EXAMINATION OF BODY IMAGE AMONG CANADIAN ADOLESCENTS: RELATIONS WITH PHYSICAL ACTIVITY AND SCREEN TIME

by

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Abstract

Background: Adolescence is a period of life associated with self-perceptions of negative body image. Physical activity levels are low and screen time levels are also high during this stage of child development. These perceptions and behaviours are each associated with poor health outcomes, making research on their determinants important. With adolescent populations, certain groups may be at higher risk of body dissatisfaction than others, and body dissatisfaction may influence individual physical activity and screen time levels.

Objectives: The objectives of this thesis were to: 1) describe body image among young Canadians, examining possible health inequalities by age, ethnicity, socioeconomic status (SES), and time resident in Canada, 2) estimate the strength and significance of associations between body satisfaction, physical activity and screen time, and 3) examine the potential etiological role of biological sex in these relationships.

Methods: Objective 1: The 2013/2014 Health Behaviour in School-aged Children (HBSC) study was employed. Sex-stratified Rao-Scott chi-square analyses were conducted to examine associations between socio-demographic factors and body satisfaction. Objective 2: The 2005/2006 and 2013/2014 cross-sectional and 2006 longitudinal HBSC data sets were used, focusing exclusively on grade 9 and 10 students (this objective only). Sex-stratified modified Poisson regressions were conducted and risk estimates and associated confidence intervals obtained.

Results: Objective 1: Among males, being older, of East and Southeast Asian ethnicity, and reporting low SES all were independently associated with experiencing body dissatisfaction. Among females, being older, of Arab and West Asian or African ethnicity, being born in Canada, and reporting low SES were all associated with being body dissatisfied. Objective 2: Cross-sectionally, males who reported ‘too fat’ body
dissatisfaction were more likely to be physically inactive. Adolescents of both sexes who reported ‘too fat’ body dissatisfaction were more likely to engage in high levels of screen time. No associations with physical activity and sedentary behaviours were found for those experiencing ‘too thin’ body dissatisfaction. Data from the longitudinal component supported the idea that male ‘too fat’ body dissatisfaction temporally leads to physical inactivity, but showed an inverse relationship between body dissatisfaction and screen time. Sex was not an effect modifier.

**Conclusions: Objective 1:** Future prevention efforts in Canada should target subgroups to effectively help those at greatest risk of body dissatisfaction, and ameliorate potential inequalities at the population level. **Objective 2:** The presence of these relationships may inform future interventions as part of a multi-factorial etiology, in order to increase physical activity and decrease screen time among youth.
Co-Authorship

This thesis is the work of Nicole Roberts, in collaboration with her supervisor Dr. William Pickett.

**Manuscript 1:** Body dissatisfaction among Canadian adolescents: a health inequality focus. The idea to study health inequalities was Dr. Pickett’s. Nicole Roberts and Dr. Pickett outlined the socio-demographic factors of interest collaboratively. The statistical analyses, interpretation of results and writing of the manuscript was performed by Nicole Roberts with feedback from Dr. Pickett.

**Manuscript 2:** Body dissatisfaction as a predictor of physical inactivity and screen time among Canadian adolescents. The idea to examine the associations between body satisfaction, physical activity and screen time was a collaborative effort between Nicole Roberts and Dr. Pickett. The idea to use longitudinal data was Dr. Pickett’s. Dr. Janssen also had some methodological contributions at both the proposal and analysis stage. The statistical analyses, interpretation of results and writing of the manuscript was performed by Nicole Roberts with feedback from Dr. Pickett.
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**HBSC** Health Behaviour in School-aged Children Study

**MVPA** Moderate-to-vigorous physical activity

**SES** Socioeconomic status

**WHO** World Health Organization

**PR** Prevalence ratio

**RR** Relative risk
Chapter 1

Introduction

1.1 General Background

Body dissatisfaction occurs when there are differences between a person’s current and self-perceived ideal body, and adolescence is a period in life associated with being at high risk for body dissatisfaction.\(^1\)\(^2\) This is a public health problem as body dissatisfaction has been shown to be related to adverse health outcomes including depression and unhealthy weight loss strategies such as anorexia and bulimia.\(^1\)

Health inequalities refer to differences in health outcomes among different socio-demographic groups.\(^3\) Due to the multi-faceted etiology of body image, one focus of health inequalities could be on body satisfaction and dissatisfaction. Few inequalities in body dissatisfaction have been established for adolescent populations, especially in Canada. One exception is inequality by gender, with females at a significantly higher risk of experiencing body dissatisfaction than males, across all ages in adolescence.\(^1\)\(^4\)

Other potential health inequalities are less established, including those that may exist by age, ethnicity and socioeconomic status (SES). Most existing studies of this issue are also regional or local in scope.\(^1\)\(^5\)\(^-\)\(^8\)

Current Canadian guidelines recommend that adolescents aged 12-17 years engage in at least 60 minutes of moderate-to-vigorous physical activity (MVPA) each day and limit screen time to less than two hours per day.\(^9\) However, less than 20% of children and youth are meeting the screen time guidelines, and data from the 2013 Canadian Health Measures Survey indicates that only 5% are meeting the physical activity guidelines.\(^10\)\(^\ 11\) This is a concern as physical inactivity and sedentary behaviour can lead to poor health outcomes that can last throughout adulthood.\(^12\)\(^-\)\(^16\) It is therefore important to examine what determinants can influence associated physical activity and screen time levels during adolescence. Body
image could be one determinant as it is plausible that a person’s body satisfaction would influence their physical activity and screen time levels. Few studies have examined the relationship with body satisfaction as the determinant, and none of these have been conducted on a national Canadian adolescent sample.\textsuperscript{17-21} This is an important research gap, as body dissatisfaction could be contributing to decreasing rates of physical activity and increases in screen time, and if so, this could be a possible focus for intervention.

1.2 Objectives

This thesis examined potential health inequalities associated with body image, and investigated associations between body satisfaction, physical activity and screen time among Canadian adolescents. Biological sex was considered in these relationships, by determining if the health inequalities differ by sex as well as if any of the associations between body satisfaction, physical activity, and screen time were modified by sex. This manuscript-based thesis is organized as follows:

1.2.1 Manuscript 1: Body dissatisfaction among Canadian adolescents: A health inequality focus

The objective of the first manuscript was to describe self-perceptions of body image among Canadian adolescents in 2014, examining possible health inequalities by age, socioeconomic status (SES), ethnicity, and time resident in Canada. We additionally were interested in seeing if there were differences in these potential health inequalities according to biological sex. Using the 2014 Health Behaviour in School-aged Children (HBSC) study, associations of body dissatisfaction with the inequalities of interest were evaluated. We hypothesized that health inequalities would be present, however no \textit{a priori} hypotheses were made about each socio-demographic factor individually.
1.2.2 Manuscript 2: Body dissatisfaction as a predictor of physical inactivity and screen time among Canadian adolescents

The objective of this manuscript was to estimate the strength and statistical significance of associations between body satisfaction, physical activity and screen time, and to determine if biological sex modified any of these relationships. The 2006 and 2014 cross-sectional data from the HBSC were used initially. Additionally, a longitudinal component from the 2006 HBSC that included adolescents from 16 Ontario schools was analyzed. Examination of this association using both cross-sectional and longitudinal components helped address the temporal directions of these relationships, an important issue from a methodological perspective. We hypothesized that male and female adolescents who reported experiencing body dissatisfaction and perceived themselves as being ‘too fat’ would be less physically active and report higher rates of screen time than adolescents who were satisfied with their bodies. We also expected that females who perceived themselves as ‘too thin’ would be less physically active and report higher rates of screen time than females who were satisfied with their bodies, and that males who perceived themselves as ‘too thin’ would report no difference in physical activity levels or sedentary behaviours compared to their ‘body satisfied’ male counterparts.

1.3 Thesis Organization

This thesis conforms to the Queen’s University School of Graduate Studies and Research Guideline “General Forms of Theses”. The second chapter provides a literature review of potential health inequalities associated with body satisfaction, as well as its relationship with both physical activity and screen time. The third chapter is Manuscript 1, which examines the health inequalities associated with body satisfaction. The fourth chapter is Manuscript 2, which analyzes the relationships between body satisfaction and physical activity and body satisfaction and screen time using both cross-sectional and
longitudinal data. Both of these manuscripts have been developed for publication into the journal *Body Image*. Chapter 5 provides an integrative discussion of the findings from both manuscripts, as well as some concluding remarks about what future research would be helpful in this area.
1.4 References


Chapter 2

Literature Review

2.1 Body Dissatisfaction

Body image has been defined as how a person internally portrays their outward appearance, and this involves cognitive, emotional and behavioural components.\textsuperscript{1,2} Four main aspects of body image have been identified: how a person \textit{sees} their body (perceptual body image), how a person \textit{feels} about their body (affective body image), what a person \textit{thinks} about their body (cognitive body image) and how a person \textit{acts} towards their body (behavioural body image).\textsuperscript{1,2} Body dissatisfaction, one aspect of a negative body image (specifically affective body image), occurs when there are differences between a person’s current and self-perceived ideal body.\textsuperscript{2} This can result in negative affect, and has been shown previously to be related to adverse health outcomes such as depression, bulimia, and anorexia.\textsuperscript{1,3,4}

There are several theories behind what can lead to body dissatisfaction, and one of the prominent ones for Western cultures is a sociocultural model called the \textit{Tripartite Influence Model (Figure 2.1)}.\textsuperscript{5} Adherents to this model suggest that within a culture there are social ideals of what is considered attractive. These ideals are conveyed through a variety of sources, mainly the media, family, and peers. If an individual internalizes these standards then they will compare themselves to this definition of ‘beauty’, and the degree that they align with these ideals will directly influence their level of body satisfaction or dissatisfaction.\textsuperscript{5–9} Since these ideals are unattainable for most people, body dissatisfaction occurs and this can result in disordered eating and other unhealthy practices in attempts to achieve the ideal.\textsuperscript{1}

Adolescence is a stage of the life course associated with being at high risk for body dissatisfaction, and its presence among adolescents has increased over time.\textsuperscript{1,2,10–12} In 2010, 43\% of Canadian adolescents surveyed from the Health Behaviour in School-aged Children (HBSC) study were
dissatisfied with their bodies to at least a small extent. In addition to the sociocultural influences that can impact an adolescent’s body satisfaction, adolescents also have developmental changes occurring, when they go through puberty, which puts them at further risk for body dissatisfaction. The cognitive behavioural model for body image incorporates physical changes (such as puberty) as being one of the main influences of body satisfaction. This model also identifies cultural socialization, interpersonal experiences, and personality traits as being key in forming a person’s body image. Having resilience to the media’s messages or having positive self-esteem can lead to body satisfaction, whereas perfectionism and poor self-esteem can lead to body dissatisfaction. Additionally, there are other determinants of body dissatisfaction including biological factors such as genetics, and ethnicity. Therefore body image is complex and multi-factorial as many dimensions are involved in its etiology. Since adolescents are at an increased risk for experiencing body dissatisfaction it is important to explore the many factors that may contribute to it.

![Figure 2.1. Tripartite influence model for body dissatisfaction. Adapted from Keery et al.](image)

2.2 The Potential Role of Biological Sex

The HBSC data used in this thesis generally represents biological sex, not gender. These are two distinct constructs where sex refers to biological characteristics (males versus females) and gender
focuses on societal characteristics which can vary from culture to culture. While ideally we would have information on gender, as body image is a social construct, collection of such data is problematic within the HBSC. Hence we instead had to examine the potential role of biological sex in the relationships of interest, as we believed that being male or female would also affect ones body image perceptions. Many studies do not distinguish between gender and biological sex so the following section incorporates results examining either construct.

The association between gender and body image has been well established in the literature. Past literature has focused predominately on girls; however, body dissatisfaction is a problem for boys, also leading to negative health outcomes, and therefore it was important to focus on the experiences of males in this thesis.

Many studies conducted on body image have reported that girls have higher rates of body dissatisfaction than boys, across all ages in adolescence. Differences may be accounted for by distinctions in ideal societal male and female bodies. Western societies focus on a thin-ideal for women’s bodies, which is usually below a healthy weight and does not encompass the average woman’s weight and shape. Relating this back to the Tripartite Influence Model, females who are surrounded by this idealization, then internalize this thin-ideal, comparing their bodies to it, and failure to fit this ideal can therefore affect their own weight perceptions and body satisfaction, including making normal weight females perceive themselves as being too fat.

This is different for males, where instead of a thin-ideal there is a drive for muscularity. This could explain why body dissatisfaction is highest for underweight boys and why males are more likely to perceive themselves as being too thin compared to females. However the idea of muscularity is broader, with a wider range of what is acceptable, compared to the thin-ideal which could contribute to why there are higher rates of body dissatisfaction among females. These contrasts between boys and
girls demonstrate the differences in how society places emphasis on the male and female body. For women, the thin-ideal highlights the importance of appearance, especially on weight, however for men muscularity is less about appearance and more focused on the body’s function.\textsuperscript{16,18} These societal expectations can lead to body dissatisfaction in both males and females.

In addition, while biological sex is directly related to body image, it may also modify relationships between body image and health behaviours such as physical activity and screen time. Recent research examining the role that body dissatisfaction plays in an adolescent’s physical activity identified statistically significant associations for males but not females.\textsuperscript{31} The different societal ideals that males and females experience could influence if and to what degree their body image is a determinant of their physical activity and sedentary behaviours.\textsuperscript{1,18,31} For example, girls who perceive themselves to be too thin may not engage in physical activity because they may feel that they have already achieved this thin idealization, whereas boys who feel too thin may engage in physical activity to try to gain muscle and better fit the societal ideal.

### 2.3 Health Inequalities

Health inequalities refer to differences in health outcomes among different groups.\textsuperscript{32} With respect to body image specifically, these are characteristics that lead certain groups to be at higher risk of body dissatisfaction than others. These can further be considered as health inequities if the groups who are at higher risk of body dissatisfaction are also socially disadvantaged, such as being identified as an ethnic minority or from a low socioeconomic status (SES) group.\textsuperscript{33} Since body image has a multifaceted etiology, many factors can influence a persons’ body satisfaction and it can therefore be subject to health inequalities. Health inequalities potentially associated with body image that were further examined in this thesis involve the basic socio-demographic factors of age, SES, ethnicity, and time resident in Canada.
These inequalities were chosen based on previous research and will be addressed in the following sections.

2.3.1 Age

Inequalities between body satisfaction and age in adolescence have shown inconsistent conclusions. One body of research has found that during the adolescent period age is not associated with a person’s body image. Van den Berg and colleagues studied adolescents from ages 11-18 (N=4,746) and found that for both males and females there were no statistically significant differences between body dissatisfaction and age (boys p=0.28, girls p=0.29). In contrast, other studies have established that among female adolescents body dissatisfaction increases with increasing age, an opposite finding to that observed in male adolescents. A longitudinal study that followed subjects throughout adolescence found that from ages 13-15 female body dissatisfaction scores increased over time while male dissatisfaction scores decreased (F=3.7, p<0.05). However, other studies have found that in this stage of life male body satisfaction scores also decrease with increasing age, including a five-year longitudinal study that concluded that body dissatisfaction increased in males from middle school to high school (F=4.28, p=0.039).

Some theory has been developed around why these developmental trends emerge during adolescence. For both males and females, adolescence is a critical period of growth and development and is when puberty occurs. For girls, the thin-ideal conflicts with pubertal development which can result in an increase in body dissatisfaction with increasing age. Pubertal development for girls involves an increase in body mass and adiposity, which creates a bigger gap between the thin idealization and the girl’s body, and therefore girls may become less satisfied with their body. In contrast, puberty takes boys closer to the masculine body that society has deemed ideal for men, which therefore can lead to an
increase in body satisfaction over time during their adolescence. Older adolescents may also be more aware of societal idealizations, which could result in having a stronger influence on them.

### 2.3.2 Socioeconomic Status

Investigations of differences between body satisfaction and SES levels has led to mixed results. Some studies have found that adolescents with a high SES are more likely to express body dissatisfaction compared to their low or middle SES counterparts. In contrast, other studies have concluded that adolescents with a low SES have increased body dissatisfaction compared to high SES. A cross-sectional study that included 60,252 Finnish adolescents found that both girls and boys from families with low SES were more dissatisfied with their body than adolescents from families with high SES (Girls—OR 1.54 (1.37, 1.73), Boys—OR 1.83 (1.58, 2.12)). No association has been identified in other studies.

