FAMILY STRUCTURE AS A PREDICTOR OF ORGANIZED SPORTS PARTICIPATION AND SEDENTARY SCREEN TIME IN CANADIAN YOUTH

by

Rachel Alexandra McMillan

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Abstract

Background:

Canadian youth are increasingly likely to grow up in non-traditional families, such as single parent families, stepfamilies, and/or in the shared physical custody of their separated parents. Given that growing up in a non-traditional family is associated with many negative health outcomes, it is of interest to examine how family structure influences upstream health-related behaviours such as physical activity and sedentary behaviour.

Objectives:

The objectives of this thesis were to examine family structure as a predictor of organized sports participation and screen time (television-viewing, recreational computer use and video game use). A secondary objective was to assess socioeconomic status as a mediator in the relationship between family structure and organized sports participation.

Methods:

Data were obtained from a nationally representative cross-sectional survey of Canadian youth in grades 6-10 (N=26 068). Participants' family structures were classified as traditional, single parent, or reconstituted based on self-report of the number of parents and parents' partners living in their primary home. Non-traditional families were further classified based on how often the youth reported visiting a second home. Average daily screen time and current organized sports participation were also assessed via self-report. Logistic regression and bootstrap-based mediation analysis were used to examine the associations of interest.

Results:

Youth from all single parent and reconstituted families had lower odds of sports participation (OR = 0.48 (95% CI: 0.38-0.61) to 0.78 (95% CI: 0.56-1.08)) compared to their traditional family counterparts, regardless of physical custody arrangements. The relationship was moderately-to-weakly mediated by socioeconomic status (ie: <20% change in effect estimate). Youth from single parent and reconstituted

families did not have higher odds of spending more than 2 hours per day using a television, computer or video game device, or of being in the highest quartile of time spent in these behaviours.

Conclusions:

Youth living in single parent and reconstituted families experience significant disparities in organized sports participation that are partially mediated by their family's socioeconomic status. Family structure is not, however, a significant predictor of excessive screen time.

Co-Authorship

This thesis is the work of Rachel McMillan under the supervision of Dr. Ian Janssen and Dr. Michael McIsaac. The data used in this thesis are from the Canadian Health Behaviour in School-aged Children Survey (2009/10). Data collection was coordinated by Mr. Matthew King; Dr. William Pickett and Dr. John Freeman were the principal investigators. The idea to use these data to study family structure as a predictor of organized sport and screen-based activity was a collaborative effort between Rachel McMillan and Dr. Janssen.

Rachel McMillan performed the literature review, statistical analyses, interpretation of results and writing of the thesis chapters. Dr. Janssen and Dr. McIsaac provided technical and general guidance and edited the thesis. Jordan Robson and Asha Mohamed also assisted in editing the thesis.

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List of Abbreviations

CI – Confidence Interval FAS – Family Affluence Scale HBSC – Health Behaviour in School-aged Children MVPA – Moderate-to-Vigorous Physical Activity OR – Odds Ratio SES - Socioeconomic Status WHO – World Health Organization

Chapter 1

Introduction

1.1 General Overview

The structure of the typical family is changing in Canada. The proportion of families consisting of legally married couples with children decreased dramatically from 55% in 1981 to 35% in 2006 while the proportion of single parent families increased from 16.6% to 25.8%.¹ These changes mean that today's youth are more likely to live in non-traditional family structures, including single parent families or reconstituted families that include stepparents or parents' co-habiting partners. Today's youth are also more likely to spend time with a biological parent outside of their primary home regularly or on a sporadic basis.²

Changes in family structure are of interest given the profound role that parents play in shaping the development of healthy behaviours in their children through parental modeling and support of these behaviours.³⁻⁷ It is, however, unclear how these relationships are influenced by increasingly diverse family structures and custody arrangements. Existing evidence suggests that exposure to different parental structures may lead to health disparities in children and youth.² Children who come from single parent families, for example, appear to be at increased risk of negative health outcomes such as obesity^{3,4} and reduced psychological well-being⁵ when compared to their counterparts from dual-parent families, even after differences in socioeconomic status (SES) are accounted for.

Engaging in insufficient physical activity (e.g., organized sport) and excessive sedentary behaviour (e.g., television watching, video game use and recreational computer use) are two health behaviours that impact a range of physical, mental, and social health outcomes.⁶⁻¹⁰ Although it has been well established that family-related factors influence both physical activity and sedentary behaviour levels, evidence is inconsistent on whether family structure affects these health behaviours in youth. ^{3,4,6-11} It is also unclear what role child custody and visitation arrangements play in relationships between family structure and these health behaviours. The primary purpose of this thesis research was to determine whether living with both a mother and father, a single parent, or a parent and their co-habiting partner influenced participation in organized sport and excessive television viewing, video game use and recreational computer use in Canadian youth. In families where youths' parents lived apart, it was also of interest to determine whether physical custody arrangements had any effect on these behaviours.

1.2 Public Health Relevance

Organized sport and sedentary screen time behaviours are related to both current and future health-related outcomes in youth, including cardiovascular disease, academic achievement, obesity and depression.¹⁰⁻¹⁴ It is, therefore, of interest to identify barriers to engaging in healthy amounts of these activities. Although organized sports participation is reasonably high in Canadian youth,¹⁵ there are known disparities in participation by family income.¹⁶ Furthermore, only 1 in 5 Canadian children and youth meet the national recommendation to limit their screen time to less than 2 hours per day.¹⁷ This is particularly concerning given evidence that activity-related behaviours in children and youth may track into adulthood.^{18,19} It is hoped that the findings from this thesis will contribute to the body of literature looking at whether youth who grow up in non-traditional family structures are at increased risk of developing negative activity-related health behaviours. Ultimately, the goal is that this knowledge will be used to inform interventions, policies, and programs aimed at improving these health behaviours.

1.3 Objectives and Hypotheses

This thesis consists of two separate manuscripts, each with its own primary objective:

- Manuscript 1 examined whether there is a link between family structure and organized sports participation in Canadian youth and, if so, whether this relationship is mediated by socioeconomic status.
- 2. Manuscript 2 examined whether there is a link between family structure and excessive television viewing, recreational computer use and video game use in Canadian youth.

These objectives are shown visually in Figure 1.1. It was hypothesized that sports participation would be highest in youth from traditional dual-parent families and lowest in those from single parent families, with participation in youth from reconstituted families falling someplace in the middle. It was also anticipated that SES would act as a mediator. An opposite trend was expected for Manuscript 2. It was expected that screen time would be highest in single parent families and lowest in dual parent families. It was also expected that custody arrangements where children visit a second parent regularly would increase rates of sports participation and decrease screen time.



Figure 1.1. Conceptual framework of thesis.

This thesis will investigate two hypothesized mechanisms through which family structure, namely parental structure and custody arrangements, may influence youth health. Manuscript 1 will determine whether family structure influences sports participation, and if so whether this relationship is mediated by socioeconomic status (top half of figure). Manuscript 2 will determine whether family structure influences screen time behaviours (bottom half of figure). Both manuscripts will control for relevant individual-level covariates.

1.4 Thesis Organization

This thesis follows the guidelines specified by the Queen's University School of Graduate Studies' "General Forms of Theses"²⁰ for a manuscript-based thesis. The second chapter provides a review of the literature in the area of family structure and its relationship to organized sports participation and screen-based sedentary behaviour, focusing on the context of Canadian youth. The third chapter is Manuscript 1, which analyzes the relationship between family structure and organized sports participation, and assesses whether socioeconomic status is a mediator of this relationship. The fourth chapter is Manuscript 2, which assesses the relationship between family structure and television viewing, video game use and recreational computer use. Finally, the fifth chapter provides a summary and general discussion of the findings as well as their public health significance, and suggests directions for future research. Additional details of the methodology of this thesis, including statistical methods, power calculations and specific survey questions, are presented as appendices.

1.5 References

 Human Resources and Skills Development Canada. Canadians in context - households and families. Available at: <u>http://www4.hrsdc.gc.ca/.3ndic.1t.4r@-eng.jsp?iid=37</u>. Updated 2013-06-05. Accessed 2014-06-25.

 Beaupré P, Dryburgh H, Wendt M. Statistics Canada. making fathers "count". Available at: http://www.statcan.gc.ca/pub/11-008-x/2010002/article/11165-eng.htm. Updated 2010-06-08. Accessed 2013-06-25.

3. Hesketh K, Crawford D, Salmon J, Jackson M, Campbell K. Associations between family circumstance and weight status of Australian children. *Int J Pediatr Obes*. 2007;2(2):86-96.

4. Tremblay MS, Willms JD. Is the Canadian childhood obesity epidemic related to physical inactivity? *Int J Obes Relat Metab Disord*. 2003;27(9):1100-1105.

5. Bjarnason T, Bendtsen P, Borup I, et al. Life satisfaction among children in different family structures: A comparative study of 36 western countries. *Children & Society*. 2012;26(1):51-62.

6. Janssen I, Leblanc AG. Systematic review of the health benefits of physical activity and fitness in school-aged children and youth. *Int J Behav Nutr Phys Act.* 2010;7:40-5868-7-40.

7. Kwan M, Bobko S, Faulkner G, Donnelly P, Cairney J. Sports participation and alcohol and illicit drug use in adolescents and young adults: A systematic review of longitudinal studies. *Addict Behav.* 2014;39(3):497-506.

8. Eime RM, Young JA, Harvey JT, Charity MJ, Payne WR. A systematic review of the psychological and social benefits of participation in sport for children and adolescents: Informing

development of a conceptual model of health through sport. *Int J Behav Nutr Phys Act*. 2013;10:98-5868-10-98.

9. Chinapaw MJ, Proper KI, Brug J, van Mechelen W, Singh AS. Relationship between young peoples' sedentary behaviour and biomedical health indicators: A systematic review of prospective studies. *Obes Rev.* 2011;12(7):e621-32.

10. Tremblay MS, LeBlanc AG, Kho ME, et al. Systematic review of sedentary behaviour and health indicators in school-aged children and youth. *Int J Behav Nutr Phys Act.* 2011;8:98-5868-8-98.

11. Nelson TF, Stovitz SD, Thomas M, LaVoi NM, Bauer KW, Neumark-Sztainer D. Do youth sports prevent pediatric obesity? A systematic review and commentary. *Curr Sports Med Rep.* 2011;10(6):360-370.

12. Blomfield CJ, Barber BL. Developmental experiences during extracurricular activities and Australian adolescents' self-concept: Particularly important for youth from disadvantaged schools. *J Youth Adolesc*. 2011;40(5):582-594.

13. Vella SA, Cliff DP, Okely AD, Scully ML, Morley BC. Associations between sports participation, adiposity and obesity-related health behaviors in Australian adolescents. *Int J Behav Nutr Phys Act.* 2013;10:113-5868-10-113.

14. Saunders TJ, Chaput JP, Tremblay MS. Sedentary behaviour as an emerging risk factor for cardiometabolic diseases in children and youth. *Can J Diabetes*. 2014;38(1):53-61.

15. Active Healthy Kids Canada. Is Canada in the running? The 2014 active healthy kids Canada report card on physical activity for children and youth. 2014. Available at: http://www.activehealthykids.ca/ReportCard/2014ReportCard.aspx. Accessed 2014-07-23.

16. Canadian Fitness and Lifestyle Research Institute. 2011-12 CANPLAY. Bulletin 2:
Participation in organized physical activity and sport. 2013. Available at:
http://www.cflri.ca/media/node/1013/charts/Bulletin%204%20%20Organized%20sports%20ENG.pdf. Accessed 2014-07-23.

17. Canadian Society for Exercise Physiology. Canadian physical activity guidelines and Canadian sedentary behaviour guidelines. Available at:

http://www.csep.ca/english/view.asp?x=949. Updated 2013. Accessed 2014-07-23.

Schmeer KK. Family structure and obesity in early childhood. *Soc Sci Res.* 2012;41(4):820-832.

19. Kjonniksen L, Anderssen N, Wold B. Organized youth sport as a predictor of physical activity in adulthood. *Scand J Med Sci Sports*. 2009;19(5):646-654.

20. School of Graduate Studies, Queens University. General forms of theses. Available at: http://www.queensu.ca/sgs/sites/webpublish.queensu.ca.sgswww/files/files/Students-thesis%20completion/SGS-General_Forms_of_Theses_RevisedJune2011.pdf. Updated 2011. Accessed 2014-07-04.

Chapter 2

Literature Review

2.1 General Overview

The family is one of the most important factors in child development. As the typical family continues to evolve, particularly in Western countries such as Canada, it is crucial to understand how and why growing up in a non-traditional family influences children's health-related beliefs and behaviours. This thesis focuses specifically on the relationship between family structure and two activity-related behaviours, namely sedentary screen time and organized sports participation. The purpose of this chapter is to summarize the literature surrounding family structure, physical activity through organized sport and sedentary screen-based behaviour, with an emphasis on the context of Canadian youth. It will start with a working definition of each concept, and then review some of the major findings from previous studies that led to the conceptualization of this project. The chapter will finish with a brief summary of the current literature as well as some knowledge gaps that were addressed by this thesis research.

2.2 Family Structure

2.2.1 Changing Families in Canada

Research has shown that families are changing in developed countries, including Canada, the United States and Western Europe. ¹⁻⁸ Over the 50-year period between the 1961 Canadian census and that of 2011, the proportion of families^{*} headed by married couples decreased from 91.6% to

^{*} The current census definition of a "family" is any married couple (with or without children), common-law couple (with or without children), or single parent family.⁹ In 1961, the Canadian census defined the term "married couple" as including both common-law and married opposite-

67.0%.⁹ Over the same time period, the prevalence of single parent families nearly doubled from 8.4% to 16.3%. The prevalence of couples living in common-law relationships, which are generally considered less stable than marriages, nearly quadrupled from 5.6% in 1981, when these families were first captured in the Census, to 19.7% in 2011.⁹ This dramatic increase in family diversity may be attributable to a number of changes in policy and cultural norms, including the advent of no-fault divorce, increases in the proportion of women who work in paid jobs outside of the home and increases in the social acceptability of single parenthood. ⁹ Indeed, when single parents were asked about their circumstances in 1961, a majority of 61.5% reported being widowed. ⁹ Only 2.7% said that they had never been married, while 35.8% reported being separated or divorced. ⁹ Today, according to the 2011 Census, 50.8% of single parents are separated or divorced and 31.5% report never having been married. ⁹

For children and adolescents, this dramatic shift in societal norms has meant that more are exposed to diverse family structures outside of the traditional nuclear family that was the standard in 1961.^{3,9,10} Data from the Canadian Health Behaviour in School-aged Children (HBSC) survey, which is performed every four years on nationally representative cross-sections of Canadian youth, show that approximately one third of Canadian youth aged 11-15 now live in non-traditional families.¹¹ This number appears to be growing, with the prevalence of youth living in traditional families decreasing from 73% to 68% between 1994 and 2010.^{11,12} During the same 16-year time period, the proportion of HBSC participants who reported living in single parent families increased from 14% to 18%, while the proportion who reported living in reconstituted families with stepparents or parents' co-habiting partners remained relatively stable.^{11,12}

sex couples. By 2011, married couples and common-law couples were captured separately and the term "married couple" could refer to married same-sex couples.

2.2.2 Family Structure Definitions

In accordance with previous research, ^{1,13-15} family structures will be defined as traditional, reconstituted or single parent for the purposes of this thesis in order to represent the most prevalent parental structures in Canada. ^{9,11} Traditional families will refer to living arrangements where both a mother and father live with the youth in his or her primary residence, while single parent families will refer to living arrangements with either the mother or the father living in the primary home. ¹⁴ Reconstituted families refer to living arrangements that include either the mother or the father as well as a stepparent or parent's co-habiting partner.¹⁴ Some children of single parent and reconstituted families may also spend part of their time visiting another parent, most commonly their biological father, outside of their primary home. ^{16,17} For the purposes of this thesis, "regular visitation" and "irregular/no visitation" will be used to further characterize non-traditional family structures based on how often the youth sees his or her non-residential parent. This is discussed in greater depth in subsequent sections.

2.2.3 Physical and Psychological Consequences of Growing Up in a Non-Traditional Family

Families, and parents in particular, have a central influence on their children's development believed to be second only to internal factors such as a child's own attitudes and genetic predispositions. ^{1,13,18-22} Parents may directly influence their children's health-related beliefs and behaviours by modeling or encouraging activities such as physical activity. ^{1,20,23} They also provide access to opportunities to engage in health-related behaviours, such as space for active play, access to screen-based media and transportation to and from organized sports. ¹ This is of particular interest from a public health perspective given that some health behaviours and values developed during childhood are known to track to adulthood, and therefore influence long-term as well as immediate health.²¹ Previous studies have suggested that children who live in single parent or reconstituted families may experience health disparities compared to their peers who live in traditional families.^{8,13,24-27} A recent study of 184 496 adolescents in 36 Western countries, for example, showed that those living in non-traditional families without joint custody scored between 0.41 and 0.63 rungs lower in Cantril's 11-level ladder of self-reported life satisfaction than those in traditional family structures, although these differences were partially explained by socioeconomic differences.²⁸ Children who live with only one parent have consistently been shown to be at greater risk of a myriad of health and behavioural problems including overweight and obesity, asthma, reduced peer cohesion, depression, illegal drug addiction, decreased academic performance, increased risk-taking behaviours and suicide.^{24-26,29-32} Interestingly, many of these same health and behavioural disparities have been linked to both sedentary behaviour and physical inactivity, indicating that activity-related behaviours may mediate some of the discrepancies between family structures. Overall, this growing body of research on health disparities by family structure has caused UNICEF to recognize growing up in a non-traditional family structure as a determinant of global child health.¹⁵

2.2.4 Potential Mediators of the Relationship between Family Structure and Health Outcomes

Decreased material wealth in non-traditional families may explain much of the observed disparities between children of different family structures. ^{1,25,26,32-35} In 2010, the average Canadian two-parent family with children made approximately \$78 800 while the average single-mother family made only \$38 700. ³⁶ One contributing factor in this type of discrepancy is that parents of traditional families have higher baseline income on average than parents of reconstituted or single parent families. ³² This is compounded in single parent families, which often have only one income while the other family structures have the possibility of having two.

In single parent and reconstituted families resulting from separation or divorce, the process of splitting assets, as well as being required to financially support two separate households in some cases, may also contribute to decreased material wealth. ^{8,22,37} Overall, these financial disparities mean that single parent families and reconstituted families are less likely to have access to health resources and facilities, as well as disposable income to pay for commodities such as extracurricular activities (e.g., organized sports) for their children. ^{10,30,38,39}

Some studies have shown that, even after controlling for socioeconomic status, health disparities persist between family structures.^{8,15} In the case of single parent families, one hypothesized explanation is the lack of a co-parent to share in household chores and childrearing duties.²⁶ Research has suggested that this may also be an issue in reconstituted families, given that stepparents are on average less engaged in child care and supervision than biological parents. ^{8,26,27,40-42} The result of decreased parental support in non-traditional families may be that parents have less time and energy to spend participating in and monitoring their children's physical activity and other health-related behaviours, such as television-watching.^{1,7,26,40} This is supported by qualitative research by Quarmby et al.,¹ who found that low socioeconomic status English youth aged 11-14 in single parent families received less parental support and spent less time coparticipating in physically active pursuits with their parents than those of other family structures. Further disparities may be explained by a variety of factors, including self-selection.²⁶ Parents who raise their children in non-traditional families have been shown to differ systematically from those who do not on measures other than their average income, including having lower average age and educational attainment.^{8,43} Stress caused by parental conflict and family transitions such as divorce, parental death and remarriage, as experienced in many non-traditional families, may also influence family function and in turn affect child health outcomes. 7,8,21,26,27

It is of interest to determine the extent to which each of these factors, and particularly socioeconomic status, mediates the relationship between family structure and specific health behaviours in youth from non-traditional families. This will help health policy makers better understand how to evaluate the potential of targeted interventions to improve health behaviours in youth, such as providing non-traditional families with financial incentives.

2.2.5 The Influence of Visitation with a Non-Residential Parent

As discussed previously, non-traditional families are increasingly likely to be the result of parental separation or divorce rather than widowhood.⁹ According to the 2011 Canadian General Social Survey, approximately 70% of dependent children under age 18 of divorced or separated parents live in the primary physical custody of their mother while 15% live primarily with their father.³⁷ Of parents who do not have primary physical custody of their children, 18% reported never seeing the children, 44% reported seeing the children rarely (less than 3 months per year), and 20% reported spending at least 5 months per year with their children, which is defined as shared physical custody.³⁷ This means that many Canadian children and youth have diverse relationships with a parent, most often their father, living outside of their primary home.³⁷ Visiting a non-residential parent regularly may present logistical difficulties in organizing transportation to and from weekly extracurricular activities, particularly when the other parent lives outside of the child's primary home neighbourhood, as well as inconsistencies in home-level support for health-related behaviours such as physical activity.^{1,4} This was supported by the semistructured qualitative interviews conducted by Quarmby et al., which suggested that travelling to visit another parent made it difficult for low socioeconomic status English youth to participate in anything other than sedentary activities.⁴⁴

On the other hand, because sharing custody provides separated parents with a chance to share the financial, emotional and physical responsibilities of parenting children, it is possible that shared

legal or physical custody arrangements may lessen some of the negative effects of single parenthood caused by time constraints and financial stress. ^{5,45,46} Having a relationship with both biological parents has been shown to significantly predict life satisfaction and well-being in youth^{25,28,45,47,48} and may mediate some of the stress of transitioning between family structures. ³¹ Furthermore, studies have also shown that non-residential fathers who maintain contact with their children contribute more financially to their care, improving their socioeconomic status. ^{49,50} It is therefore of interest to consider whether custody arrangements play any moderating role when looking at the effects of family structure on adolescent health behaviours.²⁵

2.3 Physical Activity and Organized Sports Participation

2.3.1 Physical Activity in Canadian Youth

Increasing physical activity levels in adolescents is a major public health priority in Canada.⁵¹ Regular moderate-to-vigorous physical activity (MVPA) has been consistently associated with profound benefits for both short- and long-term health across all genders and age groups.⁵²⁻⁵⁵ There is evidence for a robust dose-response relationship between adolescent physical activity and risk of obesity, high blood pressure, the metabolic syndrome, anxiety, depression and decreased academic achievement.^{2,53,56}

Given these well-established health benefits, the Canadian Society for Exercise Physiology currently recommends that children and youth aged 5-17 engage in at least one hour of MVPA per day. ⁵⁷ Unfortunately, according to the 2014 Report Card on Physical Activity published by Active Healthy Kids Canada⁵¹, only about 5% of Canadian children and youth actually meet this minimum target. It is therefore of great importance to understand the factors that influence the many facets of youth physical activity, particularly in terms of identifying vulnerable and high risk youth groups.

2.3.2 Organized Sport

Organized sports participation represents one popular way in which youth can contribute to their recommended daily hour of MVPA.^{51,58} This type of structured physical activity occurs through participation in one or more dedicated sports teams, leagues, or clubs, either competitively or recreationally, and generally involves direct supervision and training from an adult coach or instructor.^{59,60} According to the Canadian Fitness and Lifestyle Research Institute's 2011/12 Canadian Physical Activity Levels Among Youth (CANPLAY) study, 75% of Canadian children and youth aged 5-19 participate in some form of organized sport over the course of a year and 34% participate 4 or more times per week.⁶¹ Participation is higher in adolescent boys than girls and decreases with age, with 83% of 5-10-year-olds participating compared to only 51% of 15-19-year-olds.⁶¹

2.3.3 Physical and Psychological Benefits of Organized Sports Participation

Like overall physical activity, organized sports participation has been consistently associated with a range of positive health outcomes. Youth who participate in sport are more active and physically fit than youth who do not. ⁶² One study⁶³ found that Australian adolescents aged 12-17 in the highest quintiles of time spent in organized sport had double the odds of meeting physical activity guidelines compared to those who participated less (OR: 2.07, 95% CI: 1.67-2.58), and were also more likely to adhere to sedentary screen time guidelines (OR: 1.48, 95% CI: 1.19-1.84). According to another recent American study, ⁶⁴ participating in two organized sports per year significantly reduced the risk of overweight and obesity (RR: 0.73, 95% CI: 0.61-0.87) in high school students. In the Canadian context, it has been estimated that children and youth who participate in organized sport take approximately 1500 more steps per day. ⁶¹ Furthermore, individuals who participate in sport as youths are more likely to continue as adults, allowing them to reap lifelong health benefits including decreased all-cause mortality. ⁶⁵⁻⁶⁷

Organized sport may also provide adolescents with a chance to socialize with role models and peers in an inclusive, supportive and goal-oriented setting, providing them with psychological, developmental and social benefits in addition to the physical benefits associated with increasing physical fitness. ⁶⁸ Participation in organized extracurricular activities during adolescence has been associated with increased academic achievement and engagement, improved self-concept and the development of peer friendships, ⁶⁹⁻⁷² and it has been suggested that these benefits might be most pronounced in youth of lower socioeconomic status. ⁷² Sports participation specifically has been associated with decreases in several risk behaviours, including illegal drug use, unhealthy eating patterns and excessive screen time, although it may increase fast food and alcohol consumption. ^{62,63,73-79}

2.3.4 Socioeconomic Status as a Barrier to Sports Participation

Youth face many barriers to organized sports participation, ranging from internal factors such as self-perceived ability and the desire to conform to gender stereotypes to external factors such as parental and peer support. ⁷³ Parental support and modeling appear to play a particularly large role in predicting child and youth sports participation. ^{61,80} In Canada, 90% of children aged 5-14 participate in sport if their parents do, compared to only 66% of those whose parents do not. ⁸¹ Some forms of sports participation also require a significant parental time commitment, ^{51,80} which may be challenging for non-traditional families and particularly single parent families. One factor that may be more easily addressed through targeted intervention is the growing cost of participation. According to the 2005 Canadian General Social Survey, 51% of dual-parent families spent an average of \$579 on sports and athletic equipment in 2005, before taking into account additional costs accrued through facility rentals, transportation to and from sports events, competition fees and membership fees. ⁸² These costs may mean that children from families of lower affluence are less able to participate in organized sport. This is supported by the 2011/2012

CANPLAY study, which showed that the proportion of children and youth aged 5-19 who participated in organized sport decreased with decreasing parental education and household income. ⁶¹ According to the 2010 General Social Survey, the proportion of children and adolescents aged 5-14 who participated in sport dropped from 85% to 58% when comparing families who made >\$79 999 per year to those who made <\$40 000. ⁸¹ This is particularly concerning in the context of family structure, given the socioeconomic disparities observed between traditional and non-traditional families. Other related barriers to participation may include unsafe environments and lack of access to facilities.⁸³

2.3.5 Family Structure as a Predictor of Organized Sport

Relatively few studies have looked at the relationship between family structure and physical activity in youth, and most that have done so have defined family structure as simply living in a single parent or dual parent home. Those studies looking at overall physical activity levels as an outcome have produced mixed results with several reporting no significant association, ^{20,84-88} others reporting that children from dual-parent families are marginally more active than those from single parent families ⁸⁹⁻⁹¹ and still others reporting that children from single parent families are more active. ^{19,92,93} These disparate results may have been observed because overall physical activity is achieved through a combination of activities such as playing outside, commuting to school, participating in school gym classes and engaging in organized sport. Due to the inherent differences between these types of physical activity, including cost of participation and level of parental involvement required, it is possible that they might be influenced differently by family structure. ⁶⁰ Many of these studies were also limited by small sample sizes and geographically limited convenience-based samples.

Studies considering the effects of family structure on sports participation per se have also often been limited by a generally broad definition of family structure, as well as low response rates, small sample sizes and a lack of generalizability. Although looking at a more narrow aspect of physical activity, these studies have also produced mixed results. Gorely et al,⁹⁴ for example, found that 15-year-old boys spent 25 more minutes/day in sports or exercise on weekends if they were from dual parent families as opposed to single parent families, although no significant differences were observed for girls or on weekdays. Similarly, Toftegaard-Stockel et al⁶⁰ found that boys from a sample of over 6000 Danish youth in grades 5 and 9 had significantly lower odds (OR: 0.63, 95% CI: 0.53-0.76) of participating in organized sport if they lived with their mother or their father, as opposed to living with both parents. Again, no association was observed for girls. Eime et al⁵⁹ conducted a similar cross-sectional study on a sample of 11-13 and 16-20-yearold girls from Victoria, Australia (N=732). Interestingly, they found that the girls in their sample population were more likely to participate in sports clubs if they were from dual parent families (p<0.01), although effect sizes were not given. Only one small study¹, conducted by Quarmby et al on a sample of low socioeconomic status English youth aged 11-14 (N=381) from 3 inner-city schools, compared the effects of single parent, reconstituted and traditional family status on competitive sports participation. The results showed significant (p < 0.01) differences between physical activity in boys from single parent and reconstituted families, with 3% of boys from single parent families participating for more than 90 minutes per day compared to 28% of boys from families with a stepparent. No significant differences were observed for girls, or for boys from traditional families compared to either single parent or reconstituted families. The one Canadian study⁹⁵ that looked at this research question found no statistically significant difference between single- and dual-parent status in predicting sports participation in a sample of 9-13-yearolds (N=2285) from 24 inner-city elementary schools in Montreal, Quebec in 1993. A potential explanation for the disparate findings across the studies looking at sports participation

may be their lack of power to detect small but meaningful differences between family structures

in each age- and gender-based stratum, combined with the use of non-representative conveniencebased samples that often had little exposure variation. Furthermore, most studies controlled for socioeconomic status, which might be considered to be one factor on the causal pathway between single parent status and ability to participate in sports. Statistics Canada's 2010 General Social Survey showed a small but statistically significant 6% difference in sports participation between 5-14-year-old children from single- and dual-parent families across Canada, with 74% of children from dual-parent families participating in sport compared to 68% from single parent families.⁸¹ It is of interest to consider whether this difference becomes more distinct when using a more refined definition of family structure and controlling for relevant confounders.

2.3.6 Other Known and Hypothesized Predictors of Organized Sport

Organized sport participation is a complex, multifactorial behaviour with many predictors aside from age, gender, family structure, family/peer support, parental modeling and socioeconomic factors. ^{51,59,64,81,95,96} There are, for example, regional differences in organized sport in Canada, with youth from Saskatchewan and the Yukon being more likely to participate than the national average. ⁵¹ Two related potential predictors of sports participation are access to sports facilities and urban vs rural status. Youth living in non-metropolitan areas are, for example, more likely to report a lack of access to sports facilities and difficulty in finding transportation to sporting events. ⁵⁹ Other potential predictors may include race and time since immigration to a new country, which predict cultural norms regarding physical activity and level of acculturation into the host culture, ^{81,95} as well as body mass index, self-efficacy and goal orientation/motivation.^{64,96}

2.4 Sedentary Behaviour

2.4.1 Sedentary Behaviour in Canadian Youth

Another health behaviour that may mediate the relationship between family structure and health disparities is excessive sedentary behaviour. It is important to first note that this type of activity is not simply the opposite of MVPA. ⁹⁸⁻¹⁰⁰ Sedentary behaviour refers to low-energy activities where the participant is generally sitting or lying down, including watching television, playing video games, working at a computer, reading and driving a car. ^{98,99,100} Even youth who exceed Canada's physical activity guidelines for MVPA can be excessively sedentary during their downtime.^{98,100}

Canadian youth spend approximately 9.3 hours per day, ⁵¹ or about 40-60% of their waking time, ¹⁰² being sedentary. About half of their sedentary time occurs outside of school. ¹⁰³ These high levels of sedentary behaviour are particularly concerning given emerging evidence that excessive sedentary behaviour is an independent risk factor for many of the negative health outcomes often associated with lack of MVPA, including cardiovascular disease, obesity and the metabolic syndrome, and that excessive sedentary behaviour may in fact counteract some of the health benefits of MVPA. ^{94,98,99,101,104-108} Indeed, studies on animal models suggest that reduced muscle contraction caused by prolonged sitting or lying down may alter the function of genetic and metabolic pathways that are different from those activated during MVPA. ^{99,101,109}

2.4.2 Screen Time

Sedentary screen time refers specifically to sedentary behaviour that occurs while watching or using a television, computer or other screen-based device, and is a major driver of total screen time in youth. ¹⁰³ The Canadian Society for Exercise Physiology currently recommends minimizing sedentary behaviour in children and youth as much as possible, and states that children and youth aged 5-17 should limit their recreational screen time to less than 2 hours per day. ⁵⁷ Unfortunately, data from the 2009/10 HBSC show that fewer than 1 in 5 Canadian youth meet this guideline. ¹¹ More than 50% of 2009/10 HBSC respondents reported that they watched

more than 2 hours of television alone per day.¹¹ In addition to this, 25% of girls and 50% of boys spent more than 2 hours playing video games per day while 58% of girls and 47% of boys spent more than 2 hours using a computer in their spare time per day.¹¹

2.4.3 Physical, Behavioural and Psychological Consequences of Excess Screen Time

Like overall sedentary behaviour, sedentary screen time has been linked to a wide range of negative health and behavioural outcomes in young people. ¹¹⁰ A recent longitudinal study showed that both current and past excessive television-viewing times were significantly and consistently associated with overweight and obesity in children from age 3 to 15. ¹¹¹ Another study suggested that children and youth aged 6-19 who watched excessive amounts of television (\geq 4 hours/day) had up to 2.5 times higher odds of having high cardio-metabolic risk scores (OR: 2.53, 95% CI: 1.45-4.42). ¹¹² The wide-reaching impact of excessive television-viewing was further highlighted by a recent systematic review of 232 studies, which showed evidence for a dose-response relationship between exceeding two hours of television viewing per day and reduced self-esteem, high blood pressure, insulin resistance, decreased academic performance and other negative outcomes in children and youth aged 5-17. ¹¹⁰ Although other screen-based behaviours such as video game playing and computer use have been less extensively studied, some research has suggested that they have comparable negative health effects on children and youth. ^{113,114}

In addition to increasing total sedentary time, screen-based behaviours may affect health by replacing other more physically active leisure endeavours, such as playing outside¹¹⁵⁻¹¹⁷, as well as more productive sedentary behaviours such as reading, doing homework and socializing with friends in person. ¹¹⁶ Screen time behaviours, and particularly television-viewing, have also been correlated with increased consumption of low-nutrient, high-calorie foods^{113,119-121} in children and adolescents, which may in turn impact long-term health.

