University of Alberta

Screen Time and Seasonal Variation in Physical Activity among Preschool Children in Edmonton

by

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Abstract

Background: The prevalence of childhood overweight and obesity is increasing worldwide. One main determinant of overweight and obesity is inactivity. Little is known about the factors that influence physical activity and sedentary behaviour among young children. Seasonal variation was examined as a correlate of physical activity in both a literature review and in a sample of pre-school children in Edmonton, Alberta. Neighbourhood socioeconomic status (SES) was examined as a correlate of screen time use in the same sample of children.

Methods: For study 1, databases were searched for studies on seasonal variation in physical activity levels. Studies 2 and 3 involved a sample of 4- and 5-year-old children, who were attending a health center in and around Edmonton, Alberta for preschool immunization between November, 2005 and August, 2007. Parents provided proxy reports of their children's screen time viewing and physical activity. Height and weight were measured by a trained health assistant and body mass index (BMI) was calculated. Children's postal codes were retrieved from health records to calculate neighbourhood SES through census data. The month the proxy report was completed was used to determine seasonality. Several regression models were constructed to examine relationships between variables in studies 2 and 3.

Results: The review of literature revealed that 83% (29/35) of the studies found seasonal variation in physical activity among children and/or adolescents. For study 2, total physical activity as well as active play, weekday and weekend minutes were highest in the summer and lowest in the winter. Finally, neighbourhood SES was a predictor of screen time and TV/video use for girls but not for boys in study 3.

Conclusion: Some consideration should be given to increasing physical activity opportunities in the winter for children, especially in areas of the world that experience extreme winter conditions. As well some consideration should be given to providing alternative activity opportunities for young girls who live in lower SES neighbourhoods.

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Chapter 1: Introduction

Childhood Overweight and Obesity in Canada

The prevalence of childhood overweight and obesity is increasing around the world (Koplan, Catharyn, & Kraak, 2005). There is consistent evidence in Canada that childhood overweight and obesity is reaching epidemic proportions (Shields, 2006; Statistics Canada, 2005; Tremblay, Katzmarzyk, & Willms, 2002). The prevalence of overweight and obesity has more than doubled since 1981 (Shields, 2006; Tremblay et al., 2002). A study conducted by Tremblay and Willms (2000) examined the increase of overweight and obesity among 7- to 13-year-old children from 1981 to 1996. The prevalence of overweight in boys increased from 15 % to 28.8% and obesity increased from 5% to 13.5%. Similar results were found for girls where the prevalence of overweight and obesity increased from 15% to 23.6% and from 5% to 11.8% respectively (Tremblay & Willms, 2000). Even larger increases were seen in a similar study done by Tremblay et al. (2002). In both studies, children's BMI scores were derived from parental reports of their children's height and weight. Therefore, Tremblay and colleagues speculated the increases in overweight and obesity were actually underestimated in these studies (Tremblay et al., 2002; Tremblay & Willms, 2000).

The Canadian Community Health Survey measured heights and weights of a representative sample of Canadian children between the ages of 2 to 17 in 2004. It revealed that 26% of children in Canada and 22% of children in Alberta are overweight or obese (Statistics Canada, 2005). When these BMI scores were compared to the Canada Health Survey in 1978/79, the combined prevalence of overweight and obesity rose 70% (Shields, 2006). A 1997 study from Newfoundland found that preschool children were 1.7 times more likely to be overweight or obese compared with children tested in 1984 (Canning, Courage, Frizzell, & Seifert, 2007). Such findings led Canada's 2007 Report Card on Physical Activity for Children and Youth to give a grade letter F for overweight and obesity. The report showed that the number of obese children and youth in Canada had increased 35.7% from 2003 to 2006 (Active Healthy Kids Canada, 2007). Similarly, Canada's 2008 Report Card on Physical Activity for Children and Youth gave a letter F for the proportion of Canadian children and youth who are a healthy body weight (Active Healthy Kids Canada, 2008).

Complications of Overweight and Obesity among Children

Childhood overweight and obesity is a serious problem that has major long term health and economic implications if left unresolved (Tremblay et al., 2002). Studies have found that extremely overweight and obese children tend to remain overweight and obese as adults (Freedman, Khan, Dietz, Srinivasan, & Berenson, 2001; Geo & Chumlea, 1999; Maffeis, Talamini, & Tato, 1998; Magarey, Daniels, Boulton, & Cockington, 2003; Power, Lake, & Cole, 1997; Serdula et al., 1993). According to a systematic review, 26 to 41% of obese preschool children became obese adults and 42 to 63% of obese school-age children became obese adults (Serdula et al., 1993). Overall, obese children had a 2 to 6.5 fold higher risk for becoming an obese adult than non-obese children. As well, the more obese a child was, the greater the risk they had for obesity in adulthood. This is an obvious concern as there is a close link between obesity and type 2 diabetes, cardiovascular disease and many other chronic diseases in adults (Choudhury, Donnelly, Racadio, & Strife, 2007; Hill & Trowbridge, 1998).

Further, overweight and obese children can experience negative health and psychosocial effects before they become adults (Dietz, 1998; Puhl & Latner, 2007). Conditions that are usually seen in adults are now becoming more common in adolescents such as type 2 diabetes mellitus, glucose intolerance, hyperlipidemia, hypercholesterolemia, hypertension, sleep apnea, and orthopaedic complications (Choudhury et al., 2007; Dietz, 1998; Hill & Trowbridge, 1998; Veugelers & Fitzgerald, 2005). Being overweight as a child also has adverse affects on self-esteem, body image and social development. As well, overweight children experience discrimination (Dietz, 1998; Hill & Trowbridge, 1998; Puhl & Latner, 2007; Tremblay & Willms, 2000; Veugelers & Fitzgerald, 2005). Schwimmer, Burwinkle, and Varni (2003) reported that obese children had significantly lower health-related quality of life, a construct associated with physical, emotional, social and school functioning, compared to normal weight children (Schwimmer et al., 2003).

These findings have major implications for the Canadian health care system. In 1997, it was estimated that direct medial costs due to adult obesity was 1.8 billion dollars (Birmingham, Muller, Palepu, Spinelli, & Anis, 1999). The three major contributors to the direct medial costs were hypertension, type 2 diabetes mellitus, and coronary artery disease. Given that obesity is linked to these chronic diseases, if obesity rates continue to rise among children, a major strain will be put on the Canadian health care system in the future.

Determinants of Overweight and Obesity among Children

Numerous risk factors have been examined as correlates of overweight and obesity in children. A recent review that included data from pre-school children found strong positive associations between overweight status and maternal pre-pregnancy body size, maternal smoking during pregnancy, and an inverse relationship with breast feeding (Hawkins & Law, 2006). As well, fruit and vegetable consumption, parental overweight, low SES, and a high birth weight have been stated in the literature as other correlates (Danielzik, Czerwinski-Mast, Langnase, Dilba, & Muler, 2004; Shields, 2006). There is also evidence to suggest that a link exists between physical inactivity and obesity in children (Goran, Reynolds, & Lindquist, 1999; Hawkins & Law, 2006; Must & Tybor, 2005; Tremblay & Willms, 2003). The majority of research to date on inactivity has focused on what children are not doing (physical activity) rather than what they are doing (sedentary behaviour; Spanier, Marshall, & Faulkner, 2006). Therefore, definitions of inactivity have been based on the absence or lack of physical activity (Gorely, Marshall, & Biddle, 2004; Must & Tybor, 2005). Lately, it has been argued that sedentary behaviour and physical activity should be treated as separate constructs (Hanson, & Chen, 2007; Gorley et al., 2004; Owen, Leslie, Salmon, & Fotheringham, 2000; Mark & Janssen, 2008; Must & Tybor, 2005; Shields & Tremblay, 2008; Spanier et al., 2006; Reilly, 2008). This intuitively makes sense as it is possible for children to be highly physically active, while also engaging in large amounts of sedentary activities (Hanson & Chen, 2007; Salmon, Dunstan, & Owen, 2008). As well engaging in sedentary behaviours may produce health effects independent of physical activity levels (Salmon et al., 2008). Therefore, the effects of these behaviours on obesity and other health outcomes should be considered separately (Owen et al, 2000; Reilly, 2008).

Physical activity in children includes behaviours such as free play, organized sports, exercise, and chores (Goran et al., 1999). Physical activity has been defined as, "any bodily movement produced by the contraction of skeletal muscle that increases energy expenditure above the basal level" (Caspersen, Powell & Christenson, 1985, p. 126). Therefore, physical activity can protect children from unhealthy weight gain as it increases energy expenditure (Goran et al., 1999).

In contrast, sedentary behaviours are low intensity activities that require minimal body movement (Must & Tybor, 2005). Therefore, sedentary behaviours are risk factors for overweight and obesity (Tremblay & Willms, 2003). A major source of sedentary activity in children is screen time or time spent viewing television or movies, playing video games, and using computers (Must & Tybor, 2005). The mechanisms linking screen time and obesity include the displacement of physical activity by screen time (Dietz & Gortmaker, 1985; Robinson, 2001) and the lowering of children's metabolic rate (Klesges, Shelton, & Klesges, 1993; Robinson, 2001). TV in particular, is thought to encourage between meal snacking (Francis, Lee, & Birch, 2003; Thomson, Spence, Raine, & Laing, 2008) as well as expose children to advertisements for junk food (Harrison & Marske, 2005; Taras, Sallis, Patterson, & Nader, 1989; Thomson et al., 2008).

Prevalence of Physical Activity among Children

Countries around the world have daily physical activity recommendations for children. For instance 60 minutes of at least moderate intensity exercise is recommended daily in the United Kingdom (Department of Health, 2004). In the United States, it is recommended that children engage in at least 60 minutes of physical activity most days of the week (United States Department of Health, 2005). Canada's Physical Activity Guide to Healthy Active Living for Children recommends 90 minutes of daily moderate to vigorous physical activity (Health Canada, 2002).

However, Canada's 2007 Report Card on Physical Activity for Children and Youth gave our country a letter grade F for physical activity levels (Active Healthy Kids Canada, 2007). The report card stated that 90% of children and youth are not meeting the Canadian guidelines. This information was based on the Canadian Physical Activity among Youth [CAN PLAY] study which suggests 16,500 steps is equivalent to 90 minutes of moderate-to-vigorous physical activity (CFLRI, 2005). Specifically, researchers found that 73% of Canadian and 65% of Albertan children between the ages of 5 to 19 years do not take enough steps daily to meet the sex-specific criteria associated with a healthy body mass index (12,000 – girls; 15,000 - boys). As well, 84% of Canadian and 78% of Albertan children (boys and girls combined) take less than 15,000 steps daily, and as stated earlier, 90% of Canadian and 87% of Albertan children do not take 16,500 steps daily (CFLRI, 2005). The letter grade F remained in 2008 for physical activity levels (Active Healthy Kids Canada, 2008). Even though physical activity is thought to provide significant health benefits for children, many Canadian children are still not meeting the recommended guidelines. It is important that a better understanding of the correlates and variation of children's physical activity patterns is achieved (Sallis, Prochaska, & Taylor, 2000).

Correlates of Physical Activity among Children

Physical activity is a complex, multifaceted health behaviour that is influenced by many factors (Loucaides, Chedzoy & Bennett, 2004; Spence & Lee, 2003). Recent reviews on the correlates of physical activity of children have examined multiple levels of influence including demographic/biological; psychological/cognitive/emotional; behavioural attributes/skills; social/cultural; and the physical environment (Sallis et al., 2000; Van der Horst, Paw, Twisk, & Van Mechelen, 2007). The reviews identified gender, age, body weight status, household SES, self-efficacy, parental influences, access to facilities/programs/parks, neighbourhood safety, time spent outdoors, and exercise equipment in the home as common correlates of children's physical activity examined in the literature (Sallis et al., 2000; Van der Horst et al., 2007).

Sallis et al. (2000) found gender was the most studied variable, and in 81% of the studies, boys were more active than girls. However, the association between BMI with physical activity was inconsistent in the reviews (Sallis et al., 2000 & Van der Horst et al., 2007). There is some evidence to suggest a negative relationship exists between physical activity and BMI among children in Canada

(Tremblay & Willms, 2003). This may be due to the fact that physical activity can be a precursor to obesity as well as a consequence (Must & Tybor, 2005). Neighbourhood SES was not examined in either review, however time spent outdoors and access to facilities and programs were found to be positively associated with children's physical activity (Sallis et al., 2000). Since recent studies have found that unsafe neighbourhoods may reduce children's physical activity by keeping them inside (Burdette & Whitaker, 2005; Carver, Timperio, & Crawford, 2008; Davison & Lawson, 2006; Evenson, Scott, Cohen, & Voorhees, 2007; Hanson & Chen, 2007; Li, Dibley, Sibbritt, & Yan, 2006; MacLeod, Gee, Crawford, & Wang, 2008; Molnar, Gortmaker, Bull, & Buka, 2004; Salmon Spence, Timperio, & Cutumisu, 2008; Veugelers, Sithole, Zhang, & Muhajarine, 2008; Weir, Etelson, & Brand, 2006) and lower SES neighbourhoods tend to have fewer facilities and programs (Gordon – Larsen, Nelson, Page, & Popkin, 2006), neighbourhood SES should be taken into consideration when examining children's physical activity levels.

Research examining natural environmental correlates such as seasonal differences as sources of variance in children's physical activity is also limited (Dietz & Gortmaker, 1984; Fisher et al., 2005; Goran et al., 1998; Kristensen et al., 2007), especially in Canada (Tucker & Gilliland, 2007). Seasonal variation of physical activity can be defined as a fluctuation in physical activity levels that is associated with changes in weather and daylight hours that accompany different seasons. Since children tend to have higher physical activity levels when they spend time outdoors (Baranowski, Thompson, DuRant, Baranowski, & Puhl, 2003; Burdette, Whitaker, & Daniels, 2004; Loucaides et al., 2004), decreased daylight, extremely cold temperatures, and precipitation could potentially have a negative impact on physical activity levels among children. Therefore, the impact of seasonal variation on children's physical activity levels should also be explored further.

Prevalence of Elevated Screen Time among Children

The American Academy of Pediatrics recommends that parents limit screen time to 1 – 2 hours per day for children older than 2 years of age and discourage television viewing for children under 2 years of age (American Academy of Pediatrics [AAP], 2001). Similarly, the Canadian Pediatric Society recommends that parents limit children's television viewing to 1 -2 hours a day and preschoolers should watch no more than 1 hour a day (Nieman, 2003). Canada's Physical Activity Guide to Healthy Active Living for Children also recommends that parents start by reducing children's screen time by 30 minutes a day and progressively aim to reduce screen time by 90 minutes a day (Health Canada, 2002). Canada's 2007 Report Card on Physical Activity and Youth gave Canada a letter grade D- for screen time behaviour (Active Healthy Kids Canada, 2007). In 2008, this grade dropped to an F due to new evidence showing an increase in pre-school children's screen time behaviour (Active Healthy Kids Canada, 2008).

A study conducted in Edmonton in 1967 reported that adolescents viewed, on average 12.9 hours of TV a week, or less than 2 hours of TV a day (Howell & Macnab, 1972). Some recent studies examining screen time behaviour among

Canadian children and youth show different results. The School Health Action, Planning and Evaluation System (SHAPES) study in Ontario found that grade 9 to 12 boys averaged 2.9 hours and girls averaged 2.5 hours of screen time a day. Approximately 64% of boys and 52.5% of girls in the sample engaged in more than 2 hours of screen time a day (Leatherdale & Wong, 2008). Similarly, The Health Behaviour in School-Aged Children Survey (HBSC) found that 59% of girls and 66% of boys in grades 6 to 10 viewed more than 2 hours of TV a day. When leisure computer use was included with TV time, 82% of girls and 86% of boys did not meet the guidelines (Mark, Boyce, & Janssen, 2006). The New Brunswick Student Wellness Survey also found that 44% of children in grades 1 through 5 were not meeting screen time guidelines of 2 hours a day or less (see Active Healthy Kids Canada, 2008). Even though screen time is a risk factor for childhood overweight and obesity, many Canadian children are still exceeding the recommended guidelines. Therefore, it is also important that a better understanding of the correlates of screen time is achieved (Spanier, 2006; Salmon et al., 2008).

