 31.4)	24.4 (20.6, 28.7)	
Ethnicity								
(% White)	84.5 (82.7, 86.1)	82.8 (80.5, 84.8)	84.5 (80.2, 88.0)	84.5 (80.2, 88.0)	87.2 (80.8, 91.6)	88.6 (83.9, 92.1)	81.4 (78.1, 84.2)	1.8
(% Black)	2.9 (2.2, 3.8)	3.8 (2.9, 5.1)	2.2 (1.1, 5.1)	4.5 (2.1, 9.3)	1.8 (0.5, 5.6)	2.2 (1.0, 4.6)	2.4 (1.5, 4.0)	
(% Asian)	3.2 (2.4, 4.1)	2.2‡ (1.5, 3.2)	3.0‡ (0.3, 4.1)	1.0‡ (0.3, 4.2)	2.2 (0.8, 5.2)	2.5 (1.0, 6.2)	**6.1‡ (4.5, 8.3)**	
(% Aboriginal)	4.5 (3.7, 5.5)	6.7‡ (5.4, 8.2)	4.9 (3.0, 7.8)	2.0‡ (0.8, 5.4)	5.6 (2.7, 11.1)	3.2 (1.8, 6.4)	3.2‡ (2.2, 4.9)	
(% Hispanic)	1.0 (0.7, 1.5)	0.8 (0.4, 1.6)	1.3 (0.5, 3.2)	2.9 (1.2, 6.8)	0.0	1.0 (0.2, 4.6)	2.0 (1.2, 3.4)	
(% Other)	4.0 (3.1, 5.0)	3.8 (2.8, 5.0)	4.3 (2.5, 6.9)	4.7 (2.2, 9.9)	3.3 (1.4, 7.3)	2.2 (1.0, 4.9)	4.9 (3.4, 7.0)	

Independent variable	Variable across clusters	Poly Injured (N = 1272)	Roughnecks (N = 377)	Sport-Oriented (N = 167)	Scrappers (N = 176)	Bleeding-Oriented (N = 282)	Injury Free (N = 711)	F statistic
Weekly spending								
(% unknown)	27.5 (25.1, 30.1)	23.6‡ (21.3, 26.1)	22.8‡ (18.7, 27.4)	26.8 (20.4, 34.2)	21.4‡ (15.8, 28.2)	30.0 (24.7, 35.8)	33.3‡ (29.8, 37.0)	11.4*
(% spends less than $40)	41.7 (39.0, 44.3)	38.1 (35.4, 40.9)	43.0 (37.9, 48.3)	40.3 (33.2, 48.5)	42.6 (35.1, 50.4)	39.9 (34.1, 45.9)	38.0 (34.3, 41.7)	
(% spends more than $40)	30.8 (28.6, 33.1)	**38.3‡ (35.6, 41.1)**	34.2 (29.4, 39.4)	32.6 (25.7, 40.5)	36.1 (29.0, 43.8)	30.2 (24.8, 36.1)	28.7‡ (25.4, 32.3)	

* statistically significant with a *p*-value < 0.05. A Bonferroni test was performed to test the difference between clusters and the mean, numbers in bold were statistically significant with a *p*-value < 0.05. ‡ differs significantly from at least one other cluster, with a *p*-value <0.05.

Table 4.5 – Proportions of Risk Behaviour Covariates Among Nova Scotian Adolescents Across Clusters– Comparing Between Individual Clusters as well as the Population

Independent variable	**Variable across clusters**	**Poly Injured (N = 1272)**	**Roughnecks (N = 377)**	**Sport-Oriented (N = 167)**	**Scrappers (N = 176)**	**Bleeding-Oriented (N = 282)**	**Injury Free (N = 711)**	**F statistic**
Smoking status (% yes)	14.4 (12.6, 16.3)	**22.8‡ (20.5, 25.2)**	9.5‡ (6.9, 13.0)	**5.9‡ (3.2, 10.6**)	**3.3‡ (1.4, 7.2)**	11.3‡ (8.0, 15.8)	13.7‡ (11.3, 16.5)	24.2*
Smoking susceptibility (% yes)	17.3 (15.3, 19.4)	19.4 (16.1, 23.2)	16.1 (11.6, 21.8)	14.1 (8.8, 21.9)	13.7 (8.1, 22.2)	17.9 (12.4, 25.2)	16.3 (12.7, 20.8)	1.3
Drinking behaviour								
(% no alcohol)	43.5 (40.7, 46.2)	**29.5‡ (27.0, 32.2)**	38.4‡ (33.4, 43.6)	51.1‡ (43.3, 58.9)	38.3‡ (31.2, 45.9)	41.5‡ (35.7, 47.6)	**50.1‡ (46.3, 53.9)**	25.3*
(% did not consume ≥ 5 drinks once in the last year)	6.7 (5.7, 7.9)	6.4 (5.2, 7.9)	5.7 (3.7, 8.4)	7.0 (4.1, 11.9)	3.9 (1.8, 8.2)	8.6 (5.7, 12.8)	9.5 (7.4, 12.0)	
(% drank ≥ 5 drinks once < 12 times throughout the previous year)	16.5 (14.9, 18.2)	19.1 (17.0, 21.5)	18.6 (14.8, 23.2)	15.9 (10.8, 22.7)	**25.8‡ (19.6, 33.3)**	20.6 (16.1, 26.0)	14.6‡ (12.1, 17.5)	
(% consumed ≥ 5 drinks once at least 12 times throughout the previous year)	33.4 (31.0, 35.9)	**45.0‡ (42.1, 47.8)**	37.3‡ (32.4, 42.5)	26.0‡ (19.6, 33.5)	32.0‡ (25.2, 39.7)	29.2‡ (24.0, 35.1)	**25.9‡ (22.7, 29.4)**	

Independent variable	Variable across clusters	Poly Injured (N = 1272)	Roughnecks (N = 377)	Sport-Oriented (N = 167)	Scrappers (N = 176)	Bleeding-Oriented (N = 282)	Injury Free (N = 711)	F statistic
Cannabis use								
(% none)	55.6 (53.0, 58.2)	**39.4‡ (36.6, 42.2)**	58.7‡ (53.5, 63.8)	63.2‡ (55.2, 70.5)	61.0‡ (53.3, 68.2)	54.4‡ (48.3, 60.4)	**62.1‡ (58.3, 65.7)**	34.2*
(% infrequent)	16.4 (14.8, 18.1)	**20.8 (18.6, 23.3)**	15.9 (12.4, 20.1)	15.3 (10.4, 21.9)	20.5 (15.0, 27.5)	18.7 (14.4, 23.9)	17.3 (14.5, 20.4)	
(% frequent)	28.0 (25.7, 30.4)	**39.0‡ (37.1, 42.6)**	25.4‡ (21.1, 30.2)	21.5‡ (15.5, 29.0)	18.4‡ (13.3, 24.9)	26.9‡ (21.7, 32.7)	20.7‡ (17.8, 23.9)	
Number of sexual partners								
(% none)	58.0 (55.3, 60.5)	**44.2‡ (41.4, 47.1)**	56.7‡ (51.4, 61.8)	58.6‡ (50.7, 66.2)	61.6‡ (53.8, 68.8)	60.6‡ (54.6, 66.4)	62.9‡ (59.1, 66.5)	23.3*
(% one)	23.7 (21.6, 26.0)	28.0 (25.5, 30.6)	26.6 (22.3, 31.5)	25.1 (18.9, 32.7)	28.1 (21.6, 35.6)	26.8 (21.8, 32.6)	23.0 (20.0, 26.4)	
(%, multiple)	18.4 (16.4, 20.5)	**27.8‡ (25.3, 30.5)**	16.7‡ (13.1, 21.1)	16.2‡ (11.1, 23.2)	**10.4‡ (6.5, 16.2)**	12.5‡ (9.1, 17.1)	14.1‡ (11.6, 17.0)	

* statistically significant with a *p*-value < 0.05. A Bonferroni test was performed to test the difference between clusters and the mean, numbers in bold were statistically significant with a *p*-value < 0.05. ‡ differs significantly from at least one other cluster, with a *p*-value <0.05.