Other common concerns are the psychological and behavioural effects of childhood exposure to mature content via screen-based media. Some studies have suggested that youth who are exposed to sexual content on television are more likely to have sex earlier¹²²⁻¹²⁴ and that violent content may be associated with aggression, ¹²⁵ although the existence of this relationship is controversial. ¹²⁶ A recent New Zealand-based study, for example, showed that each extra hour of television a child or adolescent watched per average weeknight was associated with a 30% increase in risk of a criminal conviction by age 26. ¹²⁷ In contrast, a Canadian study found that video game and computer use was associated with increased physical violence in students in grades 6-10, while television-viewing was not. ¹²⁸ Furthermore, excessive computer use has been associated with a 50% increase in combined risk of 6 other risk behaviours, namely drinking, not using a seat belt, cannabis use, illegal drug use and failure to use a condom, in Canadian youth in grades 6-10. ¹²⁹ Reducing screen time is therefore of great public health interest.

2.4.4 Family Structure as a Predictor of Screen Time Behaviours

Ecological systems theory posits that complex, multi-faceted behaviours such as screen time develop through the interaction of individual factors, such as age and gender, with environmental factors, such as the family, school and broader societal context. ¹⁰⁸ Parents may directly influence their children's screen time behaviours through modeling such behaviours and monitoring or implementing rules that limit them. ^{18,108,130,131} These parental behaviours are in turn affected by a wide range of broader factors related to family structure, such as family-level socioeconomic status, family dynamic and availability of a co-parent. ^{87,108} Indeed, lower family socioeconomic status and parental social support have been consistently correlated with increased time spent watching television and in other sedentary activities in youth populations. ^{115,116,132} One study of English children and adolescents (N=3 822), for example, found that those in the lowest category

of socioeconomic status watched approximately 16 more minutes of television per day than those in the highest.¹³³

Existing evidence suggests that family structure may be more consistently related to sedentary behaviour than to physical activity in young people.^{23,68} Three recent studies looking at overlapping cohorts of 878, ⁸⁷ 919² and 1678⁹⁰ youth aged 10-12, respectively, from the city of Melbourne, Australia found that girls from single parent families watched approximately 20 more minutes of television per day on average² and had significantly higher odds of watching over 2 hours per day compared to their counterparts from dual-parent families (OR: 0.7, 95% CI: 0.4-0.9)⁸⁷. No significant differences were observed for boys. A subsequent English study⁹⁴ of 1171 adolescents, on the other hand, found that boys from single parent families watched approximately 25 more minutes of television and spent 16 more minutes using a computer per day, while differences in girls were insignificant. Another recent Australian study¹⁸ of 343 youth aged 12-13 found no statistically significant difference between the television viewing habits of either gender based on family structure. The same English study¹ that found a relationship between diverse family structures and sports participation in boys also found that youth of either gender (N=381) from single parent families were more likely to engage in sedentary activity than those from traditional families (p<0.001), although the effect size was weak and the specific modes of sedentary behaviour were not considered.¹ Finally, several qualitative studies of lowincome populations in the UK have suggested that single parents, who face additional time and energy constraints due to their lack of a co-parent, may be more likely to co-watch television with their children due to its relative accessibility and low energy requirements. ^{1,23,44,134,135} Overall, it appears that children from single parent families watch more television and engage in more sedentary behaviour than children from dual-parent families, and that gender may modify this relationship.¹¹¹ It is, however, important to note that most studies of this association have
been limited by their small and geographically limited samples, low response rates, self-reported screen times and limited definition of family structure as simply single- or dual- parent status.¹¹⁶ Furthermore, it is unlikely that television viewing alone captures the complexity of screen-based sedentary behaviours or their determinants.^{87,97} To our knowledge, only one previous study⁹⁴ has reported results on the influence of family structure on computer use and none have looked at video game use independently of other sedentary behaviours. Following this body of research, a logical next step is to consider the effects of other types of common family structures and custody arrangements on all three major forms of screen-based behaviour in studies with greater power and generalizability.

2.4.5 Other Known and Hypothesized Predictors of Sedentary Screen Time

Like organized sport, sedentary screen time is a complex behaviour with many predictors that have not been discussed in the preceding sections. Consistently observed correlates of excessive television viewing, which is the most extensively studied sedentary screen-based behaviour, include ethnicity, body weight, physical fitness, parents' television-viewing habits, and having a television in the bedroom.^{116, 136} Many of these may lie on the causal pathway between family structure and screen time.

2.5 Summary and Rationale for Thesis

The role of the family environment is critical to the development of young people's health-related beliefs and behaviours. Family structure has a profound impact on this environment, influencing factors ranging from family-level socioeconomic status to parental monitoring of health-related behaviours. It is therefore unsurprising that growing up in a non-traditional family structure is a known determinant of child health that has been linked to a myriad of physical, psychosocial and behavioural outcomes in children. As growing numbers of children and youth are exposed to non-

traditional family structures, it is increasingly important to further explain how and why such relationships between family structure and children's health come to exist.

One proposed explanation is that children from non-traditional families may have fewer opportunities to participate in organized extracurricular activities such as sport due to the financial cost or parental time requirements. They may also be more likely to engage excessively in sedentary screen-based behaviours due to the ease and accessibility of these behaviours as well as decreased parental monitoring. Previous studies correlating family structure with organized sports participation or screen-based behaviours have, however, produced inconsistent results. They have also generally been limited by low power to detect small but meaningful differences, a lack of generalizability and an over-simplified definition of family structure as being simply single- or dual-parent and screen time as simply television viewing.

There is a dearth of information on the influence of increasingly diverse family structures, such as reconstituted families, as well as the influence of custody arrangements and regular visitation with a non-residential parent, on child health-related behaviours such as sports participation and screen-based sedentary behaviour. There are also few studies that address the mechanisms and mediating factors through which family structure may influence these health behaviours, or that look at how family structure relates to screen-based behaviours other than television-viewing. This thesis addresses some of these gaps in knowledge using a large, nationally representative sample of Canadian youth. It is hoped that the results will be used to inform public health interventions aimed at increasing sports participation and reducing sedentary screen time in Canadian youth.

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2.6 References

1. Quarmby T, Dagkas S, Bridge M. Associations between children's physical activities, sedentary behaviours and family structure: A sequential mixed methods approach. *Health Educ Res.* 2011;26(1):63-76.

2. Bagley S, Salmon J, Crawford D. Family structure and children's television viewing and physical activity. *Med Sci Sports Exerc*. 2006;38(5):910-918.

3. Cliquet R. Major trends affecting families in the new millenium: Western Europe and North America. Available at:

http://social.un.org/index/Family/Publications/MajorTrendsAffectingFamilies.aspx. Updated 2004. Accessed 2013-07-08.

4. Kelly JB. Children's living arrangements following separation and divorce: Insights from empirical and clinical research. *Fam Process*. 2007;46(1):35-52.

5. Cenegy LF, Brewer M. Family matters: Links between family structure and early child health. *Journal of Applied Research on Children: Informing Policy for Children at Risk.* 2013;4(1):2013-07-05.

6. Shaw SM. Diversity and ideology: Changes in Canadian family life and implications for leisure. *World Leisure Journal*. 2010;52(1):4-13.

Waldfogel J, Craigie TA, Brooks-Gunn J. Fragile families and child wellbeing. *Future Child*.
 2010;20(2):87-112.

8. McMunn AM, Nazroo JY, Marmot MG, Boreham R, Goodman R. Children's emotional and behavioural well-being and the family environment: Findings from the health survey for England. *Soc Sci Med.* 2001;53(4):423-440.

 9. Statistics Canada. Fifty years of families in Canada: 1961 to 2011. Available at: http://www12.statcan.gc.ca/census-recensement/2011/as-sa/98-312-x/98-312-x2011003_1eng.cfm. Updated 2013-01-09. Accessed 2013-06-25.

10. Kerr D, Beaujot R. Family relations, low income, and child outcomes: A comparison of Canadian children in intact-, step-, and lone-parent families. *International Journal of Comparative Sociology*. 2002;43(2):134-152.

11. Freeman JG, King M, Pickett W, et al. The health of Canada's young people: A mental health focus. 2011. Available at: http://www.phac-aspc.gc.ca/hp-ps/dca-dea/prog-ini/school-scolaire/behaviour-comportements/publications/hcyp-sjc-eng.php. Accessed 2013-06-25.

12. Queens University. Trends in the health of Canadian youth. 1999. Ottawa: Health Canada. Available at: http://www.phac-aspc.gc.ca/hp-ps/dca-dea/publications/trends-tendances/index-eng.php#toc. Accessed 2013-06-05.

13. Levin KA, Dallago L, Currie C. The association between adolescent life satisfaction, family structure, family affluence and gender differences in parent-child communication. *Social Indicators Research*. 2012;106(2):287-305.

14. Jorgensen A, Pedersen TP, Meilstrup CR, Rasmussen M. The influence of family structure on breakfast habits among adolescents. *Dan Med Bull*. 2011;58(5):A4262.

15. UNICEF. Child poverty in perspective: An overview of child well-being in rich countries. In: *Innocenti report card* 7. Florence: UNICEF Innocenti Research Centre; 2007. Available at: http://eprints.whiterose.ac.uk/73187/1/Document.pdf. Accessed 2014-07-01.

16. Swiss L, Le Bourdais C. Father-child contact after separation. the influence of living arrangements. *Journal of Family Issues*. 2009;30(5):623-652.

17. Beaupré P, Dryburgh H, Wendt M. Statistics Canada. making fathers "count". Available at: http://www.statcan.gc.ca/pub/11-008-x/2010002/article/11165-eng.htm. Updated 2010-06-08. Accessed 2013-06-25.

18. Hardy LL, Baur LA, Garnett SP, et al. Family and home correlates of television viewing in 12-13 year old adolescents: The Nepean study. *Int J Behav Nutr Phys Act*. 2006;3:24.

19. Duncan SC, Duncan TE, Strycker LA, Chaumeton NR. A multilevel analysis of sibling physical activity. *Journal of sport & exercise psychology*. 2004;26(1):57-68.

20. Ornelas IJ, Perreira KM, Ayala GX. Parental influences on adolescent physical activity: A longitudinal study. *Int J Behav Nutr Phys Act.* 2007;4:3.

Schmeer KK. Family structure and obesity in early childhood. *Soc Sci Res*. 2012;41(4):820-832.

22. Falci C. Family structure, closeness to residential and non-residential parents, and psychological disress in early and middle adolescence. *The Sociological Quarterly*. 2006;47(1):123-146.

23. Quarmby T. Exploring the role of the family in the construction of young people's health discourses and dispositions. *Educational Review*. 2013;65(3):303-320.

24. Bramlett MD, Blumberg SJ. Family structure and children's physical and mental health. *Health Aff (Millwood)*. 2007;26(2):549-558.

 Jablonska B, Lindberg L. Risk behaviours, victimisation and mental distress among adolescents in different family structures. *Soc Psychiatry Psychiatr Epidemiol*. 2007;42(8):656-663.

26. Musick K, Meier A. Are both parents always better than one? parental conflict and young adult well-being. *Soc Sci Res.* 2010;39(5):814-830.

27. Tillman KH. Family structure pathways and academic disadvantage among adolescents in stepfamilies. *Sociological Inquiry*. 2007;77(383):424.

 Bjarnason T, Bendtsen P, Borup I, et al. Life satisfaction among children in different family structures: A comparative study of 36 western countries. *Children & Society*. 2012;26(1):51-62.
 Yannakoulia M, Papanikolaou K, Hatzopoulou I, Efstathiou E, Papoutsakis C, Dedoussis GV. Association between family divorce and children's BMI and meal patterns: The GENDAI study. *Obesity (Silver Spring)*. 2008;16(6):1382-1387.

30. Hesketh K, Crawford D, Salmon J, Jackson M, Campbell K. Associations between family circumstance and weight status of Australian children. *Int J Pediatr Obes*. 2007;2(2):86-96.

31. Demuth S, Brown SL. Family structure, family processes and adolescent delinquency: The significance of parental absence versus parental gender. *Journal of research in crime and delinquency*. 2004;41(1):58-81.

32. Spencer N. Does material disadvantage explain the increased risk of adverse health, educational, and behavioural outcomes among children in lone parent households in britain? A cross sectional study. *J Epidemiol Community Health*. 2005;59(2):152-157.

33. Langton CE, Berger LM. Family structure and adolescent physical health, behavior, and emotional well-being. *Soc Serv Rev.* 2011;85(3):323-357.

34. Thomson E, McLanahan SS. Reflections on "family structure and child well-being: Economic resources vs. parental socialization". *Soc Forces*. 2012;91(1):45-53.

35. Human Resources Development Canada. A new generation of Canadian families raising young children: A new look at data from national surveys. Available at:

http://publications.gc.ca/site/eng/256744/publication.html. Updated 2003. Accessed 2014-07-04.

36. Statistics Canada. Income of Canadians, 2010. Available at: http://www.statcan.gc.ca/daily-

guotidien/120618/dq120618b-eng.htm. Updated 2012. Accessed 2014-06-26.

37. Sinha M. Parenting and child support after separation or divorce; 2014. Ottawa: Statistics Canada. Report Number: 001.

38. Laxer R. *The proportion of obesity-related behaviours attributable to the neighbourhood built environment in Canadian youth.* Queens University; 2012.

39. Acock AC, Kiecolt KJ. Is it family structure or socioeconomic status? family structure during adolescence and adult adjustment. *Social Forces*. 1989;68(2):553-571.

40. Biblarz TJ, Raftery AE. The effects of family disruption on social mobility. *American Sociological Review*. 1993;58(1):97-109.

41. Astone NM, McLanaha SS. Family structure, parental practices and high school completion. *American Sociological Review*. 1991;56(3):309-320.

42. Thomson E, McLanaha SS, Curtin RB. Family structure, gender and parental socialization. *Journal of marriage and the family*. 1992;54(2):368-378.

43. Galameau D. Education and income of lone parents. *Perspective on Labour and Income, Statistics Canada*. 2005;6(12).

44. Quarmby T, Dagkas S. Children's engagement in leisure time physical activity: Exploring family structure as a determinant. *Leisure Studies*. 2010;29(1):53-66.

45. Bauserman R. Child adjustment in joint-custody versus sole-custody arrangements: A metaanalytic review. *J Fam Psychol*. 2002;16(1):91-102.

46. Carlsund A, Eriksson U, Sellstrom E. Shared physical custody after family split-up:

Implications for health and well-being in swedish schoolchildren. Acta Paediatr.

2013;102(3):318-323.

47. King V. Non-residential father involvement and child well-being: Can dads make a difference? *Journal of family issues*. 1994;15(1):78-96.

48. King V. Variation in the consequences of nonresidential father involvement for children's well-being. *Journal of marriage and the family*. 1994;56(4):963-972.

49. Seltzer JA. Father by law: Effects of joint legal custody on nonresident fathers' involvement with children. *Demography*. 1998;35(2):135-146.

50. Bartfield J. Child support and the postdivorce economic well-being of mothers, fathers, and children. *Demography*. 2000;37(2):203-213.

51. Active Healthy Kids Canada. Is Canada in the running? The 2014 active healthy kids Canada report card on physical activity for children and youth. 2014. Available at:

http://www.activehealthykids.ca/ReportCard/2014ReportCard.aspx. Accessed 2014-07-23.

52. Timmons BW, Leblanc AG, Carson V, et al. Systematic review of physical activity and health in the early years (aged 0-4 years). *Appl Physiol Nutr Metab*. 2012;37(4):773-792.

53. Janssen I, Leblanc AG. Systematic review of the health benefits of physical activity and fitness in school-aged children and youth. *Int J Behav Nutr Phys Act*. 2010;7:40-5868-7-40.

54. Warburton DE, Charlesworth S, Ivey A, Nettlefold L, Bredin SS. A systematic review of the evidence for Canada's physical activity guidelines for adults. *Int J Behav Nutr Phys Act.*

2010;7:39-5868-7-39.

55. Paterson DH, Warburton DE. Physical activity and functional limitations in older adults: A systematic review related to Canada's physical activity guidelines. *Int J Behav Nutr Phys Act*. 2010;7:38-5868-7-38.

56. Reilly JJ, Kelly J. Long-term impact of overweight and obesity in childhood and adolescence on morbidity and premature mortality in adulthood: Systematic review. *Int J Obes (Lond)*. 2011;35(7):891-898.

57. Canadian Society for Exercise Physiology. Canadian physical activity guidelines and Canadian sedentary behaviour guidelines. Available at:

http://www.csep.ca/english/view.asp?x=949. Updated 2013. Accessed 2013-07-10.

58. Belanger M, Gray-Donald K, O'Loughlin J, et al. Participation in organised sports does not slow declines in physical activity during adolescence. *Int J Behav Nutr Phys Act.* 2009;6:22-5868-6-22.

59. Eime RM, Harvey JT, Brown WJ, Payne WR. Does sports club participation contribute to health-related quality of life? *Med Sci Sports Exerc*. 2010;42(5):1022-1028.

60. Toftegaard-Stockel J, Nielsen GA, Ibsen B, Andersen LB. Parental, socio and cultural factors associated with adolescents' sports participation in four Danish municipalities. *Scand J Med Sci Sports*. 2011;21(4):606-611.

61. Canadian Fitness and Lifestyle Research Institute. 2011-12 CANPLAY. Bulletin 2:
Participation in organized physical activity and sport. 2013. Available at:
http://www.cflri.ca/node/1161. Accessed 2014-07-23.

62. Nelson TF, Stovitz SD, Thomas M, LaVoi NM, Bauer KW, Neumark-Sztainer D. Do youth sports prevent pediatric obesity? A systematic review and commentary. *Curr Sports Med Rep.* 2011;10(6):360-370.

63. Vella SA, Cliff DP, Okely AD, Scully ML, Morley BC. Associations between sports participation, adiposity and obesity-related health behaviors in Australian adolescents. *Int J Behav Nutr Phys Act.* 2013;10:113-5868-10-113.

64. Drake KM, Beach ML, Longacre MR, et al. Influence of sports, physical education, and active commuting to school on adolescent weight status. *Pediatrics*. 2012;130(2):e296-304.

65. Jose KA, Blizzard L, Dwyer T, McKercher C, Venn AJ. Childhood and adolescent predictors of leisure time physical activity during the transition from adolescence to adulthood: A population based cohort study. *Int J Behav Nutr Phys Act.* 2011;8:54-5868-8-54.

66. Kjonniksen L, Anderssen N, Wold B. Organized youth sport as a predictor of physical activity in adulthood. *Scand J Med Sci Sports*. 2009;19(5):646-654.

67. Tammelin T, Nayha S, Hills AP, Jarvelin MR. Adolescent participation in sports and adult physical activity. *Am J Prev Med*. 2003;24(1):22-28.

68. Eime RM, Harvey JT, Craike MJ, Symons CM, Payne WR. Family support and ease of access link socio-economic status and sports club membership in adolescent girls: A mediation study. *Int J Behav Nutr Phys Act.* 2013;10:50-5868-10-50.

69. Knifsend CA, Graham S. Too much of a good thing? how breadth of extracurricular participation relates to school-related affect and academic outcomes during adolescence. *J Youth Adolesc*. 2012;41(3):379-389.

70. Mahoney JL, Cairns RB. Do extracurricular activities protect against early school dropout? *Dev Psychol*. 1997;33(2):241-253.

71. Schaefer DR, Simpkins SD, Vest AE, Price CD. The contribution of extracurricular activities to adolescent friendships: New insights through social network analysis. *Dev Psychol*. 2011;47(4):1141-1152.

72. Blomfield CJ, Barber BL. Developmental experiences during extracurricular activities and Australian adolescents' self-concept: Particularly important for youth from disadvantaged schools. *J Youth Adolesc*. 2011;40(5):582-594.

73. Kwan M, Bobko S, Faulkner G, Donnelly P, Cairney J. Sports participation and alcohol and illicit drug use in adolescents and young adults: A systematic review of longitudinal studies. *Addict Behav.* 2014;39(3):497-506.

74. Lisha NE, Sussman S. Relationship of high school and college sports participation with alcohol, tobacco, and illicit drug use: A review. *Addict Behav*. 2010;35(5):399-407.

75. Donnelly P, Darnell S, Wells S, Coakley J. The use of sport to foster child and youth development and education. In: Kidd B, Donnelly P, eds. *The benefits of sport in international development: Five literature reviews*. Geneva, Switzerland: International Working Group for Sport, Development and Peace; 2007:7-47.

76. Eime RM, Young JA, Harvey JT, Charity MJ, Payne WR. A systematic review of the psychological and social benefits of participation in sport for children and adolescents: Informing development of a conceptual model of health through sport. *Int J Behav Nutr Phys Act*. 2013;10:98-5868-10-98.

77. Taliaferro LA, Rienzo BA, Donovan KA. Relationships between youth sports participation and selected health risk behaviors from 1999 to 2007. *J Sch Health*. 2010;80(8):399-410.

78. Cohen DA, Taylor SL, Zonta M, Vestal KD, Schuster MA. Availability of high school extracurricular sports programs and high-risk behaviors. *J Sch Health*. 2007;77(2):80-86.

79. DeMeulenaere E. Playing the game: Sports as a force for promoting improved academic performance for urban youth. *J Cult Divers*. 2010;17(4):127-135.

80. Council on Sports Medicine and Fitness, Council on School Health. Active healthy living: Prevention of childhood obesity through increased physical activity. *Pediatrics*.

2006;117(5):1834-1842.

Canadian Heritage. Sports participation 2010. Ottawa: Government of Canada. 2013.
 Available at: <u>http://publications.gc.ca/site/archivee-</u>

archived.html?url=http://publications.gc.ca/collections/collection_2013/pc-ch/CH24-1-2012eng.pdf. Accessed 2013-07-10. 82. Clark W. Kids' sport. In: *Canadian social trends: Number 85*. Vol 85. Ottawa: Statistics
Canada; 2008. Available at: <u>http://www.statcan.gc.ca/pub/11-008-x/11-008-x2008001-eng.htm</u>.
Accessed 2013-07-10.

 Allender S, Cowburn G, Foster C. Understanding participation in sport and physical activity among children and adults: A review of qualitative studies. *Health Educ Res*. 2006;21(6):826-835.

84. Sallis JF, Prochaska JJ, Taylor WC, Hill JO, Geraci JC. Correlates of physical activity in a national sample of girls and boys in grades 4 through 12. *Health Psychol*. 1999;18(4):410-415.
85. Sallis JF, Alcaraz JE, McKenzie TL, Hovell MF. Predictors of change in children's physical activity over 20 months. variations by gender and level of adiposity. *Am J Prev Med*. 1999;16(3):222-229.

86. Sallis JF, Taylor WC, Dowda M, Freedson PS, Pate RR. Correlates of vigorous physical activity for children in grades 1 through 12: Comparing parent-reported and objectively measured physical activity. *Pediatric exercise science*. 2002;14(1):30-44.

87. Salmon J, Timperio A, Telford A, Carver A, Crawford D. Association of family environment with children's television viewing and with low level of physical activity. *Obes Res.* 2005;13(11):1939-1951.

88. Hesketh K, Graham M, Waters E. Children's after school activity: Associations with weight status and family circumstance. *Pediatr Exerc Sci.* 2008;20(1):84-94.

89. Tremblay MS, Willms JD. Is the Canadian childhood obesity epidemic related to physical inactivity? *Int J Obes Relat Metab Disord*. 2003;27(9):1100-1105.

90. Hesketh K, Crawford D, Salmon J. Children's television viewing and objectively measured physical activity: Associations with family circumstance. *Int J Behav Nutr Phys Act.* 2006;3:36.

91. McVeigh JA, Norris SA, de Wet T. The relationship between socio-economic status and physical activity patterns in south african children. *Acta Paediatr*. 2004;93(7):982-988.
92. Lindquist CH, Reynolds KD, Goran MI. Sociocultural determinants of physical activity among children. *Prev Med*. 1999;29(4):305-312.

93. Sallis JF, Alcaraz JE, McKenzie TL, Hovell MF, Kolody B, Nader PR. Parental behavior in relation to physical activity and fitness in 9-year-old children. *Am J Dis Child*. 1992;146(11):1383-1388.

94. Gorely T, Atkin AJ, Biddle SJ, Marshall SJ. Family circumstance, sedentary behaviour and physical activity in adolescents living in England: Project STIL. *Int J Behav Nutr Phys Act*. 2009;6:33-5868-6-33.

95. Kukaswadia A, Pickett W, Janssen I. Time since immigration and ethnicity as predictors of physical activity among Canadian youth: A cross-sectional study. *PLoS One*. 2014;9(2):e89509.
96. Van Der Horst K, Paw MJ, Twisk JW, Van Mechelen W. A brief review on correlates of physical activity and sedentariness in youth. *Med Sci Sports Exerc*. 2007;39(8):1241-1250.

97. O'Loughlin J, Paradis G, Kishchuk N, Barnett T, Renaud L. Prevalence and correlates of physical activity behaviors among elementary schoolchildren in multiethnic, low income, innercity neighborhoods in Montreal, Canada. *Ann Epidemiol*. 1999;9(7):397-407.

98. Salmon J, Dunstan D, Owen N. Should we be concerned about children spending extended periods of time in sedentary pursuits even among the highly active? *Int J Pediatr Obes*. 2008;3(2):66-68.

99. Owen N, Healy GN, Matthews CE, Dunstan DW. Too much sitting: The population health science of sedentary behavior. *Exerc Sport Sci Rev.* 2010;38(3):105-113.

100. Chinapaw MJ, Proper KI, Brug J, van Mechelen W, Singh AS. Relationship between young peoples' sedentary behaviour and biomedical health indicators: A systematic review of prospective studies. *Obes Rev.* 2011;12(7):e621-32.

101. Hamilton MT, Healy GN, Dunstan DW, Zderic TW, Owen N. Too little exercise and too much sitting: Inactivity physiology and the need for new recommendations on sedentary behavior. *Curr Cardiovasc Risk Rep.* 2008;2(4):292-298.

102. Saunders TJ, Chaput JP, Tremblay MS. Sedentary behaviour as an emerging risk factor for cardiometabolic diseases in children and youth. *Can J Diabetes*. 2014;38(1):53-61.

103. Colley RC, Garriguet D, Janssen I, Craig CL, Clarke J, Tremblay MS. Physical activity of Canadian children and youth: Accelerometer results from the 2007 to 2009 Canadian health measures survey. *Health Rep.* 2011;22(1):15-23.

104. Katzmarzyk PT, Church TS, Craig CL, Bouchard C. Sitting time and mortality from all causes, cardiovascular disease, and cancer. *Med Sci Sports Exerc*. 2009;41(5):998-1005.

105. Koster A, Caserotti P, Patel KV, et al. Association of sedentary time with mortality independent of moderate to vigorous physical activity. *PLoS One*. 2012;7(6):e37696.

106. Healy GN, Dunstan DW, Salmon J, Shaw JE, Zimmet PZ, Owen N. Television time and continuous metabolic risk in physically active adults. *Med Sci Sports Exerc*. 2008;40(4):639-645.

107. Martinez-Gomez D, Eisenmann JC, Gomez-Martinez S, Veses A, Marcos A, Veiga OL.

Sedentary behavior, adiposity and cardiovascular risk factors in adolescents. the AFINOS study.

Rev Esp Cardiol. 2010;63(3):277-285.

108. Davison KK, Birch LL. Childhood overweight: A contextual model and recommendations for future research. *Obes Rev.* 2001;2(3):159-171.

109. Bey L, Akunuri N, Zhao P, Hoffman EP, Hamilton DG, Hamilton MT. Patterns of global gene expression in rat skeletal muscle during unloading and low-intensity ambulatory activity. *Physiol Genomics*. 2003;13(2):157-167.

110. Tremblay MS, LeBlanc AG, Kho ME, et al. Systematic review of sedentary behaviour and health indicators in school-aged children and youth. *Int J Behav Nutr Phys Act.* 2011;8:98-5868-8-98.

111. Hancox RJ, Poulton R. Watching television is associated with childhood obesity: But is it clinically important? *Int J Obes (Lond)*. 2006;30(1):171-175.

112. Carson V, Janssen I. Volume, patterns, and types of sedentary behavior and cardio-metabolic health in children and adolescents: A cross-sectional study. *BMC Public Health*. 2011;11:274-2458-11-274.

113. Utter J, Neumark-Sztainer D, Jeffery R, Story M. Couch potatoes or french fries: Are sedentary behaviors associated with body mass index, physical activity, and dietary behaviors among adolescents? *J Am Diet Assoc*. 2003;103(10):1298-1305.

114. Iannotti RJ, Kogan MD, Janssen I, Boyce WF. Patterns of adolescent physical activity, screen-based media use, and positive and negative health indicators in the U.S. and Canada. *J Adolesc Health*. 2009;44(5):493-499.

115. Leatherdale ST, Faulkner G, Arbour-Nicitopoulos K. School and student characteristics associated with screen-time sedentary behavior among students in grades 5-8, ontario, Canada, 2007-2008. *Prev Chronic Dis.* 2010;7(6):A128.

116. Gorely T, Marshall SJ, Biddle SJ. Couch kids: Correlates of television viewing among youth. *Int J Behav Med*. 2004;11(3):152-163.

117. Vara LS, Epstein LH. Laboratory assessment of choice between exercise or sedentary behaviors. *Res Q Exerc Sport*. 1993;64(3):356-360.

118. Leatherdale ST, Wong SL. Modifiable characteristics associated with sedentary behaviours among youth. *Int J Pediatr Obes*. 2008;3(2):93-101.

119. Pearson N, Biddle SJ. Sedentary behavior and dietary intake in children, adolescents, and adults. A systematic review. *Am J Prev Med*. 2011;41(2):178-188.

120. Francis LA, Lee Y, Birch LL. Parental weight status and girls' television viewing, snacking, and body mass indexes. *Obes Res.* 2003;11(1):143-151.

121. Coon KA, Tucker KL. Television and children's consumption patterns. A review of the literature. *Minerva Pediatr*. 2002;54(5):423-436.

122. Chandra A, Martino SC, Collins RL, et al. Does watching sex on television predict teen pregnancy? findings from a national longitudinal survey of youth. *Pediatrics*. 2008;122(5):1047-1054.

123. Collins RL, Elliott MN, Berry SH, et al. Watching sex on television predicts adolescent initiation of sexual behavior. *Pediatrics*. 2004;114(3):e280-9.

124. Ashby SL, Arcari CM, Edmonson MB. Television viewing and risk of sexual initiation by young adolescents. *Arch Pediatr Adolesc Med.* 2006;160(4):375-380.

125. Huesmann LR, Moise-Titus J, Podolski CL, Eron LD. Longitudinal relations between children's exposure to TV violence and their aggressive and violent behavior in young adulthood:
1977-1992. *Dev Psychol.* 2003;39(2):201-221.

126. Mitrofan O, Paul M, Spencer N. Is aggression in children with behavioural and emotional difficulties associated with television viewing and video game playing? A systematic review. *Child Care Health Dev.* 2009;35(1):5-15.

127. Robertson LA, McAnally HM, Hancox RJ. Childhood and adolescent television viewing and antisocial behavior in early adulthood. *Pediatrics*. 2013;131(3):439-446.

128. Janssen I, Boyce WF, Pickett W. Screen time and physical violence in 10 to 16-year-old Canadian youth. *Int J Public Health*. 2012;57(2):325-331.

129. Carson V, Pickett W, Janssen I. Screen time and risk behaviors in 10- to 16-year-old Canadian youth. *Prev Med.* 2011;52(2):99-103.

130. Totland TH, Bjelland M, Lien N, et al. Adolescents' prospective screen time by gender and parental education, the mediation of parental influences. *Int J Behav Nutr Phys Act.* 2013;10:89-5868-10-89.

131. Maitland C, Stratton G, Foster S, Braham R, Rosenberg M. A place for play? the influence of the home physical environment on children's physical activity and sedentary behaviour. *Int J Behav Nutr Phys Act.* 2013;10:99-5868-10-99.

132. Sisson SB, Broyles ST. Social-ecological correlates of excessive TV viewing: Difference by race and sex. *J Phys Act Health*. 2012;9(3):449-455.

133. Coombs N, Shelton N, Rowlands A, Stamatakis E. Children's and adolescents' sedentary behaviour in relation to socioeconomic position. *J Epidemiol Community Health*.
2013;67(10):868-874.

134. Quarmby T, Dagkas S. Locating the place and meaning of physical activity in the lives of young people from low-income, lone-parent families. *Physical Education and Sport Pedagogy*. 2012;17(2):157-175.