Correlates of Screen Time among Children

Unlike physical activity, little is known about the correlates of screen time (Gorely et al., 2004, McGuire, Neumark-Sztainer, & Story, 2002; Salmon et al., 2008, Spanier, 2006). Although screen time encompasses time spent viewing television or movies, playing video games, and using computers, the majority of studies to date examining screen time in children have focused solely on television viewing (Shields & Tremblay, 2008). A recent review on the correlates of television viewing among 2- to 18- year-olds found that parental SES, ethnicity, body weight, between meal snacking, number of parents in the home, parents' TV viewing habits, weekend, and having a TV in one's bedroom are variables consistently associated with TV viewing among youth (Gorely et al., 2004). BMI was positively associated with screen time, while physical activity and sex were not found to be significantly associated with screen time.

In contrast, among Ontario students in the SHAPES study physical activity, gender, and BMI were associated with sedentary behaviours (Leatherdale & Wong, 2008). Though TV viewing has been linked to factors within the family environment (Gorely et al., 2004; MacLeod et al., 2008), little is known about the impact of factors within the neighbourhood environment. Recently, neighbourhood income was found to influence TV viewing in girls (MacLeod et al., 2008). As mentioned previously, negative perceptions of neighbourhood safety (Burdette et al., 2005; Carver et al., 2008; Davison & Lawson, 2006; Evenson et al., 2007; Hanson and Chen, 2007; Li et al., 2006; MacLeod et al., 2008; Molnar et al., 2004; Salmon et al., 2008; Veugelers et al., 2008; Weir et al., 2006), lack of resources for programs (Shann, 2001), and lack of recreational facilities/parks/playgrounds (Gordon-Larsen et al., 2006; Shann, 2001) in lower SES neighbourhoods may restrict children to indoor activities where they have increased opportunities to engage in screen time activities. Furthermore, a number of studies have found that neighbourhood environment may impact boys and girls differently (Gomez, Johnson, Selva, & Sallis, 2004; Hoefer, Mckenzie, Sallis, Marshall, & Conway, 2001; Li et al., 2006; MacLeod et al., 2008; Norman et al., 2006; Santos, Page, Cooper, Ribeiro, & Mota, 2009; Spence, Cutumisu, Edwards, & Evans, 2008). For example, residing in a low walkable neighbourhood was associated with an increased risk of overweight and obesity among young girls in Edmonton, but not boys (Spence et al., 2008). Sedentary behaviours may differ between boys and girls as well (Boone, Gordon-Larsen, Adair, & Popkin, 2007; Leatherdale & Wong, 2008; Salmon et al., 2008). For example, boys usually spend more time playing video games and using the computer than girls (Salmon et al., 2008). Therefore, the impact of neighbourhood SES on children's TV viewing and overall screen time viewing should be explored further, especially between genders and across different age groups.

Further examination of the determinants of physical activity and sedentary behaviour is needed to create effective and efficient interventions in the prevention and treatment of childhood obesity (Gorely et al., 2004; Sallis et al., 2000; Salmon et al., 2008; Trost, Kerr, Ward, & Pate, 2001; Van der Horst et al., 2007). By doing so, researchers, practitioners, parents, schools, and society as a whole will be in a better position to promote healthy active lifestyles among children in an effort to reduce the burden of obesity in Canada. Therefore, the purposes of this thesis were to examine (a) seasonal variation as a correlate of physical activity through a literature review; (b) seasonal variation as a correlate of physical activity in a sample of pre-school children in Edmonton, Alberta; and (c) neighbourhood SES as a correlate of screen time in the same sample of children.

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Chapter 2

Seasonal Variation in Physical Activity among Children and Adolescents: A Review

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Background

Physical activity plays a key role in the physical growth, biological maturation, and behavioural development of children (28, 51). Children who are more physically active are less at risk for chronic diseases such as obesity and type 2 diabetes (28, 51). Recommended guidelines for children and adolescents range from 60 minutes of daily physical activity in the United States, (60) United Kingdom, (18) and Australia (16, 17) to 90 minutes in Canada (26). However, reports indicate that 90% of Canadian children and adolescents are not meeting these guidelines (11). Similarly low levels of habitual physical activity have been documented among U.S. and British children and adolescents (2, 38, 57). For instance, 58% of U.S. children and 92% of adolescents are not meeting these guidelines (57). A large international study found the proportion of youth aged 10 to 16 years who were physically active for at least 60 minutes, at least 5 days of the week, was below 50% for all 34 countries examined; the lowest being 19.3% in France (29). Therefore, understanding the determinants of physical activity among children and adolescents is necessary in order to design effective interventions (45, 61).

The determinants of physical activity involve many individual, social, and environmental factors (43, 44, 50). More recently, associations between physical activity and the physical and built environment have been explored. For example, access to facilities/programs/parks, neighbourhood safety, time spent outdoors, and exercise equipment in the home have all been shown to be associated with physical activity among children and adolescents (19, 45, 46, 58, 61). However, the influence of aspects of the natural environment such as seasons and weather on physical activity among children is less understood (30). Seasonal variation of physical activity can be defined as a fluctuation in physical activity levels that is associated with changes in weather and daylight hours that accompany different seasons. In the northern hemisphere, we may expect that children and adolescents will be more physically active in the spring and summer months (March to August) than the fall and winter months (September to February) as warmer temperatures and longer daylight hours may encourage more outdoor play and activities . In the southern hemisphere, we would expect to observe the same pattern except that the months will be reversed with the spring and summer months falling in the September to March period.

Though a review recently found seasonal variation in physical activity among humans (59), it did not have a specific focus on children or adolescents. As a result, the bulk of studies reviewed involved adults and many key studies involving children and adolescents were not included. Furthermore, the review did not examine moderating variables that may have been unique to children and adolescents (e.g., age, type of physical activity measure). Because children are not just little adults, it is unreasonable to assume that changes in seasons may have the same influence on physical activity patterns among children as observed for adults. Seasonality is important to study in children and adolescents because patterns of inconsistent physical activity participation may carry over into adulthood (35). As well, if children are not active year round, their fitness levels will most likely decrease and therefore they will not enjoy the beneficial health outcomes associated with physical activity (5, 35). Thus, interventions may need to be modified according to seasons as more opportunities and programs for children and adolescents may be required at different times of the year. Therefore, the purposes of this review were to examine seasonal variation in physical activity among children and adolescents and determine the role of potential moderators such as region, age, physical activity measure, and research design.

Method

To obtain articles for the review, a computer search of PubMed, Google Scholar, and Sport Discus was conducted. The search terms used were “seasons”, “weather”, “physical activity”, “exercise”, and “energy expenditure”. The review ended February 15, 2009. The abstracts of articles located in the initial search were reviewed for relevance. To be included in the review, studies needed to be published in English, include samples of either children and/or adolescents between the ages of 2 to 19 years, and report results for measurements of physical activity or energy expenditure in more than one season or month (see Appendix 1 for adult review and Appendix 2 for weather review). Of the 914 abstracts initially reviewed, 46 appeared to fit these criteria and journal articles were located and thoroughly reviewed. Of those, 18 articles were kept and 28 were dropped (21 were on adults only, 6 were not relevant, and 1 was a qualitative study). The bibliographies of all reviewed articles, including a previously published review on seasonal variation (59), were then searched and 16 more journal articles were located and thoroughly reviewed. Of those, 4 were dropped (2 were on adults only and 2 were not relevant). Finally, 5 new relevant articles were published during the review process. Therefore, a total of 35 relevant articles were coded with some overlap across age groups. The entire review process involved both authors and any differences of opinion were resolved through discussion. The following characteristics were recorded for all 35 articles: author(s), year, sample age, sample size, country, research design, physical activity measure (e.g., questionnaire), definition of season, and finding (see Appendix 3). As well, most and least active seasons or months were recorded (see Table 1).

Results

Included studies were published between the years 1980 to 2009 and represented 39010 participants ranging from 16 to 11892 participants per study. The studies were conducted in 12 different countries (Canada, United States, England, Scotland, France, Portugal, Cyprus, Denmark, Sweden, Australia, New Zealand and Senegal). Overall, 83% (29/35) of the studies found seasonal variation in physical activity among children and/or adolescents (3, 4, 5, 6, 8, 10, 12, 13, 14, 20, 22 - 25, 27, 30 - 33, 35, 38, 40 – 42, 47, 48, 62, 63; see Table 1). The age of the samples varied with some studies focusing on a specific age group (e.g., preschool children) while others spanned various age categories. A variety of techniques were used in the measurement of physical activity and approximately half the studies used a repeated-measure design while the other half used a cross-sectional design.

Region

The impact of seasonal variation can depend on the region where children reside. For example, seasonal variation might influence the behaviour of children in regions that experience extremely cold temperatures and short daylight hours in the winter differently than those in regions that do not experience such dramatic changes in temperature and daylight. The majority of studies conducted in the European region did in fact find seasonal variation in children's physical activity with higher levels of activity occurring in the spring/summer months compared to the fall/winter months (22, 25, 30, 31, 33, 38, 42, 47, 62, 63). For example, children in England had lower physical activity levels in the winter compared to other seasons (25, 33, 38, 42).

Similar conclusions can be drawn for the North American region. Physical activity was highest in the spring/summer and lowest in the fall/winter among studies conducted in the United States (4, 10, 13, 23, 24, 27, 35, 40, 41) and Canada (5, 12, 14, 48). Although, Baranowski et al. found seasonal variation through direct observation of 191 children in Texas, it was the exact opposite (3). Outside activities of children were lower during the summer months, with the lowest level occurring in July.

Among studies conducted in the southern hemisphere, seasonal variation was also found with higher levels of physical activity occurring in the summer than the winter (8, 20, 32). For example, children and youth between the ages of 5 to 18 years were more active in the summer (September to March) compared to the winter (April to August) in New Zealand and Australia (8, 20, 32). Benefice and colleagues (6), reported higher levels of physical activity during the rainy season, in comparison to the dry season, among 40 girls in Senegal.

However, in both the European and North American regions, several studies reported no significant seasonal differences in children's and/or adolescents' physical activity levels (7, 21, 30, 39, 49, 56). For example, no seasonal differences in moderate to vigorous physical activity (MVPA) and vigorous physical activity (VPA) were found in a sample of English children during recess between summer (June) and winter (November; 39). Similarly, inactivity among children in the winter months was not significantly different in comparison to other months in Vancouver, Canada (49).

Another variant of regions is the distinction between rural and urban areas. For instance, more time was spent playing outside in the summer in both rural and urban settings in Cyprus among 11- and 12- year-olds (31). However, rural school children were significantly more active than urban school children in the summer. On the other hand, urban school children were significantly more active than rural school children in the winter. Similar results were seen in Canada, where rural children were more active in the summer compared to fall and urban children were more active in the fall compared to the summer (56).

Age

The studies in this review included children and/or adolescents ranging in age from 2 to 19 years. Because younger children are known to be more active than older children (11, 44), we examined whether age had any influence on seasonal variation of physical activity. The World Health Organization defines adolescents as the period roughly between 10- to 19- years-old (64). However, many of the samples included participants ranging across child and adolescent age groups. Therefore, we looked for natural breaks among samples and identified three age groups that the majority of studies could fit into. The young age group encompassed children less than 6 years old, the middle group included children and adolescent between 8- and 12- year-olds, and the older age group encompassed adolescents over the age of 12. There were 6 studies that examined seasonal variation exclusively in the young age group (3, 10, 12, 21, 22, 35). The findings on seasonality of physical activity are not clear for this age group. For example, seasonal variation was found in children aged 4 to 5 years in Edmonton, Canada where the highest levels of physical activity occurred in the summer and the lowest in the winter (12). As well, physical activity was significantly lower in spring (February - April) compared to summer (May - July), autumn (August - October) and winter (November - January) among 3- to 6- year-olds in Scotland (22). However, it was concluded in the latter study that the differences were not practically significant and seasonality in physical activity was relatively unimportant. No seasonal variation was observed among 3- to 5- year-olds in South Dakota (21). As well, Baranowski and colleagues found seasonal variation for outdoor physical activity, but little variance was seen for indoor physical activity (3).

Seasonal variation in children and adolescents primarily between the ages of 8 to 12 years was examined in 14 studies (13, 23, 25, 27, 30, 31, 33, 38, 39, 41, 42, 48, 49, 56). The findings for this age group are fairly consistent; 79% (11/14) of studies found seasonal variation (13, 23, 25, 27, 30, 31, 33, 38, 41, 42, 48). For example, physical activity among 9- to 10- year-olds was significantly lower in the winter than any other season in Massachusetts (27). Similarly, physical activity was the lowest in the winter for 11- to 12- year-olds in England (33, 38), Cyprus (31), and the United States (13). Further, 83% (5/ 6) of studies found seasonal variation in the older age group (5, 6, 8, 32, 62). Of the studies that did not fit mainly in the middle or older age category, 89 % (8/9) reported seasonal variation in physical activity (4, 14, 20, 24, 40, 41, 47, 63).

Physical Activity Measure

Seasonal variation may also depend on the measurement tool used. Assessing physical activity in children can be challenging as the behaviour is spontaneous, sporadic and of short duration (1, 33, 54). As well, children may lack the cognitive ability to recall activity accurately (1, 33, 42, 54). Furthermore, proxy reports by parents or teachers are limited to adult's opportunities to observe the child being physical active (54). Direct measures (e.g., pedometers, accelerometers) are thought to offer more accurate and robust estimates of physical activity (1). A recent systematic review found considerable disagreement and low to moderate correlations between direct and indirect measurements (1). Thus, when examining an outcome such as seasonal variation, it is important to consider the measurement tool being used. For example, Burdette and colleagues found seasonal variation among 2.5- to 4.5- year-olds when physical activity was measured by proxy reports from parents; when accelerometers were used, seasonal variation was less pronounced (10).

A large proportion of studies examining seasonal variation among children and adolescents used direct measures in the form of accelerometers, pedometers, heart rate monitors, and direct observation (3, 4, 6, 7, 20, 21, 22, 24, 30, 31, 33, 38, 39, 42, 56, 62, 63). However, among the studies reviewed, seasonal variation was evident regardless of the type of physical activity measure used. Seventy-two percent (13/18) of studies using direct measures and 94% (16/17) of those using indirect measures found seasonal variation in physical activity. For instance, children who wore accelerometers for 7 consecutive days in England were most active in the summer and least active in the winter (33, 38). Similarly, adolescents who wore pedometers for 3 to 4 consecutive days in Sweden were most active in the spring months of April and May (63). Based upon responses to a questionnaire, participation in organized and non-organized sport was highest in the spring/summer period in Portugal (47). Of the studies that did not find seasonal variation, 5 used direct measures (7, 21, 30, 39, 56) while 1 used indirect measures (49).