During the past decade, theories have emerged about associations between SES and body image, including the idea that adolescents with high SES may be more greatly influenced by the media and their family (two of the major influences shown in the Tripartite Influence Model) which can lead to an increase in body dissatisfaction, if the influences are unattainable ideals.

In contrast, another theory is that adolescents with low SES have been shown to have lower self-esteem than adolescents with high levels of SES. Personality traits have been shown to be a determinant for individuals’ perceptions of their bodies, where having strong social support and traits of resiliency can help protect a person from experiencing body dissatisfaction, and lack of social support and low self-esteem can make an individual more susceptible to body dissatisfaction. Therefore, low self-esteem could in turn directly influence body image perceptions and lead to body dissatisfaction.
Additionally, people have argued that the observed lack of associations between SES and body image is because people from different socioeconomic classes all have similar body ideals from society, unlike in previous centuries where body size provided a reflection of social class.¹

2.3.3 Ethnicity

Body image and body satisfaction are known to vary by ethnicity, although for adolescents this is not a universal finding.²⁻⁴⁴ Differences by sex are particularly important for this covariate. For both males and females, African Americans have been shown to have the lowest prevalence of body dissatisfaction compared to all other ethnicities.¹,³,²¹,²⁴,³⁸,⁴³,⁴⁵⁻⁴⁸ Among females, African culture emphasizes a larger ideal body size, and this shape is more comparable to the shape of an adolescent girl once they have gone through puberty, as opposed to the thin-ideal.³⁸ This could be why this ethnic group has lower levels.

While past research has illustrated that African culture is more encouraging of females having a larger body size than other cultures, leading to less females having negative body image, other research indicates that this difference between Black and White females and their perceptions of their bodies is diminishing. A meta-analysis conducted by Roberts et al.⁴⁹ that examined Black-White differences in body dissatisfaction found that the gap between Black and White females has significantly diminished over time in regards to weight-related body image measures. The latter research suggests that this thin-ideal portrayed in society is becoming increasingly important, regardless of cultural ideals.

For females, some studies have found that compared to Caucasian girls, Hispanic girls have significantly higher levels of body dissatisfaction,²²,²³,⁴⁵ while others have shown the opposite relation,²¹,⁴⁷,⁵⁰,⁵¹ and further studies have shown no differences.³,³⁴,⁴⁴,⁵² These varied results are similar for Asian girls where some studies have found higher, lower or no significant differences between prevalence of body dissatisfaction compared to Caucasian girls.³,²¹,²³,⁴⁴,⁴⁵,⁴⁷,⁵⁰,⁵³
For adolescent boys, multiple studies have found that Asian boys have the highest levels of body dissatisfaction, compared to all other ethnicities.\textsuperscript{21,23,43,45} In general, Asian boys have a smaller physique than other ethnicities and with the drive for muscul arity present in adolescence, this could lead to higher proportions of body dissatisfaction for this group.\textsuperscript{43,53} In addition, the prevalence of body dissatisfaction between Hispanic and Middle Eastern boys have not varied in a statistically significant manner, although there have been inconsistencies in such findings.\textsuperscript{1,3,43–45,52}

2.3.4 Time Resident in Canada

Time since immigration has not previously been examined quantitatively as a possible source of health inequalities for body image in Canada. A review conducted in 2014 identified no literature that examined body dissatisfaction among immigrant adolescents in Canada.\textsuperscript{54} This highlights the need for future research in this area, especially with the increasing amount of immigrant adolescents coming to Canada. Further, this is an important variable to consider as culture plays a role in influencing a person’s body satisfaction. How long an adolescent has resided in Canada may have an impact on how long they have been exposed to Western culture where this thin and masculine idealization is prominent. Over time immigrants may begin to adopt the behavioural norms of communities that they migrate to, and this could include body ideals that are different from their heritage culture, which could impact their level of body satisfaction. A qualitative study on immigrant adolescents in Canada and their thoughts on body satisfaction found immigrant adolescents reporting similar body ideals as found in Western societies—the slim female and muscular male.\textsuperscript{55} However, there was no comparison with Canadian-born adolescents to examine whether the degree of body satisfaction based on these societal influences was the same.
2.4 Relationships and Temporality Between Body Satisfaction and Physical Activity/Screen Time

2.4.1 A Conceptual Model

In addition to health inequalities, this thesis also examined relationships between body satisfaction and physical activity, and body satisfaction and screen time, including the temporal direction of the potentially causal relationships. Figure 2.2 provides a schematic depiction of the conceptual model upon which this epidemiological thesis is organized.

![Conceptual Model Diagram]

**Figure 2.2.** Conceptual model depicting relationships between body satisfaction and physical activity, and body satisfaction and screen time

2.4.2 Body Satisfaction and Physical Activity

Physical activity refers to any bodily movement that raises energy expenditure, and moderate-to-vigorous physical activity (MVPA) includes any activity, such as swimming or riding a bicycle, that
increases energy expenditure by a minimum of three times a person’s basal metabolic rate. Adolescence is a period of life where physical activity decreases. Based on the current Canadian physical activity guidelines, adolescents should engage in at least 60 minutes of MVPA every day to be considered physically active. However, findings from the 2013 Canadian Health Measures Survey show that approximately 14% of Canadians aged 5-11 years and 5% of Canadians aged 12-17 are meeting these guidelines. Low physical activity levels are associated with poor health outcomes, especially in adolescents, and these outcomes can last throughout adulthood. Therefore it is important to determine why physical activity levels are so low in this developmental group and the factors that potentially underlie this pattern of behaviour. Body dissatisfaction could play a role in these phenomena.

When determining if there is an association between body image and physical activity the majority of studies have examined the influence of physical activity on body image. Included in this are two meta-analyses that found that, overall, people who are physically active have higher levels of body satisfaction and that physical activity interventions are useful for increasing body satisfaction. However, much less emphasis has been placed on research examining the effect that body image may have on physical activity levels, and this is an important gap as body satisfaction could potentially be an important determinant for physical activity.

There are two viewpoints about the potential influence that body image can have on physical activity levels. (1) The first is that an individual with body dissatisfaction may be more likely to engage in physical activity as it could provide motivation to participate in weight management behaviours. However, this finding has only been demonstrated in a few studies in specific populations. (2) The other and more commonly described view is that a person with body dissatisfaction is less likely to engage in physical activity compared to a person with positive body image. This has been shown in previous studies conducted with a variety of adolescent and adult
populations. Included in these findings is a study conducted by Kopcakova and colleagues who used the 2010 Slovakian Health Behaviour in School-aged Children study and found that male adolescents who perceived themselves as being too fat were at a 45% decreased odds of engaging in sufficient physical activity (60 minutes per day).

An adolescent who perceives themselves to be fat may feel self-conscious and discouraged about participating in activities, and therefore be less physically active. The social comparison theory can be applied in this situation. This theory developed by Festinger in 1954, suggests that people make self-evaluations by comparing themselves to others surrounding them, which can subsequently affect their attitudes and behaviours. Adolescents for example, compare themselves to their peers, and if differences between themselves and others are magnified in some manner, negative health and behavioural outcomes can occur. Hence, a young person who perceives themselves to be ‘too fat’ may compare their perceived body size to others who they view as having a more ideal body size. If the gap between their perceptions of themselves and the body size of others whom they emulate is large, then they may feel discouraged, thinking that their ideal size is unattainable. This may then discourage them from participating in physical activity.

Still other studies have found no association for adolescents between body image and physical activity, indicating overall inconclusive findings for this relationship. While the study mentioned above conducted by Kopcakova et al. identified statistically significant associations between body satisfaction and physical inactivity for male adolescents, they found no differences between adolescent girls who reported body dissatisfaction compared to satisfaction. Other results have shown the opposite findings, where there is a statistically significant association for females but not for males. A longitudinal study conducted by Neumark-Sztainer et al. found that after adjustment for race, SES, age, time 1 behaviours, and body mass index, females who experienced low body satisfaction engaged in an
average of 0.53 fewer hours per week of MVPA compared to those who had high body satisfaction (p=0.034). There was no significant difference after adjusting for the previously mentioned covariates between males with low and high body satisfaction in terms of their MVPA (p=0.376). These differences further illustrate the importance in examining the effects that biological sex may have on the relationships of interest.

2.4.3 Body Satisfaction and Screen Time

In addition to observed decreases in levels of physical activity during adolescence, this is also a developmental period where sedentary behaviour, including screen time, increases. High levels of sedentary behaviours have similarly been shown to lead to negative health outcomes. Screen time, which includes activities such as computer use, watching television, and playing video games, is an important measurable aspect of sedentary behaviour. The current Canadian guideline recommends that adolescents engage in no more than two hours of screen time per day, as excess of this has been associated with both negative physical and mental health outcomes. However, the average time that adolescents spend in front of a screen per day is almost 8 hours, and only 19% of Canadian adolescents aged 10-16 years are actually meeting the recommended guideline. Therefore, understanding what factors may influence screen time is important in developing strategies to reduce screen time among youth.

A potential challenge with some of the research conducted on sedentary behaviour is that it is treated as the opposite of physical activity. However, an emerging view is that sedentary behaviour and physical activity should be treated as separate constructs. A person can meet the requirements for physical activity but still engage in a high amount of sedentary behaviours. This thesis therefore examined the relationship with body satisfaction and physical activity and screen time separately in order to not make any assumptions about the similarity of the relationships. The studies that have clearly
separated these two constructs have looked at the effect that sedentary behaviours such as screen time have on body image and have found that increased sedentary time is associated with negative body image.\textsuperscript{62,85,89}

Similar to physical activity, body image may act as a risk factor for screen time. The stress and coping theory supports why this might be the case. This theory suggests that coping strategies are commonly used to adapt to stressors, however such strategies may at times actually worsen the stressor.\textsuperscript{90,91} An adolescent experiencing body dissatisfaction (stressor) might cope with this by increasing their screen time, which can further emphasize their body dissatisfaction, especially if they are comparing themselves to the media depictions that are present for many of the screen time activities.\textsuperscript{92,93}

2.4.4 Temporality

One main criterion for causation is temporality—in epidemiological terms, ensuring that the exposure precedes the outcome in the relationship of interest. It is very clear that the etiological questions that underlie this thesis are plagued by this methodological challenge, as the temporal directions of these relationships are not clearly established. It is plausible that both physical activity and sedentary behaviours are determinants of body image, and it is also plausible that body image is a determinant of physical activity and sedentary behaviours.\textsuperscript{58} Due to this, examination of these relationships longitudinally is important for interpretation of the results. Some studies have examined the effect that negative body image has on physical activity longitudinally. A five-year study on adolescents in Minnesota found that body satisfaction was related to engagement in physical activity in girls but not in boys, where females who reported body dissatisfaction had lower levels of MVPA.\textsuperscript{68} Shorter longitudinal studies have also been conducted but have found not statistically significant associations. A one-year study conducted by Knowles \textit{et al.}\textsuperscript{83} on female adolescents from Edinburgh found that perceptions of
body attractiveness were not a predictor of changes in physical activity in adolescent girls. Similarly, a two-year study conducted in Saskatoon by Crocker et al. found that there was not an association between perceptions of body appearance and changes in physical activity. These inconsistent findings illustrate a need to explore this relationship further, as well as focus on both males and females, as males were not included in two of these three studies. To our knowledge no published studies have focused on the effect that body satisfaction has on screen time longitudinally in an adolescent sample.

2.5 Thesis Objectives

In summary, the objectives of this thesis are as follows: 1) To describe body image in Canadian adolescents in 2014 examining possible health inequalities by age, ethnicity, socioeconomic status, and time resident in Canada. 2) To estimate the strength and statistical significance of associations between body satisfaction, physical activity and screen time in cross-sectional then longitudinal analyses of young people in Canada. 3) To examine the role of biological sex in these relationships, by determining if the possible health inequalities differ by sex, and also whether any associations between body image, physical activity and screen time are modified by sex.

2.6 Thesis Rationale

The existence of possible health inequalities in terms of adolescent body image, and the effects of these inequalities on the health of adolescents are not very well understood, especially at a national level. Objective 1 of this thesis will permit the detection of effects of inequalities on body image in adolescents, which is important in order to target the content and delivery of health promotion messages.

In addition, little research has been conducted that examines body image as a potential determinant of physical activity and screen time, especially in Canada. This is an important research gap, as body dissatisfaction could be contributing to the decreasing rates of physical activity and increase
in screen time, and if so, this could be a possible focus for intervention. *Objective 2* of this thesis will permit the examination of this association using both cross-sectional and longitudinal components, which will help in the exploration of the temporal directions of these relationships, an important issue from a methodological perspective.

Finally, *objective 3* of this thesis will allow us to further examine how biological sex influences health inequalities and potentially modifies the relationships of interest, which is important in order to gain a well-rounded understanding of sex patterns in Canadian adolescents. Highlighting the differences between males and females in these relationships will be important in informing future interventions as well as accurately targeting health promotion messages. In addition, including males in this thesis is important as they are under-studied in body image research.

### 2.7 Conclusion

It is our hope that this thesis will help us better understand body image among Canadian adolescents and potentially help explain one reason as to why physical activity levels are so low and screen time is so high among this group. Our findings can contribute to public health understanding by illustrating the population groups that are at greatest risk of experiencing negative body image, which can then be used for prevention efforts. Further, if body image were found to be a determinant of physical activity and screen time in this research, incorporating positive body messages to young people in future interventions may be beneficial in order to increase physical activity and decrease screen time.
2.8 References


21. Van Den Berg, P. A., Mond, J., Eisenberg, M., Ackard, D. & Neumark-Sztainer, D. The link between body dissatisfaction and self-esteem in adolescents: Similarities across gender, age,


89. Suchert, V., Hanewinkel, R. & Isensee, B. Screen time, weight status and the self-concept of


Chapter 3

Body dissatisfaction among Canadian adolescents: a health inequality focus
3.1 Abstract

In a contemporary analysis involving Canadian adolescents, we examined potential health inequalities related to body dissatisfaction. Variations in body dissatisfaction were assessed by sex, age, ethnicity, time resident in Canada and socioeconomic status (SES). The cross-sectional data source was the 2013/2014 Health Behaviour in School-aged Children (HBSC) study. Forty-four percent of adolescents reported being dissatisfied with their body, with a higher prevalence of females reporting body image problems compared to males. Among males, being older, of East and Southeast Asian ethnicity, and reporting low SES all were independently associated with experiencing body dissatisfaction. Among females, being older, having a heritage culture of Arab and West Asian or African, being born in Canada, and reporting low SES were each associated with being body dissatisfied. Future prevention efforts in Canada may optimally target such subgroups to effectively help those at greatest risk of body dissatisfaction.

**Keywords:** adolescence, body dissatisfaction, body image, epidemiology, health inequalities, ethnicity, age, socioeconomic status
3.2 Introduction

Health inequalities refer to differences in health outcomes among different groups.\textsuperscript{1} Due to the multi-faceted etiology of body image, one focus of health inequalities could be on body satisfaction. Body dissatisfaction occurs when there are differences between a person’s current and self-perceived ideal body, and adolescence is a stage of the life course associated with being at high risk for body dissatisfaction.\textsuperscript{2,3} This is a public health problem as body dissatisfaction has been shown to be related to adverse health outcomes including depression, and unhealthy weight loss strategies such as bulimia.\textsuperscript{2}

Cognitive behavioural models have been developed to describe various factors that can determine a young person’s body image. Such factors include cultural socialization, interpersonal experiences, physical attributes and personality traits.\textsuperscript{4} While these determinants and their effect on body image perceptions will vary based on the individual, groups that are similar in some of these aspects may consequently share similar perceptions. Being a member of an at-risk group defined, for example, according to culture, age, gender or even socioeconomic status (SES) may contribute to these determinants and subsequently affect a persons’ level of body satisfaction. If these socio-demographic factors result in such patterns, then health inequalities are present. Such variations in turn can be considered health inequities if the groups of people who are experiencing body dissatisfaction are also socially disadvantaged.\textsuperscript{5}

Few inequalities in body dissatisfaction have been established for adolescent populations. One exception is inequality by gender, with girls at a significantly higher risk of experiencing body dissatisfaction than boys, across all ages in adolescence.\textsuperscript{2,6} Other potential health inequalities are less well established, including those that may exist by age, ethnicity and socioeconomic status. Most existing studies of this issue are also regional or local in scope.\textsuperscript{2,7–10} In response to these gaps in evidence, we had an opportunity to conduct a national study to examine Canadian adolescents’ perceptions of body image.
and profile these perceptions by a number of socio-demographic factors that are hypothesized to result in health inequalities. Specifically, we examined sex, age, ethnicity, SES, and time resident in Canada as potential determinants of such inequalities. It is our hope that evidence generated through this analysis will be used to target prevention efforts to at-risk adolescent groups in Canada, in order to decrease the prevalence of body dissatisfaction and its associated negative health consequences.