135. Dagkas S, Stathi A. Exploring social and environmental factors affecting adolescents' participation in physical activity. *European Physical Education Review*. 2007;13(3):369-384.
136. Salmon J, Tremblay MS, Marshall SJ, Hume C. Health risks, correlates, and interventions to reduce sedentary behavior in young people. *Am J Prev Med*. 2011;41(2):197-206.

Chapter 3

Family structure as a predictor of organized sports participation in Canadian youth

3.1 Abstract

INTRODUCTION: Organized sport is one popular way that youth participate in physical activity. There are, however, known disparities in organized sports participation by family-level socioeconomic status and other family-related factors. This study's objective was therefore to determine whether non-traditional family structure and physical custody arrangements are associated with organized sports participation in Canadian youth, and if so whether this relationship is mediated by socioeconomic status.

METHODS: Data were from the Canadian 2009/10 Health Behaviour in School-aged Children survey, which consisted of a nationally representative cross-section of Canadian youth in grades 6-10 (N = 26 068). All information was based on self-report. Logistic regression was used to compare the odds of sports participation in youth living in traditional dual-parent families to those living in single parent or reconstituted/step-families, with or without regular visitation with a nonresidential parent, while controlling for relevant covariates and survey design effects. Information on family structure was derived from a survey item asking about the number of parents living with participants in their homes and their relationships to the participants, as well as whether/how often participants visited another parent outside of the primary home. Sports participation was assessed through an item asking whether participants currently participated in organized sport. Bootstrap-based mediation analysis was used to assess mediation by selfreported socioeconomic status.

RESULTS: Both boys and girls from all non-traditional family structures had lower odds of participating in sport than those from traditional families, regardless of visitation with a non-residential parent. Before controlling for socioeconomic status, the odds ratios of participation in non-traditional families to traditional families in each gender ranged from a minimum of 0.48 (95% CI: 0.38-0.61) to a maximum of 0.78 (95% CI: 0.56-1.08). This relationship was

significantly mediated by socioeconomic status, although the magnitude of the mediation was moderate to weak (ie: <20% change in effect estimate).

CONCLUSION: Youth living in both single parent and reconstituted families experience significant disparities in sports participation that are partially mediated by their family's socioeconomic status.

3.2 Introduction

Physical inactivity is strongly associated with decreased mental and physical health in children and youth. ^{1,2} It is therefore concerning that children and youth are becoming less active in Canada² and across the world. ³ In Canada, only 7% of 5-19 year olds meet the national guidelines of at least 60 minutes per day of moderate-to-vigorous physical activity (MVPA). ⁴ Organized sport offers one way for young people to engage in physical activity, improve their fitness, and develop positive social and physical skills. ^{5,6} It is associated with decreases in several risk behaviours, including illegal drug use and excessive screen time. ⁶⁻¹¹ Furthermore, young people who participate in sport are more likely to continue as adults, allowing them to reap lifelong health benefits including decreased all-cause mortality. ¹²⁻¹⁴ It is therefore beneficial to identify determinants of youths' organized sports participation.

Family structure may be one such factor. Growing up in a non-traditional family such as a single parent family or reconstituted family, which includes a stepparent or parent's partner, is a recognized determinant of child well-being that has been linked to many of the same negative health outcomes as insufficient physical activity.¹⁵⁻²⁰ Results from the 2010 General Social Survey in Canada showed that 74% of 5-14 year olds from dual-parent families had participated in organized sport during the past year compared to 68% of those from single parent families.²¹ Other studies have largely concluded that youth from single parent families are less likely to participate in sport and that this relationship may be moderated by gender, ²²⁻²⁴ although null findings have also been observed.²⁵ Many of these studies were limited by their use of a simple single- or dual-parent families and reconstituted dual-parent families.^{26,27} It also fails to take into account how shared custody or visitation with a non-residential parent may influence sports

participation. This type of visitation is associated with improvements in some of the child health outcomes that are also related to organized sport. ^{19,28,29}

The pathway(s) that explains the association between family structure and organized sports participation remains unclear. This association may be explained in part by less favourable socioeconomic conditions in youth from non-traditional families ^{30,31}, which may influence their ability to participate in health-related behaviours such as organized sport. ¹⁸ Indeed, the proportion of 5-19 year olds who participate in organized sport decreases with decreasing household income in Canada. ³²

The typical family is becoming increasingly diverse.³³ Today, approximately 32% of Canadian youth live in non-traditional families.³⁴ It is therefore prudent to identify any disparities in organized sports participation by family structure using a detailed definition of family structure. This study examined whether participation in organized sport differed in youth from traditional dual-parent families, single parent families and reconstituted families, while also considering the effects of visitation with the non-custodial parent. It also evaluated whether socioeconomic status (SES) was a mediator of this relationship. This research could potentially inform future targeted interventions aimed at reducing disparities in sports participation among youth.

3.3 Methods

Study design and population:

Study data are from the nationally representative cross-sectional 2009/2010 Canadian Health Behaviour in School-aged Children Survey (HBSC). The HBSC is conducted every 4 years in 43 countries in collaboration with the World Health Organization.¹⁰ This study is limited to the Canadian data. The HBSC consists of a standardized self-report survey filled out in a classroom setting, with the goal of determining the prevalence and distribution of a wide range of psychological, social and physical determinants of health in 11-15 year olds. All HBSC questionnaire items are continuously developed, piloted and validated by the HBSC international network.¹⁰

The 2009/2010 Canadian HBSC consisted of 26 068 students in grades 6-10 from 436 public schools across Canada. All provinces and territories participated, with the exceptions of New Brunswick and Prince Edward Island. The student response rate was 77%. The provincial samples were obtained using a two-tiered cluster-sampling procedure to sample entire classrooms for participation, while all students living in the three territories were invited to participate if they met the study inclusion criteria in order to ensure adequate representation. Students attending private, on-reserve, special needs or home-based schools were excluded, as were those who did not provide consent for participation or who were absent from school on the day the survey was completed.

Participants were included in the analysis if they had complete data for all of the questions of interest and lived with at least one of their parents. A total of 4 862 participants were excluded from the analysis using self-reported family affluence to measure SES, for the reasons outlined in Figure 3.1. This left a final sample of 21 201 participants. Characteristics of excluded participants were similar to included participants (see Table 5.6 in Appendix H), although those excluded were slightly more likely to be males and in grades 6 or 7.

Exposure (Family structure):

Information on family structure was derived from two questions. The first asked participants to check off the adults who live in the home *"where [they] live all or most of the time"* from a list of choices including mother, father, stepmother (or father's girlfriend) and stepfather (or mother's boyfriend). The second asked whether they had a second home, and if so how often they stayed there (*"half the time"*, *"regularly but less than half the time"*, *"sometimes"* or *"hardly ever"*). Families were defined as traditional (includes both a mother and a father), single parent (includes

either a mother or a father), or reconstituted (includes either a mother or a father and either a stepmother/father's girlfriend or stepfather/mother's boyfriend), based on previous literature.

^{16,35,36} Adolescents from non-traditional families were further defined as having "regular

visitation" with a second parent if they had a second home and reported visiting it "*half the time*" or "*regularly but less than half the time*" and "irregular visitation" if the adolescent reported not having a second home, or having a second home but visiting it "*sometimes*" or "*hardly ever*". Youths who reported that neither their mother nor their father lived in their primary home constituted ~4% of the sample and were excluded from the analysis.³⁴

Outcome (Organized sports participation):

Organized sports participation was assessed by a question that asked participants whether they were involved in any "*sport club or team*", with two response options ("*yes*" or "*no*"). A study of the 2-week test-retest reliability of a similarly worded question from the American Youth Risk Behavior Survey showed that students in grades 7 and 10 reliably reported their organized sports participation over the past year (r=0.84).³⁷

Potential confounders:

Potential confounders were selected based on previous literature and their availability within the HBSC. These included gender, grade, ethnicity (Canadian, which includes those who self-identified as Caucasian or Aboriginal; East and Southeast Asian; South Asian; Black; Arab; or other, which includes those of mixed ethnicity and those who self-identified as other), ³⁸ immigration status (born in Canada/immigrated >5 years or immigrated \leq 5 years), and presence of siblings in the primary home (yes or no).

Socioeconomic status as a potential mediator:

Self-reported family affluence was used as a proxy of SES, and was assessed via two methods. The first method looked at self-perceived family wealth, which is assessed through a single item on the HBSC that asked students to report "how well off [they] think [their] family is", with five ordinal responses ranging from "not at all well off" to "very well off". The second method used the Family Affluence Scale (FAS), ³⁹ which attempts to score family material wealth based on four items asking participants whether they "have [their] own bedroom for [themselves]", "how many times [they] travel[ed] away on holiday with [their family]" in the past year, whether their family "own[s] a car, van or truck," and "how many computers [their] family own[s]."⁴⁰ Some studies have suggested that the FAS may have relatively high validity compared to other measures of affluence.^{40, 41} It has, however, not been validated in Canada or in youth whose parents have shared custody. Both measures of SES were treated as continuous variables during regression analyses. Because the findings were extremely consistent based on the two SES measures, the Results section only presents the findings based on self-perceived family affluence. The results based on the FAS are briefly summarized in the Results section and presented in Appendix H.

Statistical analysis:

All analyses used survey procedures in SAS 9.4 to account for the complex sampling design used by the HBSC, including clustering and sampling weights. All analyses were stratified by gender as it has been shown previously that sports participation levels as well as reasons for participation differ by gender. ⁴²⁻⁴⁴ The HBSC sample was characterized using simple descriptive statistics. A contemporary mediation analysis approach ⁴⁵⁻⁴⁷ was used to assess the total, direct and indirect associations of family structure on organized sports participation, considering SES as a potential mediator of this relationship. These associations are depicted in Figure 3.2. The total association represents the full effect of the exposure, family structure, on the outcome, organized sport. A mediator is an intermediate factor that falls on the causal pathway between an exposure and outcome, thereby transmitting all or part of the total effect on the outcome. The direct association

therefore represents the portion of the total effect that occurs independently of the pathway through the proposed mediator, SES (path c' in Figure 3.2). The indirect association, on the other hand, is the portion of the total effect that can be accounted for by family structure's effect on SES (path *a* in Figure 3.2), which in turn affects organized sport (path *b* in Figure 3.2). Multiple logistic regression was used to quantify the total association between family structure and organized sport after controlling for covariates, without adjusting for SES (see c' pathway in Figure 3.2), as well as the direct association, which did adjust for SES. Analyses of the direct association were performed separately for the two measures of SES. Final covariate selection for the multivariate models was performed through backwards deletion using a 10% change-inestimate threshold.⁴⁸ If a covariate changed the odds ratio of at least one non-traditional family structure by more than 10% for either boys or girls in any of the total or indirect models of sports participation, it was included in all final models. All covariates of interest met this criterion. The indirect association between family structure and organized sport (see the a and b pathways in Figure 3.2) was estimated using a bootstrap sampling procedure with 2500 resamples, controlling for relevant covariates identified in the previous analysis. This was done in SAS using a modified version of a macro developed by Carson and Janssen.⁴⁹ The *a* pathways were estimated for each family structure category through multiple linear regression (SAS Proc SurveyReg), while the b pathways were estimated using multiple logistic regression (SAS Proc SurveyLogistic) for each of the resamples. Point estimates of the indirect associations and their 95% bootstrap-based confidence intervals were calculated for each pathway based on the products of the two regression coefficients for each resample. There was evidence of mediation if the 95% confidence interval did not include 0, the null value.

3.4 Results

Sample characteristics:

Demographic characteristics of the participants are in Table 3.1. The majority of participants were of Canadian ethnicity (76.4%), and most were either born in Canada or had lived there for more than 5 years (95.6%). The majority of participants considered their families to be quite well off or very well off (57.6%). Almost three quarters of the sample lived in traditional, dual-parent families (71.0%). The remainder lived in single parent families with irregular visitation with their non-custodial parent (14.3%), reconstituted families with irregular visitation (7.1%), single parent families with regular visitation (3.0%). Approximately 55.1% participated in organized sport at the time the survey was completed. Table 3.2 shows the proportion of boys and girls who participated in organized sport was consistently lower among non-traditional families than among traditional families. For those youth from reconstituted and single parent families, organized sport was consistently higher in the regular visitation subgroup than the irregular visitation subgroup.

Association between family structure and self-perceived family wealth:

Lower self-perceived family wealth scores were observed in non-traditional family structures (p<0.0001, Table 3.3). When self-perceived family wealth was treated as a 5-point ordinal scale with 1 being "*not at all well off*" and 5 being "*very well off*" youth from non-traditional families perceived their family wealth as being 0.18 to 0.49 units lower than youth from traditional families after controlling for covariates.

Association between self-perceived family wealth and organized sport:

Self-perceived family wealth was significantly (p<0.0001) associated with organized sport. After controlling for covariates, each one-unit increase in self-perceived family wealth was associated

with a 22% increase in the odds of participating in organized sport among boys (odds ratio of 1.22 with 95% confidence interval of (1.15-1.29)) and a 24% increase in the odds of participating in organized sport among girls (odds ratio of 1.24 with 95% confidence interval of (1.17-1.31)). *Association between family structure and organized sport*

Total association. Table 3.4 shows the relative odds of organized sports participation for each of the non-traditional family structures compared to traditional families. Before accounting for the effects of self-perceived family wealth, boys and girls had significantly lower odds of participating in sport if they were from any of the non-traditional family structures. The one exception was the reconstituted with regular visitation group in boys, which was not significantly different from the traditional family structure group (OR = 0.78, 95% CI: 0.56-1.08).

Direct association. Including self-perceived family wealth in the model consistently increased the odds of organized sports participation for non-traditional families, bringing them closer to the odds for traditional families (Table 3.4). The changes in the magnitude of the odds ratios by comparison to those observed for the total associations ranged from 4.4% to 16.5%, suggesting that 4.4% to 16.5% of the association between family structure and organized sport was mediated by self-perceived family wealth.

Indirect association. Table 3.4 shows the results of the formal bootstrap-based test of mediation of the relationship between family structure and organized sports participation by self-perceived family wealth. There was statistical evidence of mediation for all non-traditional family structures.

The bootstrap-based point estimates are equal to the products of coefficients generated through different forms of regression, and are therefore not directly meaningful.⁴⁷ As organized sports participation is a binary outcome, the range of the point estimates is -1 (complete negative mediation) to 1 (complete positive mediation).⁴⁹ In all cases the sign of the point estimate for the

mediation was negative, indicating that the indirect effect of non-traditional family structure on organized sport transmitted by SES was negative. Most of the point estimates were small in magnitude (i.e., between -0.1 and 0), regardless of statistical significance.

Family affluence scale (FAS):

All of the analyses described above were repeated using the FAS in place of self-perceived family wealth as the SES measure. These results are summarized in Appendix H, Tables 5.6 to 5.9. The observed results were extremely similar for the most part. The most notable difference was that being from a reconstituted family with regular visitation was not significantly related to FAS scores (see Table 5.8), although all other family structures were. The indirect effect of family structure on organized sports participation through the FAS was also more pronounced for youth from single parent families. When adding the FAS score as a covariate in the logistic models, the odds ratios of sports participation in girls from single parent families compared to traditional families changed by 29.8% and 30.3% for those with rare and regular visitation, respectively. In boys from single parent families who rarely or never saw a non-residential parent, the odds ratio changed by 21.6%. The bootstrap-based point estimates were also further from 0 when using the FAS to measure SES in boys and girls from single parent families with irregular visitation (-0.16 and -0.24, respectively), and were insignificant for youth from reconstituted families with regular visitation.

3.5 Discussion

This study looked at differences in organized sports participation by family structure, as well as potential mediation of this relationship by SES, in a large and representative sample of Canadian youth. Overall, youth from single parent and reconstituted families were less likely to participate in organized sport than those from traditional families regardless of custody arrangements. The relationship between family structure and organized sport was partially mediated by SES.

The majority of previous studies of this relationship have defined family structure as simply single- or dual-parent, and have reported inconsistent associations. One study, ²⁴ for example, showed that girls from single parent families were less likely to participate in sport than girls from dual-parent families, while two other studies ^{22,23} showed that this relationship between single- and dual-parent family structure and sports participation existed only among boys. Still another study ²⁵ found no such relationship in either gender. A key finding of the current study is that organized sports participation differs between youth from traditional and non-traditional families, and that this difference is similar in magnitude regardless of whether youth are from single parent or reconstituted families. It is unclear why differences between traditional and reconstituted dual-parent families might exist. One potential explanation is that stepparents may be less engaged in childcare than biological parents. ⁵⁰⁻⁵³ Another is that reconstituted families may be of lower socioeconomic status on average than traditional families. ⁵³ Finally, youth from reconstituted dual-parent families may also be more likely to transition between single parent and reconstituted families, such as when a single parent remarries. This type of transition was not captured in our cross-sectional data.

Some previous studies of the relationship between non-traditional family structure and youth sports participation have controlled for SES as a covariate. Our study instead considered it as a mediator on the causal pathway of this relationship. Two SES measures available in the HBSC were the FAS and self-reported family affluence. While the FAS has been validated, ^{40,41} there are no studies to our knowledge that have validated it in Canadian youth or in youth who spend time living in more than one home. Given this and other known limitations of the FAS, ⁵⁴ we also performed each of our analyses using self-reported family affluence to approximate SES. The results from both sets of analyses were similar, showing evidence of weak-to-moderate mediation. SES is therefore likely only one of many mediating pathways through which family

structure influences organized sports participation. Other plausible factors might include family dynamics, access to sports facilities, parental support of sports-related behaviours, and availability of a co-parent to assist in transportation to and from organized sport activities. It has been hypothesized that shared physical custody arrangements may lead to decreases in physical activity given that visiting another parent may lead to logistical complications or inconsistencies in support for behaviours such as organized sports participation.³⁵ Our findings did not support this hypothesis, in that youth who visited a non-residential parent regularly were not less likely to participate in organized sport than those from similar non-traditional family structures who rarely or never did so. This may partially reflect the fact that non-residential parents who have regular visitation with their children are more likely to contribute financially to their care. ^{55,56} Indeed, the influence of mediation by SES was marginally stronger for youth from non-traditional families who did not have regular visitation with their second parent. As increasing numbers of Canadian youth are exposed to non-traditional family structures, it is becoming increasingly important to understand why disparities in health-related behaviours exist by family structure and how best to intervene. This study suggests that interventions aimed at increasing organized sports participation in youth might be more successful if they consider both family structure and the financial cost of sports participation. This could be done by targeting non-traditional families with advertisements or information to increase their awareness of financial incentives to cover the cost of their children's sports participation, such as the Canadian federal government's Children's Fitness Tax Credit.⁵⁷ In the case of low-income families unable to cover the up-front cost of organized sports participation, another more viable intervention might be for sports organizations to subsidize the cost of low-income youth participation and then apply for government funding equivalent to the tax credit.⁵⁸ Other options might address the

time constraints experienced by some non-traditional families, for example by providing youth with community- or school-based transportation to and from sporting events.

One strength of this study was its large sample size, which allowed us the statistical power to compare reconstituted and traditional families and also divide non-traditional families by custody arrangements. In addition, the HBSC is nationally representative and therefore generalizable to the Canadian youth population. A final strength is the use of a contemporary bootstrap-based test of mediation by SES. This test is high in power compared to other methods of testing mediation and does not require the assumption that all mediating pathways influence the outcome in the same direction. ^{45,59}

Our study also has some limitations. All data were based on self-report and are therefore subject to recall and reporting biases. This was a particular concern for the SES measures. The use of cross-sectional data meant that we were unable to determine how long participants had been in their current family structure or the timeframe of their organized sports participation, which may have led to exposure and outcome misclassification. Several potential covariates and mediators, such as parental sports participation and employment status, were not available in the dataset. Finally, selection bias was a concern given that youth who did not provide consent or who were absent from school on the day of the survey may have been systematically different from those who did participate.

3.6 Conclusion

Our findings suggest that youth from single parent and reconstituted families have lower odds of participating in organized sport than those from traditional families and that this relationship is partially mediated by socioeconomic disparities. Future research should focus on elucidating additional mediating pathways between family structure and sports participation.

3.7 References

1. Janssen I, Leblanc AG. Systematic review of the health benefits of physical activity and fitness in school-aged children and youth. *Int J Behav Nutr Phys Act*. 2010;7:40-5868-7-40.

2. Tremblay MS, Shields M, Laviolette M, Craig CL, Janssen I, Connor Gorber S. Fitness of Canadian children and youth: Results from the 2007-2009 Canadian health measures survey. *Health Rep.* 2010;21(1):7-20.

 Tomkinson G, Annandale M, Ferrar K. Global changes in cardiovascular endurance of children and youth since 1964: Systematic analysis of 25 million fitness test results from 28 countries [abstract]. *Circulation*. 2013;128(A13498).

4. Colley RC, Garriguet D, Janssen I, Craig CL, Clarke J, Tremblay MS. Physical activity of Canadian children and youth: Accelerometer results from the 2007 to 2009 Canadian health measures survey. *Health Rep.* 2011;22(1):15-23.

5. Belanger M, Gray-Donald K, O'Loughlin J, et al. Participation in organised sports does not slow declines in physical activity during adolescence. *Int J Behav Nutr Phys Act*. 2009;6:22-5868-6-22.

6. Eime RM, Young JA, Harvey JT, Charity MJ, Payne WR. A systematic review of the psychological and social benefits of participation in sport for children and adolescents: Informing development of a conceptual model of health through sport. *Int J Behav Nutr Phys Act*. 2013;10:98-5868-10-98.

7. Vella SA, Cliff DP, Okely AD, Scully ML, Morley BC. Associations between sports participation, adiposity and obesity-related health behaviors in Australian adolescents. *Int J Behav Nutr Phys Act.* 2013;10:113-5868-10-113.

8. Kwan M, Bobko S, Faulkner G, Donnelly P, Cairney J. Sport participation and alcohol and illicit drug use in adolescents and young adults: A systematic review of longitudinal studies. *Addict Behav.* 2014;39(3):497-506.

9. Lisha NE, Sussman S. Relationship of high school and college sports participation with alcohol, tobacco, and illicit drug use: A review. *Addict Behav.* 2010;35(5):399-407.

10. Donnelly P, Darnell S, Wells S, Coakley J. The use of sport to foster child and youth development and education. In: Kidd B, Donnelly P, eds. *The benefits of sport in international development: Five literature reviews*. Geneva, Switzerland: International Working Group for Sport, Development and Peace; 2007:7-47.

11. Taliaferro LA, Rienzo BA, Donovan KA. Relationships between youth sport participation and selected health risk behaviors from 1999 to 2007. *J Sch Health*. 2010;80(8):399-410.

12. Jose KA, Blizzard L, Dwyer T, McKercher C, Venn AJ. Childhood and adolescent predictors of leisure time physical activity during the transition from adolescence to adulthood: A population based cohort study. *Int J Behav Nutr Phys Act.* 2011;8:54-5868-8-54.

13. Kjonniksen L, Anderssen N, Wold B. Organized youth sport as a predictor of physical activity in adulthood. *Scand J Med Sci Sports*. 2009;19(5):646-654.

14. Tammelin T, Nayha S, Hills AP, Jarvelin MR. Adolescent participation in sports and adult physical activity. *Am J Prev Med*. 2003;24(1):22-28.

15. UNICEF. Child poverty in perspective: An overview of child well-being in rich countries. In: *Innocenti report card 7.* Florence: UNICEF Innocenti Research Centre; 2007. Available at: http://eprints.whiterose.ac.uk/73187/1/Document.pdf. Accessed 2014-03-10.

16. Levin KA, Dallago L, Currie C. The association between adolescent life satisfaction, family structure, family affluence and gender differences in parent-child communication. *Social Indicators Research*. 2012;106(2):287-305.

 Jablonska B, Lindberg L. Risk behaviours, victimisation and mental distress among adolescents in different family structures. *Soc Psychiatry Psychiatr Epidemiol*. 2007;42(8):656-663.

18. Bramlett MD, Blumberg SJ. Family structure and children's physical and mental health. *Health Aff (Millwood)*. 2007;26(2):549-558.

 Bjarnason T, Bendtsen P, Borup I, et al. Life satisfaction among children in different family structures: A comparative study of 36 western countries. *Children & Society*. 2012;26(1):51-62.
 Hesketh K, Crawford D, Salmon J, Jackson M, Campbell K. Associations between family circumstance and weight status of Australian children. *Int J Pediatr Obes*. 2007;2(2):86-96.

21. Canadian Heritage. Sport participation 2010. Ottawa: Government of Canada. 2013. Available at: <u>http://publications.gc.ca/site/archivee-</u>

archived.html?url=http://publications.gc.ca/collections/collection_2013/pc-ch/CH24-1-2012eng.pdf. Accessed 2013-07-10.

22. Gorely T, Atkin AJ, Biddle SJ, Marshall SJ. Family circumstance, sedentary behaviour and physical activity in adolescents living in England: Project STIL. *Int J Behav Nutr Phys Act*. 2009;6:33-5868-6-33.

23. Toftegaard-Stockel J, Nielsen GA, Ibsen B, Andersen LB. Parental, socio and cultural factors associated with adolescents' sports participation in four Danish municipalities. *Scand J Med Sci Sports*. 2011;21(4):606-611.

24. Eime RM, Harvey JT, Brown WJ, Payne WR. Does sports club participation contribute to health-related quality of life? *Med Sci Sports Exerc*. 2010;42(5):1022-1028.

25. O'Loughlin J, Paradis G, Kishchuk N, Barnett T, Renaud L. Prevalence and correlates of physical activity behaviors among elementary schoolchildren in multiethnic, low income, innercity neighborhoods in Montreal, Canada. *Ann Epidemiol*. 1999;9(7):397-407. 26. Thomson E, McLanahan SS. Reflections on "family structure and child well-being: Economic resources vs. parental socialization". *Soc Forces*. 2012;91(1):45-53.

27. Blackwell DL. Family structure and children's health in the United States: Findings from the national health interview survey, 2001-2007. *Vital Health Stat 10*. 2010;(246)(246):1-166.
28. Jablonska B, Lindberg L. Risk behaviours, victimisation and mental distress among adolescents in different family structures. *Soc Psychiatry Psychiatr Epidemiol*. 2007;42(8):656-663.

29. Bauserman R. Child adjustment in joint-custody versus sole-custody arrangements: A metaanalytic review. *J Fam Psychol*. 2002;16(1):91-102.

30. Statistics Canada. Income of Canadians, 2010. Available at: <u>http://www.statcan.gc.ca/daily-</u> <u>quotidien/120618/dq120618b-eng.htm</u>. Updated 2012. Accessed 2014-06-26.

31. Musick K, Meier A. Are both parents always better than one? parental conflict and young adult well-being. *Soc Sci Res.* 2010;39(5):814-830.

32. Canadian Fitness and Lifestyle Research Institute. 2011-12 CANPLAY. Bulletin 2:

Participation in organized physical activity and sport. 2013. Available at:

http://www.cflri.ca/media/node/1013/charts/Bulletin%204%20-

<u>%20Organized%20sports%20ENG.pdf</u>. Accessed 2014-07-23.

33. Human Resources and Skills Development Canada. Canadians in context - households and families. Available at: <u>http://www4.hrsdc.gc.ca/.3ndic.1t.4r@-eng.jsp?iid=37</u>. Updated 2013-06-

05. Accessed 2013-06-05.

34. Freeman JG, King M, Pickett W, et al. The health of Canada's young people: A mental health focus. 2011. Available at: http://www.phac-aspc.gc.ca/hp-ps/dca-dea/prog-ini/school-scolaire/behaviour-comportements/publications/hcyp-sjc-eng.php. Accessed 2013-06-25.
35. Quarmby T, Dagkas S, Bridge M. Associations between children's physical activities, sedentary behaviours and family structure: A sequential mixed methods approach. *Health Educ Res.* 2011;26(1):63-76.

36. Jorgensen A, Pedersen TP, Meilstrup CR, Rasmussen M. The influence of family structure on breakfast habits among adolescents. *Dan Med Bull.* 2011;58(5):A4262.

37. Brener ND, Collins JL, Kann L, Warren CW, Williams BI. Reliability of the youth risk behavior survey questionnaire. *Am J Epidemiol*. 1995;141(6):575-580.

38. Kukaswadia A, Pickett W, Janssen I. Time since immigration and ethnicity as predictors of physical activity among Canadian youth: A cross-sectional study. *PLoS One*. 2014;9(2):e89509.

39. Currie CE, Elton RA, Todd J, Platt S. Indicators of socioeconomic status for adolescents: The

WHO Health Behaviour in School-aged Children survey. Health Educ Res. 1997;12(3):385-397.

40. Currie C, Molcho M, Boyce W, Holstein B, Torsheim T, Richter M. Researching health inequalities in adolescents: The development of the Health Behaviour in School-aged Children (HBSC) family affluence scale. *Soc Sci Med.* 2008;66(6):1429-1436.

41. Boyce W, Torsheim T, Currie C, Zambon A. The family affluence scale as a measure of national wealth: Validation of an adolescent self-reported measure. *Social Indicators Research*,.
2006;78(3).

42. Sallis JF, Prochaska JJ, Taylor WC, Hill JO, Geraci JC. Correlates of physical activity in a national sample of girls and boys in grades 4 through 12. *Health Psychol*. 1999;18(4):410-415.
43. Eime RM, Harvey JT, Craike MJ, Symons CM, Payne WR. Family support and ease of access

link socio-economic status and sports club membership in adolescent girls: A mediation study. *Int J Behav Nutr Phys Act*. 2013;10:50-5868-10-50.

44. Eccles JS, Harold RD. Gender differences in sport involvement: Applying the eccles' expectancy-value model. *Journal of Applied Sport Psychology*. 1991;3(1):7-35.

45. Hayes AF. Beyond Baron and Kenny: Statistical mediation analysis in the new millennium. *Communication Monographs*. 2009;76(4):408-420.

46. Hayes AF. Introduction to mediation, moderation, and conditional process analysis: A regression-based approach. New York: Guilford Press; 2013.

47. Iacobucci D. Mediation analysis and categorical variables: The final frontier. *Journal of Consumer Psychology*. 2012;22:582-594.

48. Rothman KJ, Greenland S, Lash TL, Ovid Technologies I. Modern epidemiology. 3rd ed.

Philadelphia: Wolters Kluwer Health/Lippincott Williams & Wilkins; 2008. Available at:

https://library.sso.queensu.ca/vwebv/holdingsInfo?bibId=3131634. Accessed 2014-07-13.

49. Carson V, Iannotti RJ, Pickett W, Janssen I. Urban and rural differences in sedentary behavior among American and Canadian youth. *Health Place*. 2011;17(4):920-928.

50. McMunn AM, Nazroo JY, Marmot MG, Boreham R, Goodman R. Children's emotional and behavioural well-being and the family environment: Findings from the health survey for England. *Soc Sci Med.* 2001;53(4):423-440.

51. Thomson E, McLanaha SS, Curtin RB. Family structure, gender and parental socialization. *Journal of marriage and the family*. 1992;54(2):368-378.

52. Astone NM, McLanaha SS. Family structure, parental practices and high school completion. *American Sociological Review*. 1991;56(3):309-320.

53. Tillman KH. Family structure pathways and academic disadvantage among adolescents in stepfamilies. *Sociological Inquiry*. 2007;77(383):424.

54. *Health Behaviour in School-aged Children: A world-health organization cross-national study. research protocol for the 2009/2010 survey.* Vienna & Edinburgh: Ludwig-Boltzmann Institute Health Promotion Research & Child & Adolescent Health Research Unit; 2010.

55. Seltzer JA. Father by law: Effects of joint legal custody on nonresident fathers' involvement with children. *Demography*. 1998;35(2):135-146.

56. Bartfield J. Child support and the postdivorce economic well-being of mothers, fathers, and children. *Demography*. 2000;37(2):203-213.

57. von Tigerstrom B, Larre T, Sauder J. Using the tax system to promote physical activity:

Critical analysis of Canadian initiatives. Am J Public Health. 2011;101(8):e10-6.

58. Spence JC, Holt NL, Dutove JK, Carson V. Uptake and effectiveness of the children's fitness

tax credit in Canada: The rich get richer. BMC Public Health. 2010;10:356-2458-10-356.

59. Zhao Z, Lynch JG, Chen Q. Reconsidering Baron and Kenny: Myths and truths about

mediation analysis. Journal of Consumer Research, Inc. 2010;37:197-206.