Research Design

Cross-sectional designs measure physical activity among different children and adolescents in each season. Therefore it is possible, especially in studies with smaller sample sizes, that seasonal differences are the result of differences in the characteristics of children and adolescents being compared. Thus, repeated-measure designs should be the stronger of the two designs as the same children and adolescents are being measured across seasons. However, caution should be taken when interpreting the results of this type of design because differences in physical activity between measurements may be caused by growth and maturation of the child. Specifically, over a period of 3 to 6, months young children can experience substantial changes in fine and gross motor skills that may enhance their ability to engage in physical activity (23). Whereas in adolescence, a time when physical activity has been shown to decrease (1), a period of 3 to 6 months could be marked by declines in physical activity (5). Approximately half the studies used a repeated-measure design (3, 4, 5, 13, 14, 23, 25, 31, 32, 33, 39, 40, 42, 48, 49, 56) while the others used a cross-sectional design (6, 7, 8, 10, 12, 20, 21, 22, 24, 27, 30, 35, 38, 41, 47, 62, 63). Regardless, the design of the study did not appear to impact the results of seasonal variation. Eighty-one percent (13/16) of studies using a repeated-measure design (3, 4, 5, 13, 14, 23, 25, 31, 32, 33, 40, 42, 48), and 84% (16/19) using a cross-sectional design, found seasonal variation in physical activity (6, 8, 10, 12, 20, 22, 24, 27, 30, 35, 38, 41, 47, 62, 63). For example, a cross-sectional study in the United States found the average number of days per week children spent participating in physical activity varied between seasons (27). Similarly, when accelerometers were worn for 7 consecutive days in the summer and the winter in England, children were more active in the summer (38). Of the studies that reported no seasonal variation, 3 were cross-sectional designs (7, 21, 30) and 3 were repeated-measure designs (29, 49, 56).

Discussion and Conclusions

Based on our review of the literature, it appears that seasonal variation of physical activity may exist among older children and adolescents in many different geographic locations. The results are consistent regardless of the physical activity measure or the study design. However, the evidence for seasonal variation among younger children (2- to 6- years-old) appears less clear. In fact, research on physical activity among pre-school children is very limited, (55) despite the fact overweight is becoming more common in pre-school children in many parts of the world including Canada and the UK (36, 37, 55). The pre-school years have been identified as a critical period for growth and acquisition of motor skills that are needed to be physically active throughout life (55). Recently, physical activity guidelines have been developed for children under the age of 5 years in the United States (34), recommending that preschoolers (3- 5 years of age) should accumulate at least 60 minutes of daily structured physical activity. However, national guidelines for physical activity among pre-school children are limited in other countries (55). Thus, more research is needed on what constitutes an appropriate level of physical activity for very young children and the factors that influence participation in this age group. Therefore, it is important to understand if seasonality impacts all age groups, or if the impact occurs later on when children begin to have more autonomy from their parents in terms of play and activities.

Several studies in this review report no significant seasonal differences in children's and adolescents' physical activity levels (7, 21, 30, 39, 49, 56) and one study actually recorded lower physical activity levels in the spring/summer period (3). There are several possible explanations for these discrepancies. For example, it may not be reasonable to expect to observe seasonal variation in physical activity in locations with mild winter temperatures (39, 49). However, two studies one in South Dakota and one in Saskatchewan, locations characterized by extremely cold winter conditions, reported no seasonal differences in physical activity (21, 56). Potential limitations, that may lead to questions about the reliability of these findings, is that activity monitors were only worn for 2 days instead of the recommended 4 days for children in South Dakota (1) and winter was not measured in the Saskatchewan study. Since regions such as South Dakota and, Saskatchewan experience extremely cold temperatures in the winter, more research is needed on seasonal variation of physical activity in regions characterized by extreme climates. Finally, the observation that activity levels were lowest in July in a study conducted in Texas was likely due to extremely hot temperatures in the summer (3). Therefore, activity levels may only be higher in warmer months to a certain threshold of temperature. Once average temperatures go beyond the threshold, then the extreme heat may impact children's activity levels in a similar manner as extremely cold temperature do. It is also possible that the discrepancy in this study is due to differences in measurement methodology, as this was the only study in the review that used direct observation to assess children's physical activity levels (1). Regardless, this further emphasizes the point that additional research is needed in locations characterized by extreme cold and hot climates.

Being outdoors was a significant predictor of physical activity levels in three of the studies (3, 10, 31). Play is an important source of physical activity among children (52). This has implications for regions that experience extreme temperatures in the winter and summer. However, Beighle and colleagues (4) speculated that children may still be active in colder weather if they experienced longer daylight hours. The authors found students measured in the spring experienced an additional 3.5 daylight hours compared to students in the winter. Similarly, there was additional 2 hours of daylight when children in Cyprus were measured in the summer compared to the winter (31). Thus, temperature and reduced daylight hours may reduce outdoor play which could limit children's opportunities for physical activity.

Another interesting finding was the interaction between season and rural/urban regions among youth's physical activity levels (31, 56). In two different parts of the world, rural youth were more active in the warmer months and urban youth were more active in the colder months. A review conducted on the correlates of physical activity of children and adolescents found associations between physical activity and urban/rural environments were inconsistent and concluded more research is needed is this area (45). Loucaides and colleagues speculated youth in rural areas were more active in the summer because they spent more time outside due to greater access to larger, safer spaces (31). In the winter, when the temperatures were colder and daylight hours were shorter, urban youth had more access to exercise equipment at home and a wider selection of sport facilities than rural youth (31). These findings suggest that when planning physical activity interventions for youth, both the time of year and the geographic location may influence the effectiveness of the intervention.

The main focus of this review was seasonal variation in physical activity; however, day-to-day variation in weather within seasons may also have an impact on physical activity. Though either may be a barrier to physical activity (53) and active commuting to school for youth (15), little research exists on the direct effects of meteorological variables on physical activity levels among youth (5, 9, 20). Some studies in the review that did not find seasonal variation took place in locations with little variation in temperatures and weather between seasons (39, 49). However, seasonal variation of physical activity was reported in similar locations in other studies reviewed (25, 33, 38, 42). This suggests that although weather appears to be an important factor, other factors may also be associated with seasonal variation. One study in the review that looked at both seasonal and weather variation concluded that daily fluctuations in weather did not have as much impact on adolescents' physical activity compared to the effect of month or season. Day-to-day variation in weather impacted unplanned activities more than planned activities (5). Regardless, more research is needed examining weather variation in physical activity among children and youth.

In summary, the majority of studies reviewed found that seasonal variation exists for physical activity among children and adolescents. As the seasons become more extreme in temperature, especially colder, children and adolescents were less likely to be physically active. These variations in physical activity were observed in countries such as England, Scotland, Canada, and the United States even though these countries have traditions around engaging in winter activities (e.g., skiing, ice hockey). Although another recent review found seasonal variation in physical activity among humans (59), only 13 of the 37 reviewed studies focused specifically on seasonal variation of physical activity among children and adolescents. Therefore, our review synthesized the findings of a further 22 studies on the topic for a total of 35. Furthermore, the previous review did not examine moderating variables that may have been unique to children and adolescents (e.g., age, type of physical activity measure).

Our findings have important implications for the design of physical activity interventions, the provision of programs for children and adolescents, and for the monitoring/surveillance of physical activity. Specifically, a single measurement occasion will not adequately characterize children's and adolescents' usual physical activity. One study in the review reported increases in activity in the warm seasons did not balance the decreases in physical activity seen in the colder seasons among adolescents resulting in a 7% decrease in activity per year (5). If physical activity varies by season, children and adolescents may lose the health benefits associated with physical activity when not participating in it year round. As well, these patterns of inconsistent physical activity participation along with yearly decreases may continue on into adulthood. Therefore, parents, teachers, and community recreational programmers should be aware of seasonal variation and take it into consideration when working with, or caring for, children and adolescents.

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Table 1: Seasonality of Physical Activity among Children and Adolescents

	Summer	Fall	Winter	Spring	Month/Other
Baranowski et al. (3)					
Males	NM	NM	NM	NM	Nov./Dec. = 1; Jul. = 4
Females	NM	NM	NM	NM	Jan.= 1; July = 4
Beighle et al. (4)	NM	NM	4	1	NM
Belanger et al. (5)	1	3	4	2	NM
Benefice et al. (6)	NM	NM	NM	NM	Rainy = 1; Dry = 4
Bitar et al. (7)	NM	ND	NM	ND	NM
Booth et al. (8)	1	NM	4	NM	NM
Burdette et al. (10)	1	2	4	3	NM
Carson et al. (12)	1	3	4	2	NM
Coe et al. (13)	NM	1	4	1	NM
Crocker et al. (14)	NM	4	4	1	NM
Duncan et al. (20)	1	NM	4	NM	NM
Finn et al. (21)	ND	ND	ND	ND	NM
Fisher et al. (22)	1	2	4	3	NM
Garcia et al. (23)	NM	NM	4	1	NM
Goran et al. (24)	NM	4	NM	1	NM
Hagger et al.(25)	1	NM	4	NM	NM
Huang et al. (27)	1	3	4	2	NM
Kristensen et al. (30)	1	4	4	1	NM
Kristensen et al. (30)	ND	ND	ND	ND	NM

Loucaides et al. (31)	1	NM	4	NM	NM
Lunt et al. (32)	1	NM	4	NM	NM
Mattocks et al. (33)	1	NM	4	NM	NM
Poest et al. (35)	1	3	4	2	NM
Riddoch et al. (38)	1	3	4	2	NM
Ridgers et al. (39)	ND	NM	ND	NM	NM
Rifas-Shiman et al. (40)	1	3	4	2	NM
Ross et al.(41)	1	3	4	2	NM
Ross et al. (41)	1	3	4	2	NM
Rowlands et al. (42)	1	NM	4	NM	NM
Santos et al. (47)	1	4	4	1	NM
Shephard et al. (48)	NM	1	NM	4	NM
Smith et al. (49)	ND	ND	ND	NM	NM
Tremblay et al. (56)	ND	ND	NM	NM	NM
Vermorel et al. (62)	NM	4	NM	1	NM
Wennlof et al. (63)	NM	NM	NM	NM	April/May - 1

1 = Most Active; 2 = Second Most Active; 3 = Second Least Active; 4 = Least Active; NM = Not measured in the study; ND = No difference.

Chapter 3

Seasonal Variation in Physical Activity among Pre-School Children in a Northern Canadian City

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Background

Childhood overweight and obesity has been identified as a major public health issue (Koplan, Catharyn, & Kraak, 2005). The prevalence of overweight and obesity in Canada has more than doubled since 1981 (Shields, 2006; Tremblay, Katzmarzyk, & Willms, 2002) and approximately 26% of children aged 2 to 17 years are currently overweight or obese (Shields, 2006; Tremblay et al., 2002). Among younger Canadian children, aged 2 to 5 years, approximately 18% are overweight or obese (Shields, 2006). Since obese children tend to remain obese as adults, this current trend is alarming (Freedman, Khan, Dietz, Srinivasan, & Berenson, 2001; Geo & Chumlea, 1999; Maffeis, Talamini, & Tato, 1998; Magarey, Daniels, Boulton, & Cockington, 2003; Power, Lake, & Cole, 1997; Serdula et al., 1993). Though many factors are associated with obesity risk (Danielzik, Czerwinski-Mast, Langnase, Dilba, & Muler, 2004; Hawkins & Law, 2006; Shields, 2006), physical inactivity has been implicated as an important determinant among Canadian children (Tremblay & Willms, 2003). Unfortunately, approximately 90% of Canadian children do not meet recommended physical activity (PA) guidelines (Canadian Fitness Lifestyle Research Institute [CFLRI], 2005). Thus, further examination of the variation and determinants of PA patterns is warranted.

Determinants of PA include individual, social, and environmental factors (Sallis & Hovell, 1990; Spence & Lee, 2003; Sallis et al., 2006). Sex, age, body weight status, SES, self-efficacy, and parental influences are common correlates of children's PA (Sallis, Prochaska, & Taylor, 2000; Trost, Kerr, Ward, & Pate, 2001; Van de Horst, Paw, Twisk, & Van Mechelen, 2007). More recently, aspects of the physical and built environment have also been associated with PA. For example, access to facilities/programs/parks, neighbourhood safety, time spent outdoors, and exercise equipment in the home are associated with PA among children (Sallis et al., 2000; Trost et al., 2001; Van der Horst et al., 2007; Tucker & Gilliland, 2007; Salmon, Spence, Timperio, & Cutumisu, 2008). However, factors within the natural environment such as seasons and the weather have received limited attention as determinants of PA among young children (Dietz & Gortmaker; Fisher et al., 2005; Goran et al., 1998; Kristensen et al., 2007).

A review of the literature reveals that lower levels of PA have been found among children and adolescents in the colder seasons compared to the warmer seasons in Australia (Booth, Okely, Chey, Bauman, & Macaskill, 2002; Lunt, Briffa, Briffa, & Ramsay, 2001), New Zeland (Duncan, Hopkins, Schofield, & Duncan, 2008), England (Hagger, Cale, Almond, & Kruger, 1997; Mattocks et al., 2007; Riddoch et al., 2007; Rowlands & Hughes, 2006), France (Vermorel, Vernet, Bitar, Fellmann, & Coudert, 2002), Scotland (Fisher et al., 2005), Portugal (Santos, Matos, & Mota, 2004), Denmark (Kristensen et al., 2007), Sweden (Wennlof, Yngve, Nilsson, & Sjostrom, 2005), the United States (Beighle, Alderman, Morgan, & Masurier, 2008; Garcia, Pender, Antonakos, & Ronis, 1998; Goran et al., 1998; Huang & Volpe, 2004; Poest, Williams, Witt, Atwood, 1989; Rifas-Shiman et al., 2001; Ross & Gilbert, 1985), and Canada (Belanger, Gray-Donald, O'Loughlin, Paradis, & Hanley, 2009; Crocker, Bailey, Faulkner, Kowalski, & McGrath, 1997). Overall, the results are consistent regardless of PA measure (e.g., self-report, pedometer) or research design (cross-sectional, longitudinal). But the findings are inconsistent across age categories. Though seasonal variation of PA occurs for older children and adolescents, the evidence for seasonal variation among younger children appears less clear (Carson & Spence, in press). Furthermore, few studies were conducted in locations characterized by extremely cold winter temperatures. The one study conducted with pre-school children in a cold climate region (i.e., South Dakota) found no seasonal differences in daily activity counts or the proportion of time spent in vigorous PA (Finn, Johannsen, & Specker, 2002). Thus, a need exists to further examine the influence of seasonality on PA among young children. The purpose of this study, therefore, was to examine associations between seasonality and PA levels among pre-school children in a region that is characterized by a northern climate. Our hypothesis was that young children would be more physically active in seasons characterized by warmer weather than seasons with colder weather.

Methods

Participants

Children who were attending a Capital Health Center for preschool immunization in the Edmonton region between November 2005 and August 2007 were recruited for a longitudinal cohort study to investigate determinants of childhood obesity. The city of Edmonton, the largest northern city in North America, is the capital of the Province of Alberta, and is located in western Canada (City of Edmonton, 2008). The data reported here is from the baseline phase of that study. Though not mandatory, a high proportion of children in the region visit these health centers for immunizations and other services from birth through preschool. For example, in 2004, 74% of children in the Capital Health region were immunized for DTap-PIV (Diphtheria, Tetanus, Pertussis, and Polio) before entering grade 1 (Edwards, Evans, & Brown, 2008). Therefore, these health centers allow access to the majority of children in the region. This research was approved by the Health Research Ethics Board of the University of Alberta and informed consent was obtained from the parents or guardians of all participating children.

We experienced approximately a 20% recruitment rate when trying to contact and recruit parents and children. However, if contact was made with the parent the recruitment rate was approximately 93%. In total, 2114 parents participated with their 4- or 5- year-old child. However, 399 parents did not complete the PA portion of the questionnaire correctly. Therefore, 1715 participants were included in the initial analyses.