3.3 Methods

3.3.1 Study Sample

Our study was based on Canadian data from the 2013/2014 Health Behaviour in School-aged Children Study (HBSC), with ethics clearance from Queen’s University.11 The HBSC study is conducted in collaboration with the World Health Organization and involves a cross-sectional survey distributed to adolescents aged 11-15 every four years.11 A multi-level cluster sampling approach was used during survey recruitment. Schools were randomly selected for study using a weighted probability technique, and entire classes within selected schools were asked to participate. This ensured a nationally representative sample based on geographic location, predominant language of teaching, religion, and community size.12

3.3.2 Body Satisfaction Measure

Within the HBSC study body satisfaction was measured using the single question “Do you think your body is...?” where subjects were considered to have body satisfaction if their response was ‘about the right size.’ The other four categories ‘much too thin, a bit too thin, a bit too fat, much too fat’ express some level of body dissatisfaction. A past test-retest survey of this item resulted in a high level of intra-rater agreement (kappa of 0.75).13 Based on this item, participants were categorized into either: body satisfied, body dissatisfied (‘too thin’) and body dissatisfied (‘too fat’).
3.3.3 Health Inequality Measures

Questions on biological sex, age, ethnicity, SES, and time resident in Canada were used to analyze potential health inequalities. Biological sex was assessed using the question ‘Are you male or female?’ Age was estimated from the survey date relative to month and year of birth; the latter inferred from questions ‘What year were you born?’ as well as ‘What month were you born?’

Ethnicity was determined using the question ‘People living in Canada come from many different cultural and racial backgrounds. How do you describe yourself?’ In order to meaningfully categorize ethnicity, groups were formed using the 2006 Canadian Census of Population categorizations, with slight adjustments. Due to the small proportion of West Asian youth, this ethnicity was grouped with Arab ethnicity. Additionally, a Canadian dominant culture group was created for North American, European and Aboriginal youth (due to ethics restrictions, we were unable to examine Aboriginal youth separately).

To determine SES, two proxy measures were used. First, a question that measures relative wealth asked participants to report “How well off do you think your family is?”, with responses ranging from ‘very well off’ to ‘not at all well off’. Adolescents were categorized into either below average, average, or above average relative wealth. The second proxy was the family affluence scale (FAS) which is comprised of questions on how many vehicles and computers the family owns, as well as how many times in the past year the family has vacationed, and whether or not the participant has their own bedroom, to determine family material wealth. Subjects were classified into low, medium, or high family affluence.

Time resident in Canada was determined using the question ‘How many years have you lived in Canada?’ and participants were categorized into either: born in Canada, 1 to 5 years, or 6 or more years.
3.3.4 Statistical Analyses

Descriptive analyses were performed to profile the sample socio-demographically, and prevalence values were calculated to summarize Canadian adolescent perceptions of body satisfaction. To look for the presence of health inequalities, Rao-Scott chi-square tests which took into account clustering at the school-level were conducted. Any participants that responded to both the body satisfaction question and the health inequality of interest were included in this analysis. Due to clear differences in biological sex with regards to body image, each potential health inequality was stratified by sex. Weighting was used to ensure that each province/territory contributed proportionally in accordance to the Canadian student population.

3.4 Results

3.4.1 Demographic Characteristics

This study used data on 29,991 participants (weighted sample) from 377 schools from across Canada. The response rate from all students asked to participate was 77%. Forty-nine percent of the sample was male. 33% of the sample was aged 15-years-old or older, followed by 14-year-olds (22%), 13-year-olds (19%), 12-year-olds (17%) and 11-years-old or younger (9%). The majority of adolescents were born in Canada (80%), identified as being part of the Canadian dominant culture (79%), and reported above average relative wealth (59%) or high family affluence (67%).

3.4.2 Prevalence of Body Dissatisfaction

Overall, 44% of adolescents sampled reported being body dissatisfied, with two-thirds of the dissatisfaction in the categories reflecting feeling ‘too fat’ (Table 3.1). Females were more body dissatisfied than males and had a higher proportion of ‘too fat’ body dissatisfaction compared to ‘too
Table 3.1. Prevalence of body satisfaction among Canadian adolescents grades 6-10 in the 2013/2014 HBSC study.

<table>
<thead>
<tr>
<th>Categories</th>
<th>Overall</th>
<th></th>
<th></th>
<th>Males</th>
<th></th>
<th></th>
<th>Females</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>Confidence Limit</td>
<td>n</td>
<td>%</td>
<td>Confidence Limit</td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>‘Too Thin’</td>
<td>3 982</td>
<td>14.4</td>
<td>(13.8, 15.0)</td>
<td>2 564</td>
<td>18.9</td>
<td>(17.9, 19.9)</td>
<td>1 418</td>
<td>10.1</td>
</tr>
<tr>
<td>‘Too Fat’</td>
<td>9 230</td>
<td>30.0</td>
<td>(29.2, 30.8)</td>
<td>3 427</td>
<td>22.2</td>
<td>(21.2, 23.3)</td>
<td>5 803</td>
<td>37.4</td>
</tr>
<tr>
<td>‘About Right’</td>
<td>15 822</td>
<td>55.6</td>
<td>(54.8, 56.5)</td>
<td>8 309</td>
<td>58.9</td>
<td>(57.6, 60.1)</td>
<td>7 766</td>
<td>52.5</td>
</tr>
<tr>
<td>Total</td>
<td>29 034</td>
<td></td>
<td>(54.8, 56.5)</td>
<td>14 300</td>
<td>50.5</td>
<td>(50.0, 51.0)</td>
<td>14 734</td>
<td></td>
</tr>
<tr>
<td>Missing</td>
<td>957</td>
<td></td>
<td></td>
<td>502</td>
<td></td>
<td></td>
<td>455</td>
<td></td>
</tr>
</tbody>
</table>
thin’, whereas the prevalence of ‘too thin’ and ‘too fat’ dissatisfaction in males was more equally distributed.

3.4.3 Health Inequalities

Among males, body dissatisfaction increased with increasing age, with 15-year-old males reporting the highest proportion of both ‘too thin,’ and overall body dissatisfaction (Table 3.2). Canadian males who classified themselves as being African had the lowest overall prevalence of body dissatisfaction, with significantly lower prevalence values of ‘too fat’ body dissatisfaction compared to all other ethnicities. In contrast, East and Southeast Asian males reported being the most dissatisfied. Males born in Canada had the lowest proportions of body satisfaction compared to males that immigrated to Canada, however this association was not statistically significant. Body dissatisfaction was the highest for low relative to high SES male adolescents, although this association was only statistically significant for the ‘relative wealth’ proxy measure.

Among females, body dissatisfaction was lowest for girls 11-years-old and younger, and highest for 14-year-olds. Those who reported being part of the Canadian Dominant, Latin American and South Asian (female only) groups all reported the highest prevalence of body satisfaction. Females who identified as Arab and West Asian as well as African adolescents were the most body dissatisfied. Compared to immigrants, females born in Canada were more body dissatisfied. Both relative wealth and FAS found that low SES females were the most body dissatisfied, with over 50% of low affluent females reporting ‘too fat’ body satisfaction alone.

3.5 Discussion

This study examined the prevalence of body dissatisfaction and its associations with potential health inequalities in a nationally representative sample of Canadian adolescents. Body dissatisfaction among Canadian adolescents was high, with more females reporting body dissatisfaction than males.
Table 3.2. Potential health inequalities in body dissatisfaction among Canadian adolescents in the 2013/2014 HBSC.

<table>
<thead>
<tr>
<th>Health Inequality</th>
<th>n</th>
<th>'Too Thin'</th>
<th>'Too Fat'</th>
<th>p-value</th>
<th>n</th>
<th>'Too Thin'</th>
<th>'Too Fat'</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Row %</td>
<td>Difference (CI)</td>
<td></td>
<td></td>
<td>Row %</td>
<td>Difference (CI)</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Referent</td>
<td>Referent</td>
<td>&lt;.0001</td>
<td></td>
<td>Referent</td>
<td>Referent</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>14 109</td>
<td>18.9</td>
<td>Referent</td>
<td>22.2</td>
<td>Referent</td>
<td>&lt;.0001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Females</td>
<td>14 545</td>
<td>10.0</td>
<td>-8.9 (-8.1, -9.7)</td>
<td>37.5</td>
<td>15.3 (14.3, 16.3)</td>
<td></td>
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<tr>
<td><strong>MALES</strong></td>
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<tr>
<td>11 Years Old</td>
<td>1 308</td>
<td>13.2</td>
<td>Referent</td>
<td>19.4</td>
<td>Referent</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12 Years Old</td>
<td>2 363</td>
<td>15.1</td>
<td>1.9 (-0.4, 4.2)</td>
<td>23.5</td>
<td>4.1 (1.4, 6.8)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13 Years Old</td>
<td>2 663</td>
<td>18.3</td>
<td>5.1 (2.8, 7.4)</td>
<td>21.8</td>
<td>2.4 (-0.3, 5.1)</td>
<td>&lt;.0001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14 Years Old</td>
<td>2 996</td>
<td>19.8</td>
<td>6.6 (4.3, 8.9)</td>
<td>23.2</td>
<td>3.8 (1.2, 6.4)</td>
<td></td>
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</tr>
<tr>
<td>15 Years Old</td>
<td>4 773</td>
<td>22.2</td>
<td>9.0 (6.8, 11.2)</td>
<td>22.1</td>
<td>2.7 (0.2, 5.2)</td>
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<tr>
<td><strong>FEMALES</strong></td>
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<tr>
<td>Ethnicity</td>
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<tr>
<td>Canadian Dominant Culture</td>
<td>10 990</td>
<td>18.0</td>
<td>Referent</td>
<td>22.3</td>
<td>Referent</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Arab &amp; West Asian</td>
<td>577</td>
<td>22.5</td>
<td>4.5 (1.0, 8.0)</td>
<td>13.5</td>
<td>-8.8 (-5.9, -11.7)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>East &amp; South East Asian</td>
<td>290</td>
<td>24.0</td>
<td>6.0 (1.0, 11.0)</td>
<td>21.3</td>
<td>-1.0 (-5.8, 3.8)</td>
<td>&lt;.0001</td>
<td></td>
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</tr>
<tr>
<td>Latin American</td>
<td>967</td>
<td>26.5</td>
<td>8.5 (5.6, 11.4)</td>
<td>25.8</td>
<td>3.5 (0.6, 6.3)</td>
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<tr>
<td>South Asian</td>
<td>138</td>
<td>14.4</td>
<td>-3.6 (-9.5, 2.3)</td>
<td>24.6</td>
<td>2.3 (-4.9, 9.5)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>538</td>
<td>20.2</td>
<td>2.2 (-1.3, 5.7)</td>
<td>25.1</td>
<td>2.8 (-0.9, 6.5)</td>
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<tr>
<td>Time Resided in Canada</td>
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<tr>
<td>Born in Canada</td>
<td>10 907</td>
<td>18.5</td>
<td>Referent</td>
<td>23.0</td>
<td>Referent</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>1 to 5 Years</td>
<td>785</td>
<td>20.9</td>
<td>2.4 (-0.5, 5.3)</td>
<td>18.7</td>
<td>-4.3 (-1.5, -7.1)</td>
<td>0.25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 or more years</td>
<td>2 327</td>
<td>19.6</td>
<td>1.1 (-0.7, 2.9)</td>
<td>19.7</td>
<td>-3.3 (-1.5, -5.1)</td>
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<tr>
<td><strong>Relative Wealth</strong></td>
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</tr>
<tr>
<td>Above Average</td>
<td>7 961</td>
<td>17.7</td>
<td>Referent</td>
<td>20.5</td>
<td>Referent</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>4 421</td>
<td>19.2</td>
<td>1.5 (0.1, 2.9)</td>
<td>23.5</td>
<td>3.0 (1.5, 4.5)</td>
<td>&lt;.0001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Below Average</td>
<td>1 155</td>
<td>26.9</td>
<td>9.2 (6.5, 11.9)</td>
<td>29.1</td>
<td>8.6 (5.8, 11.4)</td>
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<tr>
<td><strong>Family Affluence</strong></td>
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<tr>
<td>High</td>
<td>8 446</td>
<td>18.8</td>
<td>Referent</td>
<td>21.5</td>
<td>Referent</td>
<td></td>
<td></td>
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<tr>
<td>Medium</td>
<td>3 898</td>
<td>19.0</td>
<td>0.2 (-1.3, 1.7)</td>
<td>23.9</td>
<td>2.4 (0.8, 4.0)</td>
<td>0.075</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>319</td>
<td>23.8</td>
<td>5 (0.3, 9.7)</td>
<td>24.7</td>
<td>3.2 (-1.6, 8.0)</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

* The p-value represents the overall Chi-square association between each health inequality and body satisfaction.
More females perceived themselves as being ‘too fat’ than males, and more males perceived themselves as ‘too thin’ compared to females. Additional health inequalities were also present. Among males, being older, of East and Southeast Asian ethnicities, or reporting low relative wealth all were associated with experiencing body dissatisfaction. Among females; being older, having a heritage culture of Arab and West Asian or African, being born in Canada and having low SES were all associated with being body dissatisfied.

We identified health inequalities associated with body dissatisfaction, some of which can also be considered health inequities. Health inequities are differences in health that are considered unjust and avoidable. More specifically, these disparities further disadvantage the health of groups who are already disadvantaged socially. Health inequities existed by sex, ethnicity, and SES. Females, those of certain ethnic minorities, and adolescents of low SES were found to be at an increased disadvantage of having perceptions of body dissatisfaction.

The clear distinction between the sexes and how they experience body dissatisfaction can be attributed to differences in body idealizations found within Canadian culture. A sociocultural model called the Tripartite Influence Model is used to explain how idealizations in culture can result in body dissatisfaction and to a further extent, unhealthy weight loss practices. This model argues that societal body ideals exist in every culture, and are transmitted to people through peer, family and media influences. These ideals are then internalized and the extent that an individual internalizes and differs from these ideals can lead to satisfaction or dissatisfaction with their own appearance, which can lead to unhealthy practices to try to reach this ideal.

This sociocultural model can be used to explain our findings. For adolescent females a much higher proportion reported ‘too fat’ dissatisfaction compared to ‘too thin’. This is supported by the thin-idealization that girls in Western societies are subjected to, where this thin-ideal is usually below a healthy weight and does not encompass the average girl’s weight and shape. This ideal is difficult to
achieve, and provides one explanation as to why rates of body dissatisfaction among girls are so high. Girls then internalize this ideal, comparing their bodies to it, and failure to fit this ideal can affect their own weight perception and body satisfaction. Further, this thin-ideal conflicts with some biological aspects of pubertal development, which too can result in increased dissatisfaction with increasing age during adolescence.

For males, society focuses on muscularity where being strong and muscular is the ideal. The higher proportion of ‘too thin’ body dissatisfaction illustrates this drive for muscularity experienced by males. This is especially relevant during adolescence as males may not have reached puberty, and are therefore less likely to reflect this ideal. However, the idea of muscularity is broader, with a wider range of what is acceptable, compared to the thin-ideal which could contribute to why there are higher levels of body dissatisfaction among females.

In general, Asian males have a smaller physique than other ethnicities, and with the muscular ideal present, this could lead to body dissatisfaction. This theory can explain why we found East Asian and Southeast Asian boys to have the highest prevalence of body dissatisfaction among males. In contrast, Canadian males of African descent had the lowest proportion of overall body dissatisfaction but not of ‘too thin’ body dissatisfaction. This highlights the impact that culture-specific ideals can have on adolescents’ perceptions. African culture tends to have an ideal body size that is larger than body preferences of other ethnicities. This can explain why their prevalence of ‘too fat’ body dissatisfaction was low, yet ‘too thin’ was not. If their cultural ideal body size is larger, then adolescent boys may internalize this, think they are not big enough and therefore they may be dissatisfied with their appearance. Unlike males in our study, females of African heritage did not have the highest proportion of body satisfaction, but actually had the second lowest prevalence. These findings illustrate that the thin-ideal presented in Western cultures is internalized by all ethnicities, and cultural ideals may be less
important to adolescents compared to societal standards, when there are large discrepancies between the two.