Variable	N	0/ (0 5 0/ CI)*
	IN	70 (95% CI)"
Gender	10 157	
Male	10 15/	4/.8 (46.2, 49.4)
Female	11 044	52.2 (50.6, 53.8)
Grade	• •	
Grade 5	39	0.2 (0.0, 0.5)
Grade 6	3 950	18.4 (15.0, 21.7)
Grade 7	4 113	19.5 (17.0, 21.9)
Grade 8	4 348	20.8 (18.2, 23.4)
Grade 9	4 477	21.2 (17.9, 24.5)
Grade 10	4 152	19.5 (16.1, 22.8)
Grade 11	122	0.5 (0.3, 0.7)
Self-Perceived Family Affluence		
Very well off	4 940	23.4 (22.2, 24.5)
Quite well off	6 889	34.2 (32.8, 35.5)
Average	7 409	33.4 (32.1, 34.8)
Not very well off	1 380	6.7 (6.1, 7.4)
Not at all well off	583	2.3 (2.0, 2.6)
Immigrant Status		
Lived in Canada ≥ 5 years	20 335	95.6 (94.7, 96.5)
Lived in Canada <5 years	866	4.4 (3.5, 5.3)
Parental Structure		
Traditional family	14 930	71.0 (69.6, 72.4)
Reconstituted with irregular visitation	1 586	7.1 (6.5, 7.7)
Reconstituted with regular visitation	607	3.0 (2.6, 3.3)
Single parent with irregular visitation	3 184	14.3 (13.4, 15.3)
Single parent with regular visitation	894	4.5 (4.1, 5.0)
Siblings		
>1 sibling	18 171	86.9 (86.1, 87.7)
Only child	3 030	13.1 (12.3, 13.9)
Ethnicity		
Canadian	17 149	76.4 (73.0, 79.9)
East and Southeast Asian	1 102	5.9 (4.1, 7.7)
South Asian	561	3.3(2.2, 4.4)
Black	347	2.3 (1.7, 2.9)
Arab	179	1.2 (0.7, 1.7)
Latin American	160	0.9(0.6, 1.3)
Other	1 916	9.9 (8.9, 10.9)
Participation in Sports Club or Team		(,)
No	9 298	44.9 (43.0, 46.7)
Yes	11 903	55.1 (53.3, 57.0)

Table 3.1. Baseline characteristics of participants from the 2009/10 Canadian HBSC

N = Number of sampled individuals with complete valid data for all variables presented. *Estimated population characteristics after adjusting for sampling weights and clustering by classroom, school and province.

Family Structure	% Participate in Organized Sports (95% confidence interval)*
Boys	
Traditional	59.3 (57.0, 61.5)
Reconstituted with irregular visitation	41.1 (35.8, 46.4)
Reconstituted with regular visitation	53.4 (46.2, 60.7)
Single parent with irregular visitation	44.9 (41.2, 48.6)
Single parent with regular visitation	50.9 (44.2, 57.6)
Girls	
Traditional	53.6 (51.3, 55.8)
Reconstituted with irregular visitation	38.8 (33.9, 43.6)
Reconstituted with regular visitation	44.2 (38.1, 50.2)
Single parent with irregular visitation	36.6 (32.9, 40.3)
Single parent with regular visitation	46 2 (40 2 52 1)

Table 3.2. Sports participation by family structure

Single parent with regular visitation46.2 (40.2, 52.1)All analyses were adjusted for sample weights and clustering by classroom, school and province.Proportions with 95% confidence intervals not overlapping those of traditional families are shown in bold.

Family Structure	Regression Coefficient (Standard Error)*		
	Boys	Girls	
Traditional	0 (referent)	0 (referent)	
Reconstituted with irregular visitation	-0.31 (0.05)	-0.37 (0.05)	
Reconstituted with regular visitation	-0.21 (0.07)	-0.18 (0.07)	
Single parent with irregular visitation	-0.44 (0.05)	-0.49 (0.04)	
Single parent with regular visitation	-0.33 (0.06)	-0.37 (0.05)	

Table 3.3. Association between family structure and self-reported family affluence

All analyses were adjusted for sample weights and clustering by classroom, school and province, as well as the following covariates: number of siblings, immigration status, ethnicity, and grade. *All relationships were significant ($p \le 0.01$)

Table 3.4. Results of the analyses examining the association between family structure and organized sports participation and the extent to which this was mediated by self-reported family affluence.

	Total Association*	Direct Association [†]	Direct Association [†]	
Family Structure	Odds Ratio (95% confidence interval)	Odds Ratio (95% confidence interval)	% Change [§]	Point estimate (Percentile 95% CI)
Boys (N = 10 157)				
Traditional	1.00 (referent)	1.00 (referent)	-	0 (referent)
Reconstituted with irregular visitation	0.48 (0.38, 0.61)	0.51 (0.40 0.64)	4.4	-0.05 (-0.08, -0.03)
Reconstituted with regular visitation	0.78 (0.56, 1.08)	0.80 (0.58, 1.11)	11.7	-0.03 (-0.06, -0.01)
Single parent with irregular visitation	0.58 (0.49, 0.69)	0.62 (0.53, 0.73)	10.0	-0.07 (-0.10, -0.04)
Single parent with regular visitation	0.73 (0.56, 0.95)	0.77 (0.59, 1.00)	14.4	-0.05 (-0.08, -0.03)
Girls (N = 11 044)				
Traditional	1.00 (referent)	1.00 (referent)	-	0 (referent)
Reconstituted with irregular visitation	0.53 (0.43, 0.66)	0.57 (0.46, 0.70)	7.1	-0.06 (-0.09, -0.04)
Reconstituted with regular visitation	0.63 (0.48, 0.81)	0.64 (0.50, 0.83)	4.5	-0.03 (-0.06, -0.01)
Single parent with irregular visitation	0.54 (0.46, 0.63)	0.58 (0.49, 0.69)	9.5	-0.08 (-0.11, -0.05)
Single parent with regular visitation	0.72 (0.56, 0.93)	0.77 (0.59, 0.99)	16.5	-0.06 (-0.09, -0.04)

All analyses were adjusted for sample weights and clustering by classroom, school and province.

*Adjusted for number of siblings, immigration status, ethnicity, and grade.

[†]Adjusted for number of siblings, immigration status, ethnicity, grade, and self-perceived family wealth.

[§] Percentage change in the odds ratio from Total Effect to Direct Effect model (i.e., prior to and after controlling self-perceived family wealth).

Calculated as: $(OR_{unadjusted for wealth} - OR_{adjusted for wealth})/(OR_{unadjusted for wealth} - 1)$



Figure 3.1. Flow chart of inclusion information for participants for self-reported family affluence analyses.



Figure 3.2. The direct effect and indirect effect of family structure on sports participation, considering family affluence as a mediator.

Chapter 4

Family structure as a predictor of screen time behaviour in Canadian youth

4.1 Abstract

INTRODUCTION: The family plays a central role in the development of health-related behaviours in children. The typical family structure is becoming increasingly diverse in Canada, with 32% of Canadian youth now living in single parent or reconstituted stepfamilies. The objective of this study is to determine whether non-traditional parental structure and shared custody arrangements predict how much time youth spend watching television, using a computer recreationally and playing video games.

METHODS: Participants were a nationally representative sample of Canadian youth (N=26 068, response rate: 77%) aged 11-16 who participated in the Canadian Health Behaviour in Schoolaged Children Survey (2009/10). Weekly screen time in youth from single parent and reconstituted families, with or without regular visitation with their non-residential parent, was compared to that of youth from traditional dual-parent families. Multiple imputation was used to account for missing data.

RESULTS: After multiple imputation, youth from non-traditional families had similar odds of spending more than 2 hours per day watching television, using a computer recreationally or playing video games than those from traditional dual-parent families. They also had similar odds of being in the highest quartile of weekly time spent in any of these screen-based behaviours. CONCLUSION: Parental structure and child custody arrangements do not appear to have a meaningful impact on screen time behaviour in Canadian youth. These results suggest that youth from non-traditional families do not need to be targeted as a high-risk group in future interventions aiming to reduce screen time.

4.2 Introduction

Sedentary activities, including screen time behaviours such as watching television, using a computer and playing video games, have become ubiquitous in the lives of many young people. In Canada, fewer than 1 in 5 youth aged 10-16 meet the public health recommendation to limit their total recreational screen time to 2 hours or less per day.¹ This is concerning given a recent systematic review² that concluded that excessive screen time in youth is independently associated with several physical, mental, and social health problems such as obesity, metabolic syndrome, decreased academic achievement and antisocial behaviour. Understanding the determinants of youth sedentary behaviour is therefore a public health priority.

One such determinant of youth sedentary behaviour may be family structure, which is also associated with a wide range of behavioural, developmental and health-related outcomes.³⁻⁹ Single parent families and reconstituted families (i.e. families headed by a parent and their partner) are more likely to be of low socioeconomic status than traditional families.⁶ Furthermore, single parents may face time constraints that limit their ability to monitor or co-participate in their children's health-related behaviours.^{7,10} Approximately 68% of Canadian youth aged 11-15 live with both of their parents, while 32% have a non-traditional family structure.¹

Qualitative studies have suggested that the financial and time constraint challenges experienced by non-traditional families create environments that are conducive to excessive screen time. ¹⁰⁻¹³ Quantitative studies have, however, produced inconsistent results: some studies report that youth from non-traditional families accumulate more screen time, ^{11,14,15} while others show that the relationship holds only for girls ¹⁶⁻¹⁸ or boys ¹⁹ and still other studies show null results. ^{20,21} A major limitation of the quantitative studies is that they did not consider the diversity of modern families. The majority defined parental family structure as simply single- or dual-parent,

therefore overlooking potential differences between traditional dual-parent families and reconstituted dual-parent families that include a stepparent or parent's partner. ^{6,7} No studies have looked at how shared custody arrangements, which may involve the youth visiting or living with a non-residential parent, affect screen time. This is of interest given that spending time with a non-residential parent may negate some of the negative health outcomes related to being from a single parent family. ^{4,5,22}

The purpose of this study is to examine whether family structure, determined based on the number of adults in the home and their relationship to the young person, is associated with screen time. This study will also consider whether regular contact with a non-residential parent influences this relationship. Ultimately, it is hoped that this research will contribute to our understanding of how these negative health behaviours develop and assist in identifying high-risk youth for targeted interventions.

4.3 Methods

Study design and population:

Study data are based on the nationally representative cross-sectional 2009/2010 Canadian Health Behaviour in School-aged Children Survey (HBSC). The HBSC is conducted every 4 years in 43 countries in collaboration with the World Health Organization.¹⁰ This study is limited to the Canadian data. The HBSC consists of a standardized self-report survey filled out in a classroom setting, with the goal of determining the prevalence and distribution of a wide range of psychological, social and physical determinants of health in adolescents. All items in the HBSC study are continuously developed, piloted, and validated by the HBSC international network.¹⁰ The 2009/2010 Canadian HBSC had a 77% response rate. The final sample consisted of 26 068 students in grades 6-10 (approximate ages 11-15 years) from 436 public schools across Canada. All provinces and territories participated, with the exceptions of New Brunswick and Prince Edward Island. The provincial samples were obtained using a two-tiered cluster-sampling procedure to sample entire classrooms for participation; all students living in the three territories were invited to participate if they met the study inclusion criteria to ensure adequate representation. Students attending private, on-reserve, special needs or home-based schools were excluded, as were those who were absent from school on the day of the survey.

Exposure (Family structure):

Information on family structure was derived from two questions on the HBSC. The first asked participants to check off the adults who live in the home *"where [they] live all or most of the time"* from a list of choices including mother, father, stepmother (or father's girlfriend) and stepfather (or mother's boyfriend). The second asked participants to indicate whether they had a second home and, if they did, to identify how often they stayed there (*"half the time"*, *"regularly but less than half the time"*, *"sometimes"* or *"hardly ever"*). Families were defined as traditional (includes both a mother and a father), single parent (includes either a mother or a father), or reconstituted (includes either a mother or a father and either a stepmother/father's girlfriend or stepfather/mother's boyfriend), based on previous literature. ^{10,23,24} Adolescents from non-traditional families were further defined as having "regular visitation" with a second parent if they had a second home and reported visiting it *"half the time"* or *"regularly but less than half the time"* and "irregular visitation" if the adolescent reported not having a second home, or having a second home but visiting it *"sometimes"* or *"hardly ever"*. Youths who reported that neither their mother nor their father lived in their primary home constituted ~4% of the sample and were excluded from the analysis. ¹

Outcome (Screen time):

Information on the three screen time behaviours of interest was obtained by asking participants to report how many hours on a typical weekday and weekend day they usually "*watch television*

(including videos and DVDs)", "play games on a computer or games console (Playstation, Xbox, Gamecube, etc" or "use a computer for chatting on-line, internet, emailing, homework, etc" in their free time. For each question there were 9 ordinal response options, ranging from "none at all" to "about 7 or more hours a day". As done in previous studies, ²⁵ a weighted average of weekly time spent in each screen time behaviour was calculated by multiplying the amount spent in each activity on weekdays by 5 and that spent on weekends by 2 and dividing that number by 7. A validation study of a similar questionnaire measuring weekly television use in adolescents showed that participants' responses were significantly correlated (r=0.47) with television viewing time as measured using a detailed 7-day log.²⁶ For the purposes of logistic regression, screen time behaviour could be compared to those in the lower three quartiles. Separate analyses were performed comparing those who spent >2 hours in each screen time behaviour to those who spent \leq 2 hours, as has been done previously.^{17,20,21}

Potential covariates:

Potential covariates of the relationship between family structure and screen time were selected based on previous literature and their availability within the HBSC. These included gender, grade, ethnicity (Canadian, which includes those who self-identify as both Caucasian and Aboriginal ethnicity, East and Southeast Asian, South Asian, Black, Arab, or other, which includes those of mixed ethnicity and those who self-identify as other), ²⁷ immigration status (non-immigrant/immigrated >5 years ago or immigrated \leq 5 years ago), presence of siblings (yes or no), and family affluence. Family affluence was measured through a self-report item on the HBSC that asked students to report *"how well off [they] think [their] family is"*, with five ordinal responses ranging from "*not at all well off*" to "*very well off*". The top and bottom two responses were combined to create a three-level ordinal measure of perceived family affluence.

Statistical analysis:

All analyses used survey procedures in SAS 9.4 to account for the complex sampling design used by the HBSC, including clustering at the classroom and provincial levels and sampling weights. All analyses were stratified by gender as it has been shown previously that screen time behaviours differ by gender.²⁸ The HBSC sample population was characterized using simple descriptive statistics. Cross-tabulations of the average amount of time spent in each screen time behaviour by family structure were calculated, and differences between family structures were assessed using analysis of covariance after adjusting for relevant confounders. A Bonferroni correction was used to account for multiple comparisons.

Multiple logistic regression was used to further quantify associations between family structure and screen time behaviour. Final covariate selection for the multivariate models was performed through backwards deletion using a 10% change-in-estimate threshold.²⁹ If a covariate significantly changed the regression coefficient of at least one non-traditional family structure in at least one of the models, it was included in all final models. All covariates of interest met this criterion.

Approximately 15% of participants were missing data for at least one relevant exposure, outcome or covariate. Because we were concerned that this would bias our results, we performed two forms of multiple imputation for the missing data, one based on fully conditional specification ³⁰ and the other based on the use of Monte Carlo Markov Chains ³¹ (see Appendix F for a discussion of the importance of imputation and a description of these imputation methods). Because the two imputation methods produced consistent and similar results, only the results from the fully conditional specification-based imputation are shown in the manuscript (see Appendix F for a comparison of the results based on full case-analysis and the two imputation methods). This

method was considered more appropriate for the imputation of categorical data because it does not assume normality of imputed variables. ³²⁻³⁴

4.4 Results

Sample characteristics:

Demographic characteristics of the sample are in Table 4.1. The majority of participants had lived in Canada for more than 5 years (94.4%), were of Canadian (Caucasian or Aboriginal) ethnicity (75.3%), and considered themselves to be of higher than average socioeconomic status (53.7%). Most participants lived in traditional, dual-parent families (65.0%), followed by single parent families with irregular visitation with their non-custodial parent (13.4%), reconstituted families with irregular visitation (6.6%), single parent families with regular visitation (4.2%) and finally reconstituted families with regular visitation (2.7%). Most participants exceeded Canada's recreational screen time guidelines, with 80.6% reporting that they spent a cumulative total of more than 2 hours per day watching television, playing video games and using a computer. The average weekly screen time was 59.4 hours in boys and 53.4 hours in girls (see Table 4.2). *Relationships between family structure and screen time:*

Youth from non-traditional families had slightly higher screen time values than youth from traditional families, although few differences were statistically significant and even the significant differences were small in magnitude (e.g., <5 hours/week difference between the mean screen time in the non-traditional group and the traditional group's means of 52 hours/week in boys and 46 hours/week in girls) (see Table 4.2).

Tables 4.3 to 4.6 show odds ratios for being in the highest quartile of weekly screen time by family structure, with traditional families serving as the referent group. Statistically significant (p < 0.05, after Bonferroni correction) relationships are shown in bold. There were several significant relationships in the bivariate analyses. However, these significant relationships were

weak in strength (i.e., odds ratios <1.25) and were not consistent across gender or the three screen time behaviours; these relationships were no longer significant after controlling for the confounding variables.

The associations between family structure and screen time did not change in a meaningful way when the definition of elevated screen time was changed from being in the highest quartile of screen usage to exceeding a 2 hour/day threshold (Tables 5.15 to 5.18 in Appendix I). The associations also did not change based on the choice of imputation methods. The relationships observed in the imputed data were, however, different from those estimated using a full case analysis in which observations with missing data were simply deleted (see Table 5.5 in Appendix F). For example, the odds ratios for boys from single parent families being in the highest quartile of video game usage were significant in the full case analysis (OR 1.40, 95% CI: 1.22-1.60 for those with irregular visitation and OR 1.48, 95% CI: 1.05-2.09 for those with regular visitation), indicating that boys from single parent families watched more television than those from traditional families regardless of visitation. However, these odds ratios were not found to be significant when using either of the imputation models to reduce biases resulting from missing data (OR 1.13, 95% CI: 0.96-1.34 and OR 1.17, 95% CI: 0.91-1.51, respectively).

4.5 Discussion

The goal of this study was to examine non-traditional family structures — specifically single parent or reconstituted families, as well as shared custody arrangements — as potential predictors of excessive screen time in youth. While youth from non-traditional families did spend slightly more hours per week in total screen time, these differences were subtle (<15%) and generally not statistically significant. Youth from non-traditional families were also not more likely to exceed screen time guidelines or be in the highest quartile of weekly television, video game or computer use after controlling for relevant covariates.

Our findings were consistent with previous quantitative studies of television viewing in youth, which have generally shown null results or subtle or insignificant increases in television-viewing in youth from single parent families ^{14,16,18,19,21,35} and youth from reconstituted families. ^{11,17} Only one previous study ¹⁹ has looked at the influence of family structure on screen behaviours other than television, arguing that it is important to look at different screen time behaviours separately. While we did observe descriptive differences in the amount of time spent playing video games and using a computer by gender, we did not observe any meaningful interactions between gender and family structure.

This study was the first to our knowledge to consider visitation with the non-residential parent as a potential predictor of differences in screen time behaviour. It has been suggested that youth who regularly travel to visit another parent may have less time to do anything but sedentary activities.¹¹ Our research did not support this argument, showing no consistent differences in screen time based on visitation with the non-custodial parent. This is consistent with previous studies that have suggested that children in the shared physical custody of their separated parents experience similar emotional well-being to those who live in a traditional family.^{4,5,22} It has been hypothesized that time and energy constraints experienced by single parents in particular may create environments that encourage sedentary behaviour in their children.^{10-13,43} Our research does not support that argument. Screen time, and particularly time spent watching television, was high in all family structure groups and not just among youth from single parent homes. Therefore, while interventions to decrease screen time in youth are necessary, these interventions likely do not need to target youth in non-traditional family structures as a high risk group.

A strength of this study is its large sample size, which allowed us to delineate diverse family structures in our analyses. Furthermore, the findings are generalizable as they are based on a

nationally representative sample. Another strength was the use of multiple imputation to handle missing data in partially completed surveys, which is a common concern when analyzing survey data.³⁶ In our study ~15% of observations had data missing for at least one variable. Multiple imputation avoids the assumption that the associations observed between screen time and family structure are the same among those who answered all questions and those who did not.³⁶ The fact that the results from the imputed analyses were somewhat different from those based on full cases suggests that we would have biased some of the effect estimates had we not used imputation. This has implications for future studies with HBSC and other youth survey data.

Our study also had important weaknesses. Several potential covariates and mediators were not available in the dataset, such as family co-participation in screen time behaviours, parental employment status, parental modeling, and house rules related to screen time. We were also unable to determine how long participants had been in their current family structure. All of the variables used were based on self-report, and were therefore subject to recall and/or social desirability bias. This may have been reduced by using an objective measure of sedentary behaviour such as accelerometry in combination with self-reported screen time, as done previously. ^{16,18,21} Finally, selection bias was a concern given that youth who did not provide consent or who were absent from school on the day of the survey may have been systematically different from those who did participate.

4.6 Conclusion

In summary, family structure was not a meaningful predictor of screen time in this large and representative sample of Canadian youth. Future research should focus on identifying further determinants of sedentary behaviour, and the mechanisms through which family structure influences other health behaviours and outcomes.

4.7 References

1. Freeman JG, King M, Pickett W, et al. The health of Canada's young people: A mental health focus. 2011. Available at: http://www.phac-aspc.gc.ca/hp-ps/dca-dea/prog-ini/school-scolaire/behaviour-comportements/publications/hcyp-sjc-eng.php. Accessed 2013-06-25.

2. Tremblay MS, LeBlanc AG, Kho ME, et al. Systematic review of sedentary behaviour and health indicators in school-aged children and youth. *Int J Behav Nutr Phys Act*. 2011;8:98-5868-8-98.

3. Amato PR. Children of divorce in the 1990s: An update of the Amato and Keith (1991) metaanalysis. *J Fam Psychol*. 2001;15(3):355-370.

4. Jablonska B, Lindberg L. Risk behaviours, victimisation and mental distress among adolescents in different family structures. *Soc Psychiatry Psychiatr Epidemiol*. 2007;42(8):656-663.

 Bjarnason T, Bendtsen P, Borup I, et al. Life satisfaction among children in different family structures: A comparative study of 36 western countries. *Children & Society*. 2012;26(1):51-62.
 Thomson E, McLanahan SS. Reflections on "family structure and child well-being: Economic resources vs. parental socialization". *Soc Forces*. 2012;91(1):45-53.

7. Blackwell DL. Family structure and children's health in the United States: Findings from the national health interview survey, 2001-2007. *Vital Health Stat 10*. 2010;(246)(246):1-166.

8. Bramlett MD, Blumberg SJ. Family structure and children's physical and mental health. *Health Aff (Millwood)*. 2007;26(2):549-558.

9. Hesketh K, Crawford D, Salmon J, Jackson M, Campbell K. Associations between family circumstance and weight status of Australian children. *Int J Pediatr Obes*. 2007;2(2):86-96.

10. Quarmby T, Dagkas S, Bridge M. Associations between children's physical activities, sedentary behaviours and family structure: A sequential mixed methods approach. *Health Educ Res.* 2011;26(1):63-76.

11. Quarmby T, Dagkas S. Children's engagement in leisure time physical activity: Exploring family structure as a determinant. *Leisure Studies*. 2010;29(1):53-66.

12. Quarmby T. Exploring the role of the family in the construction of young people's health discourses and dispositions. *Educational Review*. 2013;65(3):303-320.

13. Quarmby T, Dagkas S. Locating the place and meaning of physical activity in the lives of young people from low-income, lone-parent families. *Physical Education and Sport Pedagogy*. 2012;17(2):157-175.

14. Gorely T, Marshall SJ, Biddle SJ. Couch kids: Correlates of television viewing among youth. *Int J Behav Med.* 2004;11(3):152-163.

15. Lindquist CH, Reynolds KD, Goran MI. Sociocultural determinants of physical activity among children. *Prev Med.* 1999;29(4):305-312.

16. Hesketh K, Crawford D, Salmon J. Children's television viewing and objectively measured physical activity: Associations with family circumstance. *Int J Behav Nutr Phys Act*. 2006;3:36.
17. Sisson SB, Broyles ST. Social-ecological correlates of excessive TV viewing: Difference by

race and sex. J Phys Act Health. 2012;9(3):449-455.

18. Bagley S, Salmon J, Crawford D. Family structure and children's television viewing and physical activity. *Med Sci Sports Exerc*. 2006;38(5):910-918.

19. Gorely T, Atkin AJ, Biddle SJ, Marshall SJ. Family circumstance, sedentary behaviour and physical activity in adolescents living in England: Project STIL. *Int J Behav Nutr Phys Act*. 2009;6:33-5868-6-33.

20. Hardy LL, Baur LA, Garnett SP, et al. Family and home correlates of television viewing in 12-13 year old adolescents: The Nepean study. *Int J Behav Nutr Phys Act*. 2006;3:24.

21. Salmon J, Timperio A, Telford A, Carver A, Crawford D. Association of family environment with children's television viewing and with low level of physical activity. *Obes Res.*

2005;13(11):1939-1951.

22. Bauserman R. Child adjustment in joint-custody versus sole-custody arrangements: A metaanalytic review. *J Fam Psychol*. 2002;16(1):91-102.

23. Levin KA, Dallago L, Currie C. The association between adolescent life satisfaction, family structure, family affluence and gender differences in parent-child communication. *Social Indicators Research*. 2012;106(2):287-305.

24. Jorgensen A, Pedersen TP, Meilstrup CR, Rasmussen M. The influence of family structure on breakfast habits among adolescents. *Dan Med Bull*. 2011;58(5):A4262.

25. Carson V, Iannotti RJ, Pickett W, Janssen I. Urban and rural differences in sedentary behavior among American and Canadian youth. *Health Place*. 2011;17(4):920-928.

26. Schmitz KH, Harnack L, Fulton JE, et al. Reliability and validity of a brief questionnaire to assess television viewing and computer use by middle school children. *J Sch Health*. 2004;74(9):370-377.

27. Kukaswadia A, Pickett W, Janssen I. Time since immigration and ethnicity as predictors of physical activity among Canadian youth: A cross-sectional study. *PLoS One*. 2014;9(2):e89509.
28. Marshall SJ, Gorely T, Biddle SJ. A descriptive epidemiology of screen-based media use in youth: A review and critique. *J Adolesc*. 2006;29(3):333-349.

29. Rothman KJ, Greenland S, Lash TL, Ovid Technologies I. *Modern epidemiology*. 3rd ed. ed. Philadelphia: Wolters Kluwer Health/Lippincott Williams & Wilkins; 2008:x, 758 p. : ill. <u>https://library.sso.queensu.ca/vwebv/holdingsInfo?bibId=3131634</u>.

30. van Buuren S. Multiple imputation of discrete and continuous data by fully conditional specification. *Stat Methods Med Res.* 2007;16(3):219-242.

31. SAS Institute Inc. Proc mi statement. In: SAS user's guide. 2nd ed.; 2009.

32. Allison PD. Imputation of categorical variables with PROC MI (paper 113-30). In: *SUGI 30: Focus session*. Philadelphia, PA: SAS Institute Inc.; 2005.

33. Finch WH. Imputation methods for missing categorical questionnaire data: A comparison of approaches. *Journal of Data Science*. 2010;8:361-378.

34. Lee KJ, Carlin JB. Multiple imputation for missing data: Fully conditional specification versus multivariate normal imputation. *Am J Epidemiol*. 2010;171(5):624-632.

35. Salmon J, Dunstan D, Owen N. Should we be concerned about children spending extended periods of time in sedentary pursuits even among the highly active? *Int J Pediatr Obes*.

2008;3(2):66-68.

36. Berglund PA. An introduction to multiple imputation of complex survey data using SAS 9.2 (paper 265-2010). In: *SAS global forum 2010*. Ann Arbor, Michigan: SAS Institute Inc.; 2010.

37. Salmon J, Tremblay MS, Marshall SJ, Hume C. Health risks, correlates, and interventions to reduce sedentary behavior in young people. *Am J Prev Med.* 2011;41(2):197-206.

38. Owen N, Healy GN, Matthews CE, Dunstan DW. Too much sitting: The population health science of sedentary behavior. *Exerc Sport Sci Rev.* 2010;38(3):105-113.

39. Hamilton MT, Healy GN, Dunstan DW, Zderic TW, Owen N. Too little exercise and too much sitting: Inactivity physiology and the need for new recommendations on sedentary behavior. *Curr Cardiovasc Risk Rep.* 2008;2(4):292-298.

40. Katzmarzyk PT, Church TS, Craig CL, Bouchard C. Sitting time and mortality from all causes, cardiovascular disease, and cancer. *Med Sci Sports Exerc*. 2009;41(5):998-1005.

41. Koster A, Caserotti P, Patel KV, et al. Association of sedentary time with mortality
independent of moderate to vigorous physical activity. *PLoS One*. 2012;7(6):e37696.
42. Healy GN, Dunstan DW, Salmon J, Shaw JE, Zimmet PZ, Owen N. Television time and
continuous metabolic risk in physically active adults. *Med Sci Sports Exerc*. 2008;40(4):639-645.
43. Dagkas S, Stathi A. Exploring social and environmental factors affecting adolescents'
participation in physical activity. *European Physical Education Review*. 2007;13(3):369-384.

Characteristic	Ν	% (95% CI)*
Gender		
Male	12 878	49.1 (47.7-50.6)
Female	13 169	50.8 (49.4-52.3)
Missing	31	0.0 (0.0-0.1)
Grade		· · · · ·
Grade 5	55	0.25 (0.00-0.51)
Grade 6	5 1 1 0	19.6 (16.1-23.0)
Grade 7	5 205	20.0 (17.6-22.3)
Grade 8	5 266	20.2 (17.7-22.7)
Grade 9	5 395	20 7 (17 4-23 9)
Grade 10	4 871	18.8 (15.5-22.1)
Grade 11	176	0.55(0.37-0.73)
Missina	0	0.55 (0.57 0.75)
Salf-Parcaivad Family Affluance	0	0
	2411	90(84-96)
Average	8 5 8 1	31.7(30.4.33.0)
High	13 466	53.7(50.4-55.0)
Migging	1 620	55.7(52.1-55.2)
Missing Immigrant Status	1 020	5.0 (4.0-0.0)
Lived in Canada >5 years	24700	04 4 (02 4 05 2)
Lived in Canada ≤ 5 years	24709	94.4 (95.4-95.5)
Liveu III Callada >5 years	1 095	4.0(3.6-3.3)
Missing Deventel Staneture	270	1.0 (0.80-1.2)
Traditional family	16 504	(5.0) (62.6,66.5)
fractional family	10 304	03.0(03.0-00.3)
Single parent with regular visitation	997	4.2 (3.8-4.0)
Single parent with irregular visitation	3594	13.4 (12.6-14.2)
Reconstituted with regular visitation	662	2.7(2.4-3.0)
Reconstituted with irregular visitation	1 /44	6.6 (6.0-/.1)
Other	1 533	5.0 (4.5-5.5)
Missing	1 044	3.0 (2.6-3.5)
Siblings	2 505	
Only Child	3787	13.5 (12.7-14.3)
≥l sibling	21 253	83.2 (82.4-84.1)
Missing	1 038	3.3 (2.8-3.7)
Ethnicity		
Canadian	20 624	75.3 (71.8-78.7)
East and Southeast Asian	1 285	5.7 (4.0-7.3)
South Asian	656	3.2 (2.2-4.2)
Black	481	2.6 (1.9-3.3)
Arab	229	1.3 (0.7-1.8)
Latin American	191	0.9 (0.6-1.2)
Other	2 294	10.0 (9.0-11.0)
Missing	318	1.1 (0.9-1.3)
Television Viewing		
< 2 hrs/day	12 508	50.5 (49.0-51.9)

Table 4.1. Characteristics of the 2009/10 Canadian HBSC sample, without imputations

> 2 hrs/day	11 128	41.5 (40.0-43.1)
Missing	2 442	8.0 (7.1-8.9)
Video Game Use		
≤ 2 hrs/day	15 512	32.1 (30.9-33.2)
> 2 hrs/day	8 170	60.2 (58.7-61.8)
Missing	2 396	7.7 (6.8-8.6)
Computer Use		
≤ 2 hrs/day	8902	36.8 (35.3-38.3)
> 2 hrs/day	14 819	55.5 (53.8-57.2)
Missing	2 357	7.7 (6.8-8.5)
Total Screentime [₩]		
≤ 2 hrs/day	2 706	9.7 (8.8-10.5)
> 2 hrs/day	20 510	80.6 (79.6-81.7)
Missing	2 862	9.7 (8.7-10.6)

N = Number of sampled individuals with complete valid data for all variables presented.*Estimated population characteristics after adjusting for sampling weights and clustering by
classroom, school and province.

 $^{\psi}$ Total screentime is calculated as the sum of time spent watching television, playing video games and using a computer recreationally.

Table 4.2. Mean weekly hours of screen time (television, video games and computer) per parental structure with imputation, by gender, after controlling for covariates

Parental Structure	Ν	Television [¢]	Computer ^{\$}	Video Games [¢]	Total Screen time ^{φψ}
		Mean (95% CI)	Mean (95% CI)	Mean (95% CI)	Mean (95% CI)
Boys					
Traditional	8 699	20.2 (19.1-21.3)	15.1 (14.1-16.2)	16.8 (15.8-17.8)	52.1 (49.4-54.9)
Reconstituted with irregular visitation	784	21.7 (19.9-23.4)	16.9 (15.1-18.6)	18.6 (16.9-20.3)	57.1 (53.1-61.2)
Reconstituted with regular visitation	295	19.0 (16.5-21.5)	15.3 (13.0-17.6)	18.7 (16.3-21.1)	53.0 (47.6-58.4)
Single parent with irregular visitation	1 763	20.8 (19.4-22.1)	16.5 (15.2-17.8)	19.5 (18.2-20.7) *	56.8 (53.6-59.9) *
Single parent with regular visitation	494	21.8 (19.6-23.9)	17.2 (15.1-19.4)	20.3 (18.2-22.3) *	59.3 (54.0-64.6) *
Girls					
Traditional	8 774	19.0 (17.9-20.0)	17.6 (16.6-18.6)	9.7 (8.8-10.7)	46.3 (43.8-48.7)
Reconstituted with irregular visitation	988	20.1 (18.4-21.7)	18.4 (16.9-19.9)	10.4 (8.9-11.8)	48.8 (45.2-52.3)
Reconstituted with regular visitation	414	20.3 (18.2-22.4)	20.4 (18.2-22.6) *	11.2 (9.2-13.2)	51.9 (46.6-57.1)
Single parent with irregular visitation	1 860	20.7 (19.5-21.9) *	19.4 (18.3-20.5) *	11.0 (9.8-12.2)	51.1 (48.2-53.9) *
Single parent with regular visitation	581	19.5 (17.8-21.3)	19.2 (17.2-21.2)	11.2 (9.3-13.0)	49.9 (45.5-54.2)

N = Number of sampled individuals.