Procedures

For a child to receive his or her immunization booster shot, their parent had to schedule an appointment with a Capital Health Center. Once an appointment was booked, the parents were contacted and asked if they would be interested in participating in the study. Interested parents were sent an information letter, consent form (see Appendix 4), and brief questionnaire. The questionnaire required approximately 20 minutes to complete and included questions on their child’s food and beverage consumption, eating behaviours, physical activity, and screen time use.

Instruments

Physical Activity. Children’s PA was assessed through a proxy report completed by a parent. The questionnaire was a modified version of the Children’s Leisure Activities Study Survey (CLASS; Teldford, Salmon, Jolley, & Crawford, 2004). It consisted of a checklist of 9 physical activities including swimming (lessons and for fun), soccer, ballet/dance, gymnastics, skating, hockey, bike riding, gym activities and active play (including at a playground). Parents indicated the frequency, and the average minutes each time (duration) their child participated in the activity during Monday to Friday and/or Saturday and Sunday for a typical week. At the end of the questionnaire parents could add frequency and duration of other activities their child participated in during a typical week. Total weekday and weekend minutes were summed to represent total PA (TPA) minutes in a typical week. The proxy report version of the CLASS questionnaire has shown to provide reliable estimates of PA among children aged 5 to 6 (Telford et al., 2004).

Physical Activity Concerns. Parents were asked to identify any conditions or diseases that may limit their child’s ability to engage in PA, (e.g., “Does your child have any problems that would hinder them from doing physical activities?) If yes, parents were asked to record the difficulty. These difficulties were classified into five main categories: 90 (5.2%) participants had asthma/allergies, 17 (1.0%) had a motor skill delay/issue, 4 (0.2%) had a heart/lung condition, 4 (0.2%) had type 1 diabetes, and 37 (2.2%) had an "other" condition.

Body Mass Index (BMI). Height and weight were measured by a trained health assistant. BMI was calculated (kg/m^2) and International Obesity Task Force (IOTF) cut-off points were used to classify the children according to their age and sex specific body weight status (Cole, Bellizzi, Flegal, & Dietz, 2000). Specifically, a child with a BMI less than the adult equivalent 25 kg/m^2 was classified as normal weight, between 25 kg/m^2 and 29.9 kg/m^2 was overweight, and 30 kg/m^2 and above was considered obese.

Neighborhood Socioeconomic Status (SES). Though children's addresses were not available, their postal codes were recorded in community health records. These postal codes were geocoded (assigned spatial reference) using the Postal Code Conversion File (PCCF) produced by Statistics Canada. An SES index was then created for each dissemination area where the centroids of children's postal codes were located using data extracted from the 2006 Census (Statistics Canada, 2008). Dissemination areas are geographic units consisting of one or more adjacent blocks encompassing a population of 400 to 700 persons (Statistics Canada, 2009). The SES index for each dissemination area was calculated by taking the sum of the z-scores of net educational level (the proportion of people with high education subtracted from the proportion of people with low education, aged 15 and over) and median income in 2005 of all census families, and then subtract the proportion of unemployed (unemployed people aged 15 and over as a percentage of people aged 15 and over who were in the labor force). The dissemination areas were then classified into high, medium, or low SES based upon a tertile split

Seasons. The city center of Edmonton is located at 53 degrees latitude and 113 degrees longitude (Environment Canada, 2008). The region experiences 4 distinct seasons with snow cover for approximately 5 months of the year from November to mid-March (City of Edmonton, 2008). In the winter months, Edmonton can experience extremely cold temperatures and wind chills. However, summer months are generally dry and sunny with lower humidity (City of Edmonton, 2008). Due to the northern latitude of Edmonton, summer is characterized by long daylight hours (approximately 17 hours per day) whereas winter has short daylight hours (approximately 8 hours per day; City of Edmonton, 2008). Thus, determination of seasons reflected the northern hemisphere and was characterized by significant differences in weather conditions, daylight hours, and temperature (Tucker et al., 2007; Fisher et al., 2005). Most studies based in the northern hemisphere (Goran et al., 1998; Kristensen et al., 2007; Riddoch et al., 2007; Burdette, Whitaker, & Daniels, 2004) have classified seasons as spring (March to May), summer (June to August), autumn/fall (September to November), and winter (December to February). This is consistent with the seasons found in Edmonton as the average temperature in winter is -11.7 °C, spring 3.4°C, summer 15.0°C, and fall 2.9°C (Environment Canada, 2008). The month during which the parents completed the proxy report was used to classify the participant by season.

Data analysis

To examine relationships between PA status and seasons, descriptive statistics were calculated and normality of distributions were examined. A test of normality, including the Kolmogorov-Smirnov test and inspections of the normal probability plots, revealed that the total PA minutes was positively skewed. This is a common problem when measuring population levels of PA. Basically, the majority of Canadians, including children are not physically active (CFLRI, 2005). Therefore, instead of normalizing the data by transforming the PA variable, we chose to conduct a series of non-parametric analyses. First, a Kruskal-Wallis test was conducted to determine if minutes of TPA varied as a function of season. In this test, scores are converted to ranks and then the mean rank of each group is compared in a between-group analysis. Similar analyses were performed for active play, weekday PA, and weekend PA.

To determine if the proportion of children deemed to be sufficiently active was associated with seasons, we categorized the participants by PA status. Based upon the recommendations of Canada's Physical Activity Guide to Healthy Active Living for Children (Health Canada, 2002), participants were categorized as active if they participated in at least 90 minutes of PA every day of the week (630 + minutes), somewhat active if they participated in 90 minutes of PA four to six days of the week (360 – 629 minutes) and inactive if they were active less than 360 minutes a week. Three multinomial logistic regression models were then analyzed with PA status as the criterion variable. In this case, the odds ratio refers to the odds of being in either the active or somewhat active categories versus the probability of being in the reference category (inactive). For the first model, PA status was regressed on seasons. BMI, sex, and PA concerns were added as covariates in the second model, and neighbourhood SES was added as a covariate in the final model. Census data were not available for 8 participants; therefore the analysis involving neighbourhood SES was limited to 1707 participants.

We examined whether any differences existed between the included and excluded children on some key variables. No significant differences existed for BMI, χ^2 (1) = 0.14, p = 0.71, or sex, χ^2 (1) = 1.37, p = 0.24, between the included and excluded children. With a sample size of approximately 1700 participants, and at least 200 participants per season, we were sufficiently powered to detect any medium sized associations at an alpha level of .05 (Cohen, 1992).

Results

Descriptive data for the sample on age, sex, BMI, and SES are presented in Table 1. Though the majority of the sample was registered in day care (86.4%), no significant differences existed between PA status, χ^2 (1) < 0.0001, p = 0.99 and TPA, χ^2 (1) = 0.04, p = 0.85 between children registered in day care and those who were not. Approximately 42.4% were active, 32.6% were somewhat active, and 25.0% were inactive.

Parents reported their children participating in more minutes of PA and engaging in more minutes of active play in the summer in comparison to the spring, fall, and winter (see Table 2). A series of Kruskal Wallis tests confirmed seasonal differences in minutes of active play, χ^2 (3) = 43.59, p < 0.0001, weekday PA, χ^2 (3) = 41.77, p < 0.0001, weekend PA, χ^2 (3) = 12.28, p = 0.006, and TPA, χ^2 (3) = 31.82, $p < 0.0001$. An inspection of the mean ranks showed that children were most active in the summer and the least active in the winter for all four variables.[1]

In terms of the proportion of children who met PA recommendations in each season, 47.2% were active in the summer, 41.8% in the spring, 36.7% in the fall, and 36.5% in the winter (see Table 2). With the inactive group as the reference, unadjusted analyses showed children were significantly more likely to be physically active in the summer (OR = 2.41, 95%CI: 1.70 – 3.42), and spring (OR = 1.47, 95%CI: 1.02 – 2.10) relative to winter (see Table 3). Similarly, children were more likely to be somewhat active in the summer (OR = 2.24, 95%CI: 1.54– 3.26), and fall (OR = 1.88, 95%CI: 1.21 – 2.91) relative to winter (Nagelkerke r^2 = 0.02; see Table 4). The same significant differences in seasons were maintained when sex, BMI, and PA concerns were adjusted for in the second model (Nagelkerke r^2 = 0.03) and when neighbourhood SES was adjusted for in the third model (Nagelkerke r^2 = 0.03).

Discussion

We examined whether PA levels among pre-school children in Edmonton, Canada differed between seasons. Overall, TPA levels were highest in the summer and lowest in the winter. Similar significant seasonal differences were observed for active play, weekday PA, and weekend PA. When children were grouped according to their PA status, both the active and somewhat active groups were significantly more likely to be physically active in the summer after adjusting for sex, BMI, PA concerns, and neighbourhood SES. This is one of the

[1] No seasonal variation was found for screen time, $F(1,3) = 0.75$, $p = .522$.

first studies to quantitatively and directly examine seasonal variation among young children in a northern region characterized by extremely cold temperatures and shorter daylight hours in the winter.

Being outdoors is a significant predictor of PA levels among young children (Baranowski, Thompson, DuRant, Baranowski, & Puhl, 1993; Burdette et al., 2004; Loucaides, Chedzoy, & Bennett, 2004), and play is an important source of PA among children (Strum, 2005). The extreme temperatures and weather conditions experienced in Edmonton during the winter, as well as the short daylight hours, probably reduced outdoor play among our participants and limited their opportunities for PA. It should be noted that 42% of our sample was active which is higher than the 10% reported for Canadian children in the CANPLAY study (CFLRI, 2005). This difference in likely the result of proxy reports of PA used in our study relative to the actual measures of steps taken in the CANPLAY study. Information on activities like hockey, swimming and bike riding would not have been recorded with pedometers. Further, the sample in the CANPLAY study included children between the ages of 5 to 19 and thus was, on average, much older than our sample. Because younger children are more active than older children (CFLRI, 2005; Sallis et al., 1990), it is likely that some of the difference in level of PA observed between the two studies is due to age.

Our findings are consistent with other studies conducted in Australia (Booth et al., 2002; Lunt et al., 2001), New Zealand (Duncan et al., 2008), England (Hagger et al., 1997; Mattocks et al., 2007; Riddoch et al., 2007; Rowlands et al., 2006), France (Vermorel et al., 2002), Scotland (Fisher et al., 2005), Portugal (Santos et al., 2004), Denmark (Kristensen et al., 2007), Sweden (Wennlof et al., 2005), the United States (Beighle et al., 2008; Garcia et al., 1998; Goran et al., 1998; Huang et al., 2004; Poest et al., 1989; Rifas-Shiman et al., 2001; Ross et al., 1985), and Canada (Belanger et al., 2009; Crocker et al., 1997), where lower PA was found in colder seasons. However, these findings are inconsistent with a study done in South Dakota where no significant seasonal differences in vigorous PA, as measured with accelerometers, was found with pre-school children (Finn et al., 2002). Several explanations should be considered for the differences in findings. In the South Dakota study, PA was measured only 2 days per season. However, experts recommend that a minimum of 4 days are required to determine habitual activity levels among children when using activity monitors (Tudor-Locke et al., 2004). Furthermore, since activity monitors were used, information on activities like hockey, swimming, and bike riding would not have been recorded. Finally, Finn and colleagues did not define the months used to classify their seasons making it difficult for comparisons with other studies. Our results are also inconsistent with findings from England (Ridgers, Stratton, Clark, Fairclough, & Richardson, 2006), and Vancouver, Canada (Smith, Rhodes, Naylor, & McKay, 2008), where inactivity in the winter months was not significant different in comparison to other months of the year. This could be due to the different study designs or the fact that England and Vancouver do not experience extremely cold temperatures in the winter. For example, the average winter daily temperature in Vancouver, from 1971 to 2000, was approximately 3.8^{0}C in comparison to -11.9^{0}C in Edmonton (Environment Canada, 2008).

Limitations of our study include the cross sectional design and the use of parental reports for PA. Although the CLASS is a reliable tool to measure PA among 5- and 6- year-olds (Telford et al., 2004), its reliability has not been verified with children aged 4 years and less. Furthermore, because the CLASS assesses a typical week, we assumed parents referred to a typical week within the season when they completed the questionnaire. It would also have been ideal to have household SES in addition to neighbourhood SES for all participants.

Though the proportion of variance explained by the models was small, and thus other factors contributed to children's PA levels, strengths of the study include the large sample size, the pre-school aged sample, and the objective measures of height and weight. To address some of the limitations discussed previously, future research on seasonal variation of PA among young children should use direct measures of PA in association with parental proxy reports. Finally, along with testing seasonal variation, the impact of daily weather (e.g., temperature and precipitation) on children's PA should be examined.

These findings have important implications on the design of PA interventions for children, especially in areas of the world that experience extremely cold winter temperatures. Consistent with ecological models of PA (Spence et al., 2003), the need for opportunities and programs for children to engage in PA may vary according to season and location. Community recreation programmers, teachers, and parents should be aware of seasonal variation and consider increasing the PA opportunities for children in the winter. These findings also have important implications for measurement of PA. Specifically, a single measurement occasion may not adequately characterize children's usual PA.

Conclusion

We found seasonal variation of physical activity exists among pre-school children in a northern Canadian city. Therefore, opportunities should be provided for young children to engage in PA throughout the year, especially in areas of the world that experience extreme winter conditions.

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Table 1: Demographic Information

Characteristic	Fall	Summer	Spring	Winter	Total
	n (%)	*n* (%)	*n* (%)	*n* (%)	*n (%)*
Participants	264 (15.4)	684 (39.9)	507 (29.6)	260 (15.1)	1715 (100.0)
Age					
4 years	103 (39.1)	305 (44.6)	270 (53.2)	132 (50.8)	817 (47.7)
5 years	149 (56.4)	354 (51.8)	215 (42.5)	124 (47.7)	842 (49.0)
Unknown	12 (4.5)	25 (3.6)	22 (4.3)	4 (1.5)	56 (3.3)
Sex					
Boys	133 (50.4)	337 (49.2)	255 (50.2)	152 (58.5)	876 (51.1)
Girls	131 (49.6)	347 (50.8)	252 (49.8)	108 (41.5)	839 (48.9)
BMI Weight					
Overweight	32 (12.0)	79 (11.5)	58 (11.5)	25 (9.6)	195 (11.4)
Obese	11 (4.1)	32 (4.7)	22 (4.3)	10 (3.8)	75 (4.4)
Day Care					
Yes	256 (97.0)	564 (82.4)	423 (83.4)	239 (91.9)	1481 (86.4)
No	6 (2.3)	118 (17.2)	78 (15.4)	19 (7.3)	221 (12.9)
Unknown	2 (0.8)	2 (0.4)	6 (1.2)	2 (0.8)	13 (0.7)
SES (n = 1707)					
Low	49 (18.9)	139 (20.4)	116 (22.9)	55 (21.2)	371 (21.7)
Medium	85 (32.1)	250 (36.5)	188 (37.0)	85 (32.7)	614 (36.0)
High	130 (49.1)	295 (43.1)	203 (40.1)	120 (46.2)	722 (42.3)

BMI = Body Mass Index according to IOTF classification; SES = Socioeconomic Status.