Additionally, females who were born in Canada were more likely to report body dissatisfaction than immigrants. Speculatively, Canadian born residents would be subjected to Western idealizations in Canada for their entire life and would consequently have to deal with internalization of these ideals for longer periods.

Personality traits have been shown to be a determinant for individuals’ perceptions of their bodies, where having strong social support and traits of resiliency can help protect a person from experiencing body dissatisfaction, and lack of social support and low self-esteem can make an individual more susceptible. Etiological factors surrounding why adolescents with lower perceived SES are more body dissatisfied are not fully established, however one theory is that adolescents with low SES have been shown to have lower self-esteem than adolescents with high SES. Therefore, low self-esteem could in turn directly influence body image perceptions and lead to body dissatisfaction.

Existing evidence surrounding these health disparities with respect to body image have reported similar findings, with some differences. Older age in adolescence has longitudinally been shown to result in lower body satisfaction rates than being younger. With exception to the finding of peaks in dissatisfaction occurring with 14-year-old females, our results also supported this trend. Additionally, previous research has found that Asian American males are at an increased risk of negative body image, and African American males, at decreased risk. Our results are consistent with these conclusions and add to this body of research through the provision of Canadian findings. Unlike our results, females from African heritage in the past tended to have a lower prevalence of body dissatisfaction compared to other ethnicities. However, some studies have discovered the gap on differences in weight-related body satisfaction between adolescent females of African descent and other ethnicities to be decreasing, which could explain why we found a higher rate of ‘too fat’ body dissatisfaction than expected. A review
conducted in 2014 found no quantitative literature that examined body dissatisfaction among immigrant adolescents in Canada, highlighting the need for future research in this area, especially with the increasing amount of immigrant adolescents coming to Canada.\textsuperscript{30} Finally, studies have also found an association between SES and body satisfaction, where both males and females from families with low SES were more dissatisfied with their body than adolescents from families with high SES.\textsuperscript{31} However this finding is inconsistent, as other studies have reported an increased risk of body dissatisfaction for adolescents from high SES families, or no association at all.\textsuperscript{2,7,10}

Limitations of this study warrant comment. The HBSC relies on self-reported data and this may lead to inaccuracies in responses. However given that the exposure variables of interest were mainly socio-demographic or self-perceptions, such misclassification should be minimal. In addition the question on body satisfaction focuses on weight, which is more directed towards female ideals of body image, so it is probable that we do not have a full picture of body dissatisfaction perceived by males. Due to this, the prevalence of body dissatisfaction is likely underestimated in our study. However, even with this suspected error in measurement, it is clear that body dissatisfaction is a public health problem in Canadian males. Finally, the HBSC asks participants to identify their biological sex and therefore may not fully represent gender, which is the social construct more relevant to body image.

There are also a number of strengths to this study. The HBSC study is a large and contemporary sample that through the use of weighting is nationally representative of Canadian adolescents. The findings are therefore likely generalizable to the Canadian adolescent population. This study is also novel as the inequalities associated with body image have not been fully examined nationally in Canadian adolescents. Additionally, the analysis took into consideration the nested and clustered nature of the data.
3.6 Conclusion

Body dissatisfaction is prevalent in both male and female Canadian adolescents. Additionally, certain groups of Canadian adolescents are at an increased risk of having body dissatisfaction, establishing that health inequalities and some inequities are present. Future prevention efforts conducted in Canada need to focus on the groups of young people who report being at highest risk of body dissatisfaction. Targeting females, older adolescents, those of low SES and certain ethnicities will be important in order to potentially decrease this high prevalence. Females reporting low SES were the only group in this entire study who had a higher prevalence of ‘too fat’ body dissatisfaction alone compared to body satisfaction, indicating that this is a critical group to for targeted intervention. Further research on the etiology and mechanisms of some inequalities, especially immigrant status, as well as the best approaches to target interventions to these high-risk groups in Canada would be beneficial. Current prevention initiatives across Canada should be aware of and incorporate these findings into promoting positive body messages to adolescents.

3.7 Acknowledgements

The authors would like to thank all participants of the 2014 Canadian HBSC study. Dr. John Freeman and Dr. William Pickett are the Canadian Principal Investigators currently for the HBSC study. The national coordinator is Mr. Matthew King at Queen’s University, Kingston, Ontario. Dr. Candace Currie at University of St. Andrews, Scotland was the International Coordinator, Dr. Jo Inchley at the University of St. Andrews is the current International Coordinator. Dr. Oddrun Samdal is the data bank manager at University of Bergen, Norway.

3.8 Funding

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and Heart and Stroke Foundation of Canada (MOP 97962; PCR 101415). Nicole Roberts was additionally supported by a Queen’s Graduate Award and McLaughlin Fellowship at Queen’s University.

3.9 Conflict of Interest

   None declared.
3.10 References


Chapter 4

Body dissatisfaction as a predictor of physical inactivity and screen time

among Canadian adolescents
4.1 Abstract

We performed an analysis of associations between body dissatisfaction, physical inactivity and screen time among Canadian adolescents. Cross-sectional and longitudinal data from the Health Behaviour in School-aged Children (HBSC) study were employed. Cross-sectionally, males who reported ‘too fat’ body dissatisfaction were more likely to be physically inactive. Adolescents of both sexes who reported ‘too fat’ body dissatisfaction were also more likely to engage in greater than eight hours of screen time per day. There were no statistically significant associations between ‘too thin’ body dissatisfaction and each of physical inactivity or screen time. Data from the longitudinal component supported the idea that male ‘too fat’ body dissatisfaction temporally leads to physical inactivity, but conversely showed an inverse relationship between body dissatisfaction and later screen time. Although the effects are not strong, the presence of these relationships may inform future interventions as part of a multi-factorial etiology to increase physical activity and decrease screen time among youth.

Keywords: adolescence, body dissatisfaction, physical activity, screen time, epidemiology
4.2 Introduction

Physical activity refers to any bodily movement that raises energy expenditure, and moderate-to-vigorous physical activity (MVPA) includes any activity that increases energy expenditure by a minimum of three times a person’s basal metabolic rate.\(^1\) Based on the current Canadian physical activity guidelines, adolescents should engage in at least 60 minutes of MVPA every day.\(^2\) However, findings from the 2013 Canadian Health Measures Survey show that only 5% of Canadians aged 12-17 are meeting these guidelines.\(^3\) This is of concern as low physical activity levels are associated with poor physical and emotional health outcomes, and these outcomes can last throughout adulthood.\(^4^\)-\(^7\) In addition to decreasing levels of physical activity reported by young people, adolescence is also a period where sedentary behaviour including screen time increases, which has also been shown to relate to negative health outcomes.\(^5^\),\(^8\) Screen time, which includes activities such as computer use, watching television, and playing video games, is one aspect of sedentary behaviour, and currently the Canadian guideline recommends that adolescents engage in no more than two hours of screen time per day.\(^2\) However, less than 20% of Canadian youth actually meet this recommendation, with a typical child averaging almost 8 hours per day.\(^9\)

With the low rates of physical activity and high rates of screen time observed among Canadian youth, it is important to examine what determinants can influence associated physical activity and screen time levels. Existing social theory provides reasons for the existence of such associations. The social comparison theory developed by Festinger in 1954, for example, suggests that people make self-evaluations by comparing themselves to others surrounding them, which can subsequently affect their attitudes and behaviours.\(^10\) Additionally the stress and coping theory suggests that people have different coping strategies that they use to try to adapt to stressors, however these may not help decrease the stressor.\(^11\) Both of these theories have relevance to the etiology of physical inactivity and sedentary behaviours.
Insights into such etiological pathways have emerged from evidence drawn from the body image literature. Body image refers to how a person internally portrays their outward appearance, and body dissatisfaction occurs when there are disparities between a person’s present and self-perceived ideal body.12,13 The temporal natures of relationships between body image, physical inactivity, and screen time are also intriguing. It is plausible that both physical inactivity and screen time are determinants of body image, and it is also plausible that the reverse is true. With respect to this temporal sequence, few studies have looked at the relationship with body satisfaction as the determinant, and none of these have been conducted on a national Canadian adolescent sample.14,19 This is an important research gap, as body dissatisfaction could be contributing to the decreasing rates of physical activity and increases in screen time, and if so, this could be a possible focus for intervention. Examination of these associations using both cross-sectional and longitudinal components provides opportunity to address the temporal direction of these relationships, an important epidemiological issue from a methodological perspective.

We had a unique opportunity to examine whether perceptions of body image are related to adolescents’ physical inactivity and screen time in a Canadian national study. We employed both cross-sectional and longitudinal analyses that assisted in delineating the temporal natures of these associations. The primary hypothesis was that male and female adolescents who reported experiencing body dissatisfaction and perceived themselves to be ‘too fat’ would be less physically active, and report higher engagement in screen time behaviours, than adolescents who were satisfied with their bodies. Further hypotheses were that females who perceived themselves as ‘too thin’ would also be less physically active and report higher rates of screen time than females satisfied with their bodies, and that males who perceived themselves as ‘too thin’ would report no differences in physical activity levels or sedentary behaviours compared to their male counterparts without body dissatisfaction. These hypotheses were based on existing epidemiological evidence,14,15,17,18,20 known psychological constructs that influence body image12,21-23, as well as the social comparison and stress/coping theories described previously.10,11
4.3 Methods

4.3.1 Study Sample

We examined Canadian data from various cycles of the Health Behaviour in School-aged Children (HBSC) study. HBSC is a World Health Organization-affiliated study and collects health information on adolescents aged 11-15 every four years using a cross-sectional survey.\(^{24}\) Multi-level cluster sampling was used, with students (entire classes) nested in randomly selected schools and then school boards in each Canadian province and territory. Informed consent from the participants was obtained and this study had ethics approval from Queen’s University. This study used the 2005/2006 and 2013/2014 cross-sectional HBSC data sets. An Ontario-based longitudinal component of the 2005/2006 HBSC was used to address the temporal sequence of the relationships. Students in sixteen schools from across this province were surveyed by HBSC in 2006 and then administered the same survey again in 2007, matched using an unique identifier.\(^{25}\) This longitudinal component focused exclusively on grade nine and ten students, and for consistency we therefore only examined grade nine and ten participants in the cross-sectional data.

4.3.2 Body Satisfaction Measure

Body satisfaction was measured using the question “Do you think your body is...?” where participants were thought to have body satisfaction if they responded ‘about the right size.’ The other four categories ‘much too thin, a bit too thin, a bit too fat, much too fat’ express body dissatisfaction. A test-retest survey conducted in 2005 calculated a kappa statistic of 0.75 for this question, indicating substantial intra-rater agreement.\(^{26,27}\) Due to small numbers in the extreme response categories, participants in our study were placed into one of three categories based on their response: body satisfied, body dissatisfied (‘too thin’) and body dissatisfied (‘too fat’).
4.3.3 Physical Activity Measure

Moderate to vigorous physical activity (MVPA) was measured using two questions that asked participants how many days in the past week and on a typical week that they engaged in at least 60 minutes of physical activity a day. These two questions were developed by Prochaska and colleagues and have been shown to be a reliable and valid measure for the assessment of adolescents’ MVPA levels.\textsuperscript{28} The mean of these two responses were used and students were categorized into either 7 days of 60 minutes of activity per week, or less than 7 days per week. These categories were used to coincide with the current Canadian guideline of 60 minutes or more of MVPA per day.\textsuperscript{2}

4.3.4 Screen Time Measure

Three questions were used that asked participants how often during their free time both during the week and on a weekend that they: (1) watched videos, (2) played video games (excluding moving games) and (3) used electronics for other purposes (example Facebook). Mean hours per day for each measure were estimated and summed to create an overall screen time value, as per existing precedents.\textsuperscript{5,29} Originally participants were categorized into either 2 hours or less of screen time per day, or more than two hours, based on the recommended guidelines\textsuperscript{33}; however, approximately 94% of subjects did not meet the guidelines so the cutoffs were changed to \( \leq 8 \) hours per day vs. \( >8 \) hours per day. Engagement in \( >8 \) hours of screen time would indicate that the adolescent spends at least half of their waking time on a screen.

4.3.5 Covariates

Sex (male vs. female), grade (9 vs. 10), body mass index (BMI), socioeconomic status (SES), pubertal status and ethnicity were all considered as potential confounders or effect modifiers for the associations of interest, based on existing evidence.\textsuperscript{12,20,30-37}

BMI was determined by asking the participants to record their weight and height, and WHO
growth charts were then used to classify participants into underweight, normal weight, overweight or obese categories according to their estimated BMI. To examine SES, the HBSC family affluence scale was used as an indicator of material wealth. This is comprised of questions on bedroom sharing, the number of vacations taken in the previous year, and how many vehicles and computers the family owns. Pubertal status was only available for females using the question “Have you begun to menstruate?” where participants who answered ‘yes’ subsequently filled out the age when they first started. Females were then categorized as being early, average or late onset of puberty based on cutoff values found from the National Longitudinal Survey of Children and Youth, where younger than 11.53 years was considered early, and older than 13.91 years, late. The HBSC does not have an analogous measure specific to boys and male maturation. Ethnic groups were formed using the 2006 Canadian Census of Population with two adjustments. Arab and West Asian adolescents were grouped together, and a Canadian dominant culture group was created that consisted of North American, European and Aboriginal youth (due to ethics restrictions, Aboriginal youth could not be examined separately).

4.3.6 Imputation for Missing Data

Multiple imputations were performed within the cross-sectional data sets to account for missing values. A random forest-based multiple imputation by chained equations model was used which has been shown to be efficient for use with epidemiologic data. Ten complete data sets were made for each of the cross-sectional data sets, and an average was taken to get one effect estimate for each of the associations of interest.

4.3.7 Cross-sectional Model Building

Intra class correlations were calculated to estimate the extent of variations in outcomes at the cluster (school or classroom) level, in order to support the need for multi-level modeling. Such modeling was subsequently used at the classroom level for the 2006 and 2014 cross-sectional HBSC data, and
multi-level, modified Poisson regression models were developed in order to estimate relative risks. Due to the clear differences in biological sex with regards to both body satisfaction as well as the two outcomes of interest, each model was stratified by sex to account for potential effect modification or confounding. Additional covariates of interest were examined as potential confounders using backwards elimination techniques. Prevalence ratios and associated confidence intervals were estimated based on the final models.

4.3.8 Longitudinal Model Building

A repeated measures, multi-level modified Poisson modeling was employed with participants nested within schools. Two separate analyses were conducted: one using all participants surveyed, accounting for the outcomes at time 1 as a covariate, and an additional analysis using only participants without the outcome of interest at time 1. Considering the high relative frequency of both screen time and physical inactivity, this analysis did not have the statistical power to use only subjects free of the outcomes at baseline. Relative risks and 95% confidence intervals were obtained for each regression conducted.

With the exception of the imputation, which was conducted in R (The R Foundation for Statistical Computing, Vienna, Austria), all other analyses were performed using SAS version 9.4 (SAS Institute Inc., Cary, NC).

4.4 Results

4.4.1 Study Sample

Data were collected on 2,020 adolescents in the 2006 longitudinal, 4,293 in the 2006 cross-sectional, and 13,464 in the 2014 cross-sectional samples (Table 4.1). Within all data sets, both sex and grade were distributed fairly evenly with females and grade nine youth slightly over-represented. The majority of participants reported high levels of family affluence. Most of the 2014 cross-sectional sample
Table 4.1. Description of study samples from the Canadian Health Behaviour in School-aged Children (HBSC) study, multiple cycles

<table>
<thead>
<tr>
<th>Variable</th>
<th>Categories</th>
<th>2006 Longitudinal</th>
<th></th>
<th>2006 Cross-sectional</th>
<th></th>
<th>2014 Cross-sectional</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>Sex</td>
<td>Male</td>
<td>919</td>
<td>45.5</td>
<td>2 019</td>
<td>47.0</td>
<td>6 646</td>
<td>49.4</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>1 101</td>
<td>54.5</td>
<td>2 274</td>
<td>53.0</td>
<td>6 818</td>
<td>50.6</td>
</tr>
<tr>
<td>Grade</td>
<td>9</td>
<td>1 123</td>
<td>55.6</td>
<td>2 320</td>
<td>54.0</td>
<td>6 970</td>
<td>51.8</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>897</td>
<td>44.4</td>
<td>1 973</td>
<td>46.0</td>
<td>6 494</td>
<td>48.2</td>
</tr>
<tr>
<td>Family Affluence</td>
<td>Low</td>
<td>38</td>
<td>1.9</td>
<td>115</td>
<td>2.7</td>
<td>379</td>
<td>2.8</td>
</tr>
<tr>
<td></td>
<td>Medium</td>
<td>734</td>
<td>37.7</td>
<td>1 654</td>
<td>38.5</td>
<td>4 502</td>
<td>33.4</td>
</tr>
<tr>
<td></td>
<td>High</td>
<td>1 178</td>
<td>60.4</td>
<td>2 524</td>
<td>58.8</td>
<td>8 583</td>
<td>63.8</td>
</tr>
<tr>
<td>Ethnicity</td>
<td>African</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>437</td>
<td>3.2</td>
</tr>
<tr>
<td></td>
<td>Arab &amp; West Asian</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>234</td>
<td>1.7</td>
</tr>
<tr>
<td></td>
<td>Canadian Dominant Culture</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10 874</td>
<td>80.8</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td>986</td>
<td>7.3</td>
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<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>126</td>
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</tr>
<tr>
<td></td>
<td>South Asian</td>
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<td></td>
<td></td>
<td></td>
<td>506</td>
<td>3.8</td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>301</td>
<td>2.2</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>2 020</td>
<td></td>
<td>4 293</td>
<td></td>
<td>13 464</td>
<td></td>
</tr>
</tbody>
</table>
identified as being from a Canadian dominant culture. Information on ethnicity was not collected in the 2006 cross-sectional and longitudinal samples.