[•] Adjusted for sample weights and clustering by classroom, school and province as well as the following covariates: grade, immigration status (immigrated <5 years ago vs \geq 5 years ago), siblings (only child vs has siblings), ethnicity and self-reported family affluence (low, average or high) * Significantly different from traditional families after taking into account multiple comparisons (Bonferroni-adjusted p-value<0.05)

^wTotal screentime is calculated as the sum of time spent watching television, playing video games and using a computer recreationally.

Parental Structure	Frequency	Bivariate Analysis	Fully Adjusted ^{\$} Model
—	% (95% CI)	OR (95% CI)	OR (95% CI)
Boys			
Traditional	27.5 (25.5-29.5)	-	-
Reconstituted with irregular visitation	32.9 (27.8-38.0)	1.21 (0.99-1.49)	1.20 (0.98-1.49)
Reconstituted with regular visitation	20.6 (13.9-27.3)	0.64 (0.46-0.89)	0.66 (0.47-0.92)
Single parent with irregular visitation	31.9 (28.4-35.5)	1.16 (0.99-1.36)	1.11 (0.94-1.31)
Single parent with regular visitation	32.3 (25.7-38.9)	1.18 (0.91-1.53)	1.19 (0.91-1.55)
Girls			
Traditional	24.6 (22.8-26.4)	-	-
Reconstituted with irregular visitation	28.4 (24.1-32.6)	1.05 (0.88-1.26)	1.05 (0.88-1.26)
Reconstituted with regular visitation	28.6 (21.9-35.4)	1.07 (0.82-1.40)	1.12 (0.86-1.47)
Single parent with irregular visitation	31.3 (28.4-34.2)	1.21 (1.05-1.40)	1.14 (0.98-1.32)
Single parent with regular visitation	24.0 (18.9-29.1)	0.84 (0.66-1.07)	0.84 (0.66-1.06)

Table 4.3. Unadjusted and adjusted relationships with being in the highest quartile of television viewing with multiple imputation, by gender

All analyses account for sample weights and clustering by classroom, school and province. Statistically significant odds ratios are shown in bold (i.e., 95% confidence intervals do not cross through the null).

^{\bullet} Adjusted for the following covariates: grade, immigration status (immigrated <5 years ago vs \geq 5 years ago), siblings (only child vs has siblings), ethnicity and self-reported family affluence (low, average or high)

Parental Structure	Frequency	Bivariate Analysis	Fully Adjusted ^{\Phi} Model
—	% (95% CI)	OR (95% CI)	OR (95% CI)
Boys			
Traditional	20.3 (18.6-22.1)	-	-
Reconstituted with irregular visitation	26.4 (21.3-31.6)	1.12 (0.90-1.39)	1.07 (0.86-1.35)
Reconstituted with regular visitation	22.9 (15.6-30.2)	0.92 (0.66-1.29)	0.95 (0.68-1.33)
Single parent with irregular visitation	27.3 (24.1-30.5)	1.17 (0.98-1.38)	1.08 (0.91-1.29)
Single parent with regular visitation	25.2 (18.9-31.6)	1.05 (0.79-1.38)	1.14 (0.86-1.50)
Girls			
Traditional	27.5 (25.6-29.5)	-	-
Reconstituted with irregular visitation	33.4 (29.3-37.6)	1.08 (0.92-1.28)	1.02 (0.86-1.21)
Reconstituted with regular visitation	33.0 (26.6-39.5)	1.06 (0.85-1.34)	1.14 (0.90-1.45)
Single parent with irregular visitation	35.1 (31.5-38.8)	1.17 (1.02-1.34)	1.10 (0.95-1.26)
Single parent with regular visitation	29.6 (23.3-35.9)	0.91 (0.72-1.15)	0.93 (0.73-1.18)

Table 4.4. Unadjusted and adjusted relationships with being in the highest quartile of computer use with multiple imputation, by gender

All analyses account for sample weights and clustering by classroom, school and province. Statistically significant odds ratios are shown in bold (i.e., 95% confidence intervals do not cross through the null).

 \bullet Adjusted for the following covariates: grade, immigration status (immigrated <5 years ago vs \ge 5 years ago), siblings (only child vs has siblings), ethnicity and self-reported family affluence (low, average or high)

Parental Structure	Frequency	Bivariate Analysis	Fully Adjusted ⁶ Model
	% (95% CI)	OR (95% CI)	OR (95% CI)
Boys			
Traditional	33.1 (31.4-34.9)	-	-
Reconstituted with irregular visitation	39.1 (33.8-44.5)	1.00 (0.82-1.21)	0.97 (0.80-1.18)
Reconstituted with regular visitation	38.2 (30.1-46.3)	0.96 (0.73-1.26)	0.97 (0.74-1.28)
Single parent with irregular visitation	42.4 (39.1-45.6)	1.14 (0.97-1.34)	1.11 (0.94-1.31)
Single parent with regular visitation	43.4 (35.6-51.1)	1.19 (0.93-1.53)	1.18 (0.92-1.52)
Girls			
Traditional	15.1 (13.8-16.4)	-	-
Reconstituted with irregular visitation	16.6 (13.3-20.0)	0.95 (0.77-1.16)	0.92 (0.75-1.13)
Reconstituted with regular visitation	18.3 (13.2-23.4)	1.07 (0.80-1.41)	1.12 (0.84-1.49)
Single parent with irregular visitation	19.1 (16.2-22.0)	1.12 (0.94-1.34)	1.05 (0.88-1.26)
Single parent with regular visitation	17.9 (12.7-23.2)	1.04 (0.79-1.37)	1.06 (0.80-1.39)

Table 4.5. Unadjusted and adjusted relationships with being in the highest quartile of video game use with multiple imputation, by gender

All analyses account for sample weights and clustering by classroom, school and province. Statistically significant odds ratios are shown in bold (i.e., 95% confidence intervals do not cross through the null).

^{ϕ} Adjusted for the following covariates: grade, immigration status (immigrated <5 years ago vs \geq 5 years ago), siblings (only child vs has siblings), ethnicity and self-reported family affluence (low, average or high)

Parental Structure	Frequency	Bivariate Analysis	Fully Adjusted ^{\$} Model
	% (95% CI)	OR (95% CI)	OR (95% CI)
Boys			
Traditional	28.4 (26.3-30.6)	-	-
Reconstituted with irregular visitation	34.8 (29.6-40.0)	1.07 (0.88-1.30)	1.05 (0.86-1.28)
Reconstituted with regular visitation	29.2 (21.8-36.7)	0.83 (0.62-1.12)	0.85 (0.63-1.15)
Single parent with irregular visitation	37.8 (34.2-41.3)	1.22 (1.04-1.44)	1.15 (0.98-1.36)
Single parent with regular visitation	36.4 (29.3-43.5)	1.15 (0.90-1.47)	1.19 (0.92-1.52)
Girls			
Traditional	21.6 (19.8-23.4)	-	-
Reconstituted with irregular visitation	24.0 (19.8-28.1)	0.96 (0.81-1.15)	0.93 (0.78-1.11)
Reconstituted with regular visitation	26.7 (20.5-32.9)	1.11 (0.86-1.43)	1.19 (0.91-1.54)
Single parent with irregular visitation	27.7 (24.6-30.8)	1.17 (1.00-1.36)	1.08 (0.93-1.27)
Single parent with regular visitation	23.7 (18.2-29.3)	0.95 (0.74-1.22)	0.96 (0.75-1.23)

Table 4.6. Unadjusted and adjusted relationships with being in the highest quartile of total screen time* with multiple imputation, by gender

All analyses account for sample weights and clustering by classroom, school and province. Statistically significant odds ratios are shown in bold (i.e., 95% confidence intervals do not cross through the null).

^{ϕ} Adjusted for the following covariates: grade, immigration status (immigrated <5 years ago vs \geq 5 years ago), siblings (only child vs has siblings), ethnicity and self-reported family affluence (low, average or high)

*Total screentime is calculated as the sum of time spent watching television, playing video games and using a computer recreationally.

Chapter 5

General Discussion

5.1 Study Summary

The purpose of this thesis research was to explore whether family structure, including both parental structure and custody arrangements, is associated with organized sports participation and screen time among Canadian youth. A secondary objective was to assess whether socioeconomic status acts as a mediator on the causal pathway between family structure and organized sports participation. The results were based on cross-sectional data from a large, nationally representative survey of Canadian youth (N = 26 068, grades 6-10), which was analyzed using logistic regression and contemporary mediation analysis.

5.2 Summary of Major Findings

Overall, the youth in this study had significantly lower odds of participating in organized sport if they were from non-traditional families. This relationship was partially mediated by socioeconomic status. Their odds of participating in excessive screen-based behaviour did not differ significantly by family structure.

The first manuscript investigated the influence of parental structure and custody arrangements on organized sports participation. The odds of sports participation were consistently lower in both boys and girls from non-traditional families compared to those from traditional families, with odds ratio point estimates ranging from 0.48 to 0.78 before taking socioeconomic status into account. The odds ratios comparing youth from both single parent and reconstituted families to those from traditional families were similar in magnitude. Among youth from non-traditional

families, the odds of participation were generally higher in those who regularly visited a second parent living outside of their primary home.

Socioeconomic status was a significant mediator of the relationship between family structure and organized sports participation, although the magnitude of the mediation effect was weak to moderate. This makes sense given that socioeconomic status is likely only one of many mediating pathways through which family structure influences organized sports participation. Other plausible mediators on the causal pathway might include family dynamic, access to sports facilities, parental support of sports-related behaviours and availability of a co-parent to assist in transportation to and from organized sport activities.

The second manuscript found no significant association between family structure and televisionviewing, recreational computer use or video game use, which were high in all youth. Interestingly, when excluding participants with any missing information via full case analysis (described in more detail in Appendix F), boys from single parent families had significantly higher odds of being in the highest quartile of time spent playing video games (OR = 1.40, 95% CI: 1.22-1.60 for those with irregular visitation with a second parent and OR = 1.48, 95% CI: 1.05-2.09 with regular visitation). This association disappeared when multiple imputation was used to impute reasonable values for missing data, allowing all participants who provided incomplete information to be included. This suggests that excluding those with missing data would have created bias in our results, and has implications for future studies utilizing HBSC data.

There are several possible explanations for why family structure might influence organized sports participation but not screen-based behaviours in youth. Firstly, there is often a cost and parental time commitment associated with organized sport. Access to screen-based devices, on the other hand, has become ubiquitous in the majority of Canadian homes and requires little parental

involvement. This was reflected in our data, in that screen time was universally high in all of the family structure groups we examined. It is also important to note that the analyses differed between the two manuscripts. For example, Manuscript 2 utilized a conservative Bonferroni correction to account for multiple comparisons when looking at differences in total hours of weekly screen time (see Table 4.2), which may have contributed to the null results observed in this particular analysis. Furthermore, the two manuscripts conceptualized the HBSC item on selfreported family affluence differently (see Appendix B); Manuscript 1 treated it as a potential mediator with 5 ordinal categories, whereas Manuscript 2 treated it as a potential confounder with 3 ordinal response categories (see Manuscripts for further details). Finally, the two manuscripts used slightly different samples, and therefore may not be strictly comparable. This was because those who did not provide information on any relevant exposure, outcome or covariate (~15% of participants) were excluded from the organized sport analysis due to its computational complexity. Participants with incomplete data were, however, included in the screen-based behaviour analysis following multiple imputation of all relevant missing data. Excluding participants with missing data, as was done in the organized sport analysis, is known as full case analysis and is a common approach in the analysis of survey data. Both full case analysis and multiple imputation are discussed in greater detail in Appendix F.

5.3 Strengths

This thesis research has several strengths. The first is the use of a nationally representative sample of over 26 000 Canadian youth. This large sample size provided us with the power to use more detailed definitions of family structure than most previous studies in this area, including delineating traditional and reconstituted dual-parent families. Indeed, a key finding of this thesis was that youth from reconstituted families are more similar to those from single parent families in terms of their sports participation than they are to those from traditional families. Our study was

also the first to our knowledge to take into account custody arrangements when studying the link between family structure and activity-related behaviours in youth. The finding that regular visitation with a non-residential parent does not significantly influence organized sports participation or screen-based behaviour is therefore novel. Furthermore, because the sample was nationally representative, our findings are likely generalizable to all Canadian students who met the inclusion criteria.

The use of the HBSC questionnaire, which is used in over 43 countries and regions in collaboration with the World Health Organization, is another strength of this thesis. All HBSC questions, including those used in the current study, are continuously developed, piloted and validated within the HBSC international network.^{1,2} Although validation information was not available in the peer-reviewed literature for many of the specific HBSC questions used in this study, including the items on family structure, organized sport and excessive screen time, similarly worded questions have been shown to have acceptable validity in youth. One previous study,³ for example, showed that 89% of American youth (N=14 047) in grades 7-12 and their mothers independently reported living in the same family structure during in-home interviews, indicating that youth are able to answer questions of this nature accurately. Similarly, a study of the 2-week test-retest reliability of self-reported organized sports participation from the American Youth Risk Behavior Survey showed that students (N=1 679) in grades 7 and 10 were able to reliably self-report their organized sports participation over the past year (r=0.84).⁴ Finally, similarly worded questions regarding screen-based behaviours have been shown to have acceptable reliability and validity in youth populations.¹ In one American study⁵, 2-week testretest correlations of r=0.8 for weekday and r=0.69 for weekend television viewing were observed in youth in middle and high school. Another American study⁶ of 11-15-year old students (N=245) found an acceptable validity of r=0.37-0.47, as assessed by correlating students'
responses regarding their average weekly television viewing to a daily log that they were asked to keep.

A third major strength of this thesis is the use of advanced statistical techniques to address issues caused by the survey design and missing data, and to assess mediation. Design-based modeling for complex survey data was used to account for provincial/territorial weighting as well as clustering by class and school, as observations from students in the same class or school are unlikely to be completely independent of one another. The bootstrap-based contemporary mediation analysis used to assess mediation in Manuscript 1 is one of the most powerful methods available, and does not require the assumption that all mediating pathways influence the relationship of interest in the same direction. ⁷ Finally, the use of imputation in Manuscript 2 allowed us to analyze the relationship between family structure and screen time without excluding the ~15% of participants who provided incomplete data. This was important given that the results from the imputed analyses were somewhat different from those based on full cases, which suggests that some of the effect estimates would have been biased had we not used imputation.

5.4 Limitations and Potential Limitations

This study was not without potential limitations. Because the two manuscripts were so similar in their design, exposure assessment, covariate use and sample population, their limitations have been discussed together below.

5.4.1 Chance

It is possible that the positive results of Manuscript 1 and the negative results of Manuscript 2 were observed due to random sampling error and chance. If this occurred in Manuscript 1, then it would have been classified as a <u>Type 1 error</u>. Potential random sampling error was accounted for

by comparing the upper limit of each effect estimate's 95% confidence interval to the null before concluding that a significant relationship existed. Although performing multiple comparisons for each family structure by gender would have increased the risk of Type 1 error overall, it is unlikely that we would have observed such consistent results for each non-traditional family structure and in both genders due to chance alone.

If the null relationships in Manuscript 2 were observed due to chance when there was in fact a relationship, this would have been a <u>Type II error</u>. According to *a priori* sample calculations, the minimum odds ratio of excessive (i.e., >2 hours/day) screen time that could be detected with 80% power in each gender and family structure combination ranged from 1.21 to 1.48. This suggests that some of the comparisons may have been slightly underpowered. It is, however, important to note that these minimum detectable odds ratios represent weak-to-moderate effect estimates that may not have been practically significant. Detailed power calculations are shown in Appendix E.

5.4.2 Internal Validity

<u>Internal validity</u> refers to how accurately a study's results reflect what is truly happening in the sample population, assuming that the results are not due to chance. ⁸ Common threats to internal validity in epidemiological studies include selection bias, information bias and confounding. *Selection Bias:*

<u>Selection bias</u> may have occurred if the survey participants differed systematically from the overall population that they were meant to represent, namely all Canadian youth who met the study inclusion criteria, and this caused bias in the study's results.⁸

One common source of selection bias is <u>volunteer bias</u>, which occurs when those who elect to participate in a study differ systematically from those who do not. While the 2009/10 HBSC had a relatively high response rate (77%), it is possible that students who refused to consent, did not receive consent from their parents, attended a school that did not consent or were absent on the

day of the survey differed systematically from those who were included. These exclusions may feasibly have affected internal validity if students with certain exposure-outcome combinations were more likely to be excluded (e.g., if students from single parent families who also participated in sport were more likely to be absent or fail to obtain parental consent). If this type of bias occurred, however, it would most likely have affected only a small minority of students and therefore was likely not a major threat to internal validity.

Participants were also excluded from Manuscript 1 if they failed to provide a response for any of the exposure, outcome, or covariate measures. The baseline characteristics of included participants were, however, comparable to the information available from those excluded (see Table 5.6 in Appendix H), which suggests that their exclusion did not strongly affect internal validity.

Information Bias:

<u>Information error</u> refers to any intentional or unintentional error made in the measurement of a relevant exposure, outcome or covariate, and may become a <u>bias</u> if these errors are made systematically. As discussed above in the Strengths section, all HBSC items are extensively piloted and validated, and peer-reviewed studies have shown that youth are able to self-report their family structure, organized sports participation and screen time with acceptable accuracy and/or reliability. There is, however, still the potential for some degree of information error on the part of the participant due to misinterpretation of questions, incorrect recall, deliberate response error and/or the survey's use of limited multiple-choice questions rather than more open-ended response options. For example, the current HBSC's item on family structure does not provide a multiple-choice option for youth with same-sex parents. Youth currently experiencing a transition in family structure or living in an ambiguous family structure may also have been unable to report their family structure accurately. Overall, this type of error would likely have

had little meaningful effect on the study results given that it would have affected only a small minority of participants.

<u>Social desirability bias</u> occurs when participants intentionally or unintentionally over-report characteristics that are seen as "good" and under-report those that are seen as "bad". One example of potential social desirability bias was observed in the measure of self-reported family affluence, where 53.7% of participants perceived their family as being more "well off" than average and only 9.0% perceived it as being below average (see Table 4.1). Although it was not possible to directly test whether other measures such as screen time were influenced by social desirability bias, a previous validity study suggests that youth systematically underreport their televisionviewing and computer use by approximately 0.09 and 0.68 hours per week, respectively. ⁶ This type of bias would likely have been systematic but non-differential and therefore would have biased the results towards the null.

Finally, it is unclear which characteristics of non-traditional families actually cause increased risk of negative child and youth health outcomes. Family structure is closely related to many factors that influence child and youth health, including socioeconomic status, family stress levels, parent-child relationships and cultural norms, all of which may act as "active agents" in terms of causing health disparities. Although non-traditional families appear to be more likely to experience "active agents" that influence their health negatively, all families are ultimately different and experience them to differing extents. The inability of our measure of family structure to capture these complexities would likely have resulted in non-differential exposure misclassification and biased our results towards the null. Furthermore, it was not possible for us to determine how long youth had been in their current family structure, which may have resulted in varying levels of exposure and additional misclassification.

Confounding:

Confounding occurs when a relationship of interest is distorted or hidden by the effects of a third factor related to both the exposure and outcome but not on the causal pathway.⁸ Analyses in both manuscripts controlled for several potential covariates identified in previous studies, namely school grade, presence of siblings and whether the participant had lived in Canada for more than 5 years. All final analyses were also stratified by gender, and Manuscript 2 controlled for selfreported family affluence as well. It is, however, still possible that the results were observed due to residual confounding caused by imprecise measurement of any of the confounders and/or by not including relevant confounders because they were not available in the HBSC dataset. Such variables might include parental participation in organized sport, the presence of rules regarding screen-based behaviours, parental employment and additional parental time commitments. It is also possible that there was residual confounding by socioeconomic status in Manuscript 2 due to the fact that we were unable to measure family affluence directly. Self-reported family affluence has been correlated with socioeconomic status but is ultimately a subjective measure of the vouth's perception of their family compared to other families.¹ The family affluence scale is more objective, but has not been validated for youth whose parents have shared physical custody. It is also not an ideal measure of affluence in wealthy countries such as Canada where the majority of youth have access to a computer and their own bedroom.¹

5.4.3 External Validity

<u>External validity</u> is a term used to describe whether a study's results can be generalized to other populations outside of the sample population. The 2010 Canadian HBSC had a relatively high response rate (77%) and was designed to create a nationally representative cross-section of this population. Assuming that the results are internally valid, they should therefore be generalizable to all Canadian youth attending public school who met the inclusion criteria of the study, namely being in grades 6-10 and not attending an on-reserve or special needs school.⁹ The results are

likely also generalizable to youth from other industrialized countries with similar social policies and demographic characteristics.

5.5 Causation

The ultimate goal of this study was to determine whether family structure actually caused differences in activity-related behaviours, and in the case of sports participation, to determine whether this causal effect was partially transmitted through socioeconomic status. In 1965, Sir Austin Bradford-Hill proposed a series of nine criteria to aid researchers in deciding whether an observed association is likely to be causal.⁸ Five are still commonly used today, and will be discussed in detail below. This section will focus primarily on the significant relationship observed between family structure and organized sports participation, but will also touch on the null relationship observed between family structure and screen-time behaviour.

5.5.1 Temporality

<u>Temporality</u> refers to whether an exposure precedes development of the outcome of interest and is the only Bradford-Hill criterion that is considered necessary for causality. ⁸ Because this study used cross-sectional data, it is not possible to directly verify temporality. <u>Reverse-causality</u> is, however, conceptually unlikely in Manuscript 1 in that a youth's organized sports participation would most likely not influence his or her family structure.

The mediation analysis required the additional assumptions that the relationships between family structure and socioeconomic status and subsequently socioeconomic status and organized sports participation were causal. Again, it is unlikely that youth sports participation could meaningfully influence family-level socioeconomic status. It is, however, feasible that family material wealth could contribute to differences in family structure as decreased socioeconomic status is associated

with increased marital tension, pregnancy outside of marriage and other related factors. This caveat should be considered when interpreting the results of Manuscript 1.

5.5.2 Biological Plausibility

The hypothesis that family structure might cause differences in organized sports participation is plausible. Ecological systems theory posits that complex health-related behaviours develop in children and youth through the combination of individual-level factors (e.g., age and gender) and their environment. ¹⁰ Family has a demonstrated impact on this environment, affecting everything from family-level socioeconomic status to the amount of time that a parent has to provide transportation to and from sporting events. ¹¹ Furthermore, growing up in a non-traditional family is a recognized determinant of child well-being ¹² that has been linked to many of the same negative health outcomes as insufficient physical activity. ¹²⁻¹⁷

5.5.3 Strength of Association

A weak-to-moderate strength association was observed between family structure and organized sports participation. This does not preclude causality, as organized sport is a complex behaviour that is influenced by many different physical, social and personal factors. It is therefore expected that the ability of any one contributing factor, including family structure, to accurately predict sports participation will be relatively small but nonetheless meaningful from a public health perspective given that such a large population of Canadian adolescents live in non-traditional family structures.

5.5.4 Dose-Response Relationship

It is challenging to conceptualize the measurement of a <u>dose-response relationship</u> between family structure and any health-related behaviour, including organized sport. As mentioned above, the "active agents" associated with non-traditional family structure that cause observed health-related disparities remain unclear and therefore were not measured directly. Furthermore, we were unable to determine how long youth had been in their current family structure and therefore could not use this as a proxy of their dose of exposure to these active agents. An exception to this was SES, which may act as one such agent. Two proxies of SES, the FAS and the 5-point scale of self-reported family affluence described in Manuscript 1, were found to be mediators of the relationship between family structure and organized sports participation. Both scales were linearly associated with both family structure and the odds of sports participation, indicating a possible dose-response relationship.

5.5.5 Consistency

The findings of this thesis were internally consistent between boys and girls, as well as consistent with previous studies of different populations. Previous studies have generally shown similar negative trends between family structure and organized sport for at least one gender, ¹⁸⁻²⁰ although null results have also been observed. ²¹ Similarly, previous quantitative studies of television viewing in youth have generally shown null results or subtle increases in television viewing in youth from single parent families ^{20,22-26} and youth from reconstituted families. ^{11,27} It is, however, important to note that this study is not directly comparable to any previous study due to its detailed definition of family structure, which both separates reconstituted dual-parent families from traditional dual-parent families and takes physical custody arrangements into account.

5.6 Public Health Implications

As increasing numbers of Canadian youth are exposed to non-traditional family structures, it is becoming increasingly important to understand how family structure-related disparities in health outcomes and related behaviours come to exist and how best to intervene. The findings of this thesis suggest that interventions aimed at increasing sports participation in youth might be more successful if they consider both family structure and the financial cost of sports participation, for example by providing financial incentives to families of youth from non-traditional families. This could be done by having sports organizations or governments subsidize the up-front cost of organized sport for children and youth from low-income families.²⁸ Another option would be to increase awareness of currently available financial reimbursement programs such as the Children's Fitness Tax Credit²⁹ among non-traditional families through targeted advertising. It might also be useful to address the time constraints experienced by some non-traditional families, for example by providing youth with free or low-cost community- or school-based transportation to and from sporting events.

Sedentary screen-based behaviours were found to be high in all youth regardless of family structure, suggesting that youth from non-traditional families should not necessarily be treated as high-risk in future interventions aimed at decreasing screen-time. Our findings also did not support the hypothesis that regular visitation with a second parent negatively influences youths' average sports participation or screen-based sedentary behaviour. This information may be useful in the context of family law or for separated parents considering various physical custody options.

5.7 Future Research Directions

This research contributes to the growing body of literature on family structure as a predictor of health and health-related behaviours in children and youth, but there is still much that is unknown. Future research should continue to focus on how the physical, social and psychological environment differs among family structures in order to gain a more complete understanding of how health-related disparities come to exist by family structure. It would also be of interest to examine the effect of changes in family structure over time in a youth cohort study.

Our findings suggest that shared physical custody does not negatively influence health behaviours in youth, and may even slightly increase organized sports participation. It would therefore be interesting to further investigate the potential influence of shared custody on health and healthrelated behaviours in youth to determine whether it can moderate some of the negative effects of growing up in a non-traditional family structure.

Another interesting avenue for future research would be to further evaluate the effect of imputation of missing data in studies using the HBSC, to evaluate the extent to which missing data may bias results using various HBSC survey items. Further exploration of the relationship between family structure and organized sport might also benefit from more appropriate treatment of incomplete data.

5.8 Summary of MSc Research Experience

Overall, my experience as a Master's student has increased my depth as a professional in the field of epidemiology and public health. I expanded my knowledge of epidemiology, biostatistics and the Canadian healthcare system during my initial year of coursework. These skills were then cemented and enhanced as a result of my role as a teaching assistant for Master's level epidemiology. During the second year of my Master's program, I conceptualized, executed and critically evaluated my own work via an original research project using the large, nationally representative Health Behaviour in School-aged Children dataset. During this process, I wrote an in-depth review of the relevant literature, developed novel research questions, and developed an advanced knowledge of database management, biostatistical methods and the use of SAS software. I also interpreted the results from these statistical analyses, presented my findings orally to my peers at a national research conference (Canadian Society for Epidemiology and Biostatistics, 2014) and prepared my research for publication in this thesis as well as in peerreviewed journals. Through this combination of coursework, independent thesis research and practical experience as a MSc student, I have developed the skills required to work as a professional in the epidemiology field.

5.9 Conclusion

In summary, family structure was not a meaningful predictor of screen time in this large and nationally representative sample of Canadian youth. Youth living in both single parent and reconstituted families did, however, experience significant disparities in organized sports participation that were partially mediated by their family's socioeconomic status. These results suggest that youth from non-traditional families do not need to be targeted as a high-risk group in future interventions aiming to reduce screen time. Future interventions aiming to increase physical activity levels in youth could, however, consider targeting sports participation in these groups. It is hoped that the findings from this thesis will contribute to the growing body of literature on the development of negative activity-related health behaviours in children and youth, and that this knowledge will be used to inform interventions, policies and programs aimed at improving these behaviours.

5.10 References

1. Health Behaviour in School-aged Children: A world-health organization cross-national study. research protocol for the 2009/2010 survey. Vienna & Edinburgh: Ludwig-Boltzmann Institute Health Promotion Research & Child & Adolescent Health Research Unit; 2010.

 Roberts C, Freeman J, Samdal O, et al. The Health Behaviour in School-aged Children (HBSC) study: Methodological developments and current tensions. Int J Public Health. 2009;54 Suppl 2:140-150.

3. Brown SL, Manning WD. Family boundary ambiguity and the measurement of family structure: The significance of cohabitation. Demography. 2009;46(1):85-101.

4. Brener ND, Collins JL, Kann L, Warren CW, Williams BI. Reliability of the youth risk behavior survey questionnaire. Am J Epidemiol. 1995;141(6):575-580.

5. Utter J, Neumark-Sztainer D, Jeffery R, Story M. Couch potatoes or french fries: Are sedentary behaviors associated with body mass index, physical activity, and dietary behaviors among adolescents? J Am Diet Assoc. 2003;103(10):1298-1305.

 Schmitz KH, Harnack L, Fulton JE, et al. Reliability and validity of a brief questionnaire to assess television viewing and computer use by middle school children. J Sch Health.
 2004;74(9):370-377.

Hayes AF. Beyond Baron and Kenny: Statistical mediation analysis in the new millennium.
 Communication Monographs. 2009;76(4):408-420.

8. Webb P, Bain C, eds. Essential epidemiology: An introduction for students and health professionals. 2nd ed. United Kingdom: Cambridge University Press; 2011.

9. Freeman JG, King M, Pickett W, et al. The health of Canada's young people: A mental health focus. 2011. Available at: http://www.phac-aspc.gc.ca/hp-ps/dca-dea/prog-ini/school-scolaire/behaviour-comportements/publications/hcyp-sjc-eng.php. Accessed 2013-06-25.

10. Davison KK, Birch LL. Childhood overweight: A contextual model and recommendations for future research. Obes Rev. 2001;2(3):159-171.

11. Quarmby T, Dagkas S. Children's engagement in leisure time physical activity: Exploring family structure as a determinant. Leisure Studies. 2010;29(1):53-66.

12. UNICEF. Child poverty in perspective: An overview of child well-being in rich countries. In: Innocenti report card 7. Florence: UNICEF Innocenti Research Centre; 2007. Available at: http://eprints.whiterose.ac.uk/73187/1/Document.pdf. Accessed 2014-03-14.

13. Levin KA, Dallago L, Currie C. The association between adolescent life satisfaction, family structure, family affluence and gender differences in parent-child communication. Social Indicators Research. 2012;106(2):287-305.

 Jablonska B, Lindberg L. Risk behaviours, victimisation and mental distress among adolescents in different family structures. Soc Psychiatry Psychiatr Epidemiol. 2007;42(8):656-663.

15. Bramlett MD, Blumberg SJ. Family structure and children's physical and mental health. Health Aff (Millwood). 2007;26(2):549-558.

16. Bjarnason T, Bendtsen P, Borup I, et al. Life satisfaction among children in different family structures: A comparative study of 36 western countries. Children & Society. 2012;26(1):51-62.
17. Hesketh K, Crawford D, Salmon J, Jackson M, Campbell K. Associations between family circumstance and weight status of Australian children. Int J Pediatr Obes. 2007;2(2):86-96.

18. Eime RM, Harvey JT, Craike MJ, Symons CM, Payne WR. Family support and ease of access link socio-economic status and sports club membership in adolescent girls: A mediation study. Int J Behav Nutr Phys Act. 2013;10:50-5868-10-50.

19. Toftegaard-Stockel J, Nielsen GA, Ibsen B, Andersen LB. Parental, socio and cultural factors associated with adolescents' sports participation in four Danish municipalities. Scand J Med Sci Sports. 2011;21(4):606-611.

20. Gorely T, Atkin AJ, Biddle SJ, Marshall SJ. Family circumstance, sedentary behaviour and physical activity in adolescents living in England: Project STIL. Int J Behav Nutr Phys Act. 2009;6:33-5868-6-33.

21. O'Loughlin J, Paradis G, Kishchuk N, Barnett T, Renaud L. Prevalence and correlates of physical activity behaviors among elementary schoolchildren in multiethnic, low income, innercity neighborhoods in Montreal, Canada. Ann Epidemiol. 1999;9(7):397-407.

22. Gorely T, Marshall SJ, Biddle SJ. Couch kids: Correlates of television viewing among youth. Int J Behav Med. 2004;11(3):152-163.

23. Bagley S, Salmon J, Crawford D. Family structure and children's television viewing and physical activity. Med Sci Sports Exerc. 2006;38(5):910-918.