Table 4.6 – Proportions and Means of Psychosocial and School Involvement Covariates Among Nova Scotian Adolescents Across Clusters – Comparing Between Individual Clusters as well as the Population

Independent variable	**Variable across clusters**	**Poly Injured (N = 1272)**	**Roughnecks (N = 377)**	**Sport-Oriented (N = 167)**	**Scrappers (N = 176)**	**Bleeding-Oriented (N = 282)**	**Injury Free (N = 711)**	**F statistic**
Absenteeism								
(%no classes)	63.7 (61.3, 66.1)	**48.4‡ (45.5, 51.2)**	60.2‡ (55.0, 65.1)	**74.8‡ (67.5, 80.9)**	69.5‡ (61.9, 76.1)	57.5‡ (51.4, 63.4)	63.5‡ (59.8, 67.1)	21.9*
(% 1 or 2)	18.8 (16.9, 20.8)	23.0 (19.0, 27.6)	23.0 (19.0, 27.6)	16.1 (11.1, 22.6)	17.7 (12.6, 24.3)	22.5 (17.8, 28.0)	19.2 (16.4, 22.4)	
(% 3 or more classes)	17.5 (16.0, 19.2)	**27.8‡ (25.3, 30.4)**	16.8‡ (13.3, 21.0)	**9.2‡ (5.6, 14.6)**	12.8‡ (8.5, 19.0)	20.0‡ (15.4, 25.4)	17.3‡ (14.6, 20.3)	
Academic achievement (% ≥ 70%)	73.6 (71.2, 75.9)	**65.8‡ (63.1, 68.5)**	**81.6‡ (77.2, 85.2)**	**87.5‡ (81.4, 91.8)**	**88.9‡ (82.9, 92.9)**	72.4‡ (66.6, 77.5)	70.5‡ (66.9, 73.9)	22.3*
Self-esteem (score from 0 to 12)	8.8 (8.7, 8.9)	**8.5‡ (8.4, 8.7)**	8.5‡ (8.3, 8.8)	**9.8‡ (9.5, 10.1)**	**9.6‡ (9.3, 9.9)**	8.4‡ (8.1, 8.7)	**9.1‡ (8.9, 9.3)**	15.4*
School connectedness (score from 6 to 24)	11.9 (11.8, 12.0)	**12.5‡ (12.2, 12.7)**	11.7‡ (11.4, 11.9)	**10.9‡ (10.5, 11.3)**	**10.7‡ (10.4, 11.1)**	12.4‡ (12.0, 12.8)	**11.3‡ (11.1, 11.6)**	22.0*
Depression (% yes)	21.3 (19.4, 23.4)	**28.5‡ (26.0, 31.1)**	21.9‡ (18.0, 26.5)	**12.0‡ (7.8, 17.9)**	16.3‡ (11.4, 22.6)	21.0 (16.6, 26.2)	17.0‡ (14.3, 20.1)	9.1*
Sports participation (% yes)	37.5 (35.0, 40.1)	35.5‡ (32.8, 38.3)	39.0‡ (34.0, 44.3)	**69.9‡ (62.1, 76.7)**	**73.8‡ (66.3, 80.2)**	**18.7‡ (14.4, 23.9)**	**28.9‡ (25.5, 32.4)**	49.7*

* statistically significant with a *p*-value < 0.05. A Bonferroni test was performed to test the difference between clusters and the mean, numbers in bold were statistically significant with a *p*-value < 0.05. ‡ differs significantly from at least one other cluster, with a *p*-value <0.05.

Chapter Five – Results: Objective Two

Chapter Five addresses the results of the statistical analyses for the second objective, which examines the profiles of the clusters identified in the first objective. Multivariable logistic regression was performed to explore the relationship between clusters and sociodemographic, risk taking behaviour, psychosocial, and school level factors. The sociodemographic covariates included sex, grade, ethnicity, and weekly spending. Risk taking behaviours included smoking status and susceptibility, drinking behaviour, cannabis use, and number of sexual partners. Finally, the psychosocial and school level factors included depressive symptoms, self-esteem, school connectedness, absenteeism, and academic achievement. Chapter Five begins by presenting the unadjusted multivariable logistic regressions; followed by multivariable logistic regressions adjusted for other covariates.

5.1 Unadjusted Multivariable Logistic Regressions with Injury Free as the Referent Group

Tables 5.1 to 5.3 present the unadjusted odds ratios of the sociodemographic, risk-taking behaviours, and psychosocial and school level covariates. Each cluster was compared to the Injury Free group. The odds of belonging to the Poly Injury cluster rather than the Injury Free cluster were decreased in Asian students and increased in Aboriginal students when compared to their white peers. Students who engaged in risk taking behaviours had increase in the odds of being members of the Poly Injury group. The odds were also increased in students who skipped classes, increasing levels of school connectedness scores, depressive symptoms, and participation in sports.

When membership to the Roughnecks cluster was compared to the Injury Free group the odds were increased in males compared to females. The odds of membership were also increased for students who engaged in both infrequent and frequent binge drinking, as well as students with averages of 70% and higher and those who participated in sports. Conversely, the odds of belonging to the Roughnecks were decreased as self-esteem score increased.

The odds of belonging to the Sport-Oriented cluster were decreased in Asian students when compared to their white counterparts, smokers compared to non-smokers, and truants compared to non-truants. On the other hand, the odds of membership were increased in students with grades of 70% and higher compared to those with lower grades, increasing levels of self-esteem scores, and students who participate in sports compared to those who do not.

Students who smoked saw a decrease in the odds of belonging the Scrappers cluster rather than the Injury Free group. The odds of membership to the Scrappers increased in infrequent binge drinkers compared to non-drinkers, students with higher grades, and those who played sports. Finally, the odds of belonging to the Bleeding-Oriented cluster decreased as self-esteem scores increased and increased as school connectedness scores increased.

5.2 Adjusted Multivariable Logistic Regressions with Injury Free as the Referent Group

Table 5.4 presents the odds ratios of the sociodemographic, risk taking behaviours, psychosocial, and school variables when they are adjusted for each other. The odds of males belonging to the Roughnecks cluster rather than the Injury

Free cluster were 2.74 times greater than female students (95% CI (1.81, 4.14)). Asian students had a decrease in the odds of belonging to the Poly Injured and Sport-Oriented groups when compared to white students (OR = 0.45, 95% CI (0.23, 0.88); OR = 0.11, 95% CI (0.03, 0.46)). Similarly, students who identified their ethnicity as "Other" when compared to white students had a decrease in the odds of being a member of the Poly Injured group (OR = 0.50, 95% CI (0.26, 0.94)). Conversely, Aboriginal students had a significantly greater odds of being in the Poly Injured cluster than their white counterparts (OR = 2.21, 95% CI (1.28, 3.83)).

Smokers when compared to non-smokers had a decrease in the odds of being associated with the Scrappers cluster (OR = 0.30, 95% CI (0.11, 0.81)). Students who engaged in infrequent binge drinking had an increase in the odds of belonging to the Poly Injury, and Scrappers clusters when compared to students who did not drink (OR = 1.65, 95% CI (1.10, 2.47); OR = 2.69, 95% CI (1.28, 5.65)). Similarly, the odds of a student engaging in frequent binge drinking were higher in the Roughnecks and Scrappers compared to non-drinkers (OR = 2.11, 95% CI (1.27, 3.50); OR = 2.67, 95% CI (1.13, 6.30)). The odds of belonging to the Poly Injured cluster, rather than the Injury Free group, increased in frequent cannabis users when compared to non-users (OR = 1.73, 95% CI (1.07, 2.79)). Conversely, the odds of frequent cannabis users being members of the Scrappers were decreased by 57% (95% CI (0.19, 0.96)) when compared to their peers who did not use cannabis.

Adolescents who had a higher academic average had an increase in the odds of being members of the Roughnecks, Sport-Oriented, and Scrappers rather than the Injury Free cluster (OR = 2.03, 95% CI (1.32, 3.14); OR = 2.95, 95% CI (1.34, 6.49);

OR = 2.25, 95% CI (1.07, 4.76)) when compared to students with average grades of less than 70%. The odds of belonging to the Roughnecks cluster decreased by a factor of 0.91 with every 1-point increase on the self-esteem scale (95% CI (0.85, 0.99)). Conversely, the odds of belonging to the Poly Injured or the Sport-Oriented groups increased by factors of 1.07 and 1.11 respectively with every 1-point increase on the school connectedness scale (95% CI (1.01, 1.13); 95% CI (1.02, 1.21)). Finally, the odds of belonging to the Poly Injured; Roughnecks; Sport-Oriented; and Scrappers clusters as opposed to the Injury Free cluster were higher for students who participated in sports compared to their counterparts who did not (OR = 1.56, 95% CI (1.15, 2.13); OR = 2.05, 95% CI (1.37, 3.06); OR = 7.55, 95% CI (4.31, 13.22); OR = 5.42, 95% CI (3.13, 9.38)).