4.4.2 Prevalence of Body Dissatisfaction

Females reported higher overall prevalence values for body dissatisfaction, as well as more specific perceptions of being ‘too fat’ relative to males, and males had higher levels of perceived ‘too thin’ dissatisfaction (Table 4.2). Body dissatisfaction among females was higher in 2014 vs. 2006, resulting in a greater proportion of girls being body dissatisfied compared to satisfied.

4.4.3 Prevalence of Physical Activity

The majority of males and females were not meeting the Canadian physical activity guidelines, with approximately three-quarters of males and almost 9 in 10 females reporting engagement in less than seven days of physical activity per week, irrespective of HBSC cycle (Table 4.2).

4.4.4 Prevalence of Screen Time

In 2006, females were engaged in less screen time on average than males. By 2014 the screen time hours were more equivalent by sex (Table 4.2). Approximately one half of both males and females were engaging in more than 8 hours per day of screen time in 2014.

4.4.5 Cross-sectional Relationships

Variance in the different outcomes at the cluster levels (schools/classrooms) ranged from 2.1% to 5.9%, and these findings from the empty models were felt to provide sufficient area-level variation to warrant the use of multi-level modeling. All covariates that were maintained in the models were confounders. Findings from the cross-sectional data sets suggested that the relationships were consistent between 2006 and 2014. Males in 2014 who considered themselves to be ‘too thin’ were no more likely to be physically inactive than those who were satisfied with their bodies. (Table 4.3). Males who reported
Table 4.2. Prevalence of body satisfaction, physical activity, and screen time among grade 9/10 adolescents, Canadian HBSC Studies.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Categories</th>
<th>2006 Longitudinal</th>
<th>2006 Cross-sectional</th>
<th>2014 Cross-sectional</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>Prevalence (%)</td>
<td>Confidence Limit</td>
<td>n</td>
</tr>
<tr>
<td><strong>MALES</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Body Satisfaction</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>‘Too Thin’</td>
<td>218</td>
<td>24.1</td>
<td>(21.3, 26.9)</td>
<td>442</td>
</tr>
<tr>
<td>‘Too Fat’</td>
<td>188</td>
<td>20.8</td>
<td>(18.2, 23.5)</td>
<td>483</td>
</tr>
<tr>
<td>‘About Right’</td>
<td>498</td>
<td>55.1</td>
<td>(51.8, 58.3)</td>
<td>1 109</td>
</tr>
<tr>
<td>Total</td>
<td>904</td>
<td></td>
<td></td>
<td>2 034</td>
</tr>
<tr>
<td><strong>Physical Activity</strong>&lt;sup&gt;1&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inactive</td>
<td>713</td>
<td>77.8</td>
<td>(75.1, 80.5)</td>
<td>1 551</td>
</tr>
<tr>
<td>Active</td>
<td>203</td>
<td>22.2</td>
<td>(19.5, 24.9)</td>
<td>483</td>
</tr>
<tr>
<td>Total</td>
<td>916</td>
<td></td>
<td></td>
<td>2 034</td>
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<tr>
<td><strong>Screen Time</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt; 8 hours/day</td>
<td>319</td>
<td>38.2</td>
<td>(34.9, 41.5)</td>
<td>691</td>
</tr>
<tr>
<td>≤ 8 hours/day</td>
<td>515</td>
<td>61.8</td>
<td>(58.4, 65.1)</td>
<td>1 343</td>
</tr>
<tr>
<td>Total</td>
<td>834</td>
<td></td>
<td></td>
<td>2 034</td>
</tr>
<tr>
<td><strong>FEMALES</strong></td>
<td></td>
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<td><strong>Body Satisfaction</strong></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>‘Too Thin’</td>
<td>105</td>
<td>9.6</td>
<td>(7.9, 11.4)</td>
<td>241</td>
</tr>
<tr>
<td>‘Too Fat’</td>
<td>448</td>
<td>41.0</td>
<td>(38.0, 43.9)</td>
<td>881</td>
</tr>
<tr>
<td>‘About Right’</td>
<td>541</td>
<td>49.4</td>
<td>(46.5, 52.4)</td>
<td>1 167</td>
</tr>
<tr>
<td>Total</td>
<td>1 094</td>
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<td></td>
<td>2 289</td>
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<tr>
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<td></td>
<td></td>
<td>2 289</td>
</tr>
<tr>
<td><strong>Screen Time</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt; 8 hours/day</td>
<td>253</td>
<td>24.0</td>
<td>(21.4, 26.6)</td>
<td>517</td>
</tr>
<tr>
<td>≤ 8 hours/day</td>
<td>800</td>
<td>76.0</td>
<td>(73.4, 78.6)</td>
<td>1 772</td>
</tr>
<tr>
<td>Total</td>
<td>1 053</td>
<td></td>
<td></td>
<td>2 289</td>
</tr>
</tbody>
</table>

<sup>1</sup>Physical activity where Active is defined as any adolescent engaged in seven days a week of at least 60 minutes of physical activity per day and Inactive is any adolescent engaged in less than 7 days a week of at least 60 minutes of activity per day.
Table 4.3. Prevalence ratio (PR) estimates describing the association between body satisfaction and physical activity in Grade 9-10 students, Canadian HBSC Studies

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% Inactive</td>
<td>Unadjusted Model</td>
<td>Adjusted Model</td>
</tr>
<tr>
<td></td>
<td>PR</td>
<td>95% CI</td>
<td>PR</td>
</tr>
<tr>
<td><strong>MALES</strong> 1,2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>‘Too Thin’</td>
<td>77.15</td>
<td>(0.99, 1.12)</td>
<td>1.05</td>
</tr>
<tr>
<td>‘Too Fat’</td>
<td>81.57</td>
<td>(1.05, 1.17)</td>
<td>1.10*</td>
</tr>
<tr>
<td>‘About Right’</td>
<td>73.58</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td><strong>FEMALES</strong> 3,4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>‘Too Thin’</td>
<td>87.14</td>
<td>(0.94, 1.05)</td>
<td>0.99</td>
</tr>
<tr>
<td>‘Too Fat’</td>
<td>90.58</td>
<td>(1.00, 1.07)</td>
<td>1.03</td>
</tr>
<tr>
<td>‘About Right’</td>
<td>87.66</td>
<td>1.00</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Prevalence ratios obtained from modified Poisson regression are relative to body satisfied as the reference group.

*p<.05

1 2006 male model adjusted for family affluence, screen time, grade and class-level clustering (n=2,034).

2 2014 male model adjusted for family affluence, screen time, grade, ethnicity and class-level clustering (n=6,646).

3 2006 female model adjusted for family affluence, screen time, and class-level clustering (n=2,289).

4 2014 female model adjusted for family affluence, screen time, grade, ethnicity and class-level clustering (n=6,818).
perceptions of being ‘too fat’ in 2014 were 1.16 times more likely to be physically inactive than those reporting ‘about right’ satisfaction. Females who reported both ‘too thin’ and ‘too fat’ body dissatisfaction were more likely to be physically inactive than those with positive body image, however these associations did not remain after adjustment for confounding.

Cross-sectionally in 2006 and 2014, males who considered themselves to be ‘too fat’ were more likely to engage in high amounts of screen time (Table 4.4). There was no statistically significant association between ‘too thin’ dissatisfaction and screen time among males. Females who reported being ‘too fat’ were 1.21 times more likely to engage in more than 8 hours of screen time compared to females with body satisfaction. The direction of the relationship for ‘too thin’ females also indicated an increased likelihood of engaging in high amounts of screen time compared to their body satisfied counterparts.

4.4.6 Longitudinal Relationships

Males who thought they were ‘too fat’ were at greater risk of being physically inactive for both the entire sample as well as those without the outcome at time 1 (Table 4.5). Opposite to what the cross-sectional data found, ‘too fat’ males were at a decreased risk of engaging in more than 8 hours of screen time compared to males satisfied with their bodies. Among all female participants sampled, those that were ‘too fat’ were at a decreased risk of 8 or more hours of screen time, except when looking only at individuals without the outcome at time 1 there was an increased risk. However, none of these associations were found to be statistically significant.

4.5 Discussion

The most important findings of this analysis of body dissatisfaction, physical inactivity and screen time were as follows: (1) Body dissatisfaction, physical inactivity and high amounts of screen time were prevalent among these samples of Canadian adolescents; (2) Modest associations were found between perceptions of being ‘too fat’ and higher levels of screen time among both males and
Table 4.4. Prevalence ratio (PR) estimates describing the association between body satisfaction and screen time in Grade 9-10 students, Canadian HBSC datasets.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% &gt;8 Hours Unadjusted Model</td>
<td>Adjusted Model</td>
<td>% &gt;8 Hours Unadjusted Model</td>
</tr>
<tr>
<td></td>
<td>PR 95% CI</td>
<td>PR 95% CI</td>
<td>PR 95% CI</td>
</tr>
<tr>
<td><strong>MALES</strong>&lt;sup&gt;1,2&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>‘Too Thin’</td>
<td>33.71</td>
<td>1.07</td>
<td>(0.88, 1.29)</td>
</tr>
<tr>
<td>‘Too Fat’</td>
<td>39.13</td>
<td>1.22*</td>
<td>(1.02, 1.46)</td>
</tr>
<tr>
<td>‘About Right’</td>
<td>31.83</td>
<td>1.00</td>
<td>1.00</td>
</tr>
</tbody>
</table>

| **FEMALES**<sup>3,4</sup>  |            |            |            |            |            |
| ‘Too Thin’                  | 24.90      | 1.16       | (0.91, 1.49) | 1.16       | (0.91, 1.47) | 47.93 | 1.13* | (1.03, 1.24) | 1.12 | (0.98, 1.27) | 1.12 | (0.99, 1.27) |
| ‘Too Fat’                   | 23.38      | 1.09       | (0.93, 1.28) | 1.09       | (0.92, 1.30) | 52.19 | 1.23* | (1.17, 1.30) | 1.22* | (1.13, 1.31) | 1.21* | (1.13, 1.31) |
| ‘About Right’               | 21.51      | 1.00       | 1.00        | 42.43      | 1.00        | 1.00 |

Prevalence ratios obtained from modified Poisson regression are relative to body satisfied as the reference group.

*<sup>p</sup><.05

1 2006 male model adjusted for family affluence, physical activity and class-level clustering (n=2 034).
2 2014 male model adjusted for family affluence, physical activity, ethnicity and class-level clustering (n=6 646).
3 2006 female model adjusted for physical activity, grade and class-level clustering (n=2 289).
4 2014 female model adjusted for family affluence, physical activity, ethnicity, and class-level clustering (n=6 818).
Table 4.5. Relative Risk (RR) estimates describing the associations between body satisfaction, physical activity and screen time from 2006 longitudinal HBSC data.

<table>
<thead>
<tr>
<th>Sample Used</th>
<th>Body Satisfaction</th>
<th>Physical Activity</th>
<th>Screen Time</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>% Inactive</td>
<td>Adjusted Model</td>
<td>% &gt;8 Hours</td>
<td>Adjusted Model</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RR</td>
<td>95% CI</td>
<td>RR</td>
<td>95% CI</td>
</tr>
<tr>
<td><strong>MALES</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Participants</td>
<td>‘Too Thin’</td>
<td>80.18</td>
<td>1.04</td>
<td>(0.85, 1.26)</td>
<td>42.11</td>
</tr>
<tr>
<td></td>
<td>‘Too Fat’</td>
<td>84.57</td>
<td>1.07</td>
<td>(0.88, 1.31)</td>
<td>38.29</td>
</tr>
<tr>
<td></td>
<td>‘About Right’</td>
<td>74.19</td>
<td>1.00</td>
<td></td>
<td>36.30</td>
</tr>
<tr>
<td></td>
<td><strong>n</strong></td>
<td></td>
<td></td>
<td>813</td>
<td></td>
</tr>
<tr>
<td>Outcome Free at Time 1</td>
<td>‘Too Thin’</td>
<td>50.00</td>
<td>1.11</td>
<td>(0.61, 2.02)</td>
<td>25.00</td>
</tr>
<tr>
<td></td>
<td>‘Too Fat’</td>
<td>53.13</td>
<td>1.29</td>
<td>(0.70, 2.40)</td>
<td>19.67</td>
</tr>
<tr>
<td></td>
<td>‘About Right’</td>
<td>43.75</td>
<td>1.00</td>
<td></td>
<td>22.41</td>
</tr>
<tr>
<td></td>
<td><strong>n</strong></td>
<td></td>
<td></td>
<td>200</td>
<td></td>
</tr>
<tr>
<td><strong>FEMALES</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Participants</td>
<td>‘Too Thin’</td>
<td>95.24</td>
<td>1.05</td>
<td>(0.84, 1.32)</td>
<td>27.08</td>
</tr>
<tr>
<td></td>
<td>‘Too Fat’</td>
<td>91.05</td>
<td>1.01</td>
<td>(0.88, 1.16)</td>
<td>23.08</td>
</tr>
<tr>
<td></td>
<td>‘About Right’</td>
<td>89.01</td>
<td>1.00</td>
<td></td>
<td>24.14</td>
</tr>
<tr>
<td></td>
<td><strong>n</strong></td>
<td></td>
<td></td>
<td>1 034</td>
<td></td>
</tr>
<tr>
<td>Outcome Free at Time 1</td>
<td>‘Too Thin’</td>
<td>63.64</td>
<td>0.92</td>
<td>(0.36, 2.37)</td>
<td>18.99</td>
</tr>
<tr>
<td></td>
<td>‘Too Fat’</td>
<td>55.00</td>
<td>0.89</td>
<td>(0.51, 1.55)</td>
<td>12.36</td>
</tr>
<tr>
<td></td>
<td>‘About Right’</td>
<td>62.67</td>
<td>1.00</td>
<td></td>
<td>12.21</td>
</tr>
<tr>
<td></td>
<td><strong>n</strong></td>
<td></td>
<td></td>
<td>124</td>
<td></td>
</tr>
</tbody>
</table>

1 Male physical inactivity model adjusted for baseline physical activity, screen time, family affluence, grade and school level cluster.
2 Male screen time model adjusted for baseline screen time, physical activity, family affluence and school level cluster.
3 Female physical inactivity model adjusted for baseline physical activity, screen time, family affluence and school level cluster.
4 Female screen time model adjusted for baseline screen time, physical activity, grade and school level cluster.
females, as well as physical inactivity for males; (3) longitudinal analyses within the 2006 Ontario sub-sample supported the direction of the relationships between body satisfaction and physical activity, where young males who were body dissatisfied were at greater risk of not meeting the physical activity guidelines; (4) cross-sectional and longitudinal findings with regards to body satisfaction and screen time were inconsistent, where the longitudinal indicated in some cases that body dissatisfaction decreased the risk of engaging in more than 8 hours per day of screen time.

The prevalence estimates identified within our samples of Canadian adolescents are similar to external reports from other countries. On average, across 42 countries in 2014, 22% of 15 year-old males and 43% of 15 year-old females perceived themselves to be ‘too fat’. Additionally, only 21% of males and 11% of females were found to be meeting the physical activity guidelines of at least 60 minutes of MVPA per day. Screen time is also high among this age group in other countries, with the average teenage boy engaging in 8 hours of screen time a day and teenage girl, 7.5 hours in the United Kingdom.