Table 2: Median (Interquartile Range) Weekly Minutes per Season for Active Play, Total Physical Activity (TPA), Weekday TPA, and Weekend TPA

Seasons	*n*	Active Play	Weekday TPA	Weekend TPA	Weekly TPA	% active
Winter	260	180.0 (261.0)	315.0 (395.0)	120.0 (180.0)	494.0 (537.50)	36.5
Spring	507	218.0 (320.0)	385.0 (388.75)	150.0 (205.0)	540.0 (536.25)	41.8
Summer	684	270.0 (330.0)	445.0 (360.0)	170.0 (215)	600.0 (520.0)	47.2
Fall	264	197.5 (240.0)	370.0 (309.38)	150.0 (172.50)	535.0 (436.25)	36.7

Table 3: Active Children: Odds Ratios for Seasons, Sex, BMI, PA Concerns, and Neighbourhood SES

		Model 1 (*n* = 1715)			Model 2 (*n* = 1715)			Model 3 (*n* = 1707)		
		ß	OR	95%CI	ß	OR	95%CI	ß	OR	95%CI
Intercept		0.32			-0.37			-0.38		
Seasons	Fall	0.34	1.40	0.92-2.14	0.38	1.47	0.95-2.20	0.41	1.50	0.98-2.31
	Summer	0.88*	2.41	1.70-3.42	0.94*	2.55	1.79-3.64	0.95*	2.58	1.81-3.69
	Spring	0.38*	1.47	1.02-2.10	0.43*	1.53	1.07-2.19	0.43*	1.54	1.07-2.21
	Winter		1.00			1.00			1.00	
Sex	Female				-0.42	0.66	0.51-0.84	-0.41	0.66	0.52-0.85
	Male					1.00			1.00	
BMI	Other				0.41	1.51	0.85-2.70	0.41	1.51	0.85-2.70
	Overweight				0.43	1.53	0.79-3.00	0.44	1.56	0.80-3.03
	Obese					1.00			1.00	
PA Concerns	No				0.19	1.21	0.78-1.84	0.19	1.21	0.80-1.84
	Yes					1.00			1.00	
SES	Low							-0.05	0.95	0.69-1.31
	Medium							0.01	1.01	0.77-1.33
	High								1.00	

BMI = Body Mass Index according to IOTF classification; PA = Physical Activity; SES = Socioeconomic Status; * $p < .05$.

Table 4: Somewhat Physically Active Children: Odds Ratios for Seasons, Sex, BMI, PA Concerns, and Neighbourhood SES

		Model 1 (n = 1715)			Model 2 (n = 1715)			Model 3 (n = 1707)		
		ß	OR	95%CI	ß	OR	95%CI	ß	OR	95%CI
Intercept		-0.23			-0.79			-0.76		
Seasons	Fall	0.63*	1.88	1.21-2.91	0.66*	1.94	1.25-3.00	0.68*	1.97	1.27-3.06
	Summer	0.81*	2.24	1.54-3.26	0.85*	2.33	1.60-3.40	0.85*	2.34	1.61-3.42
	Spring	0.33	1.40	0.95-2.05	0.36	1.43	0.97-2.10	0.37	1.44	0.98-2.12
	Winter		1.00			1.00			1.00	
Sex	Female				-0.20	0.82	0.64-1.06	-0.20	0.82	0.64-1.06
	Male					1.00			1.00	
BMI	Other				0.27	1.31	0.73-2.37	0.27	1.31	0.73-2.40
	Overweight				0.26	1.29	0.65-2.57	0.27	1.31	0.66-2.61
	Obese					1.00			1.00	
PA Concerns	No				0.42	1.52	0.95-2.41	0.42	1.52	0.96-2.42
	Yes					1.00			1.00	
SES	Low							-0.10	0.91	0.65-1.27
	Medium							-0.05	0.95	0.71-1.27
	High								1.00	

BMI = Body Mass Index according to IOTF classification; PA = Physical Activity; SES = Socioeconomic Status; * $p < .05$.

Chapter 4

The Influence of Neighbourhood SES on Screen Time among Pre-School Children in Canada

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Background

Sedentary activity is considered a separate construct from physical activity (Hanson and Chen, 2007; Mark and Janssen, 2008; Reilly, 2008; Smith and Biddle, 2008; Salmon et al., 2008) and engaging in sedentary behaviours produces health effects independent of physical activity levels (Salmon et al., 2008). Therefore, the determinants of these behaviours should also be considered separately (Reilly, 2008). A major source of sedentary activity in children is screen time or time spent viewing television or movies, playing video games, and using computers (Must and Tybor, 2005). Professional pediatric organizations recommend that children engage in screen time for a maximum of 1-2 hours a day (American Pediatric Association [AAP], 2001; Nieman, 2006). For pre-school children, the Canadian Pediatric Association recommends less than 1 hour a day (Nieman, 2006). However, The Health Behaviour in School-Aged Children Survey (HBSC) revealed that only 18% of Canadian girls and 14% of Canadian boys in grades 6 to 10 are meeting these guidelines (Mark et al., 2006). This is a concern as a recent longitudinal cohort study found that viewing television more than 2 hours per day as a child and adolescent was associated with overweight, poor fitness, increased smoking, and elevated cholesterol in adulthood (Hancox et al., 2004). This could be explained by several mechanisms including the displacement of physical activity by screen time (Robinson, 2001; Dietz and Gortmaker, 1985) and the lowering of children's metabolic rate (Robinson, 2001; Klesges et al., 1993). TV in particular, is thought to encourage between meal snacking (Francis et al., 2003; Thomson et al., 2008) as well as expose children to advertisements for junk food (Harrison and Marske, 2005; Taras et al., 1989; Thomson et al., 2008).

Therefore, it is critical to understand the factors that influence screen time. However, unlike physical activity, little is known about the determinants of sedentary behaviour (Gorely et al., 2004; Salmon et al., 2008; Spanier et al., 2006; McGuire et al., 2002). Parental socioeconomic status (SES), ethnicity, body weight, between meal snacking, number of parents in the home, parents TV viewing habits, weekend, and having a TV in one's bedroom have been linked to TV viewing in children and adolescents between the ages of 2 and 18 (Gorely et al., 2004). Recently, characteristics of neighbourhood environment (e.g., safety, sidewalk characteristics, walkability, income) have also been examined as a correlate for screen time in children/adolescents (Burdette and Whitaker, 2005; Jago et al., 2005; MacLeod et al., 2008) and adults (Sugiyama et al., 2007). For instance, when neighbourhood income increased by $10,000, there was a subsequent 2-hour decrease of time spent in front of the television in a sample of 9- and 10- year-old girls in the U.S. (MacLeod et al., 2008). It is possible that higher income neighbourhoods have more resources for after-school programs (Shann, 2001) and recreational facilities (MacLeod et al., 2008), while perceived lack of safety in lower income areas may keep children inside (Burdette and Whitaker, 2005; MacLeod et al., 2008; Molnar et al., 2004; Weir, et al., 2006). Furthermore, a number of studies have found that neighbourhood environment may impact males and females differently in both children/adolescents (Gomez et al., 2004; Hoefer et al., 2001; Li et al., 2006; MacLeod et al., 2008; Norman et al., 2006; Santos et al., 2006; Spence et al., 2008), and adults (Sugiyama et al., 2008). For example, residing in a low walkable neighbourhood was associated with an increased risk of overweight and obesity among young girls in Edmonton but not boys (Spence et al., 2008). As well it is thought that sedentary behaviours may differ between males and females in both children/adolescents (Boone et al., 2007; Leatherdale and Wong, 2008; Salmon et al., 2008), and adults (Salmon et al., 2008; Sugiyama et al., 2007; Shields and Tremblay, 2008). For example, boys usually spend more time playing video games and using the computer than girls (Salmon et al., 2008). Therefore these relationships should be explored separately among males and females and across age groups.

By determining the factors that contribute to sedentary behaviours for both boys and girls, effective interventions can be designed to promote active, healthy lifestyles and prevent the development of overweight and obesity among children (Van Der Horst et al., 2007). Though aspects of the neighbourhood environment have been associated with screen time among children, to date no study has examined the association of neighbourhood SES with pre-school children’s screen time behaviour. Therefore, the main purpose of this study was to determine whether neighbourhood SES is associated with screen time use among, 4- and 5-year-old boys and girls.

Methods

Participants

Children who were attending a Capital Health Centre for preschool immunization in the Edmonton region between November 2005 and August 2007 were recruited for a longitudinal cohort study to investigate the determinants of childhood obesity. The city of Edmonton is the capital of the Province of Alberta and is located in western Canada. It is the largest northern city in North America with a metropolitan population of 1,034,045 in 2006 (Environment Canada, 2009). The data reported here is from the baseline phase of that study. Though not mandatory, a high proportion of children in the region visit these health centres for immunizations and other services from birth through to preschool. Approximately 74% of children were immunized for DTap-PIV (Diphtheria, Tetanus, Pertussis, and Polio) in the Capital Health region before entering grade 1 in 2004 (Edwards et al., 2008). Therefore, these health centres allow access to the majority of children in the region.

We experienced approximately a 20% recruitment rate when trying to contact and recruit parents and children. However, if contact was made with the parent the recruitment rate was approximately 93%. In total, 2114 parents participated with their 4- or 5- year-old child. Of those children, 1633 (805 girls and 828 boys) were part of the analyses; those excluded were 391 whose parent's did not complete the physical activity portion of the questionnaire correctly and 90 cases lacking age, BMI, SES, or daycare information.

Procedures

For a child to receive his or her immunization booster shot, their parent had to schedule an appointment with a Capital Health Center. Once an appointment was booked, the parents were contacted by mail and asked if they would be interested in participating in the study. Those parents who were interested were then contacted prior to their appointment by telephone. The study was then explained to the parents and any questions were answered. If the parents were still interested they were mailed an information letter, consent form (see Appendix 4), and brief questionnaire, which they were to bring to their child's appointment. If parents forgot to bring their package to the appointment, extra copies were available at the health center. The questionnaire required approximately 20 minutes to complete and included questions on their child's food and beverage consumption, eating behaviours, physical activity, and screen time.

Instruments

Screen Time. Children's screen time was assessed through a proxy report on leisure activities completed by a parent. It consisted of a checklist of 4 leisure activities including: TV/ videos, playstation/nintendo/x-box/gameboy, computer/internet/computer games, and play indoors with toys. Parents indicated yes or no if their child participated in these activities in a typical week. For the activities circled "yes", parents recorded the total hours/minutes (duration) their child participated in the activity during Monday to Friday and/or Saturday and Sunday. At the end of the questionnaire parents could add other leisure activities their child participated in during a typical week along with the duration of those activities. Total weekly screen time minutes (TV/movies, video games, and computer use) were calculated for each participant.

Neighborhood Socioeconomic Status (SES). Though children's addresses were not available, their postal codes were recorded in community health records.

These postal codes were geocoded (assigned spatial reference) using the Postal Code Conversion File (PCCF) produced by Statistics Canada. An SES index was then created for each dissemination area where the centroids of children's postal codes were located using data extracted from the 2006 Census (Statistics Canada, 2008). Dissemination areas are geographic units consisting of one or more adjacent blocks encompassing a population of 400 to 700 persons (Statistics Canada, 2009). The SES index for each dissemination area was calculated by taking the sum of the z-scores of net educational level (the proportion of people with high education subtracted from the proportion of people with low education, aged 15 and over) and median income in 2005 of all census families, and then subtract the proportion of unemployed (unemployed people aged 15 and over as a percentage of people aged 15 and over who were in the labor force). The dissemination areas were then classified into high, medium, or low SES based upon a tertile split

Body Mass Index (BMI). When children attended their appointment, height and weight were measured by a trained health assistant and BMI (kg/m^2) was calculated for each participant.

Physical Activity. Children's physical activity was assessed through a proxy report completed by a parent. The questionnaire was a modified version of the Children's Leisure Activities Study Survey (CLASS; Telford et al., 2004). It consisted of a checklist of 9 physical activities and parents indicate how many times (frequency), and the average minutes each time (duration) their child participated in an activity during the weekday and/or weekend of a typical week.

Participants were categorized as active if they participated in at least 90 minutes of physical activity every day of the week (630 + minutes), somewhat active if they participated in 90 minutes of physical activity four to six days of the week (360 – 629 minutes), and inactive if they were active less than 360 minutes a week (Health Canada, 2002).

Physical Activity Concerns. Parents were asked to identify any conditions or diseases that may limit their child's ability to engage in physical activity, (e.g., "Does your child have any problems that would hinder them from doing physical activities?) If yes, parents were asked to record the difficulty. These difficulties were classified into five main categories: 84 (5.1%) participants had asthma/allergies, 17 (1.0%) had a motor skill delay/issue, 4 (0.2%) had a heart/lung condition, 3 (0.2%) had type 1 diabetes, and 34 (2.1%) had an "other" condition.

Seasons. Determination of seasons reflected the northern hemisphere and was characterized by significant differences in weather conditions, daylight hours, and temperature (Tucker and Gilliland, 2007; Fisher et al., 2005). Most studies based in the northern hemisphere (Goran et al., 1998; Kristensen et al., 2007; Riddoch et al., 2007; Burdette et al., 2004) have classified seasons as: spring (March to May); summer (June to August); autumn/fall (September to November); and, winter (December to February). This is consistent with the seasons found in Edmonton. The month in which the parents completed the proxy report was used to classify the participant into a season. Seasons were then coded "0" for fall and winter and "1" for spring and summer.

Daycare. Parents were asked, “Does your child attend any of the following: day care, play school, preschool, or kindergarten?” This variable was coded, “0” for no and “1” for yes.

Junk Food and Fruit and Vegetable Intake. Proxy dietary reports were completed by parents on behalf of their child. Parents were asked: “Thinking back over the past couple of weeks, how many servings has your child had of the following foods and beverages? Estimate the number of servings for each food or beverage, either over an average day or over an average week. If your child rarely or never has the food or beverage, write zero per day or per week.” There were 14 items for foods and 5 for beverages, as well as one blank line for “other, please specify.” Weekly servings of junk food were determined by adding weekly servings of chips, French fries, candy, chocolate bars, cookies/cakes, ice cream, and pop/slushes. Weekly servings of fruits and vegetables were summed up.

Data Analysis

To examine the relationship between screen time and neighbourhood SES, descriptive statistics were calculated and normality of distributions was examined. Through inspections of the normal probability plots, it was determined that the variables total screen time and TV/video viewing had a normal distribution. However, videogame and computer variables were highly positively skewed. Correlations between all independent variables revealed no multicolinarity concerns. Due to an unconditional intra-class coefficient of .01, multilevel modeling procedures were not necessary to address nesting effects of neighbourhoods on total screen time. Chi-squared tests were conducted to examine if any differences existed between girls and boys for the independent and dependent variables. Dependent sample t-tests and Wilcoxon Signed Rank tests were conducted to compare weekday versus weekend screen time minutes. Correlational analyses were also conducted to examine the associations between screen time and junk food, fruits/vegetables and physical activity.

Since a number of studies have found that sedentary behaviours (Boone et al., 2007; Leatherdale and Wong, 2008; Salmon et al., 2008), and the impact of neighbourhood environment may differ between boys and girls (Gomez et al., 2004; Hoefer et al., 2001; Li et al., 2006; MacLeod et al., 2008; Norman et al., 2006; Santos et al., 2006; Spence et al., 2008), sex-specific hierarchical multiple linear regression models were analyzed for the outcomes total weekly screen time minutes and weekly TV/video minutes. Step 1 included the controls: age, day care status, physical activity concerns, seasonal variations, BMI, and physical activity status and step 2 included neighbourhood SES. Before proceeding with our analyses, we examined whether any differences existed between the included and missing cases on some key variables. No significant differences existed for total screen time, χ^2 (1) = 0.06, p =0.81, or any of the subscales of screen time between the included and missing cases. Sample sizes of n = 805 and n = 828 were deemed sufficient to detect medium to small associations at an alpha level of 0.05 (Cohen, 1992).

Results

Descriptive data for the sample are presented in Table 1. We examined whether any differences existed between boys and girls for the independent and dependent variables. The independent variables age, problems hindering physical activity, seasons, activity status were significantly different between sexes (see Table 1). The dependent variables total weekly screen time minutes and weekly video game minutes were also significantly different between sexes. Boys had significantly higher total weekly screen time minutes, χ^2 (1) = 6.92, p = 0.009, and weekly video game minutes, χ^2 (1) = 110.81, $p < 0.0001$ compared to the girls.