5.3 Chapter Summary

The second objective aimed to identify relationships between clusters identified in the first objective and covariates including sociodemographic, risk taking behaviours, psychosocial, and individual school factors. In summary, Aboriginal students, infrequent binge drinkers, frequent cannabis users, those with lower school connectedness scores, and students who participate in sports have an increase in the odds ratio of being members of the Poly Injured cluster rather than the Injury Free cluster. Male students, Aboriginal adolescents, frequent binge drinkers, students with higher grades, athletes, and those with higher self-esteem have an increase in the odds of being members of the Roughnecks cluster as opposed to the Injury Free cluster.. Asian students and non-athletes had a decrease in the odds of being in the Sport-Oriented cluster both when it was compared to the

Injury Free group. Students who had higher grades and lower school connectedness had an increase in the odds of being in the Sport-Oriented cluster rather than Injury Free. Non-smokers, binge drinkers, students with higher grades, and students who played sports had greater odds of being members of the Scrappers cluster, while frequent cannabis users had a decrease in the odds. Aboriginal students, those who had multiple sexual partners, and those who played sports were less likely to fall into the Bleeding-Oriented cluster when compared to non-membership. Finally, Asian students had greater odds of belonging to the Injury Free group, while Aboriginal students, infrequent binge drinkers, those with higher school connectedness, and students who participated in sports had a decrease in the odds of being injury free.

5.4 Tables

Table 5.1 – Unadjusted Separate Multivariable Logistic Regressions Between Sociodemographic Covariates Among Nova Scotian Adolescents and Membership to Each Cluster Compared to the Injury Free Cluster

Independent variable	**Poly Injured (N = 1272)**		**Roughnecks (N = 377)**		**Sport-Oriented (N = 167)**		**Scrappers (N = 176)**		**Bleeding-Oriented (N = 282)**	
	OR	CI(95%)	OR	CI(95%)	OR	CI(95%)	OR	CI(95%)	OR	CI(95%)
Sex										
Female	Ref		Ref		Ref		Ref		Ref	
Male	0.93	(0.70, 1.25)	**2.90**	**(1.97, 4.26)**	1.52	(0.91, 2.54)	0.83	(0.53, 1.30)	1.16	(0.74, 1.82)
Grade										
9	Ref		Ref		Ref		Ref		Ref	
10	1.05	(0.63, 1.76)	1.07	(0.58, 1.98)	1.30	(0.51, 3.33)	1.10	(0.49, 2.43)	0.71	(0.34, 1.51)
11	1.04	(0.62, 1.74)	0.97	(0.52, 1.80)	0.81	(0.32, 2.08)	1.36	(0.61, 3.01)	0.82	(0.39, 1.75)
12	1.01	(0.60, 1.68)	1.31	(0.71, 2.39)	0.96	(0.37, 2.49)	1.30	(0.60, 2.83)	0.85	(0.41, 1.80)
Ethnicity										
White	Ref		Ref		Ref		Ref		Ref	
Black	1.57	(0.76, 3.21)	1.55	(0.51, 4.67)	1.58	(0.53, 4.67)	0.72	(0.16, 3.26)	0.60	(0.22, 1.60)
Asian	**0.42**	**(0.22, 0.80)**	0.64	(0.27, 1.54)	**0.12**	**(0.03, 0.53)**	0.32	(0.10, 1.05)	0.52	(0.17, 1.58)
Aboriginal	**2.46**	**(1.42, 4.29)**	1.79	(0.85, 3.78)	0.52	(0.17, 1.61)	2.13	(0.79, 5.72)	0.85	(0.38, 1.94)
Hispanic	0.52	(0.20, 1.33)	0.67	(0.23, 1.95)	1.33	(0.45, 3.93)	1.00	-	0.90	(0.14, 5.65)
Other	0.70	(0.39, 1.28)	1.00	(0.45, 2.22)	0.93	(0.33, 2.60)	0.41	(0.15, 1.10)	0.45	(0.14, 1.52)
Weekly spending										
Spends less than $40	Ref		Ref		Ref		Ref		Ref	
Spends more than $40	1.24	(0.88, 1.75)	0.90	(0.60, 1.36)	1.15	(0.67, 1.97)	1.01	(0.60, 1.70)	1.06	(0.67, 1.68)
Unknown	**0.63**	**(0.44, 0.90)**	**0.50**	**(0.32, 0.78)**	0.93	(0.46, 1.88)	**0.44**	**(0.25, 0.79)**	1.35	(0.78, 2.32)

Numbers in bold are statistically significant (p <0.05).

Table 5.2 – Unadjusted Separate Multivariable Logistic Regressions Between Risk Taking Covariates Among Nova Scotia Adolescents and Membership to Each Cluster Compared to the Injury Free Cluster

Independent variable	**Poly Injured (N = 1272)**		**Roughnecks (N = 377)**		**Sport-Oriented (N = 167)**		**Scrappers (N = 176)**		**Bleeding-Oriented (N = 282)**	
	OR	CI(95%)	OR	CI(95%)	OR	CI(95%)	OR	CI(95%)	OR	CI(95%)
Smoking status										
No	Ref		Ref		Ref		Ref		Ref	
Yes	**2.30**	**(1.64, 3.22)**	0.85	(0.52, 1.39)	**0.43**	**(0.12, 0.98)**	**0.18**	**(0.07, 0.44)**	0.84	(0.48, 1.46)
Smoking susceptibility										
No	Ref		Ref		Ref		Ref		Ref	
Yes	1.08	(0.75, 1.56)	1.00	(0.62, 1.61)	0.91	(0.50, 1.66)	0.91	(0.47, 1.75)	1.14	(0.68, 1.90)
Drinking behaviour										
No alcohol	Ref		Ref		Ref		Ref		Ref	
Did not consume ≥ 5 drinks once in the last year	1.40	(0.88, 2.21)	0.83	(0.44, 1.57)	0.72	(0.32, 1.64)	0.86	(0.30, 2.46)	1.00	(0.49, 2.01)
Drank ≥ 5 drinks once < 12 times throughout the previous year	**2.18**	**(1.50, 3.15)**	**1.80**	**(1.12, 2.88)**	1.22	(0.62, 2.41)	**2.52**	**(1.41, 4.49)**	1.38	(0.80, 2.36)
Consumed ≥ 5 drinks once at least 12 times throughout the previous year	**2.79**	**(1.96, 3.95)**	**1.80**	**(1.19, 2.73)**	0.87	(0.48, 1.57)	1.54	(0.90, 2.66)	1.09	(0.65, 1.82)
Cannabis use										
None	Ref		Ref		Ref		Ref		Ref	
Infrequent	**1.92**	**(1.37, 2.69)**	0.94	(0.60, 1.46)	0.72	(0.40, 1.31)	1.08	(0.62, 1.89)	1.13	(0.67, 1.89)
Frequent	**3.05**	**(2.14, 4.36)**	1.29	(0.84, 1.98)	1.01	(0.55, 1.84)	0.66	(0.38, 1.13)	1.32	(0.79, 2.20)
Number of sexual partners										
None	Ref		Ref		Ref		Ref		Ref	
One	**1.52**	**(1.05, 2.20)**	1.09	(0.71, 1.70)	1.46	(0.69, 3.07)	1.04	(0.61, 1.77)	1.10	(0.66, 1.83)
Multiple	**2.80**	**(1.96, 4.00)**	1.28	(0.81, 2.03)	1.39	(0.75, 2.56)	0.65	(0.33, 1.31)	0.73	(0.42, 1.27)

Numbers in bold are statistically significant (p <0.05).

Table 5.3 – Unadjusted Separate Multivariable Logistic Regressions Between Psychosocial and Individual School Covariates Among Nova Scotia Adolescents and Membership to Each Cluster Compared to the Injury Free Cluster

Independent variable	**Poly Injured (N = 1272)**		**Roughnecks (N = 377)**		**Sport-Oriented (N = 167)**		**Scrappers (N = 176)**		**Bleeding-Oriented (N = 282)**	
	OR	CI(95%)	OR	CI(95%)	OR	CI(95%)	OR	CI(95%)	OR	CI(95%)
Absenteeism										
No classes	Ref		Ref		Ref		Ref		Ref	
1 or 2 classes	**1.84**	**(1.31, 2.58)**	1.23	(0.83, 1.81)	0.76	(0.42, 1.38)	0.80	(0.47, 1.38)	1.08	(0.68, 1.71)
3 or more classes	**2.26**	**(1.66, 3.08)**	1.12	(0.73, 1.71)	**0.40**	**(0.22, 0.76)**	0.64	(0.35, 1.18)	1.27	(0.77, 2.10)
Academic achievement										
< 70%	Ref		Ref		Ref		Ref		Ref	
≥ 70%	**0.65**	**(0.49, 0.86**)	**1.83**	**(1.25, 2.69)**	**2.99**	**(1.59, 5.64)**	**2.48**	**(1.27, 4.85)**	0.93	(0.55, 1.57)
Self-esteem										
Low to high	**0.92**	**(0.87, 0.97)**	**0.91**	**(0.85, 0.97)**	**1.14**	**(1.01, 1.28)**	1.09	(1.00, 1.19)	**0.90**	**(0.83, 1.57)**
School connectedness										
Low to high	**1.10**	**(1.05, 1.15)**	1.03	(0.98, 1.09)	0.96	(0.91, 1.02)	0.94	(0.89, 1.00)	**1.09**	**(1.02, 1.16)**
Depression										
No	Ref		Ref		Ref		Ref		Ref	
Yes	**1.75**	**(1.22, 2.52)**	1.31	(0.84, 2.04)	0.57	(0.30, 1.12)	0.95	(0.52, 1.74)	1.07	(0.64, 1.77)
Sports participation										
No	Ref		Ref		Ref		Ref		Ref	
Yes	**1.42**	**(1.05, 1.92)**	**1.82**	**(1.26, 2.64)**	**6.46**	**(3.82, 10.90)**	**5.36**	**(3.23, 8.88)**	0.67	(0.41, 1.09)

Numbers in bold are statistically significant (p <0.05).