More theoretically, an adolescent who perceives themselves to be ‘too fat’ may feel self-conscious and discouraged about participating in physical activities. The social comparison theory reasons that adolescents compare themselves to their peers, and if the difference between themselves and others are magnified in some manner, negative health and behavioural outcomes can occur. Hence, a young person who perceives themselves to be ‘too fat’ may compare their perceived body size to others who they view as having a more ideal body size. If the gap between their perceptions of themselves and the body size of their peers or even popular media personalities, is large, then they may feel discouraged, thinking that their ideal size is unattainable. This therefore may discourage them from participating in physical activity.

The stress and coping theory can be applied to further understand why a young person with negative body image could engage in higher levels of screen time than those with positive body image, as suggested by our findings. This theory suggests that coping strategies are commonly used to adapt to
stressors, however such strategies may at times actually worsen the stressor.\textsuperscript{11,46} An adolescent experiencing body dissatisfaction (a stressor) might cope with this by increasing their screen time, which can further emphasize their body dissatisfaction, especially if they are comparing themselves to the media depictions that are present for many of the screen time activities.\textsuperscript{37,47}

A small number of studies have examined the possible influence of body image on physical activity among adolescents. Kopcakova \textit{et al.} found from the 2010 Slovakian HBSC that males that considered themselves as being ‘too fat’ were at a 45\% decreased odds of engaging in sufficient physical activity, and that there was no significant association evident for females.\textsuperscript{15} However, their approach to the classification of body dissatisfaction (combining ‘too thin’ and ‘satisfied’ as a referent category) and physical activity (use of only one question, ‘physical activity during the past week’) may have led to discrepant findings. In our own analysis, using two physical activity questions permitted us to get a reliable overall activity level,\textsuperscript{28} as a person’s physical activity in the past week could differ greatly from their typical level. We also estimated relative risk directly as opposed to having a reliance on odds ratios generated from logistic models, which too would lead to discrepant results.

There is little scientific evidence available on the association between body satisfaction and screen time. This could in part be due to sedentary behaviours (such as screen time) being treated as the opposite of physical activity, and not as a separate construct. However a person can meet the recommended guidelines for physical activity and still engage in a high amount of sedentary behaviour, indicating that these behaviours can be independent of each other.\textsuperscript{5,29,48} Studies that have maintained a separation between screen time and physical activity have found that increased screen time is associated with body dissatisfaction.\textsuperscript{5,29} Our findings are complimentary, in that adolescent males and females who perceived themselves as being ‘too fat’ were more likely to engage in high levels of screen time.

Our longitudinal findings that focused on the association between body satisfaction and physical activity are supportive of findings that emerged cross-sectionally. Although we did not achieve statistical
significance in the longitudinal analysis, the direction of the effect was similar to the cross-sectional findings, indicating that males who perceived that they were ‘too fat’ at baseline reported higher levels of being physically inactive upon follow-up. Failure to identify a statistically significant effect is likely attributable to a lack of statistical power. After adjustment for confounding, the longitudinal findings also showed no relationship between body satisfaction and physical activity among females, suggesting that there are other determinants underlying why many female adolescents engage in low levels of physical activity. These associations have also been examined longitudinally in existing literature. Among adolescent girls, perceived body appearance was not a significant predictor of change in physical activity, in both a 1-year\textsuperscript{18} and 2-year longitudinal study.\textsuperscript{17} However, a longitudinal study that examined both male and female adolescents found that after five years, perceptions of body dissatisfaction predicted lower physical activity levels, although after adjustment for BMI this only remained significant for females.\textsuperscript{14} Following participants for longer periods of time may therefore be important when examining this relationship.

To our knowledge no past longitudinal studies have examined whether body satisfaction influences an adolescent’s screen time. Our findings are unstable for this association as some of them indicate that having body dissatisfaction increases a person’s risk of engaging in high levels of screen time, an opposite finding to our longitudinal results. However, a lack of statistical power could be contributing to this finding and longitudinal studies with a larger sample and that have a longer follow-up period than one year would be more revealing.

Limitations of our study are as follows. Methodologically, the HBSC uses self-reported survey data, which may lead to misclassification, both non-differential and differential, and associated imprecision and bias. Second, the question used to infer body image is more directed towards females as it focuses on weight, which could result in an inaccurate representation of body dissatisfaction in males. Third, some uncontrolled confounding occurred as ethnicity was not obtained for the 2006 data sets but
was a confounder in the 2014 data. Fourth, the longitudinal component had a small sample size, making it impossible to only use subjects who were physically active or engaged in less than 8 hours a day of screen time at baseline, which is what is used for a typical cohort study. Instead, our main analysis had to include all participants and account for baseline outcome status, which could be a source of bias. Additionally, the follow-up period for the longitudinal component is only one year, which may be insufficient to observe changing levels of physical activity and screen time. Strengths of our study also warrant comment. The cross-sectional data involved large samples that were nationally representative of the Canadian adolescent populations. The use of longitudinal data helped to sort out the direction of the associations inferred from cross-sectional findings. Additionally, the analysis took into consideration the clustered nature of the data via multi-level modeling. Finally, the use of multiple imputation in both the 2006 and 2014 cross-sectional data allowed us to account for key missing values for the variables of interest.

4.6 Conclusion

Our results indicate that while body satisfaction does appear to partially explain why many Canadian adolescents are physically inactive and engage in high amounts of screen time, the effects are not strong. Other factors may be more influential in such etiological pathways. Although small, the presence of this relationship may inform future interventions as part of a multi-factorial etiology. Due to the high prevalence of physical inactivity and screen time, targeting many determinants simultaneously will be important in collectively decreasing these unhealthy behaviours. Additional longitudinal research on Canadian adolescents is also warranted.

4.7 Acknowledgements

The authors would like to thank all participants of the 2006 and 2014 Canadian HBSC study. Special thanks to Dr. Ian Janssen for his guidance with this project. Dr. William Boyce and Dr. William
Pickett were the Canadian Principal Investigators for the 2006 HBSC study. Dr. John Freeman and Dr. William Pickett are the Canadian Principal Investigators currently for the HBSC study. The national coordinator is Mr. Matthew King at Queen’s University, Kingston, Ontario. Dr. Candace Currie at University of St. Andrews, Scotland was the International Coordinator, Dr. Jo Inchley at the University of St. Andrews is the current International Coordinator. Dr. Oddrun Samdal is the data bank manager at University of Bergen, Norway.

4.8 Funding

The HBSC study in Canada is funded by the Public Health Agency of Canada and Health Canada. The longitudinal study was supported by Canadian Institutes of Health Research (2004MOP-CHI-128223-C). Additional support included operating grants from the Canadian Institutes of Health Research and Heart and Stroke Foundation of Canada (MOP 97962; PCR 101415). Nicole Roberts was additionally supported by a Queen’s Graduate Award and McLaughlin Fellowship at Queen’s University.

4.9 Conflict of Interest

None declared.
4.10 References


31. Davison, K. K., Werder, J. L., Trost, S. G., Baker, B. L. & Birch, L. L. Why are early maturing


Chapter 5

General Discussion

5.1 Study Summary

The purpose of this thesis was to conduct a national study to examine Canadian adolescents’ perceptions of body image, and profile these perceptions by a number of socio-demographic factors that were hypothesized to result in health inequalities. In addition, we investigated whether perceptions of body image were related to adolescents’ physical activity and screen time levels using both cross-sectional and longitudinal analyses. Finally, based upon the potential role of biological sex in such relationships, we examined the influence that sex has on body image, how sex impacts the inequalities that were investigated, and whether sex modified the relationship between body image, physical activity and screen time.

5.2 Summary of Main Findings

Overall, the prevalence of body dissatisfaction was high, with the percentage of adolescents experiencing some form of body dissatisfaction ranging from 45-55%. The prevalence of physical inactivity and excessive screen time ranged from 75-78% of males and 88-90% of females being considered physically inactive, and 34-48% of males and 23-48% of females engaged in more than eight hours of screen time among the samples.

Health inequalities and some inequities were related to perceptions of body image. Among males, being older, of East and Southeast Asian ethnicities, or reporting low relative wealth all were associated with experiencing body dissatisfaction. Among females, being older, having a heritage culture of Arab
and West Asian or African, being born in Canada and reporting a low SES were all associated with being body dissatisfied.

For the cross-sectional data, males who perceived themselves as being ‘too fat’ were more likely to be physically inactive and engage in greater than eight hours of screen time compared to males who experienced body satisfaction. Females who perceived themselves as being ‘too fat’ were more likely to engage in greater than eight hours of screen time compared to females who were considered body satisfied. There were no statistically significant associations found between body satisfaction and physical activity or screen time among adolescents who perceived themselves as being ‘too thin’.

The 2006 Ontario longitudinal sub-sample found no statistically significant associations for the relationships of interest. However, it did support the direction of the relationships between body satisfaction and physical activity, where young males who were body dissatisfied were at greater risk of not meeting the physical activity guidelines. In contrast, the cross-sectional and longitudinal findings with regards to body satisfaction and screen time were inconsistent, where the results from the longitudinal data indicated in some cases that body dissatisfaction decreased the risk of engaging in more than 8 hours per day of screen time.

There was a clear distinction in body satisfaction between the sexes, with females experiencing overall body dissatisfaction and ‘too fat’ body dissatisfaction more than males, and males experiencing ‘too thin’ body dissatisfaction more than females. Health inequalities also differed by sex. Sex was not found to significantly modify the relationships between body satisfaction, physical activity and screen time although it was a confounder. Stratifying the relationships by sex further showed distinctions in the associations based on sex, including differences in confounders retained in models as well as on the prevalence ratios obtained.
5.3 Study Limitations

The Health Behaviour in School-aged Children (HBSC) study uses self-reported data from adolescents who participate, which can lead to error and bias. Participants are asked to recall their past physical activity and screen time levels that they engage in, which some students may have difficulty in remembering with accuracy. This would result in recall error, not bias, as it is unlikely that students who are experiencing body dissatisfaction would be more or less likely to correctly recall their past levels than those who have body satisfaction. As a result, non-differential misclassification may have occurred which would bias the prevalence ratios towards the null.

Social desirability bias could also be introduced into this study from the use of self-reported data. Social desirability bias arises when people systematically underreport undesirable behaviours or over-report desirable behaviours.\(^1\) People know that physical activity is good for you and being sedentary is harmful, so adolescents in our study may have reported higher levels of physical activity and lower levels of screen time than what they actually engage in. This has been demonstrated in previous studies. One study found that children tended to over-report their past physical activity (p=0.02) and a validity study found that participants over-reported their physical activity anywhere from 4.15 to 11.30 minutes per day.\(^2,3\) This has also been shown with screen time where youth aged 11-15 years underestimated their television screen time by 0.09 hours per week and their computer screen time by 0.68 hours per week.\(^4\) This would result in non-differential misclassification if the proportion of subjects falsely reporting meeting the guidelines was similar for the exposed and unexposed groups, which would bias the results towards the null. However, if there are differences between body dissatisfied subjects and body satisfied subjects in terms of their reporting, then differential misclassification would result, which could bias the results in either direction.

Selection bias may have also occurred in this study if adolescents who participated in the HBSC were systematically different than the source population of interest, which was all Canadian adolescents.
who met the inclusion criteria.\textsuperscript{1} Since the HBSC is a volunteer-based study, and the response rate was 74\% and 77\% for the 2006 and 2014 cross-sectional surveys respectively,\textsuperscript{5,6} selection bias is possible in the form of volunteer bias. Subjects who chose to participate in the study could be different than those who refused in terms of their health behaviours. If there were a difference between adolescents that consented to participate and those that did not in terms of both body satisfaction and the two outcomes, then selection bias would occur. This would affect the representativeness of the prevalence values calculated for the Canadian adolescent population (selection bias in terms of “representativeness”) as well as change the size of the effect estimates (more classic selection bias, in terms of bias in associations). In addition the longitudinal study had one Ontario school who withdrew before the second data collection due to a student’s death.\textsuperscript{5} However, it is unlikely that all of these students were systematically different than the adolescents in the 16 schools that participated and therefore this most likely was not an issue.

Uncontrolled confounding is another limitation with this thesis, specifically for the second manuscript. Information was not available on pubertal status of males, which was identified as a potential confounder. Pubertal status was assessed as a potential confounder among females and it was not found to be one, so it is likely that this would have been the case for males as well, and therefore would not have greatly influenced the prevalence ratios obtained for the associations. In addition information on ethnicity was not available for the 2006 cross-sectional or longitudinal data, and was likely a confounder in both of the relationships.

Residual confounding could also be present in this study, which occurs when confounding exists even after efforts have been made to control for it.\textsuperscript{1} This can appear from imprecise measurements used to assess variables of interest, and due to the self-reported nature of the data it is likely that residual confounding is present. The family affluence scale (FAS) was used as a proxy measure of socioeconomic status and examined as a potential confounder. This is one example where imprecise measurements may have resulted in some residual confounding. Approximately 60\% of the participants were categorized as
being from high family affluence, which is unlikely to be true. While the family affluence scale is associated with socioeconomic status, it is no longer an ideal measure of affluence in developed countries as most families now own computers, cars, and have their own bedroom. Therefore misclassification of this confounder most likely occurred, and residual confounding would result. Relative wealth is another proxy of socioeconomic status used in the HBSC, so this was also examined as a potential confounder; however, it was not found to be a significant confounder in the associations of interest which was why family affluence was used. The question on relative wealth also has limitations as it is a subjective measure that resulted in more than half of the sample reporting ‘above average’ relative wealth. Therefore regardless of the proxy used, residual confounding is likely present.

The body satisfaction question used in the HBSC revolves around weight which is much more directed towards females compared to males. The thin-ideal that females experience from society is weight based, whereas the muscular-ideal that males face is less about weight and more focused on strength and muscle. Therefore the HBSC question does not fully encompass this prominent ideal for males, which is a limitation. This would result in an underrepresentation of body dissatisfaction in males which would therefore affect the prevalence’s of body dissatisfaction obtained, as this would most likely be higher than what we found. This additionally could affect our estimates obtained for the second manuscript as misclassification of true exposure is likely. Despite these limitations it was still important to include males in this thesis as they are under-studied in body image research, even though negative body image is evidently a problem for them as well. A question on muscularity in the HBSC would be beneficial.

It is important to note that the questions on screen time vary slightly between the 2006 and the 2014 HBSC studies (Appendix B). These differences reflect the advancements in technology between these two dates. For example in 2006 one of the screen time questions asked participants “How many hours a day do you usually use a computer for chatting on-line, internet, emailing, homework etc, in your
free time?” For the 2013/2014 survey this question got expanded and became “How many hours a day, in your free time, do you usually spend using electronic devices such as computers, tablets or smartphones for other purposes (e.g. homework, emailing, tweeting, Facebook, chatting, surfing the internet)?” While these questions vary slightly in content, their overall meaning is the same and it is unlikely that this would lead to response differences, or be unreasonable for us to compare the prevalence values and associations found for these data sets.

The longitudinal data had some additional limitations that warrant discussion. While our hope was to address the temporality of the associations of interest using the longitudinal data, this ended up being difficult to accomplish for two reasons. Firstly, due to the high prevalence of both physical inactivity and excessive screen time among this sample, we were unable to only include adolescents who did not have the outcome at time 1, which is how a typical cohort study is conducted. Instead we had to include the whole sample of adolescents and adjust for baseline physical activity and screen time levels, in an attempt to control for differences at baseline. In doing this, additional bias may have been introduced. This bias is known as Lord’s paradox and reasons that: while adjusting for baseline factors in studies that are looking at a change in an outcome can help reduce certain biases, it can also introduce bias which could affect the estimates obtained.\textsuperscript{11,12} It is therefore possible that some bias was introduced by doing this however we felt that it was important for us to control for baseline physical activity and screen time in order to more accurately examine these associations. This bias was found to be small as it did not substantially change the relative risks for any of the associations (Appendix E) and it is therefore not a considerable limitation.

Secondly we did not have adequate power to detect any differences that we found with the longitudinal data (Appendix F). This means that even if there is a true association between body satisfaction and physical activity or screen time, we were unable to see it with the longitudinal data, due to both the small effects that were identified as well as the small sample size used. Therefore we cannot
come to the definitive conclusion that there was no statistically significant association between the variables of interest based upon the relative risks obtained. While we were unable to fully establish temporality of these associations, the longitudinal data was still useful in informing the interpretation of cross-sectional results.

One final limitation for the longitudinal data is that the follow-up period was only 1 year, which may not have been adequate enough to examine changes in physical activity and screen time.