24. Salmon J, Timperio A, Telford A, Carver A, Crawford D. Association of family environment with children's television viewing and with low level of physical activity. Obes Res.

2005;13(11):1939-1951.

25. Salmon J, Dunstan D, Owen N. Should we be concerned about children spending extended periods of time in sedentary pursuits even among the highly active? Int J Pediatr Obes. 2008;3(2):66-68.

26. Hesketh K, Crawford D, Salmon J. Children's television viewing and objectively measured physical activity: Associations with family circumstance. Int J Behav Nutr Phys Act. 2006;3:36.
27. Sisson SB, Broyles ST. Social-ecological correlates of excessive TV viewing: Difference by race and sex. J Phys Act Health. 2012;9(3):449-455.

28. Spence JC, Holt NL, Dutove JK, Carson V. Uptake and effectiveness of the children's fitness tax credit in Canada: The rich get richer. BMC Public Health. 2010;10:356-2458-10-356.
29. von Tigerstrom B, Larre T, Sauder J. Using the tax system to promote physical activity: Critical analysis of Canadian initiatives. Am J Public Health. 2011;101(8):e10-6.

Appendix A - Ethics clearance



QUEEN'S UNIVERSITY HEALTH SCIENCES & AFFILIATED TEACHING HOSPITALS RESEARCH ETHICS BOARD-DELEGATED REVIEW November 01, 2013

Ms. Rachel McMillan Department of Public Health Sciences Queen's University

Dear M5. McMillan Study Title: EPID-446-13 Family Structure as a Predictor of Organized Sport Participation and Excessive Television Viewing in Canadian Youth File # 6011069 Co-Investigators: Dr. I. Janssen

I am writing to acknowledge receipt of your recent ethics submission. We have examined the protocol for your project (as stated above) and consider it to be ethically acceptable. This approval is valid for one year from the date of the Chair's signature below. This approval will be reported to the Research Ethics Board. Please attend carefully to the following listing of ethics requirements you must fulfill over the course of your study:

Reporting of Amendments: If there are any changes to your study (e.g. consent, protocol, study procedures, etc.), you must submit an amendment to the Research Ethics Board for approval. Please use event form: HSREB Multi-Use Amendment/Full Board Renewal Form associated with your post review file # 6011069 in your Researcher Portal (<u>https://eservices.queensu.ca/romeo_researcher/</u>)

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. Serious Adverse Event forms are located with your postreview file 6011069 in your Researcher Portal (https://eservices.queensu.ca/romeo_researcher/)

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.

Annual Renewal: Prior to the expiration of your approval (which is one year from the date of the Chair's signature below), you will be reminded to submit your renewal form along with any new changes or amendments you wish to make to your study. If there have been no major changes to your protocol, your approval may be renewed for another year.

Yours sincerely,

aller & Clark.

Chair, Health Sciences Research Ethics Board November 01, 2013

Appendix B – Key HBSC survey items

5.1 Family Structure

48. All families are different (for example, not everyone lives with both their parents, sometimes people live with just one parent, or they have two homes or live with two families) and we would like to know about yours. Please answer this first question for the home where you live all or most of the time and mark the people who live there.

	<u>Adults</u>		<u>Children</u>
M60		Mother	Please say how many brothers and sisters
M61		Father	live here (including half, step or foster
M62		Stepmother (or father's girlfriend)	number or write 0 (zero) if there are none.
M63		Stepfather (or mother's boyfriend)	Please do not count yourself.
M64		Grandmother	How many brothers? M68
M65		Grandfather	How many sisters? M69
M66		I live in a foster home or children's home	
M67		Someone or somewhere else: (please write it down)	

49. Do you have another home or another family, such as the case when your parents are separated or divorced?



5.2 Sedentary Screen-Based Behaviour

73. About how many hours a day do you usually watch television (including videos and DVDs) in your free time? (*Please mark one box for <u>weekdays</u> and one box for <u>weekend</u>)*

M19 <u>Weekdays</u>	M20 <u>Weekend</u>
¹ None at all	¹ None at all
² About half an hour a day	² About half an hour a day
³ About 1 hour a day	³ About 1 hour a day
⁴ About 2 hours a day	⁴ About 2 hours a day
⁵ About 3 hours a day	⁵ About 3 hours a day
6 About 4 hours a day	6 About 4 hours a day
⁷ About 5 hours a day	⁷ About 5 hours a day
⁸ About 6 hours a day	⁸ About 6 hours a day
⁰ About 7 or more hours a day	⁹ About 7 or more hours a day

74. 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 <u>weekdays</u> and one box for <u>weekend</u>)

M21 <u>Weekdays</u>	M22 <u>Weekend</u>
¹ None at all	¹ None at all
² About half an hour a day	² About half an hour a day
³ About 1 hour a day	³ About 1 hour a day
⁴ About 2 hours a day	⁴ About 2 hours a day
⁵ About 3 hours a day	⁵ About 3 hours a day
⁶ About 4 hours a day	6 About 4 hours a day
⁷ About 5 hours a day	⁷ About 5 hours a day
⁸ 🗋 About 6 hours a day	⁸ About 6 hours a day
⁹ About 7 or more hours a day	⁹ About 7 or more hours a day

75. 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 <u>weekdays</u> and one box for* <u>weekend</u>)

M23 <u>Weekdays</u>	M24 <u>Weekend</u>
¹ None at all	¹ None at all
² About half an hour a day	² About half an hour a day
³ About 1 hour a day	³ About 1 hour a day
⁴🔲 About 2 hours a day	⁴ About 2 hours a day
⁵ About 3 hours a day	5 About 3 hours a day
6 About 4 hours a day	6 About 4 hours a day
⁷ About 5 hours a day	⁷ About 5 hours a day
⁸ 🔲 About 6 hours a day	⁸ About 6 hours a day
⁹ About 7 or more hours a day	°□ About 7 or more hours a day

5.3 Organized Sports Participation

76. Are you involved in any of these kinds of clubs or organizations?

(Check "yes" or "no" for each line)

Q76a organ	. I am not involved in any kind of club or ization	¹∏ (Go to q	juestion 77)
		Yes	No
q76b	Sport club or team	1	2
q76c	Voluntary service	1	2
q76d	Political organization	1	2
q76e	Cultural association (music, science or other)	1	2
q76f	Church or religious group	1	2
q76g	Youth club	1	2
q76h	Other club	1	²

5.4 Self-Reported Family Affluence

M122	How	well	off	do	you	think	your	family	is?
------	-----	------	-----	----	-----	-------	------	--------	-----

- ¹ Very well off ² Quite well off ³ Average ⁴ Not very well off
- ⁵ Not at all well off

5.5 Family Affluence Scale

M119	Do you have your own bedro	oom for yourself?	
	¹ No	² Yes	
M118	Does your family own a car	, van or truck?	
	¹ No	² Yes, one	³ Yes, two or more
M120	During the past 12 months your family?	, how many times dia	l you travel away on holiday (vacation) with
	¹ Not at all		
	² Once		
	³ Twice		
	⁴ More than twice		

M121 How many computers does your family own?

- ¹ None
- ²One
- ³ Two
- ⁴ More than two

Appendix C – Health Behaviour in School-aged Children survey, 2009/10

HBSC surveys are conducted every 4 years in 43 European and North American countries and regions in collaboration with the World Health Organization. Their goal is to generate both international and country-specific cross-sectional data on a broad range of social, behavioural and psychological determinants of health in 11- to 15-year-old youth. ¹ This age range was chosen because it represents a critical period of development where adolescents are beginning to make their own health-related decisions. ² All HBSC questions are continuously developed, piloted and validated within the HBSC international network, although these development and validity studies are often not published in the peer-reviewed literature. ^{2,3} Canada has participated in the HBSC since its 1989/90 cycle, with the most recent cycle occurring in 2009/10. ¹

This thesis will be limited to the 2009/10 Canadian HBSC survey data. This survey included 26 078 Canadian students in grades 6-10 (approximate ages 11-15 years) from 436 publically funded schools across each province and territory, with the exceptions of Prince Edward Island and New Brunswick. ¹ Participants filled out an anonymous written survey between September 2009 and June 2010, which was completed in the classroom setting over approximately 45-60 minutes. ¹ The vast majority of items required multiple-choice responses that could be filled out by checking off the appropriate box, rather than by providing an open-ended written answer. ¹ The survey was available in three languages: English, French and Inuktitut. ¹

The Canadian HBSC uses a complex sampling strategy intended to produce a nationally representative sample of all Canadian students in grades 6-10 attending publicly funded schools. In the 2009/10 cycle, all eligible students living in the three Canadian territories were approached to participate if they met the study's inclusion criteria, to ensure their adequate representation in the sample.¹ Provincial participants, on the other hand, were selected using two-stage clustered

sampling.¹ At the first level, schools within consenting school jurisdictions from each province were listed in order based on their size, grade coverage, language of instruction, public/Roman Catholic designation, community size, school jurisdiction and location. Individual schools were systematically selected to participate.¹ At the second level, entire classrooms of students from selected schools were randomly selected by school administrators to participate.¹ Youth were excluded if they attended a private, special needs, at-home or on-reserve school, or if they were absent from school on the day of the survey.¹ Finally, data for each grade within each provincial and territorial dataset was assigned a sampling weight to prevent over- or under-representation in the final national sample.¹

The 2009/10 HBSC had a high participation rate at approximately 77% of students who were approached. ¹ Consent for participation was collected from school jurisdictions, individual school principals, parents of participants and participants themselves. ¹ Passive parental consent, where consent was assumed if parents did not return the consent form, was used in jurisdictions where it was permitted. ¹ The study was approved by the General Research Ethics Board at Queen's University and Health Canada's research ethics board. ¹

References

1. Freeman JG, King M, Pickett W, et al. The health of Canada's young people: A mental health focus. 2011. Available at: http://www.phac-aspc.gc.ca/hp-ps/dca-dea/prog-ini/school-scolaire/behaviour-comportements/publications/hcyp-sjc-eng.php. Accessed 2013-06-25.

2. *Health Behaviour in School-aged Children: A world-health organization cross-national study. research protocol for the 2009/2010 survey.* Vienna & Edinburgh: Ludwig-Boltzmann Institute Health Promotion Research & Child & Adolescent Health Research Unit; 2010.

3. Roberts C, Freeman J, Samdal O, et al. The Health Behaviour in School-aged Children (HBSC)
study: Methodological developments and current tensions. *Int J Public Health*. 2009;54 Suppl
2:140-150

Appendix D – Rationale for the use of logistic regression

Relative risks and odds ratios are commonly used to describe relationships between predictors and binary outcomes from cross-sectional surveys.¹ Although both are valid measures of effect, it is crucial to understand how they are different and interpret each measure correctly.^{1,2} Relative risks measure the ratio of the probability of observing an outcome in one group to that of a comparison group.^{1,3} Odds ratios, on the other hand, measure the ratio of the odds of observing an outcome in one group to that in a comparison group.¹⁻³ When outcomes are rare (i.e., prevalence of <10%), the odds ratio is roughly equivalent to the relative risk.¹⁻³ When describing more common outcomes, such as those analyzed in this thesis, the odds ratio can be significantly greater in magnitude (i.e., further from 1) than the relative risk.¹ The odds ratio is therefore considered problematic by many epidemiologists, given that non-specialists often misinterpret relative risks and odds ratios as being interchangeable.^{2,4} This is worrisome in that it may cause policy-makers and other non-biostatisticians to believe that the relationship of interest is stronger than it truly is.^{1,2}

Despite its controversial use, the odds ratio is relatively easy to obtain through multiple logistic regression of complex survey data.^{3,4} Logistic regression correctly models binomial data using a binomial distribution and logit link to constrain all probabilities predicted by the model between 0 and 1, and can easily be performed using SAS procedures such as Proc Glimmix and Proc Surveylogistic.³⁻⁵

There is no ideal regression model for the relative risk in the case of complex survey data with multiple covariates.^{2,3} Simple formulas to convert the odds ratio to a relative risk, such as that proposed by Zhang and Yu⁶, have been postulated as potential workarounds to this issue but subsequently shown to be biased.⁵ The most intuitive method of directly estimating the relative risk through regression, log-binomial regression, correctly utilizes a binomial distribution but

incorrectly uses a logarithmic link function.^{3,5} This contributes to frequent convergence failures, particularly when the maximum likelihood estimates of the model parameters lie near the boundary of the valid parameter space or when the model includes many covariates.^{5,7} The COPY method has been proposed as a solution to this well-known convergence issue, although its statistical properties remain unclear.^{8,9} It should also be noted that failure to converge is one sign that the log-binomial model fits the data poorly.³ Forcing convergence is therefore controversial.³

Two other methods of estimating the relative risk are modified Poisson regression and Cox regression with constant time at risk.^{2,3} Both misspecify the true distribution of the data, using a Poisson distribution with a log link, and can therefore produce a model-predicted outcome probability that is greater than 1.^{3,10} While these models produce accurate point estimates of the relative risk, they inflate the standard error when the outcome is common.³ Modified Poisson regression, which utilizes Poisson regression with a robust variance estimator, has been suggested as a method to make the model robust to the distribution misspecification and produce accurate standard errors for both clustered^{7,12} and non-clustered¹¹ datasets. Overall it has been argued that although modified Poisson regression is imperfect, it may be the most stable regression technique for directly estimating the relative risk.³

Another somewhat controversial decision to make when modelling complex survey data is whether to use model-based or design-based inference.¹³ To use model-based inference, researchers must create a statistical model that they believe correctly describes their relationship of interest in a hypothetical, infinite population, and also make an assumption about how the dependent variable would be distributed in an infinite population. ¹³⁻¹⁵ The data are then treated as a sample from this hypothetical, infinite population, which makes all statistical inferences theoretically generalizable to external populations.¹³⁻¹⁵

Design-based inference, on the other hand, assumes that the sample is representative of the source population from which it was taken and therefore is intended to provide inferences about the source population. ¹³⁻¹⁵ Design-based inference is generally considered more robust and less subjective, ¹²⁻¹⁵ giving "valid inferences, even in some cases when the model is misspecified."^{14,15} It is considered the more appropriate option when the target population is the same as that from which the participants were selected, as is the case in a nationally representative survey such as the HBSC.¹⁶ Unfortunately, design-based inference of complex survey data is only possible for linear and logistic regression using the built-in procedures in SAS 9.3.¹⁷

Ultimately, it was decided that logistic regression using design-based inference would be the most robust and mathematically correct method of analyzing the data presented in this thesis. The resulting odds ratios have been presented carefully to reduce the risk of their misinterpretation.

References:

1. Vandenbroucke JP. Continuing controversies over "risks and rates"--more than a century after william farr's "on prognosis". *Soz Praventivmed*. 2003;48(4):216-218.

2. Barros AJ, Hirakata VN. Alternatives for logistic regression in cross-sectional studies: An empirical comparison of models that directly estimate the prevalence ratio. *BMC Med Res Methodol*. 2003;3:21.

3. Lee J, Tan CS, Chia KS. A practical guide for multivariate analysis of dichotomous outcomes. *Ann Acad Med Singapore*. 2009;38(8):714-719.

4. Cook TD. Advanced statistics: Up with odds ratios! A case for odds ratios when outcomes are common. *Acad Emerg Med*. 2002;9(12):1430-1434.

5. McNutt LA, Wu C, Xue X, Hafner JP. Estimating the relative risk in cohort studies and clinical trials of common outcomes. *Am J Epidemiol*. 2003;157(10):940-943.

6. Zhang J, Yu KF. What's the relative risk? A method of correcting the odds ratio in cohort studies of common outcomes. *JAMA*. 1998;280(19):1690-1691.

7. Yelland LN, Salter AB, Ryan P. Performance of the modified poisson regression approach for estimating relative risks from clustered prospective data. *Am J Epidemiol*. 2011;174(8):984-992.

8. Spiegelman D, Hertzmark E. Easy SAS calculations for risk or prevalence ratios and

differences. Am J Epidemiol. 2005;162(3):199-200.

Deddens JA, Petersen MR. Approaches for estimating prevalence ratios. *Occup Environ Med*.
 2008;65(7):481, 501-6.

10. Petersen MR, Deddens JA. A comparison of two methods for estimating prevalence ratios. *BMC Med Res Methodol*. 2008;8:9-2288-8-9.

11. Zou G. A modified poisson regression approach to prospective studies with binary data. *Am J Epidemiol*. 2004;159(7):702-706.

12. Zou GY, Donner A. Extension of the modified poisson regression model to prospective studies with correlated binary data. *Stat Methods Med Res.* 2013;22(6):661-670.

13. Gregoire TG. Design-based and model-based inference in survey sampling: Appreciating the difference. *Canadian Journal of Forest Research*. 1998;28(10):1429-1447.

14. Sterba SK. Alternative model-based and design-based frameworks for inference from samples to populations: From polarization to integration. *Multivariate Behav Res*. 2009;44(6):711-740.

15. Chambers RL, Skinner CJ. *Analysis of survey data*. West Sussex, England: John Wiley & Sons, Ltd.; 2003.

16. Sahai H, Khurshid A. *Statistics in epidemiology: Methods, techniques and applications.*Florida, United States: CRC Press; 1996.

17. SAS Institute Inc. Inference principles for survey data. Available at:

http://support.sas.com/documentation/cdl/en/statug/63962/HTML/default/viewer.htm#statug_intr omod_a0000000344.htm. Updated 2014. Accessed 2014-02-09.

Appendix E – Power calculations

The following appendix presents the definitions and equations used to calculate power, followed by a sample power calculation. Finally, it shows four summary tables presenting the minimum detectable differences and corresponding odds ratios that can be detected by each of the logistic regression analyses presented in Manuscripts 1 and 2.

Because there is no standard power calculation that accounts for complex survey design, mediation analysis or covariate use, a classical power calculation was used with a design effect of 1.2. This design effect should account for the typical clustering that occurs within HBSC survey items, based on previous findings.¹ The possibility of missing data in Manuscript 1 and uncertainty introduced due to imputation in Manuscript 2 was accounted for by excluding 10% of the total sample size in each analysis. Power calculations were performed separately for boys and girls.

Definitions:

Unexposed refers to living in a traditional family type

Exposed refers to living in a specified non-traditional family type

N_{exposed} is the number of participants exposed

 $N_{exposed, adjusted}$ is the number of participants exposed, after controlling for a design effect of 1.2 and assuming that 10% of the sample is missing

r is the ratio of exposed to unexposed

p is the proportion of participants who have the outcome (i.e., participate in organized sport)

 \mathbf{p}_0 is the proportion of participants who have the outcome in the unexposed group

 α is the acceptable probability of making a Type 1 error ($\alpha = 0.05$)

 β is the acceptable probability of making a Type 2 error ($\beta = 0.20$)

Power is the probability that the study will detect an association if there truly is one in the population

d is the minimum detectable difference that can be detected with the specified amount of power
p₁ is the proportion of participants who have the outcome in the exposed group
OR is the minimum detectable odds ratio with the specified amount of power

Relevant Equations:

$$d = \sqrt{\frac{(z_{\alpha/2}+z_{\beta})^2 p(1-p)(r+1)}{(n_{exposed})r}}$$

 $OR = [p_1/(1-p_1)]/[p_0/(1-p_0)]$

Sample Calculation:

Outcome: Participation in organized sports

Exposed Group: Girls in reconstituted families with regular visitation arrangements (least common exposure)

Unexposed Group: Girls in traditional families

Givens (*=value was calculated directly through preliminary analysis of the 2009/10 HBSC data, without adjusting for covariates):

p = P(participant does participate in sports) = 0.51*

 $n_{exposed, crude}$ = number of girls in reconstituted families with regular visitation = 414*

 $n_{exposed, \; adjusted} = 414*0.9/1.2 = 311$

 $n_{unexposed, crude} = number of girls in traditional families = 8406*$

 $n_{unexposed, adjusted} = 8406*0.9/1.2 = 6305$

r = 6305/311 = 20.3

 p_0 = prevalence of sports participation in girls from traditional families = 0.54*

 $z_{\alpha/2} = z_{0.025} = 1.96$ $z_{1-\beta} = z_{0.80} = 0.842$

Find minimum detectable difference with 80% power:

d = smallest difference in prevalence of organized sports participation that can be detected between exposed and unexposed groups = $p_1 - p_0$

$$n_{exposed} = \frac{\left(\frac{z_{\alpha/2} + z_{\beta}}{p}\right)^2 p(1-p)(r+1)}{(d)^2 r}$$
$$d = \sqrt{\frac{\left(\frac{z_{\alpha/2} + z_{\beta}}{p}\right)^2 p(1-p)(r+1)}{(n_{exposed})r}} = \sqrt{\frac{(1.96 + 0.842)^2 * 0.51(1-0.51)(20.3+1)}{(311)(20.3)}} = 0.08$$

Find corresponding odds ratio:

$$p_1 = p_0 - d = 0.54 - 0.08 = 0.45$$

$$OR = [p_1/(1-p_1)]/[p_0/(1-p_0)] = [0.45/(1-0.45)]/[0.54/(1-0.54)] = 0.72$$

Therefore this study will have 80% power to detect an odds ratio of 0.72 when comparing organized sports participation in girls from reconstituted families with regular visitation arrangements to girls from traditional families.

Summary of power for each analysis:

 Table 5.1. Minimum detectable differences for organized sports participation

Comparison – Organized Sport	N _{exposed} ,	N _{exposed} ,									
	crude *	adjusted	r	р*	p ₀ *	$Z_{\alpha/2}$	Z _(1-β)	Power	d	p ₁	OR
Boys											
Traditional Families	8350	6263	-	-	-	-	-	-	-	-	-
Single parent with Regular Visitation vs	1000	750	8.35	0.59	0.59	1.96	0.84	0.80	0.05	0.54	0.80
Traditional											
Single parent with Irregular Visitation vs	1148	861	7.27	0.59	0.59	1.96	0.84	0.80	0.05	0.54	0.82
Traditional											
Reconstituted Family with Regular	317	238	26.34	0.59	0.59	1.96	0.84	0.80	0.09	0.50	0.69
Visitation vs Traditional											
Reconstituted Family with Irregular	705	529	11.84	0.59	0.59	1.96	0.84	0.80	0.06	0.53	0.78
Visitation vs Traditional											
Girls											
Traditional Families	8406	6305	-	-	-	-	-	-	-	-	-
Single parent with Regular Visitation vs	998	749	11.54	0.51	0.54	1.96	0.84	0.80	0.05	0.48	0.81
Traditional											
Single parent with Irregular Visitation vs	1297	973	6.48	0.51	0.54	1.96	0.84	0.80	0.05	0.49	0.82
Traditional											
Reconstituted Family with Regular	414	311	20.30	0.51	0.54	1.96	0.84	0.80	0.08	0.45	0.72
Visitation vs Traditional											
Reconstituted Family with Irregular	976	732	8.61	0.51	0.54	1.96	0.84	0.80	0.05	0.48	0.80
Visitation vs Traditional											

* = obtained directly from 2009/2010 HBSC dataset and account for provincial/territorial weighting.

Comparison – Excess Television Viewing	N _{exposed} ,	N _{exposed} ,									
	crude*	adjusted	r	p*	p ₀ *	$Z_{\alpha/2}$	$Z_{(1-\beta)}$	Power	d	p ₁	OR
Boys											
Traditional Families	8350	6263	-	-	-	-	-	-	-	-	-
Single parent with Regular Visitation vs	1000	750	8.35	0.61	0.55	1.96	0.84	0.80	0.05	0.60	1.24
Traditional											
Single parent with Irregular Visitation vs	1148	861	7.27	0.61	0.55	1.96	0.84	0.80	0.05	0.60	1.23
Traditional											
Reconstituted Family with Regular	317	238	26.34	0.61	0.55	1.96	0.84	0.80	0.09	0.64	1.46
Visitation vs Traditional											
Reconstituted Family with Irregular	705	529	11.84	0.61	0.55	1.96	0.84	0.80	0.06	0.61	1.29
Visitation vs Traditional											
Girls											
Traditional Families	8406	6305	-	-	-	-	-	-	-	-	-
Single parent with Regular Visitation vs	998	749	11.54	0.58	0.52	1.96	0.84	0.80	0.05	0.57	1.24
Traditional											
Single parent with Irregular Visitation vs	1297	973	6.48	0.58	0.52	1.96	0.84	0.80	0.05	0.57	1.21
Traditional											
Reconstituted Family with Regular	414	311	20.30	0.58	0.52	1.96	0.84	0.80	0.08	0.60	1.39
Visitation vs Traditional											
Reconstituted Family with Irregular	976	732	8.61	0.58	0.52	1.96	0.84	0.80	0.05	0.57	1.24
Visitation vs Traditional											

 Table 5.2. Minimum detectable differences for excessive television viewing (>2 hours/day)

* obtained directly from 2009/2010 HBSC dataset and account for provincial/territorial weighting.

Comparison – Excess Computer Use	N _{exposed} ,	N _{exposed} ,									
	crude*	adjusted	r	р*	p ₀ *	$Z_{\alpha/2}$	$\mathbf{Z}_{(1-\beta)}$	Power	d	p ₁	OR
Boys											
Traditional Families	8350	6263	-	-	-	-	-	-	-	-	-
Single parent with Regular Visitation vs	1000	750	8.35	0.39	0.32	1.96	0.84	0.80	0.05	0.37	1.26
Traditional											
Single parent with Irregular Visitation vs	1148	861	7.27	0.39	0.32	1.96	0.84	0.80	0.05	0.37	1.25
Traditional											
Reconstituted Family with Regular	317	238	26.34	0.39	0.32	1.96	0.84	0.80	0.09	0.41	1.48
Visitation vs Traditional											
Reconstituted Family with Irregular	705	529	11.84	0.39	0.32	1.96	0.84	0.80	0.06	0.38	1.31
Visitation vs Traditional											
Girls											
Traditional Families	8406	6305	-	-	-	-	-	-	-	-	-
Single parent with Regular Visitation vs	998	749	11.54	0.50	0.45	1.96	0.84	0.80	0.05	0.50	1.24
Traditional											
Single parent with Irregular Visitation vs	1297	973	6.48	0.50	0.45	1.96	0.84	0.80	0.05	0.50	1.21
Traditional											
Reconstituted Family with Regular	414	311	20.30	0.50	0.45	1.96	0.84	0.80	0.08	0.53	1.39
Visitation vs Traditional											
Reconstituted Family with Irregular	976	732	8.61	0.50	0.45	1.96	0.84	0.80	0.05	0.50	1.25
Visitation vs Traditional											

 Table 5.3. Minimum detectable differences for excessive computer use (>2 hours/day)

* = obtained directly from 2009/2010 HBSC dataset and account for provincial/territorial weighting.

Comparison – Excess Video Game Use	N _{exposed} ,	N _{exposed} ,									
	crude*	adjusted	r	p*	p ₀ *	$Z_{\alpha/2}$	$\mathbf{Z}_{(1-\beta)}$	Power	d	p ₁	OR
Boys											
Traditional Families	8350	6263	-	-	-	-	-	-	-	-	-
Single parent with Regular Visitation vs	1000	750	8.35	0.51	0.44	1.96	0.84	0.80	0.05	0.49	1.24
Traditional											
Single parent with Irregular Visitation vs	1148	861	7.27	0.51	0.44	1.96	0.84	0.80	0.05	0.49	1.23
Traditional											
Reconstituted Family with Regular	317	238	26.34	0.51	0.44	1.96	0.84	0.80	0.09	0.53	1.45
Visitation vs Traditional											
Reconstituted Family with Irregular	705	529	11.84	0.51	0.44	1.96	0.84	0.80	0.06	0.50	1.29
Visitation vs Traditional											
Girls											
Traditional Families	8406	6305	-	-	-	-	-	-	-	-	-
Single parent with Regular Visitation vs	998	749	11.54	0.26	0.22	1.96	0.84	0.80	0.05	0.27	1.29
Traditional											
Single parent with Irregular Visitation vs	1297	973	6.48	0.26	0.22	1.96	0.84	0.80	0.04	0.26	1.26
Traditional											
Reconstituted Family with Regular	414	311	20.30	0.26	0.22	1.96	0.84	0.80	0.07	0.29	1.46
Visitation vs Traditional											
Reconstituted Family with Irregular	976	732	8.61	0.26	0.22	1.96	0.84	0.80	0.05	0.27	1.30
Visitation vs Traditional											

 Table 5.4. Minimum detectable differences for excessive video game use (>2 hours/day)

* = obtained directly from 2009/2010 HBSC dataset and account for provincial/territorial weighting.

References:

1. *Health Behaviour in School-aged Children: A world-health organization cross-national study. Research protocol for the 2009/2010 survey.* Vienna & Edinburgh: Ludwig-Boltzmann Institute Health Promotion Research & Child & Adolescent Health Research Unit; 2010.
Appendix F – Handling missing data

Missing data are a common methodological concern when analyzing epidemiological data. In the case of a cross-sectional survey such as the Health Behaviour in School-aged Children study (HBSC), missing data commonly arise when participants overlook or choose not to answer certain questions. ¹ This appendix outlines several approaches researchers can use to handle this type of missing data, and concludes with a brief explanation of the two imputation methods used in Manuscript 2.

Approaches for Handling Missing Data:

Complete case analysis, or listwise deletion, is one of the most common methods of handling missing survey data. In this method, all participants with any missing information are simply deleted prior to data analysis.² A related alternative, pairwise deletion, involves deleting only those participants with missing information for an exposure, outcome, or covariate that is relevant to the analysis of interest.² While computationally simple and convenient, these two methods decrease statistical power and may introduce bias by ignoring any systematic differences between participants with and without missing data.^{2,3}

Another option is to impute plausible values for the missing data, thereby avoiding the need to delete any potentially valuable information.² This can be accomplished most simply by imputing the mean of the non-missing values for each missing value.² This method, known as mean imputation or simple imputation, fails to take into account any measureable differences between individual observations and may therefore introduce bias.² Conditional mean imputation improves upon simple mean imputation by imputing the mean from non-missing observations that are considered sufficiently similar to each missing observation.² Both simple imputation and conditional mean imputation bias the estimated variance of imputed data towards 0 by failing to take into account the uncertainty introduced by the imputation of unknown data.²

Multiple imputation involves imputing each missing value multiple times, thereby taking into account the uncertainty associated with estimating the imputed values. ¹ Assuming that data are missing at random, meaning that any systematic differences between missing and non-missing values can be explained by the observed data, the subsequent data analysis should produce unbiased parameter estimates with appropriate variances. ^{1,2,4} Multiple imputation is therefore generally considered the preferred method of handling missing data.¹

Explanation of Multiple Imputation Procedures Used in this Thesis:

Multiple imputation in SAS 9.4 has 3 distinct steps. ¹ First PROC MI generates a series of n(generally 3-10) concatenated data sets, each with a different set of imputed missing values drawn randomly from a distribution of reasonable values.^{5,6} This distribution may be generated through regression, the propensity score method or the Markov Chain Monte Carlo (MCMC) method, depending on characteristics of the data to be imputed.⁵ For the second step, the desired analysis is performed on each of the *n* concatenated data sets individually.⁵ Finally, PROC MIANALYZE is used to average the *n* resulting parameter estimates from the *n* concatenated datasets and also provide variance estimates that account for the increased uncertainty due to the imputations.^{1,5,6} The first step in choosing an appropriate method of imputation is to determine whether data are missing in an arbitrary or monotonal pattern.¹ Monotonal missingness occurs when it is possible to arrange the variables in an order such that when one participant has missing data for any given variable, all subsequent variables will also have missing information for that participant.⁶ This type of pattern is commonly observed in longitudinal studies, where missing data occurs because participants are lost to follow-up.⁶ Monotonal missing data can be imputed with fewer assumptions and less statistical complexity, but is rarely observed in cross-sectional studies such as the HBSC where missingness is more likely to take an arbitrary pattern.⁶ Manuscript 2

therefore explored the two methods of imputing arbitrarily missing data in SAS 9.4: MCMC imputation and fully conditional specification (FCS) imputation.⁵

The MCMC imputation model relies on Bayesian inference to simulate a multivariate normal joint distribution of reasonable missing values for imputations to be drawn from. ⁵ This presents a methodological challenge when imputing data for which normality should not be assumed, such as when a dataset includes nominal or binary data. ⁷⁻⁹ The second option, FCS imputation, is more flexible in that it allows analysts to generate a multivariate sampling distribution for missing data by specifying separate logistic or linear regression models, as appropriate, for each individual variable with missing data. ^{6,9,10} It does, however, require the assumption that the joint sampling distribution exists for each of the imputed variables. ^{6,9}

In Manuscript 2, continuous and ordinal variables were imputed using logistic regression whereas nominal variables were imputed using the discriminant function for the FCS imputation. As a separate sensitivity analysis, MCMC imputation was used to impute just enough data to produce a monotonal missingness pattern. The remaining missing values could then be imputed using logistic regression, which does not assume normality or linearity. ⁵ Non-binary, non-ordinal categorical variables of interest, namely parental structure and ethnicity, were not imputed during the sensitivity analysis as MCMC imputation is inappropriate for this type of data. ⁵ The effect estimates arising from the two imputed datasets, shown in Table 5.5 below, were extremely similar so only the results from the FCS imputation were presented in Manuscript 2. In both cases, categorical data were rounded to the nearest category (e.g., either 0 or 1, in the case of a dummy variable) despite concerns that this may introduce bias. ^{2.8} This was done in an effort to yield meaningful data compatible with logistic regression. In both imputation procedures, 50 concatenated datasets were created rather than the typical 5 in an effort to reduce any potential bias caused by rounding.