Table 5.4 – Multivariable Logistic Regressions Between Sociodemographic, Risk Behaviour, Psychosocial, and School Covariates Among Nova Scotian Adolescents and Membership to Each Cluster Compared to the Injury Free Cluster

Independent variable	**Poly Injured (N = 1272)**		**Roughnecks (N = 377)**		**Sport-Oriented (N = 167)**		**Scrappers (N = 176)**		**Bleeding-Oriented (N = 282)**	
	OR	CI(95%)	OR	CI(95%)	OR	CI(95%)	OR	CI(95%)	OR	CI(95%)
Sex										
Female	Ref		Ref		Ref		Ref		Ref	
Male	0.95	(0.69, 1.31)	**2.74**	**(1.81, 4.14)**	1.47	(0.90, 2.39)	0.70	(0.42, 1.19)	1.08	(0.68, 1.72)
Grade										
9	Ref		Ref		Ref		Ref		Ref	
10	0.90	(0.53, 1.52)	1.15	(0.60, 2.19)	2.04	(0.87, 4.78)	1.13	(0.48, 2.65)	0.73	(0.37, 1.45)
11	0.80	(0.46, 1.39)	1.13	(0.57, 2.25)	1.17	(0.50, 2.75)	1.14	(0.49, 2.68)	0.82	(0.40, 1.66)
12	0.68	(0.38, 1.22)	1.56	(0.75, 3.21)	1.47	(0.59, 3.63)	1.31	(0.53, 3.28)	0.87	(0.43, 1.75)
Ethnicity										
White	Ref		Ref		Ref		Ref		Ref	
Black	1.40	(0.68, 2.91)	1.67	(0.55, 5.11)	2.33	(0.67, 8.07)	1.45	(0.39, 5.33)	0.70	(0.26, 1.88)
Asian	**0.45**	**(0.23, 0.88)**	0.59	(0.25, 1.43)	**0.11**	**(0.03, 0.46)**	0.31	(0.09, 1.08)	0.53	(0.18, 1.55)
Aboriginal	**2.21**	**(1.28, 3.83)**	**2.05**	**(1.03, 4.07)**	0.72	(0.21, 2.52)	2.90	(0.99, 8.47)	0.92	(0.41, 2.06)
Hispanic	0.47	(0.14, 1.55)	0.52	(0.15, 1.83)	1.69	(0.43, 6.54)	1.00	-	1.11	(0.22, 5.60)
Other	**0.50**	**(0.26, 0.94)**	0.93	(0.43, 1.99)	1.31	(0.42, 4.07)	0.51	(0.18, 1.41)	0.44	(0.11, 1.67)
Weekly spending										
Spends less than $40	Ref		Ref		Ref		Ref		Ref	
Spends more than $40	1.23	(0.88, 1.74)	0.95	(0.60, 1.51)	1.14	(0.64, 2.03)	1.21	(0.63, 2.33)	0.92	(0.58, 1.45)
Unknown	0.94	(0.66, 1.33)	0.90	(0.58, 1.40)	1.87	(0.98, 3.57)	0.92	(0.49, 1.70)	0.94	(0.53, 1.66)
Smoking status										
No	Ref		Ref		Ref		Ref		Ref	
Yes	1.29	(0.88, 1.89)	0.70	(0.41, 1.19)	0.68	(0.25, 1.80)	**0.30**	**(0.11, 0.81)**	0.65	(0.38, 1.12)
Smoking susceptibility										
No	Ref		Ref		Ref		Ref		Ref	
Yes	1.40	(0.93, 2.1)	0.90	(0.54, 1.49)	0.68	(0.32, 1.43)	0.62	(0.30, 1.26)	1.16	(0.67, 2.01)

Independent variable	Poly Injured (N = 1272)		Roughnecks (N = 377)		Sport-Oriented (N = 167)		Scrappers (N = 176)		Bleeding-Oriented (N = 282)	
	OR	CI(95%)	OR	CI(95%)	OR	CI(95%)	OR	CI(95%)	OR	CI(95%)
Drinking behaviour										
No alcohol	Ref		Ref		Ref		Ref		Ref	
Did not consume ≥ 5 drinks once in the last year	1.20	(0.78, 1.86)	0.87	(0.45, 1.70)	0.67	(0.28, 1.59)	1.15	(0.38, 3.46)	1.15	(0.59, 2.23)
Drank ≥ 5 drinks once < 12 times throughout the previous year	**1.65**	**(1.10, 2.47)**	1.61	(0.97, 2.70)	0.82	(0.36, 1.87)	**2.69**	**(1.28, 5.65)**	1.44	(0.81, 2.55)
Consumed ≥ 5 drinks once at least 12 times throughout the previous year	1.45	(0.98, 2.16)	**2.11**	**(1.27, 3.50)**	0.49	(0.24, 1.03)	**2.67**	**(1.13, 6.30)**	1.01	(0.59, 1.73)
Cannabis use										
None	Ref		Ref		Ref		Ref		Ref	
Infrequent	1.44	(0.99, 2.09)	0.70	(0.45, 1.15)	0.82	(0.42, 1.61)	0.64	(0.32, 1.30)	1.12	(0.65, 1.94)
Frequent	**1.73**	**(1.07, 2.79)**	1.09	(0.60, 1.99)	1.49	(0.769 3.21)	**0.43**	**(0.19, 0.96)**	1.50	(0.87, 2.58)
Number of sexual partners										
None	Ref		Ref		Ref		Ref		Ref	
One	1.00	(0.65, 1.54)	0.71	(0.40, 1.27)	1.34	(0.67, 2.68)	0.75	(0.38, 1.48)	0.96	(0.54, 1.68)
Multiple	1.34	(0.88, 2.06)	0.97	(0.56, 1.71)	2.15	(0.96, 4.83)	0.45	(0.19, 1.10)	0.63	(0.34, 1.17)
Absenteeism										
No classes	Ref		Ref		Ref		Ref		Ref	
1 or 2 classes	1.26	(0.90, 1.76)	0.93	(0.59, 1.47)	0.83	(0.42, 1.65)	0.89	(0.47, 1.70)	1.02	(0.64, 1.65)
3 or more classes	1.33	(0.9,3 1.91)	0.94	(0.56, 1.59)	0.51	(0.23, 1.09)	0.84	(0.43, 1.65)	1.18	(0.71, 1.95)
Academic achievement										
< 70%	Ref		Ref		Ref		Ref		Ref	
≥ 70%	1.11	(0.81, 1.51)	**2.03**	**(1.32, 3.14)**	**2.95**	**(1.34, 6.49)**	**2.25**	**(1.07, 4.76)**	1.08	(0.63, 1.87)
Self-esteem										
Low to high	0.98	(0.92, 1.04)	**0.91**	**(0.85, 0.99)**	1.08	(0.95, 1.23)	1.02	(0.91, 1.15)	0.92	(0.83, 1.03)
School connectedness										
Low to high	**1.07**	**(1.01, 1.13)**	1.05	(0.98, 1.12)	**1.11**	**(1.02, 1.21)**	1.05	(0.95, 1.15)	1.08	(1.00, 1.18)

Independent variable	**Poly Injured (N = 1272)**		**Roughnecks (N = 377)**		**Sport-Oriented (N = 167)**		**Scrappers (N = 176)**		**Bleeding-Oriented (N = 282)**	
	OR	CI(95%)	OR	CI(95%)	OR	CI(95%)	OR	CI(95%)	OR	CI(95%)
Depression										
No	Ref		Ref		Ref		Ref		Ref	
Yes	1.35	(0.96, 1.90)	0.92	(0.55, 1.55)	0.80	(0.35, 1.83)	1.45	(0.68, 3.08)	0.68	(0.35, 1.30)
Sports participation										
No	Ref		Ref		Ref		Ref		Ref	
Yes	**1.56**	**(1.15, 2.13)**	**2.05**	**(1.37, 3.06)**	**7.55**	**(4.31, 13.22)**	**5.42**	**(3.13, 9.38)**	0.77	(0.05, 2.93)

Numbers in bold are statistically significant (p <0.05).