5.4 Study Strengths

Strengths of this study should also be highlighted. The cross-sectional HBSC is a large and nationally representative sample. The findings of this thesis should therefore be generalizable to the Canadian adolescent population. While the longitudinal data is strictly from Ontario, the prevalence values of demographic variables as well as exposure and outcome were similar to the cross-sectional data, making comparisons and inferences between the data sets justifiable.

The large sample for the cross-sectional data also allowed us to stratify by biological sex which was important to do, as there are clear distinctions in theory based on sex, and additionally we found differences in which covariates were confounders based on sex.

Our use of multi-level modeling was another strength of this thesis. Students from the same class or school are expected to be more similar than students from different schools, which could result in clustered data, and the use of multi-level modeling accounted for this clustering analytically.

Creating multiple imputation models to account for missing cross-sectional data for the second manuscript is another strength of this thesis. The use of complete case analysis, while simple, can potentially lead to a loss of information as we are ignoring any incomplete cases, as well as can introduce bias if the missing data is not random, which would result in biased effect estimates. The use of multiple imputation allowed us to include data from all participants surveyed, in order to minimize this bias. While
effect estimates were found to be similar between the two analyses (Appendix D), there were differences in statistical significance as well as in the variables identified as confounders. Additionally, inclusion of imputed values led to modest improvements in statistical power.

Finally, while the longitudinal data had limitations, this component of our study helped inform and draw conclusions about the temporal direction of the associations found cross-sectionally.

### 5.5 Public Health Implications

It is clear from this research that body dissatisfaction is prevalent among Canadian youth. This can lead to unhealthy behaviours among young people in order to improve physical appearance, highlighting the necessity for positive body image promotion efforts.\(^{14}\) The findings of this thesis suggest that certain groups of youth are at a higher likelihood of experiencing body dissatisfaction, and prevention efforts in Canada should be mindful of this. Currently in Canada there are online resources including toolkits and curriculums that teachers and parents can access to disseminate to adolescents.\(^{15–18}\) These are broad programs, aimed at all youth. To our knowledge there are no analogous health promotion initiatives that target certain socio-demographic groups, with exception to ones that are directed towards females. While this is an important population to target, there are other groups that are also at increased risk of developing body dissatisfaction. We found that females from low socio-economic families had a higher prevalence of ‘too fat’ body dissatisfaction alone than body satisfaction, a finding that was not discovered with any other socio-demographic group examined. This is one group that should immediately be focused upon. The distinct differences found among ethnicities and body satisfaction and the etiology behind these from different cultural influences also support why targeting certain ethnicities would be beneficial. While the thin and muscular ideal is conveyed to all adolescents in Canada, certain cultures have additional views on bodies and being mindful of these differences could help reduce the prevalence of body dissatisfaction.
Due to the known negative health outcomes associated with physical inactivity and high amounts of screen time, current initiatives such as ParticipACTION are widespread, and aim to reduce these unhealthy behaviours. To our knowledge these programs do not focus on promoting positive body messages as one way to help youth become less sedentary and more active. Our results identified some associations that indicate that body image may be a determinant of physical activity and screen time behaviours. Although small, the presence of this relationship may inform future interventions as part of a multi-factorial etiology. It is our thought that targeting many determinants simultaneously will be important in collectively decreasing these unhealthy behaviours.

5.6 Future Research Directions

This thesis contributes to past research conducted on both health inequalities in regards to body image as well as the relationships between body satisfaction, physical activity and screen time. Additionally, it adds Canadian data using a national adolescent sample, which was lacking.

While we identified health inequalities that were present in relation to body satisfaction, further research on the etiology of some of the inequalities, especially immigrant status, would be beneficial in order to gain a deeper understanding of the mechanisms surrounding these relationships in Canadian adolescents. In addition, Canadian research examining the best approaches to target interventions to the high-risk groups identified would be of benefit.

It is clear that physical inactivity and high amounts of screen time represent public health challenges among Canadian youth, and therefore research needs to continue to identify factors that might be contributing to these levels. The conflicting results shown in past cross-sectional and longitudinal studies surrounding the associations between body image, physical activity and screen time, as well as the inconsistency in our cross-sectional and longitudinal findings illustrate the necessity to conduct more research on these relationships in Canadian youth. Given the plausibility of a bi-directional relationship,
longitudinal research would be of greatest benefit to establish if body image is a determinant of physical activity and screen time.

Intervention research that examines many determinants of physical activity and screen time including body image would be beneficial to see if determinants that individually showed small associations collectively can greatly influence an increase in physical activity and decrease in screen time among youth.

5.7 Conclusion

In conclusion, certain socio-demographic groups of adolescents are at a higher risk of experiencing body dissatisfaction than others. Focused messages that promote positive body image ideals to these groups could contribute to eliminating these disparities. In addition, body dissatisfaction was not a strong predictor of physical inactivity or screen time among Canadian youth. This suggests that interventions that aim to increase physical activity levels or decrease screen time would not benefit from solely addressing body image as a determinant. However, it would be unsuitable to conclude that there is no relationship between these perceptions and behaviours as some modest associations were found. Instead, interventions that concentrate on many factors that could collectively contribute to changes in physical activity and screen time levels should be considered in future research.
5.8 References


Appendix A
The Health Behaviour in School-aged Children Study

The purpose of this appendix is to describe the Health Behaviour in School-aged Children (HBSC) study that was used for this thesis in more detail.

Methodology of the Health Behaviour in School-aged Children Study

The HBSC study is administered in collaboration with the World Health Organization and involves a cross-sectional survey that is distributed to adolescents aged 11-15 years in 44 countries, including Canada, every four years. Its purpose is to increase understanding and knowledge of various behaviours relating to adolescent health. Canada has participated in seven cycles since 1990, the most recent cycle was in 2013/2014.

A multi-level cluster sampling approach is used to recruit subjects for the HBSC study in Canada. Within each province and territory school jurisdictions were first identified and a sampling list created based on predominant language of teaching, public/Roman Catholic denomination, school size, and community population size. A list of all schools in each jurisdiction was formed and schools from this list were randomly selected to participate. Entire classes within these schools were selected for each of the grades being studied. For most of the provinces, two classes for each grade were asked to participate. For Prince Edward Island, all students in the chosen schools were asked to participate if they were in grades 6-10, and for the Territories all schools were asked to participate.

Students within each selected class were asked to participate in the study and those that provided consent and filled out the questionnaire were included. There were three levels of consent obtained: the school jurisdictions had to give permission, then school principals were asked to participate, followed by
parental consent for each individual in the classrooms chosen.\textsuperscript{2} Parental active or passive consent was used, depending on the jurisdiction. Active consent involved the parents filling out a consent form, and passive consent allowed students to participate if they did not return a form where the parents refused their child to participate. Each student had between 40 and 70 minutes to fill out the survey, which was either pen and paper or web-based, and anonymity was ensured for all students.\textsuperscript{2,3}

Private schools, schools on native reserves, home schools and special needs schools were not included in this study.\textsuperscript{3}

Seventeen schools in Ontario that were sampled in the 2006 national HBSC survey were selected to participate in a HBSC longitudinal subsample. One year following the administration of the national survey, students were given an identical survey to fill out. Students who participated were given an unique identifier and their surveys from Time 1 (2006) and Time 2 (2007) were matched. Seventeen schools were initially included in the longitudinal subsample however due to a student death one school withdrew, resulting in data collected on 2,031 grade nine and ten students from 16 schools across Ontario.\textsuperscript{4}

The 2006 cross-sectional HBSC survey was administered across Canada to approximately 200 schools and included 9,670 grade six to ten participants, having an overall response rate of 74\% from the initial sample.\textsuperscript{3,4} Data used for this thesis was from 167 classes and 4,293 grade nine and ten participants. The 2014 HBSC was administered across Canada to 377 schools and included a total sample of 29,784 youth with an overall response rate of 77\%.\textsuperscript{2} Data used for the second manuscript of the thesis was from 213 schools, 380 classes and 13,464 participants.

\textbf{Ethics Approval}

Principles of ethics need to be considered when conducting research on human participants. The study must obtain informed consent, maximize benefits and do no harm, protect their anonymity and
confidentiality, and have respect for human dignity and justice. All cycles of the HBSC survey have met these principles and obtained ethics approval from the General Research Ethics Board at Queen’s University.
References


Appendix B
HBSC Survey Questions Used

The purpose of this appendix is to show the exact survey questions used in this thesis for both the 2006 and 2014 HBSC surveys. The 2006 cross-sectional and longitudinal HBSC used the same questionnaire. These questions are taken from the 2013/2014 survey, however questions that had different wording in the 2005/2006 survey are also attached where necessary.

Body Satisfaction

33. Do you think your body is...?
   □ Much too thin
   □ A bit too thin
   □ About the right size
   □ A bit too fat
   □ Much too fat

Physical Activity

Physical activity is any activity that increases your heart rate and makes you get out of breath some of the time. Physical activity can be done in sports, school activities, playing with friends, or walking to school. Some examples of physical activity are running, brisk walking, inline skating, biking, dancing, skateboarding, swimming, soccer, basketball, and football.
For these next two questions, please add up all the time you spend in physical activity each day.

15. Over the past 7 days, on how many days were you physically active for a total of at least 60 minutes per day?
   □ 0 days  □ 1 day  □ 2 days  □ 3 days  □ 4 days  □ 5 days  □ 6 days  □ 7 days

16. Over a typical or usual week, on how many days are you physically active for a total of at least 60 minutes per day?
   □ 0 days  □ 1 day  □ 2 days  □ 3 days  □ 4 days  □ 5 days  □ 6 days  □ 7 days
78. About how many hours a day do you usually watch television (including videos and DVDs) in your free time? *(Please mark one box for weekdays and one box for weekend)*

<table>
<thead>
<tr>
<th>Weekdays</th>
<th>M19</th>
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<tbody>
<tr>
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<td>About 7 or more hours a day</td>
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79. About how many hours a day do you usually play games on a computer or games console (Playstation, Xbox, GameCube etc.) in your free time? *(Please mark one box for weekdays and one box for weekend)*

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<tr>
<th>Weekdays</th>
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80. About how many hours a day do you usually use a computer for chatting on-line, internet, emailing, homework etc. in your free time? *(Please mark one box for weekdays and one box for weekend)*

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<tr>
<th>Weekdays</th>
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### Screen Time (2014)

75. **How many hours a day, in your free time, do you usually spend watching TV, videos (including YouTube or similar services), DVDs, and other entertainment on a screen?**  
   *(Please mark one box for **weekdays** and one box for **weekend**)*

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<th>Weekdays</th>
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76. **How many hours a day, in your free time, do you usually spend playing games on a computer, games console, tablet (like iPad), smartphone or other electronic device (not including moving or fitness games)?**  
   *(Please mark one box for **weekdays** and one box for **weekend**)*

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78. **How many hours a day, in your free time, do you usually spend using electronic devices such as computers, tablets (like iPad) or smartphones for other purposes (e.g., homework, emailing, tweeting, Facebook, chatting, surfing the internet)?**  
   *(Please mark one box for **weekdays** and one box for **weekend**)*

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<td>About 7 or more hours a day</td>
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95
Sex

4. Are you male or female?
   ☐ Male
   ☐ Female

Grade

1. What grade are you in?
   ☐ Grade 8
   ☐ Grade 9
   ☐ Grade 10
   ☐ Grade 11

Family Affluence Scale

80. Do you have your own bedroom for yourself?
   ☐ No
   ☐ Yes

82. Does your family own a car, van or truck?
   ☐ No
   ☐ Yes, one
   ☐ Yes, two or more

83. How many times did you and your family travel out of Canada for a holiday/vacation last year?
   ☐ Not at all
   ☐ Once
   ☐ Twice
   ☐ More than twice

85. How many computers does your family own? (including laptops and tablets, not including game consoles and smartphones)
   ☐ None
   ☐ One
   ☐ Two
   ☐ More than two
Relative Wealth

47. How well off do you think your family is?
   - □ Very well off
   - □ Quite well off
   - □ Average
   - □ Not very well off
   - □ Not at all well off

Time Resident in Canada (2014 only)

7. How many years have you lived in Canada?
   - □ I was born in Canada
   - □ 1 to 2 years
   - □ 3 to 5 years
   - □ 6 to 10 years
   - □ 11 or more years

Ethnicity (2014 only)

6. People living in Canada come from many different cultural and racial backgrounds. How do you describe yourself? (Mark all that apply)

   □ White
   □ Chinese
   □ South Asian (e.g., East Indian, Pakistani, Sri Lankan)
   □ Black
   □ Filipino
   □ Latin American
   □ Southeast Asian (e.g., Cambodian, Indonesian, Vietnamese)
   □ Arab
   □ Métis
   □ Inuit
   □ First Nations
   □ Japanese
   □ Korean
   □ West Asian (e.g., Afghan, Iranian)
   □ Other (please specify)

     ________________
Appendix C

Intra-class Correlation Calculations

Intra-class correlations (ICCs) were calculated to determine the amount of variation in the outcomes at the cluster (school or class) level (Table C.1). The method for the longitudinal data in some instances had all students filling out the survey in a large assembly, making it not possible to determine which class the participants were from, which is why there is no class identifier. No school identifier was in the cross-sectional 2006 data, making us unable to calculate the ICCs at the school level. Therefore for the longitudinal 2006 data, multi-level modeling at the school level was used and for the two cross-sectional datasets multi-level modeling at the class level was conducted.

Table C.1. Intra-class correlations for Manuscript 2 outcomes

<table>
<thead>
<tr>
<th>Cluster Level</th>
<th>Intra-class Correlation Coefficient (%)</th>
<th>Cycle 5 Longitudinal</th>
<th>Cycle 5 Cross-Sectional</th>
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<tbody>
<tr>
<td>School</td>
<td>Outcome: Physical Activity</td>
<td>2.12</td>
<td></td>
<td>3.06</td>
</tr>
<tr>
<td>Class</td>
<td></td>
<td>-</td>
<td>5.59</td>
<td>4.59</td>
</tr>
<tr>
<td>School</td>
<td>Outcome: Screen Time</td>
<td>4.56</td>
<td>-</td>
<td>3.43</td>
</tr>
<tr>
<td>Class</td>
<td></td>
<td>-</td>
<td>5.88</td>
<td>4.45</td>
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</table>
Appendix D

Multiple Imputation to Account for Missing Data

The purpose of this appendix is to briefly describe why multiple imputation was used for the second manuscript and to show the differences found between complete case analysis and multiple imputation for the relationships of interest.

Missing Data in the HBSC Study

The HBSC covers a variety of health behaviours, making the survey long and detailed. Adolescents who participate in the study are able to leave any question that they do not want to answer blank, and will still be included in the sample for any of the questions they filled out. Due to this, many of the questions contain missing values. While conducting the regression analyses on both the 2006 and 2014 cross-sectional surveys it was found that 15% (2006) and 29% (2014) of the data had at least one missing value when looking at all of the variables of interest (Figure D.1). This was thought to be high and therefore we decided that imputation was warranted.

Complete Case Analysis Versus Imputation

Often in epidemiologic research complete case analysis is used. As the name suggests, complete case analysis excludes subjects that have missing data for any of the variables of interest. While this method is simple it can lead to a loss of information, which may result in a decrease in precision and can introduce bias if the missing data is not missing completely at random. It also leads to a loss of power due to the decrease in sample size.

Imputation is one way to handle missing data where instead of excluding any participants that have missing values we can impute plausible values, and therefore include the participant in the analysis.
Figure D.1. Diagram of the amount of missing data in each sample, and the final sample used for manuscript 2.

a Number of subjects missing including all potential covariates of interest

b Number of subjects missing based on final models used
There are two main types of imputation: single and multiple. Single imputation assigns one possible value to the missing data, to create one complete data set. However this form of imputation has limitations as it fails to account for between imputation variability as there is only one plausible value given to each missing data point.\(^1\) Multiple imputation assigns various possible values to the missing data thus creating multiple completed data sets. Multiple imputation is therefore a better method as it can account for both between and within imputation variability therefore reflecting the uncertainty about what values get imputed.\(^1,2\)

**Multiple Imputation Model Used**

A random forest-based multiple imputation by chained equations model was used. This was chosen as this method has been shown to be efficient, produce unbiased effect estimates, and is able to accommodate nonlinearities and complex non-parametric data.\(^3\) Multiple imputation was conducted on both the cross-sectional data sets. Ten complete data sets for each study were created, and regression analyses were run. An average of the prevalence ratios obtained was calculated to provide a single estimate for each relationship of interest.