Overall, participants engaged in 780 median minutes of screen time weekly (840 for boys and 750 for girls; see Table 2). Forty-two percent of participants engaged in more than 2 hours of screen time (39.8% for girls and 45% for boys). Seventy-eight percent of participants engaged in more than 1 hour of screen time (68% for girls and 80% for boys). When examining TV/video minutes independently, 25.5% of participants viewed more than 2 hours of TV/Video a day (26% for girls and 40% for boys). Sixty-eight percent of participants viewed more than 1 hour of TV/video a day (68% for girls and 69% for boys). Participants engaged in significantly more total screen time, t (1632) = 10.81, $p < 0.0001$, TV/video, t (1632) = -9.38, $p < 0.0001$, videogame, z = -16.31, $p < 0.0001$, and computer, z = -26.31, $p < 0.0001$ minutes on weekends compared to weekdays.

Correlational analysis revealed that weekly junk food servings were significantly positively correlated with total screen time (r = 0.17, $p < 0.0001$), TV/video (r = 0.13, $p < 0.0001$), video games (r = 0.11, $p < 0.0001$), and computer (r = 0.09, $p < 0.0001$) weekly minutes. As well, fruit and vegetable weekly servings were significantly negatively correlated with total screen time (r

= -0.08, p = 0.001), TV/video, (r = -0.06, p =0.017), and video games (r = -0.09, p = p < 0.0001) weekly minutes. No significant correlations were found between weekly physical activity and total screen time, TV/video, video games, or computer weekly minutes.

Step 1 of the female sex-specific hierarchical regression models, which included the control variables: age, daycare, physical activity concerns, season, BMI, and activity status, accounted for 0.8% (p = 0.39) and 0.6% (p = 0.58) of the variability in total weekly screen time and TV/video minutes, respectively. Addition of neighbourhood SES as a predictor in step 2 explained an additional 0.7% (p = 0.02) and 0.5% (p = 0.03) of the variability in both models (see Table 3 and Table 4). In the final models, neighbourhood SES was found to be a statistically significant predictor of total weekly screen time (β = -0.09, p = 0.02) and TV/video (β = -0.07 p = 0.03) minutes in 4- and 5-year-old girls.

Step 1 of the male sex-specific hierarchical regression models accounted for 0.2% (p = 0.03), and 0.1% (p = 0.24) of the variability in total weekly screen time and TV/video minutes respectively. Addition of neighbourhood SES as a predictor in step 2 did not explain any additional variance (see Table 3 and Table 4). In the final models, day care was found to be a significant predictor of total weekly screen time minutes in boys (β = -0.1, p = 0.005). Boys in day care engaged in less screen time than boys who were not in day care. Unlike the girls, neighbourhood SES was not found to be a significant predictor in total screen time or TV/video weekly minutes for boys (see Table 3 and 4).

Discussion

We examined whether neighbourhood SES was associated with screen time use among pre-school boys and girls in Edmonton, Canada after adjusting for various factors. Neighbourhood SES was found to be a predictor of total screen time and TV/video use for girls, but not for boys. Median weekly screen time minutes were highest for girls in the low SES neighbourhoods, and were lowest in the high SES neighbourhoods. Secondary analysis showed that total screen time, TV/video, video games and computer weekly minutes were significantly higher on weekends compared weekdays. As well, weekly junk food servings were found to be significantly positively correlated with total screen time, TV/video, video game, and computer weekly minutes. Where as fruit and vegetable weekly servings were negatively correlated with total screen time, TV/video, and video game weekly minutes. However, no associations were found with physical activity. We also found that a large portion of our sample exceeded the guidelines for total screen time and TV viewing recommended by the American and Canadian pediatric associations (APP, 2001; Nieman, 2003).

Two suggested mechanisms for the association between neighbourhood SES and screen time are negative perceptions of neighbourhood safety (Burdette et al., 2005; Carver et al., 2008; Evenson et al., 2007; Hanson and Chen, 2007; Li et al., 2006; MacLeod et al., 2008; Molnar et al., 2004; Veugelers et al., 2008; Weir et al., 2006) and lack of resources and access to facilities (Gordan–Larsen et al., 2006; Hoefer et al., 2001; Janssen et al., 2006; Li et al., 2006; MacLeod et al., 2008; Merchant et al., 2006; Norman et al., 2006; Santos et al., 2009). The perception of unsafe neighbourhoods is thought to limit children's outdoor play and increase sedentary indoor activities, such as screen time. For example, a study in the United States found that pre-school children who lived in neighbourhoods that their mothers perceived as unsafe viewed more TV (Burdette et al., 2005). Similarly, Canadian children in neighbourhoods that were perceived as unsafe engaged in less outdoor, unstructured play and were more likely to stay indoors and participate in sedentary activities (Veugelers et al. 2008). However, perceptions of neighbourhood safety may impact girls different than boys. Perceptions of lower neighbourhood safety were associated with less outdoor play with girls, but not boys in Texas (Gomez et al., 2004). Similar to speculation made by Gomez and colleagues (2004), gender roles and expectations may have caused parents and families of girls in our study to be more protective than boys in lower SES neighbourhoods. Therefore, girls may have been more restricted to activities in the home compared to boys.

Higher SES neighbourhoods, which have more resources, recreation facilities and play areas, can offer more alternative activities to screen time for children (MacLeod et al., 2008). For example, reduced access to facilities in lower SES block groups was associated with a decrease in physical activity and an increase in overweight in children (Gordon-Larsen et al., 2006). However, there is some evidence to show that access to facilities can affect boys and girls differently. In China, lack of access to recreational facilities was associated with inactivity in girls, but not boys (Li et al., 2006). Similarly in the United Kingdom living in a more deprived neighbourhood was associated with more hours of sedentary behaviour for girls, but not for boys (Brodersen et al., 2005). Comparable findings have been reported in other studies in the United States (Hoefer et al., 2001; Norman et al., 2006). This could be due to the fact boys perceive their neighbourhood more positively than girls when it comes to free- or low-cost recreational facilities (Santos et al., 2009). Therefore, we speculate that less access to facilities and/or negative perceptions about access to recreation facilities and play areas in lower SES neighbourhoods had a more profound influence on girls in our study compared to boys.

The majority of studies examining screen time in children focus on television viewing (Shields and Tremblay, 2008). Therefore, along with TV/video minutes, a unique aspect of our study was reported video game and computer weekly minutes. TV/video minutes were higher than video games and computers for both boys and girls. These numbers are consistent with two recent reviews (Marshall, 2006; Rey-Lopez et al., 2007). Apparently, video games and computers are not as high risk of an activity compared to viewing TV (Rey-Lopez, et al., 2007). However, we did find that even at this young age boys engaged in video games significantly more than girls.

Although the main focus of our study did not involve nutrition, our secondary analysis revealed some interesting associations with screen time and food servings. This may suggest that screen time behaviour does not only impact energy expenditure, it also impacts eating habits (Rennie et al., 2005). Our findings are consistent with a study in Germany that found children who viewed more TV ate more sweets and fast foods, and less fruit and vegetables (Grund et al., 2001). Given that lower SES neighbourhoods usually have fewer grocery stores and more fast food restaurants (Hemphill et al., 2008; Smoyer-Tomic et al., 2008), our findings on nutrition should be taken into consideration when examining the impact of neighbourhood environment factors on children's health.

Strengths of the study include the large sample size, the pre-school aged sample, and the inclusion of video games and computer use. Limitations of the study include the cross sectional design and the use of parental reports with an unvalidated questionnaire for screen time. According to a systematic review the majority of studies measuring television viewing in children and adolescents use parental reports and very few of the questionnaires have been psychometrically tested. Therefore a need exists for more standardized approaches of measurement for screen time behaviour among children (Bryant et al., 2006). It would also have been ideal to have household SES in addition to neighbourhood SES for participants. Finally, the proportion of variance explained by the models was small, and thus other factors contributed to children's screen time minutes.

These findings raise some important questions regarding the neighbourhood environment and its impact on health behaviour in young children, especially for girls. To improve the safety of lower SES neighbourhoods as well as make them more accessible to resources is a complex issue. It requires coordinated action and effort across levels and departments of government (Molnar et al., 2004). From a public health perspective, these findings have important implications for interventions designed to reduce screen time in an effort to combat childhood overweight and obesity. Some additional attention may be needed for girls who live in lower socioeconomic neighbourhoods.

Conclusion

We found neighbourhood SES is a predictor of total screen time and TV/video use among female pre-school children. Therefore, some consideration should be given to providing alternative activity opportunities for girls who live in lower SES neighbourhoods. As well, further research should continue to investigate gender differences on the impact of neighbourhood SES on screen time use as well as explore potential mechanisms in different age-groups and settings.

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Table 1: Demographic Information

Characteristic	Boys *n (%)*	Girls *n (%)*	Overall *n (%)*	Differences between Boys and Girls
Total # of Participants	828 (50.7)	805 (49.3)	1633 (100)	
Age				χ^2 (1) = 7.5, p = 0.006
4 years	376 (45.4)	420 (52.2)	796 (48.7)	
5 years	452 (54.6)	385 (47.8)	837 (51.3)	
PA Concerns				χ^2 (1) = 8.8, p = 0.003
Yes	85 (10.3)	50 (6.2)	135 (8.3)	
No	743 (89.7)	755 (93.8)	1498 (91.7)	
Day Care				χ^2 (1) = 0.5, p = 0.460
Yes	727 (87.7)	697 (86.6)	1424 (87.2)	
No	101 (12.2)	108 (13.4)	209 (12.8)	
Seasons				χ^2 (1) = 4.2, p = 0.040
Fall/Winter	273 (33.0)	229 (28.4)	502 (30.7)	
Spring/Summer	555 (67.0)	576 (71.6)	1131 (69.3)	
SES				χ^2 (2) = 0.1, p = 0.750
Low	177 (21.4)	177 (22.0)	354 (21.7)	
Medium	295 (35.6)	287 (35.7)	582 (35.6)	
High	356 (43.0)	341 (42.4)	397 (42.7)	
PA Activity Status				χ^2 (2) = 8.9, p = 0.003
Inactive	184 (22.2)	219 (27.2)	403 (24.7)	
Somewhat Active	266 (32.1)	273 (33.9)	539 (33.0)	
Active	378 (45.7)	313 (38.9)	691 (42.3)	

SES = Socioeconomic Status; PA = Physical Activity

Table 2: Median (Interquartile Range) Weekly Minutes for Total Screen Time, TV/Video, Video Games, and Computer per SES Category, Weekday and Weekend.

Characteristics	Low	Medium	High	Weekday	Weekend	Overall
Screen Time						
Boys	780 (735)	840 (630)	840(600)	540 (480)	270 (230)	840 (630)
Girls	825 (780)	750 (660)	720 (548)	480 (420)	240 (240)	750 (630)
Overall	780 (735)	780 (630)	765(608)	510 (480)	240 (240)	780 (600)
TV/Video						
Boys	600 (495)	630 (480)	660 (420)	420 (300)	240 (180)	630 (480)
Girls	660 (585)	660 (450)	600 (465)	420 (300)	180 (180)	630 (443)
Overall	660 (540)	660 (480)	600 (420)	420 (300)	240 (180)	630 (480)
Video Games						
Boys	0 (120)	0 (120)	0 (60)	0 (60)	0 (60)	0 (120)
Girls	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Overall	0 (60)	0 (30)	0 (0)	0 (0)	0 (0)	0 (13)
Computer						
Boys	32 (120)	60 (150)	60 (180)	30 (120)	0 (60)	60 (150)
Girls	60 (145)	60 (150)	30 (120)	30 (120)	0 (60)	60 (135)
Overall	30 (120)	60 (150)	60 (150)	30 (120)	0 (60)	60 (150)

Table 3: Sex-Specific Hierarchical Regression Models Predicting Total Weekly Screen Time Minutes

		B	ß	R^2
Girls				
Step 1				0.008
	Age	0.13	< 0.01	
	Daycare	-77.26	-0.05	
	PA Concerns	-84.42	-0.04	
	Seasons	-49.69	-0.05	
	BMI	6.57	0.03	
	PA Status	5.79	0.01	
Step 2				0.015*
	Neighbourhood SES	-55.29*	-0.09	
Boys				
Step 1				0.002*
	Age	15.20	0.05	
	Daycare	-149.60*	-0.10	
	PA Concerns	54.31	0.03	
	Seasons	9.10	0.01	
	BMI	12.95	0.06	
	PA Status	-1.90	-0.01	
Step 2				0.002
	Neighbourhood SES	4.39	0.01	

PA = Physical Activity; SES = Socioeconomic Status; * $p < .05$.

Table 4: Sex-Specific Hierarchical Regression Models Predicting Weekly TV/Video Minutes

		B	ß	R^2
Girls				
Step 1				0.006
	Age	-17.03	-0.02	
	Daycare	-45.17	-0.04	
	PA Concerns	-65.58	-0.04	
	Seasons	-37.67	-0.04	
	BMI	6.50	0.03	
	PA Status	3.70	0.01	
Step 2				0.011*
	Neighbourhood SES	-41.29*	-0.07	
Boys				0.001
Step 1				
	Age	3.06	0.01	
	Daycare	-69.90	-0.06	
	PA Concerns	79.43	0.06	
	Seasons	5.79	0.01	
	BMI	9.12	0.05	
	PA Status	9.76	0.02	
Step 2				0.001
	Neighbourhood SES	7.26	0.01	

PA = Physical Activity; SES = Socioeconomic Status; * $p < .05$.

Chapter 5: Conclusion

Childhood overweight and obesity is increasing in Canada and around the world (Koplan, Catharyn, & Kraak, 2005). One main determinant of overweight and obesity is inactivity, which includes a combination of sedentary behaviour and lack of physical activity (Tremblay & Willms, 2003). A major source of sedentary activity in children is screen time or time spent viewing television or movies, playing video games, and using computers (Must & Tybor, 2005). Large proportions of Canadian children are exceeding screen time recommendations and are not meeting physical activity recommendations (Active Healthy Kids Canada, 2008). Therefore, it is critically important to understand the factors that influence physical activity and sedentary behaviour so recommendations can be made and strategies designed on how to intervene (Salmon, Dunstan, & Owen, 2008; Spanier, Marshall, & Faulkner, 2006). For this thesis two correlates, one for physical activity and one for sedentary behaviour, were identified that lacked evidence in a Canadian context with young children. Seasonal variation was examined as a correlate of physical activity in both a literature review and in a sample of pre-school children in Edmonton, Alberta. As well, neighbourhood SES was examined as a correlate of screen time viewing in the same pre-school sample.

Study 1 revealed that 83% (29/35) of the studies reviewed found seasonal variation in physical activity among children and/or adolescents. These results were consistent regardless of the region, physical activity measure, or the study design; however, the findings were inconsistent across age categories. Though seasonal variation of physical activity occurs for older children and adolescents, the evidence for seasonal variation among younger children appears less clear. In study 2, total physical activity minutes as well as active play, weekday, and weekend minutes were highest in the summer and lowest in the winter in a sample of pre-school children. We speculated that extreme temperatures and weather conditions experienced in Edmonton during the winter, along with short daylight hours, reduced outdoor play among our participants and limited their opportunities for physical activity. Finally, neighbourhood SES was a predictor of total screen time and TV/video use for girls, but not for boys in study 3. We speculated that negative perceptions of neighbourhood safety and lack of access to facilities and play areas in lower SES neighbourhoods had a more profound affect on girls in our sample than boys.