Chapter Six – Discussion

The purpose of this thesis was to examine clusters of mechanisms of injuries among Canadian adolescents using data from the Health Behaviour Supplement, which provides useful injury information from across Nova Scotia. The results of this thesis provide preliminary information regarding patterns of adolescent injuries, as well as several characteristics associated with said patterns.

The following two objectives were fulfilled in this thesis:

1: To identify any existing clusters of mechanisms of injuries among Nova Scotian adolescents using the Health Behaviour Supplement.

2: To examine any associations between clusters identified in the first objective and sociodemographic, risk taking behaviours, psychosocial and individual school correlates.

The major findings of both objectives are summarized and discussed in this chapter, while reflecting on the existing injury literature. Although the literature on adolescent injury is substantial, information regarding injury patterns is limited and this study is unique in that it is the first to use a cluster analysis to identify injury patterns among Canadian adolescents. The discussion will center on the six injury clusters identified as well as associations those clusters have with sociodemographic and psychosocial indicators. The discussion will conclude with a presentation of limitations of the project, implications of the findings, and next steps for research initiatives.

6.1 Cluster Profiles

The first objective focused on identifying and describing clusters of mechanisms of injury. Six clusters were identified and were named based on the proportions of mechanisms of injury in each cluster. The clusters were as follows: Poly Injured, Roughnecks, Sport-Oriented, Scrappers, Bleeding-Oriented, and Injury Free. As the name suggests the Poly Injured cluster contained 1272 students who had sustained one or more injuries of varying mechanisms. The Roughnecks cluster had 377 students who were injured while falling, playing sports, and bled. The 167 students in the Sport-Oriented group were all injured while playing sports and sustained no other forms of injuries. The Scrappers cluster had 176 students who were injured while playing sports and who bled. The 282 Bleeding-Oriented students sustained solely injuries that bled. Finally, the 711 students who belonged to the Injury Free cluster experienced zero injuries during the past six months.

The Poly Injury cluster differed significantly compared to all other clusters for all but two mechanisms of injury, bleeding and sports injuries. Generally, students in the Poly Injured cluster spent more money per week, engaged in risky behaviours, skipped school, had lower grades, higher self-esteem, poorer school connectedness, more depressive symptoms, and did not play sports. Previous research has shown that there is a positive relationship between multiple risk taking behaviours and adolescents sustaining multiple injuries (74).

Students who fell into the Roughnecks category were mostly males, had grades of 70% or higher, and had higher self-esteem scores. The Sport-Oriented group consisted of students who did not engage in smoking, binge drinking, and truancy. The cluster also contained students with higher averages, lower self-

esteem, students who felt more connected to their school, and athletes. Studies have shown that students who participate in sports are less likely to engage in risky behaviours (75). Intuitively, it makes sense that students who participate in sports would injure themselves while playing sports.

The Scrappers cluster had fewer students who engaged in risk taking behaviours, except for infrequent binge drinking. Students who were Scrappers also generally had higher grades, lower self-esteem, higher school connectedness, and had the greatest percentage of students who played sports. Students in the Bleeding-Oriented group tended to have higher self-esteem, lower school connectedness, and did not play sports.

Finally, those in the Injury Free cluster made up the highest percentage of Asian students and consisted of mostly students who did not exhibit risk-taking behaviours. Injury Free students also had lower self-esteem scores and tended to not participate in sports. These findings support existing literature that identifies a positive relationship between risky behaviours and sports with injuries (42,43,52). Cluster profiles are summarized in table 6.1.

Previous studies that identified injury patterns among Swedish adolescents grouped injuries based on a combination of mechanisms and bodily locations of injuries (55,56). Similarly to this project one study found a cluster that involved injuries from falls and another that were related to sports (55). However, both studies only looked at the proportions of grade and sex in each group, which found that females were more represented in the falls group, whereas this study found that there was a higher proportion of males in the Roughnecks cluster, which

involved falls. The current thesis adds to the literature by examining the proportions of multiple variables for each cluster profile. It is also the first study to use cluster analysis to identify patterns across multiple mechanisms of injury, grouping students rather than injuries.

6.2 Cluster Membership and Associated Sociodemographic and Psychosocial Characteristics

The second objective tested associations between cluster membership and different correlates, and assessed the relative strength of those associations. In synopsis, female students, as well as those who are Aboriginal, those who engage in risky behaviours, truants, those who feel less connected to their school, students exhibiting depressive symptoms, and those who play sports all have an increase in the odds of belonging to the Poly Injured cluster. As expected, the association between Aboriginal students, risk-taking behaviours, truancy, depression, sports, lower school connectedness and injuries supports the literature that already exists on the subject (43,46,52,53,60,76,77). However, the positive association between Poly Injury membership and female students contradicts findings from previous studies (12). As the Poly Injury cluster was the least homogenous group this may have affected the results.

Male students, as well as frequent binge drinkers, those who do not engage in cannabis use, students with higher grades, those with higher self-esteem, and students who play sports had a greater odds of being members of the Roughnecks cluster. Aboriginal students, those who had multiple sexual partners, and those who

played sports had a decrease in the odds of falling into the Bleeding-Oriented clusters.

Asian students, as well as frequent binge drinkers, and truants had a decrease in the odds of being members of the Sport-Oriented cluster. Conversely, students with higher grades, adolescents that felt less connected to their school and those who engaged in sports had an increase in the odds of being belonging to the aforementioned cluster. It is possible that these associations are linked to the culture around sports, which is played more often by white students who engage in fewer risky behaviours (75,78). The same logic could be applied to the Scrappers group, which had a positive association with being non-smokers, binge drinkers, and students who played sports and had a negative relationship with frequent cannabis users.

Lastly, Asian students had an increase in the odds of being injury free, while Aboriginal students, infrequent binge drinkers, those with higher school connectedness, and students who participated in sports were less likely to be injury free. These findings corroborate previous research that indicates adolescents who do not engage in risky behaviours as well as those who do not participate in sports and feel connected to their school are less likely to sustain injuries (42,43,60,63). Cluster membership and the associated sociodemographic and psychosocial characteristics are summarized in table 6.2.

6.3 Implications

The findings of this project identifying patterns of adolescent injuries have several important implications, not only for the adolescent injury literature but also

for injury prevention. This thesis provides descriptive information regarding types of injuries that are prevalent amongst Nova Scotian adolescents. A typology of mechanisms of injury has never been produced for adolescents until now. The results of this thesis help us understand the relationships between mechanisms of injury as well as how they interact with individual factors. The prevalence of adolescent injuries in the Canadian population continues to rise; however, by having a better concept of how injuries and student characteristics interact we can not only increase our knowledge for the sake of knowledge but also have a practical impact as well.

Although the findings from this thesis cannot predict which students are more likely to be injured, the information regarding associations between individual characteristics and types of injuries may still be useful in prevention practices. If parents, teachers, and students are aware that associations exist between individual characteristics and types of injuries they may be able to create more specific prevention methods. Perhaps students who have a higher likelihood of belonging to a certain cluster should receive more tailored information about adolescent injuries. For example, students who have an increase in the odds of belonging to the Poly Injured cluster may benefit from initiatives that would reduce risky behaviour such as the Life Skills Training sessions, which have been shown to reduce risk taking behaviours long term by using cognitive behavioural techniques (79).

Parachute Canada currently has several injury prevention strategies in place, perhaps most notably the No Regrets leadership program (80). No Regrets gives adolescents the opportunity to take ownership of their health and safety by

promoting protective behaviours to their peers at school. By involving students themselves in the prevention practice they may be more likely to adopt safe behaviours long term. The No Regrets program may benefit from the results of this thesis by updating their informational packages, which include webinars, videos, and school activities, to include the cluster profiles. Students and those involved with the initiative would then have a more complete picture of what they should be looking out for and which cluster they may fall into.

Several elementary schools in Oklahoma implemented an injury prevention curriculum with positive results (81). Students were taught about injuries overtly as well as subtly and the project incorporated the parents as well by gifting free bike helmets if the parents completed a questionnaire. One of the main benefits found during the implementation of the curriculum was the fact that the main ideas were touched upon each year, consistently reminding students of safe practices. With the new knowledge of the clusters some activities in the curriculum could be updated. Students may complete a personal quiz to determine which cluster they have a greater chance of belonging to and see what specific prevention strategies apply to them, whether that be reduce their alcohol consumption or work closely with their teacher to raise their grades. Intervention methods may also be more effective if delivered in targeted settings, such as during soccer practice rather than the classroom. The cluster profiles may also be beneficial to guidance counselors and school administrators. For example, a guidance counselor would have an idea if a student's grades were slipping or if they were skipping classes and they could identify those students of having an increase in the odds of belonging to the Poly

Injured cluster or if a student is often injured they might support that student's school attendance or maintaining their grades. However, more research needs to be done to understand whether the independent variables act as predictors of cluster membership to identify which students will require advanced help.