References:

1. Berglund PA. An introduction to multiple imputation of complex survey data using SAS 9.2

(paper 265-2010). In: SAS global forum 2010. Ann Arbor, Michigan: SAS Institute Inc.; 2010.

2. Ake CF. Rounding after multiple imputation with non-binary categorical covariates (paper

112-30). In: SUGI 30: Focus session. Philadelphia, PA: SAS Institute Inc.; 2005.

3. Yuan YC. *Multiple imputation for missing data: Concepts and new development (version 9.0)*.Rockville, MD: SAS Institute Inc.; 2000.

4. Sterne JA, White IR, Carlin JB, et al. Multiple imputation for missing data in epidemiological and clinical research: Potential and pitfalls. *BMJ*. 2009;338:b2393.

5. SAS Institute Inc. Proc mi statement. In: SAS user's guide. 2nd ed.; 2009.

6. van Buuren S. Multiple imputation of discrete and continuous data by fully conditional specification. *Stat Methods Med Res.* 2007;16(3):219-242.

7. Allison PD. Imputation of categorical variables with PROC MI (paper 113-30). In: *SUGI 30: Focus session*. Philadelphia, PA: SAS Institute Inc.; 2005.

8. Finch WH. Imputation methods for missing categorical questionnaire data: A comparison of approaches. *Journal of Data Science*. 2010;8:361-378.

9. Lee KJ, Carlin JB. Multiple imputation for missing data: Fully conditional specification versus multivariate normal imputation. *Am J Epidemiol*. 2010;171(5):624-632.

10. van Buuren S, Boshuizen HC, Knook DL. Multiple imputation of missing blood pressure covariates in survival analysis. *Stat Med.* 1999;18(6):681-694.

	Full Case Analysis	FCS Imputation	MCMC Imputation (Sensitivity Analysis)
Family Structure	OR (95% CI)	OR (95% CI)	OR (95% CI)
TV-watching			
Boys			
Reconstituted with irregular visitation	1.24 (0.95-1.61)	1.20 (0.98-1.49)	1.19 (0.96-1.47)
Reconstituted with regular visitation	0.65 (0.43-0.99)	0.66 (0.47-0.92)	0.65 (0.47-0.91)
Single parent with irregular visitation	1.14 (0.93-1.39)	1.11 (0.94-1.31)	1.11 (0.94-1.32)
Single parent with regular visitation	1.30 (0.94-1.80)	1.19 (0.91-1.55)	1.20 (0.91-1.57)
Girls			
Reconstituted with irregular visitation	1.22 (0.97-1.54)	1.05 (0.88-1.26)	1.06 (0.88-1.28)
Reconstituted with regular visitation	1.27 (0.89-1.82)	1.12 (0.86-1.47)	1.11 (0.85-1.45)
Single parent with irregular visitation	1.32 (1.13-1.55)	1.14 (0.98-1.32)	1.14 (0.98-1.33)
Single parent with regular visitation	0.93 (0.71-1.23)	0.84 (0.66-1.06)	0.84 (0.67-1.07)
Computer Use			, , , , , , , , , , , , , , , , , , ,
Boys			
Reconstituted with irregular visitation	1.24 (0.94-1.64)	1.07 (0.86-1.35)	1.07 (0.85-1.34)
Reconstituted with regular visitation	1.12 (0.74-1.70)	0.95 (0.68-1.33)	0.92 (0.66-1.30)
Single parent with irregular visitation	1.28 (1.06-1.55)	1.08 (0.91-1.29)	1.09 (0.91-1.31)
Single parent with regular visitation	1.15 (0.83-1.58)	1.14 (0.86-1.50)	1.13 (0.86-1.49)
Girls	× , , ,		× /
Reconstituted with irregular visitation	1.14 (0.93-1.39)	1.02 (0.86-1.21)	1.03 (0.87-1.22)
Reconstituted with regular visitation	1.36 (0.98-1.88)	1.14 (0.90-1.45)	1.13 (0.89-1.44)
Single parent with irregular visitation	1.19 (0.99-1.44)	1.10 (0.95-1.26)	1.11 (0.96-1.27)
Single parent with regular visitation	1.08 (0.80-1.45)	0.93 (0.73-1.18)	0.92 (0.73-1.17)
Video Game Use		````	× /
Boys			

Table 5.5. Results of fully adjusted* logistic regression analyses examining family structure as a predictor of being in the highest quartile of various screen time behaviours in boys and girls, with and without multiple imputation (*Referent group: Traditional families*)

Reconstituted with irregular visitat	ion 1.25 (0.98-1.59)	0.97 (0.80-1.18)	0.92 (0.75-1.14)
Reconstituted with regular visitation	on 1.28 (0.89-1.84)	0.97 (0.74-1.28)	0.99 (0.74-1.34)
Single parent with irregular visitati	on 1.40 (1.22-1.60)	1.11 (0.94-1.31)	1.13 (0.96-1.34)
Single parent with regular visitatio	n 1.48 (1.05-2.09)	1.18 (0.92-1.52)	1.17 (0.91-1.51)
Girls			
Reconstituted with irregular visitat	ion 1.03 (0.78-1.35)	0.92 (0.75-1.13)	0.93 (0.75-1.15)
Reconstituted with regular visitation	on 1.42 (0.98-2.06)	1.12 (0.84-1.49)	1.06 (0.79-1.43)
Single parent with irregular visitati	on 1.21 (0.99-1.48)	1.05 (0.88-1.26)	1.04 (0.86-1.26)
Single parent with regular visitatio	n 1.26 (0.87-1.82)	1.06 (0.80-1.39)	1.07 (0.81-1.42)
Total	× /		
Boys			
Reconstituted with irregular visitat	ion 1.33 (1.05-1.68)	1.05 (0.86-1.28)	1.03 (0.84-1.26)
Reconstituted with regular visitation	on 1.02 (0.69-1.50)	0.85 (0.63-1.15)	0.82 (0.60-1.12)
Single parent with irregular visitati	on 1.40 (1.18-1.66)	1.15 (0.98-1.36)	1.16 (0.98-1.37)
Single parent with regular visitatio	n 1.45 (1.07-1.96)	1.19 (0.92-1.52)	1.23 (0.96-1.58)
Girls			`
Reconstituted with irregular visitat	ion 1.08 (0.84-1.39)	0.96 (0.81-1.15)	0.95 (0.80-1.14)
Reconstituted with regular visitation	on 1.40 (0.98-1.99)	1.11 (0.86-1.43)	1.20 (0.93-1.56)
Single parent with irregular visitati	on 1.24 (1.03-1.50)	1.17 (1.00-1.36)	1.09 (0.93-1.29)
Single parent with regular visitatio	n 1.14 (0.83-1.58)	0.95 (0.74-1.22)	0.91 (0.71-1.17)

*All analyses account for sample weights and clustering by classroom, school and province, and are adjusted for the following covariates: grade, immigration status (immigrated <5 years ago vs >5 years ago), siblings (only child vs has siblings), ethnicity and self-reported family affluence (low, average or high)

Appendix G – Mediation analysis

Mediation analysis seeks to explain causal pathways by testing whether all or part of an exposure's effect on a given outcome is transmitted through a third variable, known as the mediator.¹ In Manuscript 1 socioeconomic status was analyzed as a potential mediator in the hypothesized relationship between family structure and adolescent sports participation. Several statistical tests exist for identifying potential mediators. Most require that the hypothesized relationship between the exposure, mediator(s) and outcome of interest be broken into three distinct components, as shown in Figure 5.1.^{1.2} The direct pathway, denoted as *c*', refers to the predictor's effect on the outcome after controlling for all known or hypothesized indirect effect *ab*, namely the effect of the predictor on the mediator and the resulting effect of the mediator on the outcome.² The overall pathway, often referred to as *c* (not shown), describes the total relationship between the predictor and outcome.² It is equivalent to the sum of the direct relationship and all known and unknown indirect pathways through mediators.²



Figure 5.1. Components of a simple mediation pathway.

X represents the exposure, Y represents the outcome and M represents the mediator. *Adapted from Hayes et al, 2013.*²

A popular method of testing for mediation is the Causal Steps Approach, developed by Baron and Kenny in 1986.⁴ The first step in this procedure is to ensure that there is a significant overall

relationship (*c* pathway) between the predictor and outcome. ¹ Next, the regression coefficients of the *a* and *b* pathways are tested. ¹ Finally, if *a*, *b* and *c* are statistically significant, the regression coefficients of the *c* and *c*' pathways are compared. ¹ If *c*' is closer to 0 than *c*, it can be concluded that at least partial mediation has occurred. ¹

The Causal Steps Approach has been criticized on several grounds. ¹ One common critique is that it fails to directly test the indirect effect, *ab*, instead relying on inference from a series of statistical tests that are each subject to error. ^{1,3} Another is that researchers have historically assumed that if *c* is insignificant then there is no pathway to be mediated. ^{1,3} This is not a valid assumption when there are multiple mediating pathways that affect the outcome in opposite directions. ^{1,3} Finally, simulation studies have shown that the Causal Steps Approach is one of the least statistically powerful mediation tests available.¹

An alternative method, often used in conjunction with the Causal Steps Approach, is the Sobel test. ⁵ It uses a normal test statistic obtained by multiplying the regression coefficients of the *a* and *b* pathways, then dividing the resulting product by its standard error, to test the null hypothesis that there is no indirect pathway. ¹ A major criticism of the Sobel test is that it assumes that the distribution of the indirect effect is normal. ¹ Simulation studies have also suggested that it is relatively low in statistical power.^{3,6}

The bootstrapping test of the indirect effect and the Empirical M test are recommended as the two most powerful tests of mediation. ¹ Manuscript 1 used the bootstrap-based test because it is the statistically less cumbersome of the two. ¹ The first step of the bootstrap-based test is to generate k (generally 1000-5000) bootstrap samples by drawing *N* observations randomly, with replacement, from the original dataset of *N* observations. ¹ Assuming that the original dataset is a good representation of the overall population, this procedure should mimic the original random sampling procedure k times. ¹ Next, the product of the regression coefficients of the *a* and *b*

pathways is calculated individually for each of the *k* resamples via linear or logistic regression. ⁶ The resulting *k* products are ordered from smallest to largest, and the $0.025k^{\text{th}}$ and $0.975k^{\text{th}}$ products represent the lower and upper bounds of the 95% bootstrap-based confidence interval. ¹ If the confidence interval does not pass through 0, it can be concluded that mediation is present. The mean of the *k* products represents the point estimate of the indirect effect, which is generally interpreted as the amount by which the outcome changes through the indirect pathway with each 1-unit increase in the exposure. ⁶⁻⁸ The point estimate was, however, not directly meaningful in Manuscript 1 as the *a* pathway was estimated through linear regression while the *b* pathway was estimated through logistic regression.

The bootstrapping analysis in Manuscript 1 was performed using a modified version of a SAS macro developed by Preacher and Hayes⁷ and further refined by Carson et al.⁹ This macro is both appropriate for binary outcomes with continuous mediators and able to take into account complex survey weights and data clustering.⁹ The test was performed separately for each of the four categories of non-traditional family, as recommended by Hayes et al.² If the indirect effect was significant for any of the categories then mediation was concluded to be present.²

References:

1. Hayes AF. Beyond Baron and Kenny: Statistical mediation analysis in the new millennium. *Communication Monographs*. 2009;76(4):408-420.

2. Hayes AF, Preacher KJ. Statistical mediation analysis with a multicategorical independent variable. *Br J Math Stat Psychol.* 2013.

3. Zhao Z, Lynch JG, Chen Q. Reconsidering Baron and Kenny: Myths and truths about mediation analysis. *Journal of Consumer Research, Inc.* 2010;37:197-206.

4. Baron RM, Kenny DA. The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *J Pers Soc Psychol*.

1986;51(6):1173-1182.

5. Sobel ME. Some new results on indirect effects and their standard errors in covariance structure models. *Sociological Methodology*. 1986;16:159-186.

6. Hayes AF. Introduction to mediation, moderation, and conditional process analysis: A regression-based approach. New York: Guilford Press; 2013.

7. Preacher KJ, Hayes AF. SPSS and SAS procedures for estimating indirect effects in simple mediation models. *Behavior Research Methods, Instruments & Computers*. 2004;36(4):717-731.

8. Preacher KJ, Kelley K. Effect size measures for mediation models: Quantitative strategies for communicating indirect effects. *Psychol Methods*. 2011;16(2):93-115.

9. Carson V, Iannotti RJ, Pickett W, Janssen I. Urban and rural differences in sedentary behavior among American and Canadian youth. *Health Place*. 2011;17(4):920-928.

10. Eime RM, Harvey JT, Craike MJ, Symons CM, Payne WR. Family support and ease of access link socio-economic status and sports club membership in adolescent girls: A mediation study. *Int J Behav Nutr Phys Act.* 2013;10:50-5868-10-50.

Appendix H – Additional results from Manuscript 1

Analysis of excluded data:

Table 5.6. Baseline characteristics of excluded participants from the analysis using self-reported socioeconomic status to measure SES

	Baseline characteristics of excluded participants (N = 5 221)			
	N	% (95% CI)*	% (95% CI), excluding missing category*	
Gender				
Male	2721	56.0 (53.6-58.3)	56.1 (53.7-58.4)	
Female	2125	43.8 (41.5-46.2)	43.9 (41.6-46.3)	
Missing	31	0.2 (0.0-0.4)		
Grade				
Grade 5	16	0.4 (0.0-0.7)	0.4 (0.0-0.7)	
Grade 6	1160	25.5 (20.6-30.4)	25.5 (20.6-30.4)	
Grade 7	1092	22.4 (19.2-25.7)	22.4 (19.2-25.7)	
Grade 8	918	17.1 (14.4-19.8)	17.1 (14.4-19.8)	
Grade 9	918	18.2 (14.6-21.9)	18.2 (14.6-21.9)	
Grade 10	719	15.5 (11.7-19.3)	15.5 (11.7-19.3)	
Grade 11	54	0.9 (0.5-1.3)	0.9 (0.5-1.3)	
Missing	16	0		
Self-Perceived Family Affluence				
Very well off	752	15.1 (13.3-16.9)	22.7 (20.3-25.2)	
Quite well off	885	19.3 (17.3-21.2)	29.0 (26.6-31.4)	
Average	1172	23.3 (20.8-25.9)	35.2 (32.2-38.2)	
Not very well off	275	5.5 (4.6-6.5)	8.3 (7.0-9.7)	
Not at all well off	173	3.2 (2.3-4.0)	4.8 (3.5-6.0)	
Missing	1620	33.7 (29.6-37.8)		
Family Affluence Scale				
0 (lowest)	20	0.4 (0.1-0.6)	0.6 (0.2-1.0)	
1	40	0.7 (0.4-1.1)	1.2 (0.6-1.8)	
2	84	1.2 (0.8-1.7)	2.0 (1.2-2.7)	
3	214	4.5 (3.6-5.4)	7.2 (5.8-8.7)	
4	363	8.5 (7.2-9.9)	13.6 (11.7-15.5)	
5	484	10.7 (9.3-12.0)	17.0 (15.5-18.6)	
6	550	12.2 (10.7-13.8)	19.5 (17.4-21.7)	
7	518	11.1 (9.7-12.6)	17.8 (15.5-20.1)	
8	360	8.4 (7.0-9.9)	13.5 (11.4-15.5)	
9 (highest)	232	4.8 (3.7-5.8)	7.6 (6.1-9.1)	
Missing	2012	37.4 (33.5-41.4)		
Immigrant Status				

Lived in Canada ≥5 years	4374	88.3 (86.3-90.4)	93.9 (92.2-95.5)
Lived in Canada <5 years	227	5.8 (4.2-7.3)	6.1 (4.5-7.8)
Missing	276	5.9 (4.9-6.9)	
Parental Structure			
Traditional family	1574	35.3 (32.0-38.6)	43.2 (39.5-46.9)
Reconstituted with irregular visitation	158	4.0 (3.1-4.9)	4.9 (3.8-6.0)
Reconstituted with regular visitation	55	1.4 (0.9-1.8)	1.7 (1.1-2.3)
Single parent with irregular visitation	410	8.7 (7.6-9.9)	10.7 (9.2-12.2)
Single parent with regular visitation	103	2.3 (1.6-3.0)	2.8 (2.0-3.7)
Other	1533	30.1 (27.2-32.9)	36.8 (33.4-40.1)
Missing	1044	18.2 (16.1-20.3)	
Siblings			
≥1 sibling	3082	65.1 (62.5-67.6)	81.0 (79.1-82.9)
Only Child	757	15.3 (13.8-16.8)	19.0 (17.1-20.9)
Missing	1038	19.6 (17.5-21.8)	
Ethnicity			
Canadian	3662	69.3 (65.2-73.5)	74.1 (69.8-78.4)
East and Southeast Asian	183	4.6 (3.1-6.1)	4.9 (3.3-6.5)
South Asian	95	2.6 (1.6-3.7)	2.8 (1.7-3.9)
Black	134	4.0 (2.7-5.4)	4.3 (2.9-5.7)
Arab	50	1.5 (0.5-2.4)	1.6 (0.6-2.6)
Latin American	31	1.0 (0.5-1.4)	1.0 (0.6-1.5)
Other	404	10.6 (8.8-12.3)	11.3 (9.4-13.2)
Missing	318	6.4 (5.4-7.5)	
Participation in Sports Club or Team			
No	1347	29.1 (27.0-31.2)	50.1 (46.7-53.5)
Yes	1335	29.0 (25.5-32.5)	49.9 (46.5-53.3)
Missing	2195	41.9 (37.7-46.1)	

Missing219341.9 (3/./-40.1)N = Number of sampled individuals with complete valid data for all variables presented.*Estimated population characteristics after adjusting for sampling weights and clustering by
classroom, school and province.

Variable	Ν	% (95% CI)*
Gender		
Male	10 226	47.6 (46.0, 49.2)
Female	11 209	52.4 (50.9, 54.0)
Grade		
Grade 5	39	0.2 (0.0, 0.5)
Grade 6	4 090	19.0 (15.6, 22.4)
Grade 7	4 200	19.6 (17.2, 22.1)
Grade 8	4 388	20.7 (18.1, 23.3)
Grade 9	4 455	20.8 (17.6, 24.1)
Grade 10	4 143	19.1 (15.8, 22.5)
Grade 11	120	0.5 (0.3, 0.6)
Family Affluence Scale		
0 (lowest)	23	0.1 (0.0, 0.1)
1	97	0.3 (0.2, 0.4)
2	380	1.9 (1.5, 2.3)
3	984	4.8 (4.2, 5.4)
4	2 135	10.9 (10.2, 11.7)
5	3 389	16.4 (15.6, 17.1)
6	4 536	21.4 (20.6, 22.2)
7	4 545	20.6 (19.8, 21.5)
8	3 360	15.1 (14.3, 15.9)
9 (highest)	1 986	8.5 (7.8, 9.1)
Immigrant Status		
Lived in Canada ≥ 5 years	20 569	95.7 (94.8, 96.5)
Lived in Canada <5 years	866	4.3 (3.5, 5.2)
Parental Structure		
Traditional family	15 139	71.4 (70.0, 72.8)
Reconstituted with irregular visitation	1 593	7.1 (6.4, 7.7)
Reconstituted with regular visitation	599	2.9 (2.6, 3.3)
Single parent with irregular visitation	3 209	14.2 (13.3, 15.1)
Single parent with regular visitation	895	4.4 (4.0, 4.8)
Siblings		
≥1 sibling	18 370	86.9 (86.1, 87.7)
Only child	3 065	13.1 (12.3, 13.9)
Ethnicity		
Canadian	17 149	76.4 (73.0, 79.9)
East and Southeast Asian	1 102	5.8 (4.1, 7.6)
South Asian	573	3.3 (2.2, 4.4)
Black	353	2.3 (1.7, 2.9)
Arab	178	1.2 (0.6, 1.7)
Latin American	164	1.0 (0.6, 1.3)

Table 5.7. Baseline characteristics of participants from the 2009/10 Canadian HBSC included in

 the analysis using the Family Affluence Scale to measure family-level wealth

Other	1 916	9.9 (8.9, 10.9)
Participation in Sports Club or Team		
No	9 391	44.8 (43.0, 46.6)
Yes	12 044	55.2 (53.4, 57.0)

N = Number of sampled individuals with complete valid data for all variables presented. *Estimated population characteristics after adjusting for sampling weights and clustering by classroom, school and province.

Table 5.8. Association between family structure and family wealth, as measured through the

Family Affluence Scale

Family Structure	Regression Coefficient (Standard Error)*		
	Boys	Girls	
Traditional	0 (referent)	0 (referent)	
Reconstituted with irregular visitation	-0.36 (0.09)**	-0.54 (0.09)**	
Reconstituted with regular visitation	0.09 (0.15)	-0.04 (0.10)	
Single parent with irregular visitation	-0.97 (0.07)**	-1.20 (0.07)**	
Single parent with regular visitation	-0.21 (0.13)	-0.57 (0.11)**	

All analyses account for sample weights and clustering by classroom, school and province *Adjusted for number of siblings, immigration status, ethnicity and grade. **Statistically significant ($p \le 0.05$) **Table 5.9.** Results of the analysis examining the association between family structure and organized sports participation and the extent to which it is mediated by family wealth, as measured using the Family Affluence Scale

	Total Association*	Direct Association [†]		Indirect Association
Family Structure	Odds Ratio (95% confidence interval)	Odds Ratio (95% confidence interval)	% Change [§]	Point estimate (Percentile 95% CI)
Boys (N = 10 226)				
Traditional	1.00 (referent)	1.00 (referent)	-	0 (referent)
Reconstituted with irregular visitation	0.48 (0.38, 0.61)	0.51 (0.40, 0.65)	4.8	-0.06 (-0.10, -0.03)
Reconstituted with regular visitation	0.75 (0.54, 1.04)	0.74 (0.54, 1.01)	-6.9	0.02 (-0.03, 0.07)
Single parent with irregular visitation	0.56 (0.48, 0.67)	0.66 (0.56, 0.77)	21.6	-0.16 (-0.20, -0.12)
Single parent with regular visitation	0.69 (0.53, 0.90)	0.71 (0.55, 0.92)	7.1	-0.04 (-0.08, 0.00)
Girls (N = 11 209)				
Traditional	1.00 (referent)	1.00 (referent)	-	0 (referent)
Reconstituted with irregular visitation	0.54 (0.44, 0.67)	0.60 (0.48, 0.74)	11.4	-0.11 (-0.15, -0.07)
Reconstituted with regular visitation	0.66 (0.51, 0.86)	0.66 (0.50, 0.87)	0.0	-0.01 (-0.05, 0.04)
Single parent with irregular visitation	0.54 (0.46, 0.64)	0.68 (0.58, 0.80)	29.8	-0.24 (-0.29, -0.19)
Single parent with regular visitation	0.73 (0.57, 0.94)	0.81 (0.63, 1.04)	30.3	-0.11 (-0.17, -0.07)

All analyses adjusted for sample weights and clustering by classroom, school and province.

*Adjusted for number of siblings, immigration status, ethnicity and grade.

[†]Adjusted for number of siblings, immigration status, ethnicity, grade and Family Affluence Scale score.

[§]Percentage change in the odds ratio from Total Effect to Direct Effect model (i.e., prior to and after controlling for Family Affluence Scale score).

 $Calculated \ as: (OR_{adjusted \ for \ FAS} - OR_{unadjusted \ for \ wealth})/(OR_{unadjusted \ for \ wealth} - 1)$



Figure 5.2. Flow chart of inclusion information for participants for the Family Affluence Scale analyses

Appendix I – Additional results from Manuscript 2

Analyses by covariate:

Table 5.10. Mean adjusted weekly hours of screen time (television, video games and computer) per covariate with imputation, by gender

	Television [¢]	Computer ^{ϕ}	Video Games [¢]	Total Screen time [¢]
-	Mean (95% CI)	Mean (95% CI)	Mean (95% CI)	Mean (95% CI)
Boys	· · · · · · ·	· · · · · · · · · · · · · · · · · · ·	· · · · · ·	· · · · · · · · · · · · · · · · · · ·
Siblings				
None (<i>Ref</i>)	20.7 (19.2-22.3)	16.9 (15.5-18.4)	19.3 (17.9-20.7)	57.0 (53.4-60.6)
≥ 1	20.4 (19.0-21.9)	16.3 (15.0-17.7)	18.7 (17.3-20.2)	55.5 (52.0-59.0)
Perceived Family Affluence				
High (<i>Ref</i>)	20.2 (18.7-21.6)	16.0 (14.6-17.4)	17.9 (16.5-19.2)	54.0 (50.5-57.6)
Average	20.8 (19.4-22.1)	16.5 (15.2-17.9)	19.4 (18.0-20.8) *	56.7 (53.4-60.1) *
Low	20.8 (19.0-22.7)	17.4 (15.7-19.0)	19.8 (18.1-21.5) *	58.0 (53.7-62.2) *
Immigration Status				
Lived in Canada ≥ 5 years (<i>Ref</i>)	20.9 (19.6-22.2)	16.4 (15.2-17.7)	19.2 (18.1-20.3)	56.5 (53.5-59.6)
Lived in Canada <5 years	20.3 (18.5-22.1)	16.8 (15.1-18.6)	18.8 (17.0-20.7)	56.0 (51.5-60.4)
Grade				
6 (<i>Ref</i>)	20.5 (19.0-22.1)	13.1 (11.7-14.6)	17.9 (16.3-19.5)	51.6 (47.6-55.5)
7	21.3 (19.7-23.0)	15.4 (13.9-17.0) *	19.2 (17.6-20.8)	56.0 (52.0-60.0) *
8	20.6 (18.9-22.3)	17.0 (15.5-18.4) *	19. 5 (18.0-20.9) *	57.0 (53.3-60.8) *
9	20.7 (19.1-22.4)	19.1 (17.5-20.8) *	20.2 (18.6-21.8) *	60.0 (55.9-64.2) *
10	19.7 (18.1-21.2)	18.5 (17.0-19.9) *	18.4 (17.0-19.9)	56.6 (53.0-60.1) *
Ethnicity				
Canadian (Ref)	18.6 (17.5-19.7)	17.5 (14.0-21.0)	18.3 (17.2-19.4)	50.9 (48.3-53.5)
East and Southeast Asian	17.9 (15.919.9)	19.6 (15.723.6)	18.2 (16.0-20.4)	53.7 (47.9-59.5)
South Asian	19.3 (17.121.4)	17.5 (14.720.3)	17.3 (15.3-19.2)	51.1 (46.9-55.4)

Black	25.4 (22.0-28.8) *	15.4 (13.9-17.0)	19.9 (17.1-22.7)	62.9 (55.4-70.3) *
Arab	21.7 (18.6-24.8)	13.1 (11.7-14.6) *	22.3 (19.1-25.6)	63.6 (55.5-71.8) *
Latin American	22.7 (19.226.3)	17.6 (15.419.8)	18.5 (14.4-22.6)	58.8 (49.0-68.6)
Other	18.4 (17.0-19.9)	14.6 (12.9-16.4) *	18.7 (17.2-20.2)	52.7 (49.5-56.0)
Girls				
Siblings				
None (<i>Ref</i>)	20.1 (18.5-21.7)	19.4 (18.0-20.8)	11.5 (10.0-13.1)	51.1 (47.5-54.7)
≥ 1	19.9 (18.5-21.3)	18.9 (17.7-20.1)	11.4 (9.8-12.9)	50.1 (46.7-53.5)
Perceived Family Affluence				
High (Ref)	19.1 (17.7-20.5)	18.1 (16.8-19.4)	10.1 (8.8-11.5)	47.4 (44.0-50.7)
Average	19.5 (18.1-20.9)	19.3 (18.1-20.6) *	11.0 (9.6-12.4)*	49.9 (46.6-53.2) *
Low	21.4 (19.5-23.2)*	20.0 (18.6-21.5) *	13.2 (11.2-15.2) *	54.6 (50.3-58.9) *
Immigration Status				
Lived in Canada ≥ 5 years (<i>Ref</i>)	20.5 (19.2-21.8)	19.5 (18.3-20.6)	11.2 (10.0-12.5)	51.2 (48.3-54.2)
Lived in Canada < 5 years	19.5 (17.5-21.4)	18.9 (17.1-20.6)	11.7 (9.6-13.7)	50.0 (45.3-54.7)
Grade	· · · · · · · · · · · · · · · · · · ·			
6 (<i>Ref</i>)	19.5 (17.6-21.3)	14.1 (12.7-15.4)	10.9 (9.3-12.4)	44.4 (40.6-48.2)
7	20.3 (18.8-21.8)	18.6 (17.1-20.0) *	12.1 (10.5-13.8)	51.0 (47.2-54.8) *
8	20.2 (18.5-22.0)	20.5 (19.1-22.0) *	12.3 (10.6-14.0)*	53.1 (49.1-57.1) *
9	20.1 (18.6-21.7)	21.4 (20.1-22.7) *	11.5 (9.9-13.1)	53.0 (49.5-56.6) *
10	19.8 (18.2-21.5)	21.2 (19.6-22.7) *	10.5 (8.8-12.1)	51.5 (47.6-55.4) *
Ethnicity				
Canadian (Ref)	17.7 (16.6-18.8)	16.8 (15.6-18.1)	10.4 (9.2-11.5)	44.9 (42.1-47.7)
East and Southeast Asian	17.0 (15.3-18.8)	21.9 (19.9-23.8)*	13.1 (11.3-14.9) *	52.0 (48.1-55.9)*
South Asian	19.5 (17.9-21.0)	17.8 (15.7-19.9)	11.0 (9.1-12.8)	48.2 (43.9-52.5)
Black	25.2 (22.2-28.2) *	20.7 (17.8-23.6)	12.8 (9.7-15.9)	58.7 (51.2-66.2) *
Arab	22.0 (18.5-25.5)	21.5 (18.5-24.5) *	12.2 (9.0-15.4)	55.7 (47.6-63.8) *
Latin American	20.0 (16.8-23.1)	17.9 (14.8-21.0)	10.0 (6.7-13.2)	47.9 (41.0-54.7)
Other	18.6 (17.0-20.1)	17.6 (16.1-19.1)	10.8 (9.1-12.4)	46.9 (43.1-50.8)

All analyses account for sample weights and clustering by classroom, school and province Ref = referent group

^{\$\overline\$} Adjusted for the following covariates: grade, immigration status (immigrated <5 years ago vs >5 years ago), siblings (only child vs has siblings), ethnicity and self-reported family affluence (low, average or high)
 * Significantly different from referent group after taking into account multiple comparisons (Bonferroni-adjusted p-value<0.05)

Table 5.11. Unadjusted and adjusted relationships with being in the highest quartile of television viewing with multiple imputation, by gender, for covariates

	Frequency	Bivariate Analysis	Fully Adjusted ^{\$} Model
	% (95% CI)	OR (95% CI)	OR (95% CI)
Boys	· · · · ·		· · ·
Siblings			
None	29.6 (26.1-33.1)	-	-
≥ 1 sibling	28.3 (26.4-30.2)	0.97 (0.89-1.06)	0.88 (0.76-1.01)
Self-Perceived Family Affluence		×	× /
High	27.2 (24.9-29.5)	-	-
Average	29.7 (27.4-32.0)	0.99 (0.89-1.09)	1.13 (0.99-1.29)
Low	33.1 (28.7-37.6)	1.16 (1.01-1.33)	1.02 (0.90-1.15)
Immigration Status		× /	
Lived in Canada ≥ 5 years	28.4 (26.6-30.2)	-	-
Lived in Canada <5 years	30.2 (24.4-36.0)	1.04 (0.91-1.19)	0.99 (0.88-1.12)
Grade		×	
Grade 6	28.3 (25.2-31.3)	-	-
Grade 7	30.6 (26.9-34.3)	1.11 (0.97-1.26)	1.00 (0.90-1.10)
Grade 8	28.9 (25.5-32.2)	1.02 (0.90-1.16)	1.13 (0.98-1.30)
Grade 9	28.7 (25.6-31.8)	1.01 (0.89-1.15)	0.98 (0.87-1.11)
Grade 10	26.1 (22.9-29.3)	0.89 (0.77-1.02)	0.99 (0.90-1.07)
Ethnicity			
Canadian	27.6 (25.7-29.4)	-	-
East and Southeast Asian	26.4 (20.2-32.5)	0.69 (0.53-0.90)	0.69 (0.53-0.90)
South Asian	29.7 (23.0-36.4)	0.81 (0.61-1.08)	0.84 (0.63-1.11)
Black	50.1 (39.8-60.5)	1.94 (1.34-2.80)	1.93 (1.34-2.78)
Arab	37.7 (28.6-46.8)	1.16 (0.84-1.61)	1.21 (0.87-1.68)
Latin American	43.2 (30.7-55.8)	1.47 (0.96-2.23)	1.40 (0.93-2.12)
Other	27.7 (23.8-31.7)	0.74 (0.60-0.91)	0.73 (0.59-0.90)