Further research should investigate seasonal variation of physical activity among children in regions characterized by extreme cold and hot climates. As well, the impact of daily weather (e.g., temperature, precipitation) on physical activity among children should be explored further. When examining these relationships, direct measures of physical activity (e.g., pedometers, accelerometers) should be used in association with parental proxy reports. Additional research examining neighbourhood SES as a predictor of screen time in children is also warranted. Mechanisms to help explain the potential relationship between neighbourhood SES and screen time along with gender differences should be further explored in different age-groups and locations.

Study 2 and 3 were both cross-sectional studies, therefore definite conclusions and causal statements can not be made regarding the findings. However, the results for both studies are consistent with the literature. For example, the results in study 2 are consistent with the majority of work reviewed in study 1 that found seasonal variation of physical activity. Similarly, the results for study 3 are consistent with previous work that has reported influences of neighbourhood environments (Gomez, Johnson, Selva, & Sallis, 2004; Hoefer, Mckenzie, Sallis, Marshall, & Conway, 2001; Li, Dibley, Sibbritt, & Yan, 2006; MacLeod, Gee, Crawford, & Wang, 2008; Norman et al., 2006; Santos, Page, Cooper, Ribeiro, & Mota, 2009; Spence, Cutumisu, Edwards, Evans, 2008) and sedentary behaviours may differ between genders (Boone, Gordon-Larsen, Adair, & Popkin, 2007; Leatherdale & Wong, 2008; Salmon et al., 2008). Therefore considering practical implications as well as potential interventions with regard to these findings is still valuable.

Study 2 has implications for the measurement of physical activity among children. During the monitoring/surveillance of physical activity levels, a single measurement occasion may not adequately characterize children's usual physical activity. Also, when investigating relationships between physical activity and health, if the measurement period is not standardized to a specific season, results may be biased (Kristensen et al., 2007). These findings also have important implications for the provision of programs for children and the design of physical activity interventions. Opportunities should be provided for young children to engage in physical activity throughout the year. Community recreation programmers, teachers, and parents should consider increasing the physical activity opportunities for children in the winter, especially in areas of world that experience extreme winter conditions. Study 3 has important implications for the design of interventions to reduce screen time use in children. Alternative activity opportunities should be considered for young girls who live in lower SES neighbourhoods.

To consider more specific interventions that could address the findings in study 2 and 3, recent modules were reviewed that synthesize evidence on the effectiveness of interventions to increase physical activity (Chau & Farrell, 2008) and interventions to reduce sedentary behaviour (Farrell, Hardy & Torvaldsen, 2008) in children. Some of the examples given in the modules do not directly apply to our sample because they have a school focus. For example, active transport, school environment, teacher skills (Chu & Farrell, 2008), school programs, and curriculum based programs (Farrell et al., 2008). The children in our sample were not old enough to attend grade school, so the implementation of these strategies in these settings remains to be evaluated. However approximately 87 % of the sample did attend day care or preschool. Child care settings can serve as important targets for physical activity and sedentary behaviour interventions, although little research exists on this topic (Kaphingst & Story, 2009). Research conducted in the United States has found that some states regulate physical activity, outdoor activity time, and daily or weekly screen time use in pre-schools and day-cares (Kaphingst & Story, 2009). As of November 1st, 2008 a licence is required in Alberta and certain licensing regulations must be met in order to operate a child care program (Government of Alberta, 2009). However, there are no regulations regarding physical activity, outdoor activity time, or screen time.

Therefore, a potential intervention would be to introduce a new policy for child care licenses with regulations on minimum standards for year round physical activity, outdoor activity time, and screen time at all child care programs. A second potential intervention would be to provide child care employees with professional development in regards to physical activity and screen time. Material on strategies and ideas to increase children's physical activity and reduce screen time could be distributed to all current and new license holders. A portion of the material could have a specific focus on strategies and ideas to increase physical activity in the winter. Additional resource material on reducing screen time among girls could also be distributed to day care centers in lower SES neighbourhoods. A third potential intervention would be for the government to hire kinesiologists to visit child care centers. At these visits, the kinesiologists could run activity and education sessions on physical activity and screen time. Additional visits could be arranged in child care settings in lower SES neighbourhoods with a focus on girls' screen time behaviours. As well, additional sessions could be provided for all child care centers during the winter.

One intervention reviewed in the module on sedentary behaviour (Farrell et al., 2008) called the "Brocodile the Crocodile program" took place in preschools and child care centers in the U.S. The child care centers in the intervention group received 1 hour education sessions each week for 39 weeks. The education sessions focused on healthy eating and reducing children's television viewing. Parents also received resource material and kept track of their child's television habits over 1 week. The child care centers in the control group received material on health and safety. After 39 weeks the children in the intervention group decreased their television viewing by approximately 3 hours per week compared with an increase of approximately 2 hours per week in the control group. As well, the proportion of children meeting the American pediatric associations recommendations of 2 hours of screen time a day (American Academy of Pediatrics [AAP], 2001) was significantly higher in the intervention group, 81 % compared to 59% in the control group (Dennison, Russo, Burdick, Jenkins, 2004). Therefore, child care centers may be a promising venue for physical activity and sedentary behaviour interventions in young children.

Other examples given by the modules on physical activity and screen time interventions are family and community involvement, social marketing (Chau & Farrell, 2008), and community programs with parental components (Farrell et al., 2008). Therefore, a fourth potential intervention would be to evaluate the community programs/services/facilities/play areas available for pre-school children and their parents in Alberta. After the evaluation, community centers and community recreational programmers could be provided with information regarding seasonality of physical activity and screen time behaviours among children in Alberta. As well, they could be provided with ideas of additional programs/services/facilities/play areas or adaptations to current ones that they could offer their communities. The ideas given could have a specific focus on physical activities in the winter and alternative activities, preferably free or subsidized, for girls and their parents in lower SES neighbourhoods and communities. Therefore, this intervention would specifically address lack of resources and access to facilities, one of the possible mechanisms for the associations found in study 3.

A fifth possible intervention related to study 3 would specifically address the mechanism of negative perceptions of neighbourhood safety. This intervention would involve community wide efforts combined with government and law enforcement participation to clean up and revitalize lower SES neighbourhoods. By doing so, parents may feel more comfortable allowing their children, especially their daughters to play outside.

When targeting pre-school children for health interventions, addressing family involvement is key, because parents make many decisions on behalf of their child (Chau & Farrell, 2008). Therefore, a final potential intervention would be creating a media campaign that could make families and pre-school children more aware of community programs/services/facilities/play areas available to them. Special emphasis could be given to free and subsidized programs as well as winter physical activities.

Pre-school children are key targets for interventions that are part of health promotion efforts to reduce screen time and increase physical activity among youth (Farrell et al., 2008). Children at this age are developing habits that they may carry with them for the rest of their lives (Dennison et al., 2004). Therefore, interventions targeting child care centers, and interventions that have a family and community focus are promising areas to examine in the future for pre-school children.

Continuing efforts should be made to better understand how to treat and prevent childhood obesity by further examining the determinants of and interventions for physical activity and sedentary behaviour. Multiple stakeholders need to collaborate to address this public health crisis that will have a negative impact on the health of future generations.

References: Conclusion

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Chapter 6: Appendices

Appendix 1: Seasonality of Physical Activity among Adults

Appendix 1: Seasonality of Physical Activity among Adults

Seasonal variation of physical activity among adults has been examined in different parts of the world. Studies published from 1986 to 2007 used either a cross-sectional or repeated measures design. As well, the vast majority of studies used subjective measures of physical activity and found variation in physical activity or energy expenditure among seasons (Dannenberg, Keller, Wilson & Castelli, 1989; Ma et al., 2005; Matthews et al., 2001; Merchant, Dehghan & Akhtar-Danesh, 2007; Merrill, Shields, White & Druce, 2005; Pivarnik, Reeves & Rafferty, 2003; Uitenbroek, 1993; Van Staveren, Deurenberg, Burema, De Groot & Hautvast, 1986). This seasonal variation could be due to the fact that walking is one of the most prevalent leisure-time activities reported by adults (Dannenberg et al., 1989; Tucker & Gilliland, 2007; Tudor-Locke, Bittman, Merom & Bauman, 2005). Therefore adverse weather conditions could have an impact on adults walking outdoors.

Internationally, the conclusions on seasonality in physical activity are inconsistent. Physical activity was the highest in the spring and summer and lowest in the winter in Scotland, Japan, and the Netherlands (Haggarty, McNeill, Manneh, Davidson, Milne, Duncan & Ashton, 1994; Plasqui & Westerterp, 2003; Uitenbroek, 1993; Van Stavern et al., 1986; Westerterp, Plasqui & Goris, 2004; Yasunaga, Togo, Watanabe, Park, Park, Shephard & Aoyagi, 2008). However, physical activity was higher in the winter than the summer in the United Kingdom for 70- to 82- year-olds and no seasonal differences were seen among 20- to 30-year-olds (Goodwin, Pearce, Taylor, Read & Powers, 2001). Likewise, levels of physical activity recorded in workers' diaries of male participants in Israel were very similar between summer (June to August) and winter (January to March) (Kristal-Boneh, Froom, Harari, Malik & Ribak, 2000). Seasonal variation in estimated energy expenditure between pre-harvest and harvest seasons exists in Ethiopia (Alemu & Lindtjorn, 1995). Although no significant seasonal differences in physical activity levels between pre-harvest and post-harvest seasons exists in West Africa (Schultink, Van Raaij & Hautvast, 1993).

Seasonality of physical activity among adults has been more consistent in the United States compared to the international studies. Pivarnik and colleagues (2003) found energy expenditure significantly higher in the spring (April to June) and summer (July to September) compared to the fall (October to December) and winter (October to December) among 2843 adults in Michigan (Pivarnik et al., 2003). Levin and colleagues (1999) used accelerometers and a self-report questionnaire to measure physical activity among adults in Minnesota. Higher levels of physical activity were reported in warmer months (April through September) compared to the colder months (October through March; Levin, Jacobs, Ainsworth, Richardson & Leon, 1999). Of three studies conducted in Massachusetts, one found that men and women both tended to be more active in the summer (July to September) than the winter (January to March) based on weekly activity reports (Dannenberg et al., 1989). Likewise, Ma and colleagues (2005) found the lowest level of activity in the winter with the highest peaking in late June (Ma et al., 2005). Matthews and colleagues (2005) also found seasonal peaks of physical activity in the late spring, early summer with the use of accelerometers (Matthew et al, 2001).

Similar results were seen in a large population based studies conducted across the United States. The Behavioural Risk Factor Surveillance System (BRFSS) survey, conducted on 110,544 participants found the highest percentage of physical activity occurred in the summer (June to August) and the lowest in the winter (December to February; Merrill et al., 2005). This is similar to the study conducted by Dong and colleagues (2004) on 7515 participants across the United States. Energy expenditure based on leisure time physical activity was highest in the summer and lowest in the winter (Dong, Block, & Mandel, 2004). As well Tudor-Locke and colleagues (2004) found significantly more steps were taken in the summer than the winter in South Carolina and Tennessee, where 23 participants wore pedometers for an entire year (Tudor-Locke et al., 2004).

The only study conducted with Canadian adults on seasonality and physical activity (Merchant et al., 2007), found 64% of the 20,197 Canadians who responded to the Canadian Community Health Survey were inactive in the winter (January to March) compared to 49% in the summer (July to September). Average daily energy expenditure was 31% higher in the summer compared to winter. As well leisure-time activity was 86% more likely in the summer compared to winter. Leisure-time activity was also more likely in the spring (April to June) and fall (October to December) compared to the winter but not as likely as the summer. Lastly, the strength of the relationship between seasonality and physical activity differed between provinces (Merchant et al., 2007).

Different geological locations around the world have examined seasonal variation in adult physical activity. With the exception of a few international studies, a seasonal effect on physical activity does seem to be present. The results appear more consistent in North America, especially in the United States. However, due to the limited amount of Canadian studies it is difficult to draw conclusions for a seasonality effect among Canadian adults.

Appendix 2: Weather Variation in Physical Activity

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Along with seasonal variation in physical activity, day-to-day variation in weather within seasons may also have an impact on physical activity. It has been shown in numerous studies that higher levels of physical activity usually occur in the spring/summer seasons compared to the fall/winter seasons. However, within the spring/summer months physical activity can vary due to daily differences in precipitation, humidity, or temperature. Weather has been identified as a barrier to physical activity in studies conducted with adults (Currie & Develin, 2002; Humpel, Owen, Iverson, Leslie & Bauman, 2004; King, Castro, Wilcox, Eyler, Sallis & Brownson, 2000; McGinn, Evenson, Herring, & Huston, 2007; Nies & Motyka, 2006; Purath, 2006; Sallis, Bauman & Pratt, 1998; Salmon, Owen, Crawford, Bauman & Sallis, 2003; Stetson et al., 2005), and adolescents (Tappe, Duda & Ehrnwald, 1989). The direct relationship between physical activity and meteorological conditions has also been examined in adults (Chan, Ryan & Tudor-Locke, 2006; Suminski, Petosa, & Stevens, 2006; Togo, Watanabe, Park, Shephard, & Aoyagi, 2005; Tu, Stump, Damush, & Clark, 2004; Winters, Friesen, Koehoorn & Teschke, 2007), adolescents (Belanger, Gray-Donald, O'Loughlin, Paradia, & Hanley, 2009), and children (Brodersen, Steptoe, Williamson & Wardle, 2005; Duncan, Hopkins, Schofield, & Duncan, 2008; Sirard, Ainsworth, Mclver, & Pate, 2005).

Internationally, decreases in mean ambient temperature and increases in total rainfall had a negative effect on step counts among 5- to 12- year-olds in New Zealand (Duncan et al., 2008). Similarly, 11- and 12- year-old boys were more sedentary in cold weather and girls were less active in wet weather in the United Kingdom (Brodersen et al., 2005). In addition, average daily step counts among older adults in Japan, decreased exponentially with increasing precipitation and when precipitation exceeded 10 millimetres decreases in step counts were large (Togo et al., 2005).

Studies conducted in the United States found attendance at exercise class for women 50 years and older was associated with sunlight hours, heat index, cold temperatures, overcast sky and snowy days (Tu et al., 2004). As well Suminski and colleagues (2006) found that more individuals were observed walking a dog and biking with higher temperatures (Suminski et al., 2006). However, weather conditions and temperature were not associated with the prevalence of active commuting for elementary students in South Carolina (Sirard et al., 2005).

Three studies have examined the direct relationship between weather and physical activity in Canada. Chan and colleagues (2006) found a positive linear relationship between steps per day, as measured with pedometers, and the mean temperature in 202 adults. For every 10-degree increase in mean temperature there was a 2.9% increase in steps per day. Regarding precipitation, number of steps per day declined drastically with small amounts of rain and for every 10 centimetres of snow on the ground steps per day decreased by 3.6% (Chan et al., 2006). Winters and colleagues (2007) looked at the relationship between utilitarian cycling among adults and weather in major cities across Canada. Every 30-day increase in precipitation resulted in a 16% decrease in cycling and for every 30-day increase in freezing temperatures cycling decreased 9% (Winters et al., 2007).

Belanger and colleagues (2009) examined the influence of weather on physical activity among 1293 adolescents in Montreal. It was found for every 10 mm of rainfall, daily physical activity sessions were 2% to 4% lower and for every 10 -degree increase in temperature sessions were 1% to 2% higher. As well every 10 cm of snow accumulation was associated with 5% higher daily activity sessions, although physical activity was lower on days where there was snow fall (Belanger et al., 2009). Similar to seasonal variation, further research is also needed on the impact of weather on younger children's physical activity levels in Canada.