To ensure schools, parents, coaches, and the adolescents themselves are aware of these findings and understand how they may apply to them it may be helpful to create some educational resources. This may include brochures or an infographic that identify each of the clusters and who belongs to them. These could be distributed to guidance counselors, doctor's offices, athletic associations, etc. The results should also be presented at conferences whose audiences include key stakeholders such as school administrators, coaches, and doctors who could then disseminate the information to both parents and adolescents.

Although there have been studies that have examined potential injury patterns among both adolescents and adults (55,56,59), this project was the first to group the students rather than the injuries, which allows for a more holistic cluster profile. By looking at the proportions of multiple variables among groups of students we were able to piece together a more complete picture of who belonged to each cluster. When examining the relationships between the clusters and correlates many agreed with the existing literature that identifies certain characteristics as protective or risk factors such as risk taking behaviours increasing the odds of sustaining one or more injuries (60,74). However, many of these correlates saw similar relationships in more than one cluster; therefore, by looking at the associations of multiple variables we were able to identify unique lists of

associations for each cluster. Subsequently, if one were to try and identify which injury pattern a student would have the highest odds of belonging to they would need to look at every variable so as not to presume membership to the wrong cluster.

The results indicate that injury patterns do exist, which adds to our understanding of how mechanisms of injury are related to each other. Even though we cannot predict membership to a specific cluster we can say that there are significant groups of students who have only been injured by one mechanism, or by multiple, or have never been injured. Once the fact that injury patterns exist is accepted, perhaps people will dispel the notion that injuries are random. By recognizing the fact that certain mechanisms of injury group together preventative measures can be initiated to target students that are injured by multiple mechanisms; by sports, falling, and result in bleeding; by sports and result in bleeding; by sports; and by bleeding.

It is important to note that the Poly Injured group was the most heterogeneous cluster; however, there are still some unique take away messages regarding group membership especially when compared to the Injury Free cluster. In general, Aboriginal students, students who engaged in risky behaviours as well as those who did not feel connected to their school had an increase in the odds of falling into the Poly Injured cluster rather than the Injury Free group. The implementation of prevention methods that target risk taking behaviours and attempting to foster welcoming and inclusive school environments might impact

how many students sustain zero injuries when they were at risk of sustaining multiple.

6.4 Limitations

As is the case in many cross sectional survey based studies causality cannot be inferred with the HBS dataset. The questions asked in both the HBS and YSS do not give a timeline of when the injuries and the co-occurrences took place. It is therefore impossible to determine if a covariate occurred prior to or after an injury. Furthermore, we cannot claim that correlates may act as predictors for cluster membership, only that an association exists. The variables are considered to be bidirectional as the correlates may influence injuries, yet the relationship may very well work in the other direction. For example, does truancy lead to injury or do students skip classes after sustaining an injury, or are they both the result of a third unmeasured factor?

The responses collected in the HBS and YSS are all self-reported, which although it can provide insight into participant perceptions, they can pose their own set of problems. Although students were told repeatedly that their answers were anonymous it is possible that they were concerned that their peers, teachers, or family would learn of their responses and that may have affected their answers. Response bias may also lead students to answer the questions in a certain way, whether that is conservatively or liberally regardless of what happened.

Although both the YSS and HBS asked students many questions on their health behaviours there were some variables that were missing that could have added to the research. The Haddon's Matrix outlined in Chapter Two (Table 2.2) did

not have any variables in the Agent/Vehicle column and only one in the Physical environment column. To predict and therefore prevent injuries a complete understanding of the injury event must be taken into account. Therefore, questions regarding intentionality of injury (self-inflicted, violence) could have added to the Agent/Vehicle column, while questions regarding the physical environment (rural/urban, the location of where the injury took place, etc.) would also have helped fill the Haddon's Matrix.

It should also be noted that the data used in this study was only from the province of Nova Scotia. Although this is still valuable information it may not accurately represent injury culture in other parts of Canada. The data is 7 years old and may no longer accurately represent the injury culture in Nova Scotian adolescents. Although adolescent injuries are still very prevalent in Nova Scotia the proportion of mechanisms of injuries may have changed over the years. However, the HBS has not been included in the YSS/CSTADS since the 2010-2011 cycle; therefore, it is the most recent data available.

As mentioned in Chapter 3, there is a potential limitation with cluster analysis. Cluster analysis imposes a hierarchical structure on the data regardless of whether one exists or not. It is possible that that is the case with this project; however, ANOVAs, stopping rules, and silhouette coefficients were used to validate the clusters that were produced.

Although there are several limitations to this study, as outlined above, the results are important as they are the first to explore naturally occurring patterns of

injury. The project is the first of its kind to look at patterns across a broad range of mechanisms of injury and to do so using cluster analysis.

6.5 Directions for Future Research

As previously mentioned, due to the cross-sectional nature of this study temporality and therefore causality cannot be inferred. Future studies should aim to collect data over a longer period in order to gain insight into when injuries take place compared to correlates. By doing so correlates can then be identified as either predictors of cluster membership or outcomes.

The Adolescent Injury Checklist on the HBS also asks questions regarding the severity of the injury and if any drugs or alcohol had been consumed at the time of injury. Separate analyses should be done in the future to ascertain if severity plays a role in injury patterns as well as being under the influence.

Finally, if future injury surveys are being prepared questions surrounding intentional injuries should be included. This project touches on several psychosocial variables; however, the injury checklist did not have any questions about whether or not a student has sustained a self-inflicted injury in the past six months. As outlined in Chapter Two, intentional injuries are of great concern and it would be very illuminating to see where they lie in injury patterns.

6.6 Concluding Remarks

The results of this thesis shed some light on groupings of injuries that exist among young Nova Scotians. Although Nova Scotia is one of the smaller provinces, adolescent injury is a concern for the entire country. Adolescent injuries not only impact the individual and those around them, but the national economy as well

seeing as injuries greatly burden our health care system and disrupt adolescents during productive years of educational and occupational attainment. However, by educating stakeholders, implementing prevention practices and creating interventions the prevalence of adolescent injuries can be reduced.

This project is the first to use cluster analysis to identify preexisting patterns of mechanisms of injury using Nova Scotian data and expands our understanding of adolescent injuries. The main take away from the project's results is the existence of 6 clusters in the HBS dataset: Poly Injured; Roughnecks; Sport-Oriented; Scrappers; Bleeding-Oriented; and Injury Free; indicating that a pattern exists and injuries are therefore not random. Several associations were found between individual characteristics and membership to certain clusters; however, further research needs to be done to determine if these variables can be considered predictors or outcomes of cluster membership.

This thesis adds to the descriptive research of the epidemiology of adolescent injuries, and provides a foundation for future projects to work from to further understand the relationships between sociodemographic, risk taking behaviours, psychosocial, school factors and injury clusters. It is difficult to lessen the burden that injuries have on Canadian adoelscents; by garnering a better understanding of patterns that exist we can continue to better equip ourselves to take on this public health issue.

6.7 Tables

Table 6.1 – Variables Among Nova Scotian Adolescents with Significant Proportions and Means Among Cluster Populations

Cluster	**Significant Variables**
Poly Injured (N = 1272)	• High spenders • Risky behaviours • Skip classes • Lower grades
Roughnecks (N = 377)	• Male students
Scrappers (N = 176)	• Non-smokers • Infrequent binge drinkers • Higher grades • Engage in sports
Bleeding Oriented (N = 282)	• Do not engage in sports
Sport Oriented (N = 167)	• Non-smokers • Do not skip classes • Higher grades • Engage in sports
Injury Free (N = 711)	• Asian students • Teetotalers • Higher self-esteem • Do not engage in sports

Table 6.2 – Cluster Membership and Associated Sociodemographic and Psychosocial Characteristics Among Nova Scotian Adolescents