**Differences in Regression Analyses**

Prevalence ratios were obtained using both the complete case and multiple imputation analyses in order to examine any differences (Table D.1.). While the prevalence ratio estimates did not substantially change, there were differences in confounders for the relationships as well as changes in confidence intervals which resulted in some associations being statistically significant. Overall using multiple imputation for the second manuscript of this thesis was beneficial.
Table D.1. Prevalence ratios (PR) of adjusted Poisson regression analyses examining body satisfaction as a predictor of physical activity and screen time in Canadian adolescents, with and without multiple imputation. (Referent: Body Satisfied)

<table>
<thead>
<tr>
<th>Body Dissatisfaction</th>
<th>Physical Activity</th>
<th>Screen Time</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Complete Case Analysis</td>
<td>Random Forest Multiple Imputation</td>
</tr>
<tr>
<td></td>
<td>PR</td>
<td>95% CI</td>
</tr>
<tr>
<td><strong>MALES</strong></td>
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</tr>
<tr>
<td>2006 ‘Too Thin’</td>
<td>1.01</td>
<td>(0.92, 1.20)</td>
</tr>
<tr>
<td>2006 ‘Too Fat’</td>
<td>1.10</td>
<td>(0.97, 1.24)</td>
</tr>
<tr>
<td>2014 ‘Too Thin’</td>
<td>1.03</td>
<td>(0.95, 1.12)</td>
</tr>
<tr>
<td>2014 ‘Too Fat’</td>
<td>1.16</td>
<td>(1.08, 1.24)</td>
</tr>
<tr>
<td><strong>FEMALES</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2006 ‘Too Thin’</td>
<td>1.00</td>
<td>(0.86, 1.17)</td>
</tr>
<tr>
<td>2006 ‘Too Fat’</td>
<td>1.03</td>
<td>(0.94, 1.13)</td>
</tr>
<tr>
<td>2014 ‘Too Thin’</td>
<td>1.03</td>
<td>(0.93, 1.15)</td>
</tr>
<tr>
<td>2014 ‘Too Fat’</td>
<td>1.06</td>
<td>(1.00, 1.12)</td>
</tr>
</tbody>
</table>

*a*2006 male complete case analysis physical activity model adjusted for screen time, grade, and class-level clustering and imputation model additionally adjusted for family affluence

*b*2014 male complete case analysis physical activity model adjusted for screen time, ethnicity and class-level clustering and imputation model additionally adjusted for family affluence and grade

*c*2006 male complete case analysis screen time model adjusted for physical activity and class-level clustering and imputation model additionally adjusted for family affluence

*d*2014 male complete case analysis and imputation screen time models adjusted for physical activity, ethnicity, family affluence and class-level clustering

*e*2006 female complete case analysis physical activity model adjusted for screen time, and class-level clustering and imputation model additionally adjusted for family affluence

*f*2014 female complete case analysis physical activity model adjusted for screen time, ethnicity, family affluence and class-level clustering and imputation model additionally adjusted for grade

*g*2006 female complete case analysis and imputation screen time models adjusted for physical activity, grade and class-level clustering

*h*2014 female complete case adjusted for physical activity, ethnicity, family affluence, body mass index and class-level clustering and imputation model adjusted for family affluence, physical activity, ethnicity, and class-level clustering
References

Appendix E

Additional Results

The purpose of this appendix is to provide additional results that were conducted with the data. Table E.1 shows the differences in relative risks obtained for each association with and without adjustment of the outcome of interest at Time 1 for the 2006 longitudinal data. Table E.2 shows the frequency of body satisfaction for each body mass index (BMI) category.
Table E.1. Relative Risk (RR) estimates describing the associations between body satisfaction, physical activity and screen time from 2006 longitudinal HBSC data, with and without adjustment for Time 1 outcome.

<table>
<thead>
<tr>
<th>Body Satisfaction</th>
<th>Physical Activity</th>
<th>Screen Time</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unadjusted Model</td>
<td>Adjusted Model (not accounting for baseline physical activity levels)</td>
</tr>
<tr>
<td></td>
<td>RR 95% CI</td>
<td>RR 95% CI</td>
</tr>
<tr>
<td>MALES 1,2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>‘Too Thin’</td>
<td>1.08 (0.90, 1.29)</td>
<td>1.10 (0.91, 1.33)</td>
</tr>
<tr>
<td>‘Too Fat’</td>
<td>1.14 (0.95, 1.37)</td>
<td>1.14 (0.94, 1.39)</td>
</tr>
<tr>
<td>‘About Right’</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>n</td>
<td>901</td>
<td>821</td>
</tr>
<tr>
<td>FEMALES 3,4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>‘Too Thin’</td>
<td>1.07 (0.86, 1.33)</td>
<td>1.07 (0.85, 1.34)</td>
</tr>
<tr>
<td>‘Too Fat’</td>
<td>1.02 (0.90, 1.17)</td>
<td>1.03 (0.90, 1.18)</td>
</tr>
<tr>
<td>‘About Right’</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>n</td>
<td>1 089</td>
<td>1 040</td>
</tr>
</tbody>
</table>

1 Male physical inactivity model adjusted for screen time, family affluence, grade and school level cluster.
2 Male screen time model adjusted for physical activity, family affluence and school level cluster.
3 Female physical inactivity model adjusted for screen time, family affluence and school level cluster.
4 Female screen time model adjusted for physical activity, grade and school level cluster.
Table E.2. Frequency and row percentage of body satisfaction for each category of body mass index from the 2005/2006 and 2013/2014 cross-sectional HBSC studies.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MALES</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Underweight</td>
<td>19</td>
<td>52.78</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>8.33</td>
<td>14</td>
</tr>
<tr>
<td>Normal Weight</td>
<td>392</td>
<td>28.62</td>
<td>152</td>
</tr>
<tr>
<td></td>
<td>1 370</td>
<td>10.80</td>
<td>1 123</td>
</tr>
<tr>
<td>Overweight</td>
<td>10</td>
<td>2.46</td>
<td>181</td>
</tr>
<tr>
<td></td>
<td>79</td>
<td>5.50</td>
<td>583</td>
</tr>
<tr>
<td>Obese</td>
<td>4</td>
<td>2.56</td>
<td>131</td>
</tr>
<tr>
<td></td>
<td>47</td>
<td>5.17</td>
<td>256</td>
</tr>
<tr>
<td><strong>FEMALES</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Underweight</td>
<td>17</td>
<td>40.47</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>19</td>
<td>45.24</td>
<td>59</td>
</tr>
<tr>
<td>Normal Weight</td>
<td>218</td>
<td>11.98</td>
<td>546</td>
</tr>
<tr>
<td></td>
<td>517</td>
<td>11.27</td>
<td>1 753</td>
</tr>
<tr>
<td>Overweight</td>
<td>3</td>
<td>0.94</td>
<td>241</td>
</tr>
<tr>
<td></td>
<td>16</td>
<td>1.31</td>
<td>910</td>
</tr>
<tr>
<td>Obese</td>
<td>3</td>
<td>2.83</td>
<td>88</td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>2.48</td>
<td>458</td>
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</table>
Appendix F
Post-Hoc Power Calculations

The purpose of this appendix is to demonstrate a sample power calculation and to show the statistical power that we had to detect the differences found in the analyses for the second manuscript (Table F.1, F.2, F.3).

Sample Power Calculation:

Assessing the power to detect the relationship between ‘too fat’ body dissatisfaction and physical inactivity among male students from the 2014 HBSC, using the equations published from Kelsey et al.\textsuperscript{1} Sample sizes were reduced by a design effect of 1.2 to account for clustering, based on analyses conducted on the 1993/1994 HBSC international data.\textsuperscript{2}

Parameter Values:
\( Z_{\alpha/2} = 1.96 \) (with \( \alpha = 0.05 \))
\( n = \) number of ‘too fat’ body dissatisfied males taking into account clustering effect = 1654/1.2 = 1378.3
\( r = \) ratio of males with body satisfaction to males with ‘too fat’ body dissatisfaction = 2.18
\( p_0 = \) proportion of body satisfied males who are physically inactive = 0.7165
\( p_1 = \) proportion of ‘too fat’ body dissatisfied males who are physically inactive = 0.8390
\( d = \) absolute difference between \( p_1 \) and \( p_0 = 0.1225 \)
\( \bar{p} = \) prevalence of physical inactivity among males (weighted average of \( p_1 \) and \( p_0 \)) = \( (p_1 + r p_0)/(1+r) = (0.8390 + 2.18 \times 0.7165) / 3.18 = 0.755 \)

\[
Z_\beta = \frac{n(d^*)^2 r}{(r+1)\bar{p}(1-\bar{p})} - Z_{\alpha/2}
\]
\[
Z_\beta = \sqrt{1378.3(0.1225)^2 2.18 ÷ 3.18(0.755)(1 - 0.755)} - 1.96
\]
\( Z_\beta = 6.80 \)
Power > 99.9%
### Table F.1: Power calculations for the 2006 HBSC longitudinal data

<table>
<thead>
<tr>
<th>Type of Dissatisfaction</th>
<th>Outcome</th>
<th>Sex</th>
<th># of Exposed</th>
<th>Prevalence of Outcome</th>
<th>r</th>
<th>d</th>
<th>Power (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Too Thin</td>
<td>Physical Activity</td>
<td>Males</td>
<td>180.8</td>
<td>0.760</td>
<td>2.29</td>
<td>0.0599</td>
<td>34.8</td>
</tr>
<tr>
<td></td>
<td>Screen Time</td>
<td>Females</td>
<td>87.5</td>
<td>0.900</td>
<td>5.10</td>
<td>0.0623</td>
<td>42.9</td>
</tr>
<tr>
<td></td>
<td>Males</td>
<td>158.3</td>
<td>0.380</td>
<td>2.42</td>
<td>0.0581</td>
<td>24.5</td>
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</tr>
<tr>
<td></td>
<td>Females</td>
<td>80</td>
<td>0.246</td>
<td>5.45</td>
<td>0.0294</td>
<td>&lt;8.2</td>
<td></td>
</tr>
</tbody>
</table>

### Table F.2: Power calculations for the 2006 cross-sectional HBSC data

<table>
<thead>
<tr>
<th>Type of Dissatisfaction</th>
<th>Outcome</th>
<th>Sex</th>
<th># of Exposed</th>
<th>Prevalence of Outcome</th>
<th>r</th>
<th>d</th>
<th>Power (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Too Thin</td>
<td>Physical Activity</td>
<td>Males</td>
<td>368.3</td>
<td>0.746</td>
<td>2.51</td>
<td>0.0357</td>
<td>26.4</td>
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<tr>
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<td>Screen Time</td>
<td>Females</td>
<td>200.8</td>
<td>0.876</td>
<td>4.85</td>
<td>0.0052</td>
<td>&lt;8.2</td>
</tr>
<tr>
<td></td>
<td>Males</td>
<td>368.3</td>
<td>0.324</td>
<td>2.51</td>
<td>0.0188</td>
<td>9.5</td>
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<td>Females</td>
<td>200.8</td>
<td>0.221</td>
<td>4.85</td>
<td>0.0339</td>
<td>18.1</td>
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<tr>
<td>Too Fat</td>
<td>Physical Activity</td>
<td>Males</td>
<td>402.5</td>
<td>0.760</td>
<td>2.3</td>
<td>0.0799</td>
<td>87.9</td>
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<tr>
<td></td>
<td>Screen Time</td>
<td>Females</td>
<td>734.2</td>
<td>0.889</td>
<td>1.33</td>
<td>0.0292</td>
<td>47.6</td>
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<td></td>
<td>Males</td>
<td>402.5</td>
<td>0.340</td>
<td>2.30</td>
<td>0.0730</td>
<td>73.2</td>
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<td>Females</td>
<td>734.2</td>
<td>0.223</td>
<td>1.33</td>
<td>0.0187</td>
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### Table F.3: Power calculations for the 2014 cross-sectional HBSC data

<table>
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<th>Type of Dissatisfaction</th>
<th>Outcome</th>
<th>Sex</th>
<th># of Exposed</th>
<th>Prevalence of Outcome</th>
<th>r</th>
<th>d</th>
<th>Power (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Too Thin</td>
<td>Physical Activity</td>
<td>Males</td>
<td>1143.3</td>
<td>0.722</td>
<td>2.64</td>
<td>0.0190</td>
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<td>Screen Time</td>
<td>Females</td>
<td>507.5</td>
<td>0.852</td>
<td>4.99</td>
<td>0.0343</td>
<td>51.2</td>
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<td>1143.3</td>
<td>0.458</td>
<td>2.64</td>
<td>0.0020</td>
<td>&lt;8.2</td>
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<tr>
<td></td>
<td>Females</td>
<td>507.5</td>
<td>0.433</td>
<td>4.99</td>
<td>0.0550</td>
<td>62.6</td>
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<td>Too Fat</td>
<td>Physical Activity</td>
<td>Males</td>
<td>1378.3</td>
<td>0.755</td>
<td>2.18</td>
<td>0.1225</td>
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<td></td>
<td>Screen Time</td>
<td>Females</td>
<td>2642.5</td>
<td>0.874</td>
<td>0.957</td>
<td>0.0552</td>
<td>&gt;99.9</td>
</tr>
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<td>0.481</td>
<td>2.18</td>
<td>0.0698</td>
<td>99.0</td>
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<td>2642.5</td>
<td>0.474</td>
<td>0.957</td>
<td>0.0976</td>
<td>&gt;99.9</td>
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</table>
References


Appendix G
Ethics Certificate

QUEEN'S UNIVERSITY HEALTH SCIENCES & AFFILIATED TEACHING HOSPITALS RESEARCH ETHICS BOARD (HSREB)

HSREB Initial Ethics Clearance

July 28, 2015

Miss Nicole Roberts
Department of Public Health Sciences Queen’s University

ROMEOT/TRAQ: #6016053
Department Code: EPID-519-15
Study Title: Examination of body image among Canadian adolescents: Relations with physical activity levels and sedentary behaviours
Co-Investigators: Dr. W. Pickett
Review Type: Delegated
Date Ethics Clearance Issued: July 28, 2015
Ethics Clearance Expiry Date: July 28, 2016

Dear Miss Roberts,

The Queen's University Health Sciences & Affiliated Teaching Hospitals Research Ethics Board (HSREB) has reviewed the application and granted ethics clearance for the documents listed below. Ethics clearance is granted until the expiration date noted above.

- Protocol (June 23, 2015) Documents Acknowledged:
  - GREB approval/renewal – GMISC-062-13
  - HSBC Survey
  - CORE Certificate – N. Roberts

Amendments: No deviations from, or changes to the protocol should be initiated without prior written clearance of an appropriate amendment from the HSREB, except when necessary to eliminate immediate hazard(s) to study participants or when the change(s) involves only administrative or logistical aspects of the trial.
Renewals: Prior to the expiration of your ethics clearance you will be reminded to submit your renewal report through ROMEO. Any lapses in ethical clearance will be documented on the renewal form.

Completion/Termination: The HSREB must be notified of the completion or termination of this study through the completion of a renewal report in ROMEO.

Reporting of Serious Adverse Events: Any unexpected serious adverse event occurring locally must be reported within 2 working days or earlier if required by the study sponsor. All other serious adverse events must be reported within 15 days after becoming aware of the information.

Reporting of Complaints: Any complaints made by participants or persons acting on behalf of participants must be reported to the Research Ethics Board within 7 days of becoming aware of the complaint. Note: All documents supplied to participants must have the contact information for the Research Ethics Board.

Investigators please note that if your trial is registered by the sponsor, you must take responsibility to ensure that the registration information is accurate and complete.

Yours sincerely,
Chair, Health Sciences Research Ethics Board

The HSREB operates in compliance with, and is constituted in accordance with, the requirements of the TriCouncil Policy Statement: Ethical Conduct for Research Involving Humans (TCPS 2); the International Conference on Harmonisation Good Clinical Practice Consolidated Guideline (ICH GCP); Part C, Division 5 of the Food and Drug Regulations; Part 4 of the Natural Health Products Regulations; Part 3 of the Medical Devices Regulations, Canadian General Standards Board, and the provisions of the Ontario Personal Health Information Protection Act (PHIPA 2004) and its applicable regulations. The HSREB is qualified through the CTO REB Qualification Program and is registered with the U.S. Department of Health and Human Services (DHHS) Office for Human Research Protection (OHRP). Federalwide Assurance Number: FWA#:00004184, IRB#:00001173

HSREB members involved in the research project do not participate in the review, discussion or decision.