Girls			
Siblings			
None	27.3 (23.8-30.8)	-	-
≥ 1 sibling	25.8 (24.1-27.5)	0.96 (0.88-1.05)	0.98 (0.84-1.14)
Self-Perceived Family Affluence			
High	24.6 (22.6-26.6)	-	-
Average	26.5 (24.3-28.7)	0.95 (0.86-1.04)	1.02 (0.90-1.17)
Low	31.9 (28.1-35.8)	1.23 (1.09-1.39)	1.06 (0.92-1.21)
Immigration Status			
Lived in Canada ≥ 5 years	26.0 (24.3-27.6)	-	-
Lived in Canada <5 years	26.3 (20.1-32.6)	1.01 (0.86-1.18)	1.02 (0.89-1.17)
Grade			
Grade 6	24.5 (20.9-28.0)	-	-
Grade 7	26.3 (23.3-29.3)	1.02 (0.90-1.16)	0.95 (0.86-1.04)
Grade 8	26.8 (23.4-30.3)	1.05 (0.91-1.20)	1.20 (1.06-1.36)
Grade 9	26.5 (23.7-29.3)	1.03 (0.90-1.18)	0.95 (0.81-1.11)
Grade 10	25.7 (22.4-29.0)	0.99 (0.85-1.15)	0.99 (0.90-1.08)
Ethnicity			
Canadian	24.8 (23.1-26.5)	-	-
East and Southeast Asian	22.9 (18.3-27.4)	0.67 (0.52-0.86)	0.67 (0.52-0.87)
South Asian	27.2 (21.2-33.2)	0.84 (0.64-1.10)	0.89 (0.68-1.16)
Black	47.4 (37.9-56.8)	2.02 (1.46-2.81)	1.92 (1.37-2.68)
Arab	37.0 (23.8-50.3)	1.32 (0.84-2.08)	1.39 (0.88-2.18)
Latin American	29.7 (18.6-40.8)	0.95 (0.60-1.51)	0.94 (0.59-1.50)
Other	29.7 (26.1-33.4)	0.95 (0.79-1.14)	0.93 (0.77-1.12)

All analyses account for sample weights and clustering by classroom, school and province. Statistically significant odds ratios are shown in bold (i.e., 95% confidence intervals do not cross through the null). [•] Adjusted for the following covariates: grade, immigration status (immigrated <5 years ago vs >5 years ago), siblings (only child vs has siblings),

ethnicity and self-reported family affluence (low, average or high)

Ref = referent group

Table 5.12. Unadjusted and adjusted relationship with being in the highest quartile of computer use with multiple imputation, by gender, for covariates

	Frequency	Bivariate Analysis	Fully Adjusted ^{\$} Model
	% (95% CI)	OR (95% CI)	OR (95% CI)
Boys	· · · · ·		
Siblings			
None	25.0 (21.9-28.0)	-	-
≥ 1 sibling	21.5 (19.7-23.3)	0.91 (0.84-0.99)	1.30 (1.12-1.50)
Self-Perceived Family Affluence			· · · · ·
High	21.0 (19.0-22.9)	-	-
Average	22.8 (20.5-25.1)	0.97 (0.88-1.08)	0.86 (0.74-0.99)
Low	26.3 (22.2-30.5)	1.18 (1.02-1.36)	1.08 (0.95-1.22)
Immigration Status		× , , ,	× /
Lived in Canada ≥ 5 years	21.7 (20.0-23.4)	-	-
Lived in Canada <5 years	27.9 (22.6-33.2)	1.18 (1.03-1.35)	1.45 (1.25-1.67)
Grade			х ́́
Grade 6	13.5 (11.3-15.7)	-	-
Grade 7	18.8 (16.2-21.5)	0.85 (0.74-0.98)	0.95 (0.85-1.06)
Grade 8	22.9 (20.3-25.4)	1.09 (0.96-1.23)	1.16 (1.00-1.35)
Grade 9	28.5 (24.9-32.1)	1.46 (1.26-1.68)	1.06 (0.92-1.21)
Grade 10	26.3 (23.2-29.5)	1.31 (1.13-1.52)	0.96 (0.88-1.04)
Ethnicity		× , , ,	`
Canadian	20.0 (18.3-21.7)	-	-
East and Southeast Asian	28.1 (20.5-35.7)	0.99 (0.70-1.38)	1.02 (0.74-1.41)
South Asian	25.0 (19.3-30.7)	0.84 (0.64-1.11)	0.89 (0.68-1.17)
Black	33.6 (24.3-42.8)	1.28 (0.90-1.81)	1.20 (0.84-1.72)
Arab	34.3 (22.5-46.1)	1.32 (0.82-2.11)	1.29 (0.81-2.05)
Latin American	32.8 (20.6-44.9)	1.23 (0.75-2.02)	1.16 (0.70-1.90)
Other	26.7 (23.1-30.4)	0.92 (0.74-1.15)	0.94 (0.77-1.16)

Girls			
Siblings			
None	32.4 (28.9-35.9)	-	-
≥ 1 sibling	29.0 (27.1-30.8)	0.92 (0.85-1.00)	1.31 (1.14-1.49)
Self-Perceived Family Affluence			
High	26.8 (24.6-29.0)	-	-
Average	32.4 (30.1-34.8)	1.09 (1.01-1.18)	0.96 (0.85-1.09)
Low	32.9 (29.1-36.7)	1.11 (0.98-1.26)	1.19 (1.04-1.35)
Immigration Status			
Lived in Canada ≥ 5 years	29.2 (27.4-31.0)	-	-
Lived in Canada <5 years	32.9 (26.8-38.9)	1.09 (0.95-1.25)	1.34 (1.19-1.50)
Grade			
Grade 6	16.6 (14.2-19.1)	-	-
Grade 7	27.7 (24.7-30.6)	0.96 (0.84-1.08)	1.07 (0.99-1.15)
Grade 8	32.3 (28.8-35.8)	1.19 (1.05-1.36)	1.10 (0.97-1.25)
Grade 9	35.0 (32.1-37.9)	1.35 (1.19-1.51)	0.96 (0.82-1.12)
Grade 10	34.3 (31.1-37.6)	1.31 (1.14-1.50)	0.98 (0.90-1.06)
Ethnicity			
Canadian	27.9 (25.9-29.9)	-	-
East and Southeast Asian	43.1 (35.7-50.5)	1.50 (1.12-2.01)	1.55 (1.17-2.06)
South Asian	27.3 (21.1-33.5)	0.75 (0.55-1.02)	0.79 (0.59-1.05)
Black	39.3 (29.9-48.8)	1.29 (0.90-1.83)	1.22 (0.85-1.75)
Arab	38.1 (26.5-49.8)	1.22 (0.79-1.88)	1.27 (0.83-1.96)
Latin American	30.3 (18.5-42.1)	0.86 (0.54-1.38)	0.83 (0.52-1.34)
Other	30.2 (26.0-34.3)	0.86 (0.70-1.05)	0.85 (0.69-1.04)

All analyses account for sample weights and clustering by classroom, school and province. Statistically significant odds ratios are shown in bold (i.e., 95% confidence intervals do not cross through the null). [•] Adjusted for the following covariates: grade, immigration status (immigrated <5 years ago vs >5 years ago), siblings (only child vs has siblings),

ethnicity and self-reported family affluence (low, average or high)

Table 5.13. Unadjusted and adjusted relationships with being in the highest quartile of video game use with multiple imputation, by gender, for covariates

	Frequency	Bivariate Analysis	Fully Adjusted ^{\$} Model
	% (95% CI)	OR (95% CI)	OR (95% CI)
Boys			· · · ·
Siblings			
None	38.4 (35.2-41.7)	-	-
≥ 1 sibling	34.9 (33.2-36.7)	0.93 (0.86-1.00)	0.94 (0.81-1.07)
Self-Perceived Family Affluence			×
High	33.0 (31.0-35.0)	-	-
Average	38.7 (36.3-41.2)	1.07 (0.98-1.17)	0.99 (0.88-1.11)
Low	39.9 (35.3-44.5)	1.12 (0.98-1.28)	1.09 (0.99-1.20)
Immigration Status			
Lived in Canada ≥ 5 years	35.5 (33.8-37.2)	-	-
Lived in Canada <5 years	34.3 (29.2-39.5)	0.98 (0.87-1.09)	1.23 (1.09-1.39)
Grade			
Grade 6	30.6 (27.6-33.5)	-	-
Grade 7	34.7 (31.6-37.9)	0.97 (0.87-1.09)	1.06 (0.96-1.16)
Grade 8	37.1 (34.3-39.9)	1.08 (0.97-1.19)	1.10 (0.96-1.26)
Grade 9	40.4 (37.0-43.9)	1.24 (1.10-1.41)	0.98 (0.87-1.12)
Grade 10	34.1 (30.7-37.6)	0.95 (0.83-1.09)	0.96 (0.89-1.04)
Ethnicity			
Canadian	35.3 (33.5-37.1)	-	-
East and Southeast Asian	34.4 (27.4-41.5)	0.91 (0.69-1.21)	0.93 (0.70-1.24)
South Asian	30.2 (23.7-36.6)	0.75 (0.56-1.00)	0.79 (0.58-1.07)
Black	39.5 (31.6-47.4)	1.13 (0.83-1.54)	1.09 (0.79-1.50)
Arab	45.9 (35.1-56.7)	1.47 (1.00-2.18)	1.53 (1.03-2.26)
Latin American	35.5 (23.0-47.9)	0.95 (0.58-1.57)	0.89 (0.54-1.47)
Other	36.0 (31.5-40.5)	0.98 (0.81-1.18)	0.97 (0.80-1.17)

Girls			
Siblings			
None	17.1 (14.4-19.8)	-	-
≥ 1 sibling	15.9 (14.6-17.2)	0.96 (0.87-1.06)	0.91 (0.78-1.06)
Self-Perceived Family Affluence			
High	14.4 (13.0-15.8)	-	-
Average	16.7 (15.0-18.5)	0.93 (0.83-1.05)	1.14 (0.99-1.31)
Low	22.8 (18.9-26.8)	1.37 (1.17-1.60)	1.19 (1.03-1.38)
Immigration Status			
Lived in Canada ≥ 5 years	15.8 (14.6-17.0)	-	-
Lived in Canada <5 years	21.8 (16.8-26.7)	1.22 (1.05-1.41)	1.12 (0.98-1.28)
Grade			
Grade 6	12.0 (9.6-14.3)	-	-
Grade 7	17.7 (15.2-20.1)	1.14 (0.99-1.32)	0.93 (0.83-1.04)
Grade 8	18.3 (15.7-21.0)	1.19 (1.03-1.38)	1.37 (1.17-1.60)
Grade 9	17.3 (15.2-19.4)	1.11 (0.97-1.28)	1.12 (0.96-1.31)
Grade 10	14.7 (12.5-16.8)	0.91 (0.78-1.07)	1.00 (0.90-1.10)
Ethnicity			
Canadian	15.2 (13.9-16.5)	-	-
East and Southeast Asian	22.9 (18.2-27.5)	1.34 (0.99-1.82)	1.30 (0.95-1.80)
South Asian	15.5 (10.5-20.4)	0.83 (0.57-1.20)	0.88 (0.61-1.26)
Black	21.0 (13.8-28.2)	1.21 (0.83-1.76)	1.13 (0.77-1.67)
Arab	17.0 (8.8-25.2)	0.93 (0.56-1.52)	0.97 (0.60-1.58)
Latin American	18.3 (9.2-27.5)	1.02 (0.59-1.74)	1.00 (0.57-1.75)
Other	17.6 (14.2-21.1)	0.97 (0.80-1.18)	0.97 (0.80-1.18)

All analyses account for sample weights and clustering by classroom, school and province. Statistically significant odds ratios are shown in bold (i.e., 95% confidence intervals do not cross through the null). [•] Adjusted for the following covariates: grade, immigration status (immigrated <5 years ago vs >5 years ago), siblings (only child vs has siblings),

ethnicity and self-reported family affluence (low, average or high)

	Frequency	Bivariate Analysis	Fully Adjusted ^{\$} Model
	<u>% (95% CI)</u>	OR (95% CI)	OR (95% CI)
Dys			
Siblings			
None	33.1 (29.4-36.7)	-	-
≥1 sibling	30.2 (28.1-32.2)	0.94 (0.87-1.01)	1.02 (0.88-1.17)
Self-Perceived Family Affluence			
High	28.4 (26.1-30.7)	-	-
Average	33.0 (30.4-35.6)	1.02 (0.93-1.13)	1.02 (0.90-1.15)
Low	36.3 (31.8-40.8)	1.18 (1.04-1.35)	1.04 (0.93-1.17)
Immigration Status		· · · · ·	
Lived in Canada ≥ 5 years	30.4 (28.3-32.4)	-	-
Lived in Canada <5 years	34.5 (29.1-40.0)	1.10 (0.97-1.24)	1.20 (1.05-1.37)
Grade		· · · · ·	
Grade 6	12.0 (9.6-14.3)	-	-
Grade 7	17.7 (15.2-20.1)	1.00 (0.88-1.13)	1.02 (0.92-1.12)
Grade 8	18.3 (15.7-21.0)	1.04 (0.93-1.17)	1.15 (1.01-1.32)
Grade 9	17.3 (15.2-19.4)	1.21 (1.06-1.39)	1.03 (0.91-1.16)
Grade 10	14.7 (12.5-16.8)	1.03(0.90-1.19)	0.98 (0.90-1.06)
Ethnicity	· · · ·		
Canadian	15.2 (13.9-16.5)	-	-
East and Southeast Asian	22.9 (18.2-27.5)	0.86 (0.67-1.11)	0.87 (0.67-1.12)
South Asian	15.5 (10.5-20.4)	0.72 (0.55-0.94)	0.76 (0.59-0.99)
Black	21.0 (13.8-28.2)	1.45 (0.97-2.16)	1.40 (0.93-2.10)
Arab	17.0 (8.8-25.2)	1.46 (1.05-2.04)	1.50 (1.08-2.10)
Latin American	18.3 (9.2-27.5)	1.22 (0.73-2.02)	1.13 (0.68-1.90)
Other	17.6 (14.2-21.1)	0.89 (0.73-1.07)	0.89 (0.74-1.07)
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Table 5.14. Unadjusted and adjusted relationships with being in the highest quartile of total screen time* with multiple imputation, by gender, for covariates

Siblings			
None	25.4 (22.0-28.8)	-	-
≥ 1 sibling	22.6 (21.0-24.2)	0.93 (0.85-1.01)	1.03 (0.87-1.20)
Self-Perceived Family Affluence			
High	21.0 (19.1-23.0)	-	-
Average	24.3 (22.2-26.4)	0.99 (0.89-1.09)	1.01 (0.89-1.15)
Low	28.8 (24.7-32.8)	1.24 (1.08-1.43)	1.22 (1.07-1.40)
Immigration Status			
Lived in Canada \geq 5 years	22.7 (21.1-24.3)	-	-
Lived in Canada <5 years	29.3 (23.1-35.5)	1.19 (1.02-1.38)	1.14 (1.00-1.31)
Grade			
Grade 6	16.8 (14.5-19.1)	-	-
Grade 7	22.8 (19.7-25.8)	1.01 (0.88-1.15)	0.98 (0.89-1.08)
Grade 8	26.3 (23.1-29.5)	1.22 (1.07-1.39)	1.23 (1.06-1.42)
Grade 9	25.1 (22.3-27.9)	1.15 (1.00-1.32)	1.10 (0.94-1.29)
Grade 10	23.3 (20.1-26.5)	1.03 (0.88-1.22)	0.96 (0.88-1.06)
Ethnicity			
Canadian	21.8 (20.1-23.5)	-	-
East and Southeast Asian	27.3 (22.9-31.7)	1.02 (0.80-1.31)	1.00 (0.78-1.28)
South Asian	25.9 (19.5-32.3)	0.95 (0.69-1.31)	1.00 (0.74-1.35)
Black	40.4 (30.8-49.9)	1.84 (1.31-2.58)	1.75 (1.23-2.48)
Arab	27.1 (16.1-38.1)	1.01 (0.63-1.61)	1.05 (0.66-1.67)
Latin American	24.1 (13.3-35.0)	0.86 (0.52-1.42)	0.84 (0.51-1.39)
Other	23.7 (19.8-27.6)	0.85 (0.70-1.02)	0.85 (0.71-1.01)

All analyses account for sample weights and clustering by classroom, school and province. Statistically significant odds ratios are shown in bold

(i.e., 95% confidence intervals do not cross through the null).
 ^(a) Adjusted for the following covariates: grade, immigration status (immigrated <5 years ago vs >5 years ago), siblings (only child vs has siblings), ethnicity and self-reported family affluence (low, average or high)

*^{*w*}Total screentime is calculated as the sum of time spent watching television, playing video games and using a computer recreationally.

Analyses considering spending >2 hours in each screen-based behaviour as the outcome

	Bivariate Analysis	Fully Adjusted [•] Model
-	OR (95% CI)	OR (95% CI)
Boys		
Custody		
Traditional		
Reconstituted with irregular visitation	1.03 (0.85-1.26)	1.00 (0.82-1.23)
Reconstituted with regular visitation	0.75 (0.56-1.00)	0.76 (0.57-1.02)
Single parent with irregular visitation	1.02 (0.87-1.19)	0.99 (0.85-1.16)
Single parent with regular visitation	1.34 (1.04-1.72)	1.34 (1.03-1.73)
Siblings		
None	-	-
≥ 1 sibling	0.98 (0.90-1.07)	0.99 (0.91-1.08)
Self-Perceived Family Affluence		
High	-	-
Average	1.08 (0.98-1.19)	1.09 (0.99-1.20)
Low	1.00 (0.87-1.14)	0.98 (0.85-1.13)
Immigration Status		
Lived in Canada ≥ 5 years	-	-
Lived in Canada <5 years	0.91 (0.80-1.03)	0.89 (0.79-1.01)
Grade		
Grade 6	-	-
Grade 7	1.06 (0.94-1.20)	1.07 (0.95-1.21)
Grade 8	1.02 (0.90-1.15)	1.02 (0.90-1.15)
Grade 9	1.07 (0.94-1.21)	1.06 (0.93-1.20)
Grade 10	0.89 (0.78-1.01)	0.88 (0.77-1.01)
Ethnicity		

Table 5.15. Unadjusted and adjusted relationships with spending >2 hours watching television per day, with multiple imputation, by gender

Canadian	-	-
East and Southeast Asian	0.67 (0.54-0.83)	0.70 (0.56-0.86)
South Asian	0.78 (0.59-1.04)	0.81 (0.61-1.09)
Black	1.65 (1.12-2.41)	1.51 (1.01-2.25)
Arab	1.31 (0.86-1.99)	1.36 (0.89-2.07)
Latin American	1.42 (0.90-2.26)	1.42 (0.88-2.31)
Other	0.76 (0.62-0.92)	0.75 (0.62-0.92)
Girls		
Custody		
Traditional		
Reconstituted with irregular visitation	1.02 (0.87-1.20)	1.00 (0.85-1.18)
Reconstituted with regular visitation	0.95 (0.76-1.19)	0.97 (0.77-1.22)
Single parent with irregular visitation	1.17 (1.02-1.34)	1.14 (0.99-1.31)
Single parent with regular visitation	0.99 (0.82-1.20)	0.98 (0.81-1.19)
Siblings		
None	-	-
≥ 1 sibling	0.98 (0.91-1.05)	1.00 (0.92-1.08)
Self-Perceived Family Affluence		
High	-	-
Average	0.94 (0.86-1.01)	0.93 (0.86-1.01)
Low	1.24 (1.11-1.39)	1.23 (1.10-1.38)
Immigration Status		
Lived in Canada ≥ 5 years	-	-
Lived in Canada <5 years	0.94 (0.83-1.07)	0.90 (0.79-1.04)
Grade		
Grade 6	-	-
Grade 7	1.07 (0.97-1.18)	1.09 (0.99-1.20)
Grade 8	1.01 (0.90-1.13)	1.01 (0.90-1.13)
Grade 9	1.08 (0.96-1.21)	1.07 (0.95-1.20)
Grade 10	1.00 (0.88-1.13)	0.98 (0.87-1.11)
Ethnicity		

Canadian	-	-
East and Southeast Asian	0.59 (0.48-0.74)	0.61 (0.48-0.76)
South Asian	1.06 (0.84-1.35)	1.13 (0.89-1.44)
Black	1.57 (1.14-2.16)	1.42 (1.04-1.95)
Arab	1.31 (0.92-1.86)	1.44 (1.00-2.07)
Latin American	1.14 (0.73-1.79)	1.09 (0.68-1.73)
Other	0.88 (0.76-1.02)	0.87 (0.74-1.02)

All analyses account for sample weights and clustering by classroom, school and province. Statistically significant odds ratios are shown in bold (i.e., 95% confidence intervals do not cross through the null). [•] Adjusted for the following covariates: grade, immigration status (immigrated <5 years ago vs >5 years ago), siblings (only child vs has siblings),

ethnicity and self-reported family affluence (low, average or high)

	Bivariate Analysis	Fully Adjusted [•] Model
-	OR (95% CI)	OR (95% CI)
Boys		
Custody		
Traditional	-	-
Reconstituted with irregular visitation	1.12 (0.93-1.35)	1.07 (0.88-1.30)
Reconstituted with regular visitation)	0.91 (0.68-1.23)	0.92 (0.68-1.25)
Single parent with irregular visitation	1.14 (0.99-1.31)	1.06 (0.91-1.23)
Single parent with regular visitation	1.04 (0.83-1.30)	1.10 (0.88-1.39)
Siblings		
None	-	-
≥ 1 sibling	0.91 (0.84-0.97)	0.95 (0.88-1.02)
Self-Perceived Family Affluence		
High	-	-
Average	1.01 (0.92-1.11)	0.99 (0.90-1.09)
Low	1.17 (1.03-1.33)	1.16 (1.02-1.33)
Immigration Status		``````````````````````````````````````
Lived in Canada ≥ 5 years	-	-
Lived in Canada <5 years	1.13 (1.01-1.28)	1.05 (0.93-1.18)
Grade		``````````````````````````````````````
Grade 6	-	-
Grade 7	0.85 (0.75-0.96)	0.84 (0.74-0.96)
Grade 8	1.02 (0.91-1.14)	1.01 (0.90-1.13)
Grade 9	1.43 (1.25-1.65)	1.42 (1.24-1.64)
Grade 10	1.33 (1.17-1.51)	1.31 (1.16-1.49)
Ethnicity		``````````````````````````````````````
Canadian	-	-
East and Southeast Asian	1.02 (0.76-1.35)	1.02 (0.78-1.35)
South Asian	0.74 (0.56-0.97)	0.78 (0.60-1.02)
	163	· · · · · · ·

Table 5.16. Unadjusted and adjusted relationships with spending >2 hours using a computer per day, with multiple imputation, by gender

Black	1.24 (0.90-1.70)	1.19 (0.86-1.66)
Arab	1.31(0.81-2.13)	1.22 (0.75-1.97)
Latin American	1.58 (1.00-2.48)	1.53 (0.95-2.48)
Other	0.80 (0.65-0.98)	0.83 (0.68-1.01)
Girls		(,)
Custody		
Traditional	-	-
Reconstituted with irregular visitation	0.98 (0.83-1.15)	0.92 (0.78-1.09)
Reconstituted with regular visitation	1.24 (0.96-1.60)	1.34 (1.02-1.76)
Single parent with irregular visitation	1.04 (0.91-1.19)	0.99 (0.86-1.14)
Single parent with regular visitation	0.94 (0.78-1.13)	0.95 (0.78-1.17)
Siblings		× , , ,
None	-	-
≥ 1 sibling	0.94 (0.87-1.01)	0.98 (0.91-1.06)
Self-Perceived Family Affluence		
High	-	-
Average	1.03 (0.94-1.12)	1.01 (0.92-1.10)
Low	1.12 (0.98-1.28)	1.13 (0.99-1.29)
Immigration Status		
Lived in Canada ≥ 5 years	-	-
Lived in Canada <5 years	1.08 (0.94-1.24)	0.97 (0.84-1.13)
Grade		
Grade 6	-	-
Grade 7	0.89 (0.79-1.01)	0.88 (0.78-1.00)
Grade 8	1.27 (1.14-1.43)	1.27 (1.13-1.43)
Grade 9	1.39 (1.25-1.55)	1.38 (1.24-1.54)
Grade 10	1.33 (1.17-1.52)	1.35 (1.19-1.53)
Ethnicity		
Canadian	-	-
East and Southeast Asian	1.35 (0.99-1.83)	1.38 (1.01-1.87)
South Asian	0.86 (0.62-1.20)	0.91 (0.67-1.23)
	164	

Black	1.16 (0.83-1.61)	1.07 (0.75-1.51)
Arab	1.63 (1.10-2.43)	1.70 (1.10-2.64)
Latin American	0.73 (0.46-1.16)	0.71 (0.46-1.11)
Other	0.83 (0.69-1.00)	0.84 (0.70-1.01)

All analyses account for sample weights and clustering by classroom, school and province. Statistically significant odds ratios are shown in bold (i.e., 95% confidence intervals do not cross through the null). [•] Adjusted for the following covariates: grade, immigration status (immigrated <5 years ago vs >5 years ago), siblings (only child vs has siblings), ethnicity and self-reported family affluence (low, average or high)

	Bivariate Analysis OR (95% CI)	Fully Adjusted [¢] Model OR (95% CI)
oys		
Custody		
Traditional	-	-
Reconstituted with irregular visitation	1.02 (0.85-1.22)	1.00 (0.84-1.20)
Reconstituted with regular visitation	1.08 (0.83-1.39)	1.11 (0.85-1.45)
Single parent with irregular visitation	1.09 (0.94-1.27)	1.05 (0.90-1.23)
Single parent with regular visitation	1.14 (0.92-1.43)	1.13 (0.90-1.42)
Siblings		
None	-	-
≥ 1 sibling	0.94 (0.87-1.01)	0.98 (0.90-1.05)
Self-Perceived Family Affluence		
High	-	-
Average	1.07 (0.97-1.17)	1.06 (0.97-1.16)
Low	1.14 (1.00-1.31)	1.11 (0.98-1.26)
Immigration Status		
Lived in Canada ≥ 5 years	-	-
Lived in Canada <5 years	0.95 (0.85-1.06)	0.94 (0.83-1.06)
Grade		
Grade 6	-	-
Grade 7	1.03 (0.92-1.16)	1.04 (0.93-1.16)
Grade 8	1.03 (0.92-1.15)	1.04 (0.94-1.16)
Grade 9	1.18 (1.04-1.35)	1.17 (1.03-1.32)
Grade 10	0.96 (0.84-1.09)	0.95 (0.83-1.08)
Ethnicity		
Canadian	-	-
East and Southeast Asian	0.98 (0.75-1.26)	0.99 (0.76-1.29)
South Asian	0.74 (0.56-0.96)	0.77 (0.58-1.02)
	166	

Table 5.17. Unadjusted and adjusted relationships with spending >2 hours playing video games per day, with multiple imputation, by gender

Black	1.28 (0.91-1.82)	1.28 (0.88-1.86)
Arab	1 31 (0 82-2 08)	1 32 (0 84-2 08)
Latin American	0.95(0.58-1.54)	0.91(0.55-1.50)
Other	0.94 (0.79-1.12)	0.93 (0.78-1.11)
Girls		
Custody		
Traditional	-	-
Reconstituted with irregular visitation	0.96 (0.78-1.17)	0.95 (0.78-1.15)
Reconstituted with regular visitation	1.13 (0.86-1.48)	1.19 (0.91-1.56)
Single parent with irregular visitation	1.02 (0.87-1.19)	0.94 (0.80-1.10)
Single parent with regular visitation	1.10 (0.88-1.39)	1.10 (0.88-1.38)
Siblings		``````````````````````````````````````
None	-	-
≥ 1 sibling	0.93 (0.86-1.01)	0.96 (0.88-1.04)
Self-Perceived Family Affluence		· · · · · ·
High	-	-
Average	0.95 (0.86-1.05)	0.95 (0.86-1.05)
Low	1.35 (1.17-1.56)	1.34 (1.16-1.54)
Immigration Status		
Lived in Canada ≥ 5 years	-	-
Lived in Canada <5 years	1.13 (0.98-1.31)	1.07 (0.91-1.25)
Grade		
Grade 6	-	-
Grade 7	1.08 (0.95-1.22)	1.08 (0.95-1.22)
Grade 8	1.15 (1.01-1.31)	1.13 (0.99-1.28)
Grade 9	1.11 (0.98-1.26)	1.09 (0.97-1.24)
Grade 10	0.91 (0.78-1.05)	0.90 (0.77-1.04)
Ethnicity		
Canadian	-	-
East and Southeast Asian	1.27 (0.94-1.71)	1.25 (0.91-1.72)
South Asian	1.04 (0.74-1.46)	1.14 (0.82-1.58)
	167	

Black	1.21 (0.86-1.71)	1.09 (0.78-1.51)
Arab	0.85 (0.53-1.37)	0.88 (0.56-1.39)
Latin American	0.94 (0.56-1.59)	0.93 (0.54-1.58)
Other	0.92 (0.77-1.11)	0.92 (0.76-1.11)

All analyses account for sample weights and clustering by classroom, school and province. Statistically significant odds ratios are shown in bold (i.e., 95% confidence intervals do not cross through the null). [•] Adjusted for the following covariates: grade, immigration status (immigrated <5 years ago vs >5 years ago), siblings (only child vs has siblings), ethnicity and self-reported family affluence (low, average or high)
	Bivariate Analysis OR (95% CI)	Fully Adjusted [¢] Model OR (95% CI)
Boys		
Custody		
Traditional	-	-
Reconstituted with irregular visitation	1.11 (0.79-1.54)	1.07 (0.76-1.49)
Reconstituted with regular visitation	0.69 (0.45-1.08)	0.66 (0.43-1.01)
Single parent with irregular visitation	0.99 (0.77-1.29)	0.95 (0.74-1.23)
Single parent with regular visitation	1.55 (0.97-2.50)	1.65 (1.01-2.67)
Siblings		
None	-	-
≥ 1 sibling	0.92 (0.81-1.03)	0.94 (0.83-1.06)
Self-Perceived Family Affluence		
High	-	-
Average	1.17 (0.98-1.40)	1.17 (0.97-1.41)
Low	0.98 (0.76-1.27)	0.97 (0.75-1.25)
Immigration Status		
Lived in Canada ≥ 5 years	-	-
Lived in Canada <5 years	0.87 (0.73-1.05)	0.87 (0.73-1.05)
Grade		
Grade 6	-	-
Grade 7	0.84 (0.69-1.01)	0.82 (0.68-1.01)
Grade 8	1.00 (0.83-1.21)	1.00 (0.82-1.23)
Grade 9	1.48 (1.18-1.85)	1.55 (1.22-1.97)
Grade 10	1.22 (0.98-1.51)	1.21 (0.97-1.51)
Ethnicity		
Canadian	-	-
East and Southeast Asian	0.66 (0.41-1.07)	0.65 (0.40-1.05)
South Asian	0.77 (0.48-1.22)	0.81 (0.51-1.29)

Table 5.18. Unadjusted and adjusted relationships with spending >2 hours in total screen time* per day, with multiple imputation, by gender

Black	0.93 (0.47-1.84)	0.82 (0.39-1 75)
Arab	3.26 (1.12-9.46)	3.55 (1.25-10.03)
Latin American	103(045-233)	1 06 (0 45-2 53)
Other	0.77(0.53-1.11)	0 76 (0 52-1 09)
Girls		
Custody		
Traditional	-	-
Reconstituted with irregular visitation	1.00 (0.75-1.33)	0.95 (0.71-1.27)
Reconstituted with regular visitation	0.91(0.67-1.23)	0.95 (0.71-1.28)
Single parent with irregular visitation	1.12 (0.91-1.39)	1.08 (0.88-1.34)
Single parent with regular visitation	1.18 (0.83-1.68)	1.18 (0.83-1.69)
Siblings		
None	-	-
>1 sibling	0.84 (0.73-0.95)	0.86 (0.75-0.98)
Self-Perceived Family Affluence	· · · · · ·	
High	-	-
Average	1.06 (0.93-1.21)	1.03 (0.89-1.19)
Low	1.12 (0.91-1.37)	1.14 (0.92-1.41)
Immigration Status		· · · · · ·
Lived in Canada ≥ 5 years	-	-
Lived in Canada <5 years	0.89 (0.73-1.09)	0.75 (0.59-0.95)
Grade		
Grade 6	-	-
Grade 7	0.86 (0.74-1.00)	0.88 (0.76-1.02)
Grade 8	1.25 (1.05-1.48)	1.23 (1.04-1.46)
Grade 9	1.25 (1.06-1.47)	1.24 (1.05-1.47)
Grade 10	1.28 (1.07-1.54)	1.26 (1.05-1.51)
Ethnicity		
Canadian	-	-
East and Southeast Asian	0.90 (0.61-1.33)	0.91 (0.61-1.33)
South Asian	0.81 (0.49-1.35)	0.89 (0.53-1.52)
	170	

Black	0.97 (0.50-1.88)	1.00 (0.50-2.01)
Arab	1.38 (0.62-3.08)	1.43 (0.65-3.16)
Latin American	3.05 (1.01-9.19)	3.03 (1.05-8.75)
Other	0.56 (0.41-0.77)	0.53 (0.38-0.73)

All analyses account for sample weights and clustering by classroom, school and province. Statistically significant odds ratios are shown in bold

(i.e., 95% confidence intervals do not cross through the null). [•] Adjusted for the following covariates: grade, immigration status (immigrated <5 years ago vs >5 years ago), siblings (only child vs has siblings), ethnicity and self-reported family affluence (low, average or high)

* Total screentime is calculated as the sum of time spent watching television, playing video games and using a computer recreationally.