Cluster	**Sociodemographic and Psychosocial Characteristics Associated with Cluster Membership**
Poly Injured (N = 1272)	• ↑ OR Aboriginal students (OR 2.21, 95% CI (1.28, 3.83)), infrequent binge drinkers (OR 1.65, 95% CI (1.10, 2.47)), frequent cannabis users (OR 1.73, 95% CI (1.07, 2.79)), school connectedness score (OR 1.07, 95% CI (1.01, 1.13)), athletes (OR 1.56, 95% CI (1.15, 2.13)) • ↓ OR Asian students (OR 0.23, 95% CI (0.23, 0.88))
Roughnecks (N = 377)	• ↑ OR males (OR 2.74, 95% CI (1.81, 4.14)), Aboriginal students (OR 2.05, 95% CI (1.03, 4.07)), frequent binge drinkers (OR 2.11, 95% CI (1.27, 3.50)), higher grades (OR 2.03, 95% CI (1.32, 3.14)), athletes (OR 2.05, 95% CI (1.37, 3.06)) • ↓ OR self-esteem score (OR 0.91, 95% CI (0.85, 0.99))
Scrappers (N = 176)	• ↑ OR infrequent and frequent binge drinkers (OR 2.69, 95% CI (1.28, 5.65); OR 2.67, 95% CI (1.13, 6.30)), higher grades (OR 2.25, 95% CI (1.07, 4.76)), depressive symptoms (OR 5.42, 95% CI (3.13, 9.38)) • ↓ OR smokers (OR 0.30, 95% CI (0.11, 0.81)), frequent cannabis users (OR 0.43, 95% CI (0.19, 0.96))
Bleeding Oriented (N = 282)	• No ORs were statistically significant
Sport Oriented (N = 167)	• ↑ OR higher grades (OR 2.95, 95% CI (1.34, 6.49)), school connectedness score (OR 1.11, 95% CI (1.02, 1.21)), depressive symptoms (OR 7.55, 95% CI (4.31, 13.22)) • ↓ OR Asian students (OR 0.11, 95% CI (0.03, 0.46))

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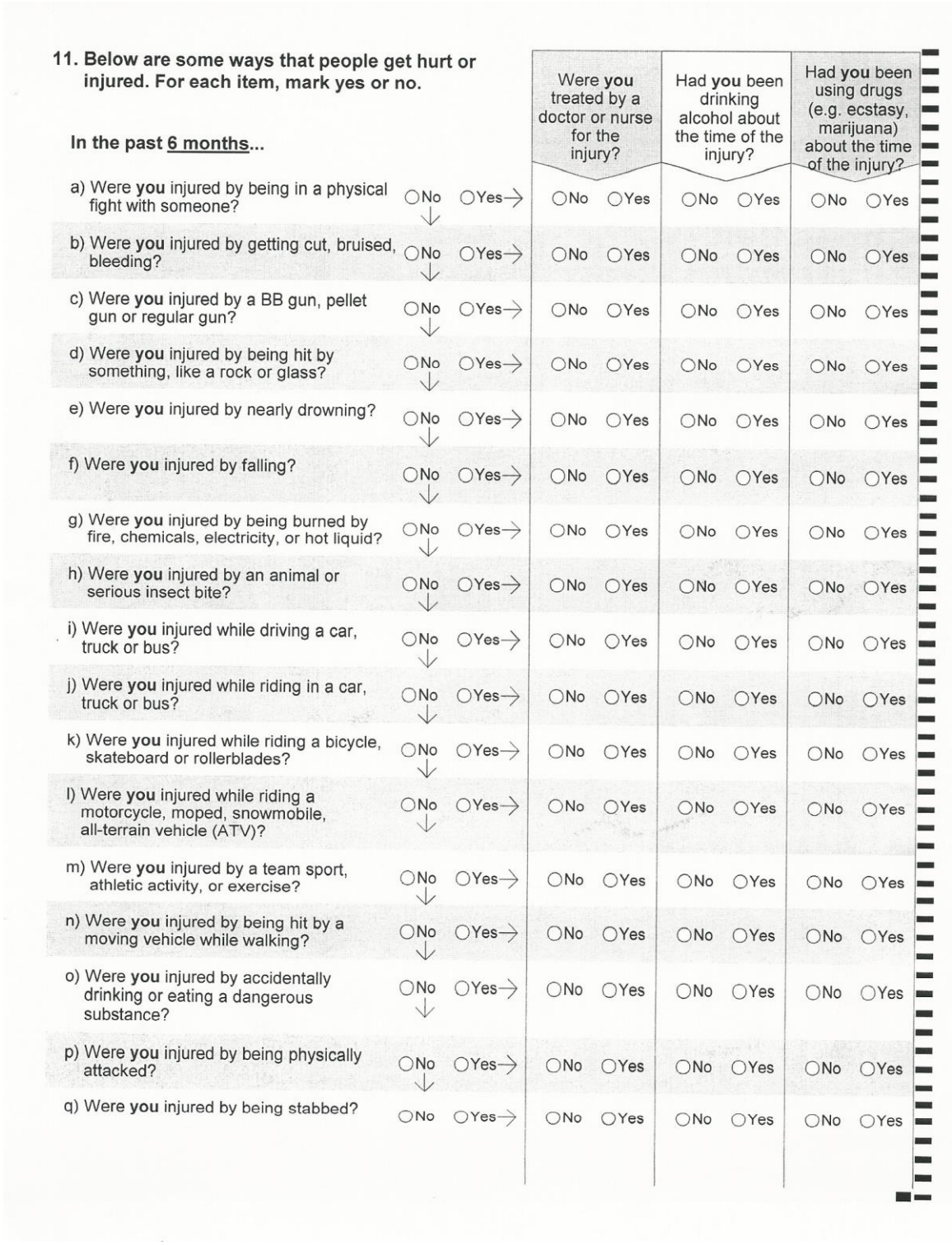
Appendix A – Adolescent Injury Checklist



11. Below are some ways that people get hurt or injured. For each item, mark yes or no.

In the past 6 months...

			Were **you** treated by a doctor or nurse for the injury?		Had **you** been drinking alcohol about the time of the injury?		Had **you** been using drugs (e.g. ecstasy, marijuana) about the time of the injury?	
a) Were **you** injured by being in a physical fight with someone?	○No ↓	○Yes →	○No	○Yes	○No	○Yes	○No	○Yes
b) Were **you** injured by getting cut, bruised, bleeding?	○No ↓	○Yes →	○No	○Yes	○No	○Yes	○No	○Yes
c) Were **you** injured by a BB gun, pellet gun or regular gun?	○No ↓	○Yes →	○No	○Yes	○No	○Yes	○No	○Yes
d) Were **you** injured by being hit by something, like a rock or glass?	○No ↓	○Yes →	○No	○Yes	○No	○Yes	○No	○Yes
e) Were **you** injured by nearly drowning?	○No ↓	○Yes →	○No	○Yes	○No	○Yes	○No	○Yes
f) Were **you** injured by falling?	○No ↓	○Yes →	○No	○Yes	○No	○Yes	○No	○Yes
g) Were **you** injured by being burned by fire, chemicals, electricity, or hot liquid?	○No ↓	○Yes →	○No	○Yes	○No	○Yes	○No	○Yes
h) Were **you** injured by an animal or serious insect bite?	○No ↓	○Yes →	○No	○Yes	○No	○Yes	○No	○Yes
i) Were **you** injured while driving a car, truck or bus?	○No ↓	○Yes →	○No	○Yes	○No	○Yes	○No	○Yes
j) Were **you** injured while riding in a car, truck or bus?	○No ↓	○Yes →	○No	○Yes	○No	○Yes	○No	○Yes
k) Were **you** injured while riding a bicycle, skateboard or rollerblades?	○No ↓	○Yes →	○No	○Yes	○No	○Yes	○No	○Yes
l) Were **you** injured while riding a motorcycle, moped, snowmobile, all-terrain vehicle (ATV)?	○No ↓	○Yes →	○No	○Yes	○No	○Yes	○No	○Yes
m) Were **you** injured by a team sport, athletic activity, or exercise?	○No ↓	○Yes →	○No	○Yes	○No	○Yes	○No	○Yes
n) Were **you** injured by being hit by a moving vehicle while walking?	○No ↓	○Yes →	○No	○Yes	○No	○Yes	○No	○Yes
o) Were **you** injured by accidentally drinking or eating a dangerous substance?	○No ↓	○Yes →	○No	○Yes	○No	○Yes	○No	○Yes
p) Were **you** injured by being physically attacked?	○No ↓	○Yes →	○No	○Yes	○No	○Yes	○No	○Yes
q) Were **you** injured by being stabbed?	○No	○Yes →	○No	○Yes	○No	○Yes	○No	○Yes

Appendix B – Table: Multivariable Logistic Regressions Between Sociodemographic, Risk Behaviours, Psychosocial, and School Covariates Among Nova Scotian Adolescents

Independent variable	Poly Injured (N = 1272)		Roughnecks (N = 377)		Sport-Oriented (N = 167)		Scrappers (N = 176)		Bleeding-Oriented (N = 282)		Injury Free (N = 711)	
	OR	CI(95%)	OR	CI(95%)	OR	CI(95%)	OR	CI(95%)	OR	CI(95%)	OR	CI(95%)
Sex												
Female	Ref		Ref		Ref		Ref		Ref		Ref	
Male	**0.73**	**(0.58, 0.92)**	**2.77**	**(1.97, 3.88)**	**1.56**	**(1.00, 2.43)**	0.66	(0.44, 1.00)	0.94	(0.61, 1.45)	0.85	(0.63, 1.15)
Grade												
9	Ref		Ref		Ref		Ref		Ref		Ref	
10	0.84	(0.58, 1.21)	1.11	(0.67, 1.82)	1.88	(0.92, 3.84)	1.28	(0.64, 2.58)	0.74	(0.42, 1.29)	1.03	(0.62, 1.69)
11	0.78	(0.54, 1.15)	1.00	(0.60, 1.66)	1.02	(0.49, 2.14)	1.56	(0.77, 3.18)	0.97	(0.55, 1.71)	1.14	(0.67, 1.94)
12	**0.61**	**(0.41, 0.90)**	1.50	(0.91, 2.48)	1.33	(0.58, 3.02)	1.75	(0.84, 3.62)	1.02	(0.59, 1.77)	1.14	(0.65, 1.98)
Ethnicity												
White	Ref		Ref		Ref		Ref		Ref		Ref	
Black	1.24	(0.69, 2.23)	1.64	(0.58, 4.59)	1.06	(0.36, 3.14)	0.60	(0.14, 2.55)	0.54	(0.23, 1.26)	0.78	(0.41, 1.49)
Asian	0.61	(0.33, 1.12)	1.27	(0.58, 2.81)	**0.23**	**(0.06, 0.99)**	0.55	(0.17, 1.82)	0.82	(0.28, 2.36)	**2.15**	**(1.24, 3.73)**
Aboriginal	1.54	(0.97, 2.44)	1.30	(0.71, 2.37)	0.39	(0.13, 1.15)	1.76	(0.69, 4.48)	**0.48**	**(0.24, 0.98)**	**0.56**	**(0.33, 0.93)**
Hispanic	0.46	(0.14, 1.57)	1.06	(0.38, 2.95)	2.91	(0.94, 9.07)	1.00	-	1.64	(0.26, 10.13)	1.79	(0.77, 4.14)
Other	0.67	(0.40, 1.16)	1.38	(0.69, 2.74)	1.26	(0.44, 3.62)	0.55	(0.22, 1.39)	0.63	(0.20, 2.00)	1.74	(0.98, 3.08)
Weekly spending												
Spends less than $40	Ref		Ref		Ref		Ref		Ref		Ref	
Spends more than $40	1.22	(0.96, 1.56)	0.86	(0.62, 1.18)	1.23	(0.72, 2.10)	1.04	(0.64, 1.67)	0.79	(0.54, 1.14)	0.87	(0.63, 1.19)
Unknown	0.91	(0.68, 1.22)	0.84	(0.57, 1.24)	**1.94**	**(1.04, 3.63)**	0.89	(0.49, 1.61)	0.91	(0.54, 1.52)	1.05	(0.75, 1.46)
Smoking status												
No	Ref		Ref		Ref		Ref		Ref		Ref	
Yes	**1.60**	**(1.19, 2.15)**	0.72	(0.44, 1.16)	0.58	(0.25, 1.36)	**0.29**	**(0.12, 0.71)**	0.60	(0.35, 1.02)	0.96	(0.66, 1.40)

Independent variable	Poly Injured (N = 1272)		Roughnecks (N = 377)		Sport-Oriented (N = 167)		Scrappers (N = 176)		Bleeding-Oriented (N = 282)		Injury Free (N = 711)	
	OR	CI(95%)	OR	CI(95%)	OR	CI(95%)	OR	CI(95%)	OR	CI(95%)	OR	CI(95%)
Smoking susceptibility												
No	Ref		Ref		Ref		Ref		Ref		Ref	
Yes	**1.40**	**(1.03, 1.91)**	0.91	(0.60, 1.38)	0.74	(0.41, 1.31)	0.71	(0.38, 1.32)	1.06	(0.66, 1.70)	0.86	(0.60, 1.22)
Drinking behaviour												
No alcohol	Ref		Ref		Ref		Ref		Ref		Ref	
Did not consume ≥ 5 drinks once in the last year	1.26	(0.85, 1.87)	0.78	(0.43, 1.41)	0.68	(0.30, 1.55)	1.05	(0.36, 3.03)	0.92	(0.49, 1.76)	0.96	(0.65, 1.41)
Drank ≥ 5 drinks once < 12 times throughout the previous year	1.25	(0.92, 1.70)	1.19	(0.78, 1.81)	0.65	(0.34, 1.26)	**2.02**	**(1.17, 3.50)**	0.98	(0.63, 1.52)	**0.61**	**(0.43, 0.86)**
Consumed ≥ 5 drinks once at least 12 times throughout the previous year	1.18	(0.88, 1.60)	1.67	(1.07, 2.58)	**0.45**	**(0.25, 0.80)**	1.82	(0.91, 3.65)	0.78	(0.50, 1.21)	0.71	(0.50, 1.01)
Cannabis use												
None	Ref		Ref		Ref		Ref		Ref		Ref	
Infrequent	**1.53**	**(1.15, 2.04)**	**0.61**	**(0.41, 0.92)**	0.76	(0.44, 1.32)	0.69	(0.40, 1.19)	1.03	(0.64, 1.66)	0.93	(0.66, 1.31)
Frequent	**1.58**	**(1.16, 2.15)**	0.76	(0.49, 1.18)	1.22	(0.63, 2.35)	**0.47**	**(0.25, 0.85)**	1.14	(0.74, 1.76)	0.71	(0.44, 1.15)
Number of sexual partners												
None	Ref		Ref		Ref		Ref		Ref		Ref	
One	1.10	(0.84, 1.43)	0.78	(0.54, 1.14)	1.55	(0.81, 2.96)	0.75	(0.45, 1.24)	1.00	(0.65, 1.55)	1.02	(0.68, 1.54)
Multiple	**1.58**	**(1.08, 2.00)**	0.84	(0.53, 1.32)	1.68	(0.82, 3.44)	**0.43**	**(0.22, 0.84)**	**0.54**	**(0.32, 0.91)**	0.88	(0.59, 1.31)

Independent variable	Poly Injured (N = 1272)		Roughnecks (N = 377)		Sport-Oriented (N = 167)		Scrappers (N = 176)		Bleeding-Oriented (N = 282)		Injury Free (N = 711)	
	OR	CI(95%)	OR	CI(95%)	OR	CI(95%)	OR	CI(95%)	OR	CI(95%)	OR	CI(95%)
Absenteeism												
No classes	Ref		Ref		Ref		Ref		Ref		Ref	
1 or 2 classes	**1.33**	**(1.03, 1.72)**	0.95	(0.67, 1.34)	0.73	(0.41, 1.30)	0.70	(0.42, 1.19)	0.92	(0.62, 1.37)	0.90	(0.66, 1.22)
3 or more classes	**1.32**	**(1.00, 1.75)**	0.99	(0.6,4 1.51)	**0.41**	**(0.21, 0.80)**	0.76	(0.41, 1.40)	1.09	(0.70, 1.70)	0.86	(0.61, 1.21)
Academic achievement												
< 70%	Ref		Ref		Ref		Ref		Ref		Ref	
≥ 70%	0.84	(0.65, 1.07)	**1.75**	**(1.20, 2.55)**	1.73	(0.88, 3.40)	1.57	(0.80, 3.06)	1.00	(0.57, 1.74)	0.79	(0.58, 1.06)
Self-esteem												
Low to high	1.00	(0.96, 1.06)	**0.93**	**(0.88, 0.99)**	1.11	(0.99, 1.25)	1.07	(0.98, 1.17)	0.93	(0.85, 1.02)	1.03	(0.97, 1.09)
School connectedness												
Low to high	1.04	(1.00, 1.07)	1.00	(0.95, 1.05)	1.02	(0.95, 1.10)	0.98	(0.92, 1.05)	1.04	(0.97, 1.13)	**0.93**	**(0.89, 0.99)**
Depression												
No	Ref		Ref		Ref		Ref		Ref		Ref	
Yes	**1.46**	**(1.13, 1.89)**	0.79	(0.54, 1.17)	0.68	(0.37, 1.27)	1.38	(0.75, 2.57)	0.61	(0.36, 1.02)	0.91	(0.65, 1.28)
Sports participation												
No	Ref		Ref		Ref		Ref		Ref		Ref	
Yes	1.00	(0.79, 1.25)	1.23	(0.89, 1.69)	**4.26**	**(2.64, 6.85)**	**3.32**	**(2.04, 5.42)**	**0.43**	**(0.28, 0.66)**	**0.51**	**(0.38, 0.68)**

Numbers in bold are statistically significant (p <0.05).