Appendix 3: Seasonality of Physical Activity among Children and Adolescents: A Detailed Review Table

Table 1: Seasonality of Physical Activity among Children and Adolescents

Author	Year	Age	N	Country	Design	Measurement of PA	Definition of Season	Finding
Baranowski et al.	1993	3 to 5	191	U.S. (TX)	Repeated-measure	Direct observation using the CARS for 6 to 12 hours, four times per year.	Month to Month	Higher activity levels for all children outside then inside. Outside activity levels of all children were lower during the summer months. Inside PA showed less variation.
Beighle et al.	2008	Grade 1 to 5	401	U.S.	Repeated–measure	Pedometer for 4 weekdays.	Spring – May. Winter – Feb.	PA was significantly different between seasons, more steps occurred in the spring compared to the winter.
Belanger et al.	2009	12 to 13	1293	Canada (QC)	Repeated-measure	7-day PA recall checklist every 3 months for 5 years.	Spring: Mar. – Jun. Summer: Jul. - Aug. Autumn: Sept.-Nov. Winter: Dec.-Feb.	Physical activity was lowest during the winter and increased in the warmer months.

Benefice et al.	1999	13 to 14 (girls only)	40	Senegal	Repeated-Measure	Direct observation during 12 hours for 2 days. As well as 4 consecutive days wearing an accelerometer.	Dry season: Jun. Rainy Season: Sept.	Higher levels of PA during the day in the rainy season compared to the dry season.
Bitar et al.	1999	10 to 16	83	France	Cross-sectional	Energy expenditure (EE) was determined over 24 hours by using 2 whole-body calorimeters.	Spring and Autumn (Exact months were not given)	A significant determinant of daily energy expenditure (DEE) and sleeping energy expenditure (SEE) was season ($r^2 = 0.021$ and 0.011). However DEE did not vary significantly with season.
Booth et al.	2002	13 to 16	2026	Australia	Cross-sectional	Adolescent Physical Activity Recall Questionnaire (APARQ).	Winter and Summer (Exact months were not given)	Youth were more active during summer than winter terms.

Burdette et al.	2004	2.5 to 4.5	250	U.S.	Cross-sectional	Accelerometer for 1 weekday and 1 weekend & Parent Questionnaire.	Spring: Mar. - May. Summer: Jun. - Aug. Autumn: Sept.-Nov. Winter: Dec.-Feb.	Average outdoor playtime via the parent questionnaire differed by season, with the highest levels of outdoor time occurring in the summer and lowest in the winter. Seasonal variation in PA levels recorded by the accelerometer was less pronounced.
Carson et al.	2008	4 to 5	2114	Canada (AB)	Cross-sectional	Parent proxy reports.	Spring: Mar. - May. Summer: Jun. - Aug. Autumn: Sept.-Nov. Winter: Dec.-Feb.	PA minutes were the highest in the summer, followed by the spring, than the fall and lowest in the winter.
Coe et al.	2005	6th grade	214	U.S.	Repeated-measure	3DPAR completed 3 times per year.	Aug. – Sep. Jan. – Feb. May – Jun.	Differences between time points suggest a seasonal influence on children's PA levels.
Crocker et al.	1997	8 to 16	200	Canada (SK)	Repeated-Measure	PAQ-C was filled out three times.	Late Fall: Oct.-Nov. Winter: Jan. Spring: Apr.	Activity scores in the spring were significantly higher than late fall and the winter. There were no significant differences between the late fall and winter activity scores.

Duncan et al.	2008	5 to 12	2000	New Zealand	Cross-sectional	Pedometers over 3 weekdays and 2 weekends.	Winter: Aug. Summer: Dec.	Boys took 11% more weekday steps and 26% more weekend steps and girls took 16% more weekday steps in summer compared to winter.
Finn et al.	2001	3 to 5	214	U.S. (SD)	Cross-sectional	Activity monitor: similar to an accelerometer except only 2 dimensional, worn for two weekdays.	Seasons were defined as spring, summer, fall and winter (Exact months were not given)	There were no seasonal differences in total daily counts or percentage of time spent in vigorous activity. However, slightly higher counts were found between 9am and 5pm in the fall versus the summer.
Fisher et al.	2005	3 to 6	209	Scotland	Cross-sectional	Accelerometer over 3 days (2 weekdays and 1 weekend) in the younger children and 7 consecutive days for the older children	Spring: Feb.-Apr. Summer: May- Jul. Autumn: Aug.-Oct. Winter: Nov. - Jan.	Total PA was significantly lower in spring compared to the summer, fall and winter. Spring has the coldest weather and most precipitation. Concluded seasons were relatively unimportant.

Garcia et al.	1998	10 to 14	132	U.S. (MI)	Repeated-Measure	CAAL was completed for 7 consecutive days pre and post transition 2 times a year.	Winter before and after transition and Spring before and after transition	There was a significant effect for season with PA lower in the winter and higher in the spring.
Goran et al.	1998	4 to 10	104	U.S. (VT, AL)	Cross-sectional	TEE was measured with doubly labeled water over 14 days. REE was measured with a metabolic monitor. AEE = TEE-REE.	Spring: Mar.-May. Summer: Jun. - Aug. Autumn: Sept. - Nov. Winter: No studies	Among white children from Vermont and Alabama there were significant effects for season on TEE values and AEE values. Both were higher in the spring than the fall.
Hagger et al.	1997	9 to 11	45	England	Repeated-measure	Cale's self-report measure of physical activity.	Summer and Winter (Exact months were not given)	Boys and girls participated in more moderate PA in the summer compared to the winter.

Huang et al.	2004	9 to 10 (low income)	16	U.S. (MA)	Cross-sectional	Self-administered questionnaire revised from NCYFS 1 and 2.	Spring, Summer, Fall and Winter (Exact months were not given)	The average days per week children spent in PA varied between seasons. Days per week spent on physical activity was lowest during winter.
Kristensen et al.	2007	8 to10	1229	Denmark	Cross-sectional	Accelerometer for at least 5 consecutive days including weekends.	Spring: Mar. - May. Summer: Jun. - Aug. Autumn: Sept. - Nov. Winter: Dec. – Feb.	Higher PA levels were found during the months of spring/summer compared to the months of autumn/winter.
Kristensen et al.	2007	14 to 16	1102	Denmark	Cross-sectional	Accelerometer for at least five consecutive days including weekends.	Spring: Mar. - May Summer: Jun. - Aug. Autumn: Sept. - Nov. Winter: Dec. - Feb.	The effect of seasons was not significant in either the 1997 or 2003 sample.

Loucaides et al.	2004	11 to 12	256	Cyprus	Repeated-measure	Pedometer for four weekdays in the winter and 4 weekdays in the summer. As well as a parent questionnaire.	Winter: Jan. and Feb. Summer: May and Jun.	A significant main effect was found for season. Rural and urban children spent more time playing outside during summer compared to winter. Urban school children were more active in winter and rural school children were more active in the summer.
Lunt et al.	2003	12 to 18 (Congenital heart disease only)	153	Australia	Repeated-measure	The new South Wales schools Fitness and Physical Activity Survey.	Summer and winter school terms (Exact months were not given)	When males and females were combined 73% of adolescents with congenital heart disease were active in the summer compared to 62% in the winter.
Mattocks et al.	2007	11 to 12	244	England	Repeated-measure	Accelerometer for 7days 4 times throughout the year.	Summer: May- Jun. Winter: Nov. - Jan.	Children had lower PA in winter months.

Poest et al.	1989	Pre-school	514	U.S.	Cross-sectional	Parental and teacher questionnaire modified from the National Children and Youth Fitness Survey.	Fall, winter, spring, summer (Exact months not given).	Activity levels peaked in the summer, dropped in the fall and winter months, and increased in the spring. Only 27.5% of the children were consistently involved in PA year-round.
Riddoch et al.	2007	11 to 12	5595	England	Cross-sectional	Accelerometer for 7 consecutive days.	Spring: Mar. – May. Summer: Jun.- Aug. Autumn: Sept.- Nov. Winter: Dec.-Feb.	Children were found to be the most active in summer and the least active in winter.
Ridgers et al.	2006	6 to 11	20	England	Repeated-measure	Heart rate monitors during recess for 3 consecutive days in the summer and winter.	Summer: Jun. Winter: Nov.	No significant differences in children's MVPA and VPA during recess across day and across seasons. Average temperature was 19 degrees Celsius for summer recess and 10 degrees Celsius for winter recess.

Rifas-Shiman et al.	2001	9 to 14	11892	U.S.	Repeated Measures	The annual and season format activity questionnaire.	Spring, summer, fall and winter. (Exact months were not given)	Participants reported exercising the most during the summer and least during the winter.
Ross et al.	1985	10 to 12	NR	U.S.	Cross-sectional	National Children and Youth Fitness Survey.	Summer, Fall, Winter, Spring (Exact months were not given).	The most weekly minutes were seen in summer (1158), than spring (785), than fall (612) and lowest was winter (477).
Ross et al.	1985	10 to 18	NR	U.S.	Cross-sectional	National Children and Youth Fitness Survey.	Summer, Fall, Winter, Spring (Exact months were not given)	Weekly activity time is at its highest in the summer. Activity levels drop in the fall, by approximately 43 %, weekly activity times reaches it low point in the winter at 47 percent of the summer level. In spring, weekly activity time increases to the annual average.
Rowlands et al.	2005	8 to 10 (boys only)	36	England	Repeated-measure	Pedometer for 4 weeks. 2 adjacent weeks in the summer and winter (1 week of vacation and 1 of school time).	Summer and Winter around vacations.	PA is higher in summer than winter and higher during the week than the weekend. Summer vacation activity was higher than summer school, winter vacation, and winter school activity.

Santos et al.	2005	10 to 17	6131	Portugal	Cross-sectional	Health Behaviour in School-Age Children questionnaire.	Spring/ Summer and Fall/Winter (Exact months were not given)	Participation in organized and non-organized physical activities of all age groups was more frequent during the spring/summer period.
Shephard et al.	1980	10 to 12	546	Canada (QB)	Repeated-measure	Two diaries of 24 hour records for a typical Wed. and a typical Sat. As well as an activity history questionnaire.	Fall and Spring (Exact months were not given)	More time was allocated to very light-light activities in the spring. Light-moderate activities were reduced significantly on weekends in the spring. Vigorous activity was slightly less on the weekdays in the spring compared to the fall. However, was more frequent during the weekends during the spring than the fall.
Smith et al.	2008	9 to 11	344	Canada (BC)	Repeated-measure	PAQ-C.	September, February, June.	Inactivity in the winter months was not significant in comparison to other months. This is probably due to the fact Vancouver does not experience extremely cold temperatures in the winter.

Tremblay et al.	2005	8 to 13	351	Canada (SK)	Repeated-measure	Accelerometer for 7 consecutive days, twice a year.	Fall and Summer (Exact months were not given)	MVPA was not significantly different between seasons. When looking at interactions, Mennonite and rural children were more active in the summer compared to fall. Where as urban children were more active in the fall compared to the summer.
Vermorel et al.	2002	12 to 16	60	France	Cross-sectional	Energy expenditure (EE) was measured using heart rate recording method and an activity diary for 5 consecutive days.	Spring: Apr.23-Jun.14 Autumn: Oct.18-Dec.17	Daily energy expenditure (DEE) were significantly higher in spring than in autumn (P<0.04). Time and EE spent in moderate PA and team sports tended to be higher in spring than in autumn (P<0.08 and P<0.06).

Wennlof et al.	2005	9 and 15	1137	Sweden	Cross-sectional	Accelerometer for 3 to 4 consecutive days, for at least 10 hours a day.	Month to Month (September to May)	A main effect for month of test was seen on total PA (P<0.001). In general, physical activity levels peaked in April and May (no registrations performed during the summer months June - August).

PA = Physical Activity; NR = Not Reported; 3DPAR = Three Day Physical Activity Recall; CAAL = Child/Adolescent Activity Log; CARS = Children's Activity Rating Scale; NCYFS = National Children and Youth Fitness survey; PDPAR = Previous Day Physical Activity Questionnaire; PAQ-C = Physical Activity Questionnaire for children.

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Appendix 4: Information letter, Consent Form and Questionnaire

Public Health Division
Primary Care Division
Capital Health

Suite 300, 10216 – 124 Street
Edmonton, Alberta
Canada T5N 4A3
Office (780) 413

Capital Health

Healthier people in healthier communities

Information Letter

Growth Assessment Study of Preschool Children

Dear Parent/Guardian:

What is the Study?
We are doing a study about the growth of preschool children in our region. The purpose is to measure height and weight and see if these link to other factors in a child's life. As well, we would like to contact you in the future for another look at your child's growth. This may be within the next two to five years. You may take part in the study today, but can change your mind about taking part in the future. The results will be used to learn about the health of children in our region and to plan services.

Why are we doing the study?
The study is needed because research shows obesity in Canada is rising quickly. This is also true for children. Today, more than 25% of Canadian children are overweight. This trend is upsetting because of the link between obesity and early onset of disease. We need to look at this trend in our children. Hopefully we will reduce, and in time reverse, this trend.

What will we be doing?
Staff from Capital Health and the University of Alberta are doing this study. We want to use the height and weight data from the preschool clinic visit. Also, we would like to use other data from the Community Health Services health record for your child. This includes information such as birth weight, type of feeding, and immunization history. We also need you to fill out a questionnaire about your child's activity and eating habits. It should take 15-20 minutes to fill out the questionnaire.

You do not have to agree to be in the study or answer the questions. If you want, you can skip questions. If you decide not to be in the study, it will not affect the services your child receives now, or in the future.

We hope these results will give us a better understanding about the height and weight of children in our region. This will help us support the healthy growth of children.

How will we protect your child's privacy?

The information about your child will be kept private. No names will be on the questionnaires or in reports from the study. The study data will be kept for at least seven years. It will be kept in a safe area and only the research team can see it. If the data is to be used for other studies, ethics approval will be obtained.

What are we asking you to do?

Two copies of a consent form and the questionnaire are included in the package. The questionnaire asks about your child's activity and eating habits. One of the copies is for you to keep and one for us. Please complete the questionnaire and bring it and the consent form to the health centre for your child's immunization visit.

If you have any questions, please call the research co-ordinator, Jeannie Dominey (413-7953) before your visit to the Health Centre. Or, you can send your questions by email to (preschool@cha.ab.ca).

If you have any questions about this study, you may contact the Patient Concerns Office of Capital Health at 407-1040. This office is not connected in any way to the study investigators.

Thank you for your help.

Sincerely,

John Spence, PhD, (492-1379)
Associate Professor,
Faculty of Physical Education & Recreation,
University of Alberta

Joy Edwards, (413-7956)
Manager, Population Health Assessment,
Public Health, Population Health and Research,
Capital Health

Del Sadoway (413-7960)
Senior Director Operations
Primary Care Division,
Capital Health

Co-Investigators

Dr. Linda Casey, Assistant Professor, Pediatrics, U of A. Pediatric Physician Nutrition Specialist, Capital Health. Tel: 407-1385	Judy Evans, Child Health Consultant, Community Health Services, Capital Health Tel: 413-7958	Gerry Predy Medical Officer of Health, Capital Health Tel : 413-7600	Normand Boule Assistant Professor Faculty of Physical Education & Rec University of Alberta Tel : 492-4695	Lee Smith, Regional Manager, Community Health Services, Capital Health Tel: 413-5033	Carlota Basualdo-Hammond Program Leader, Standards & Practice Nutrition Service, Capital Health Tel: 735-0623

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Part 1

Title of Project:
Growth Assessment Study of Preschool Children

Principal Investigator(s):

John Spence, PhD, Associate Professor, Faculty of Physical Education & Recreation,
University of Alberta (492-1379)

Joy Edwards, PhD, Manager, Population Health Assessment, Public Health, Capital Health (413-7956)

Part 2

Do you understand that you have been asked to participate in a study on the growth of Preschool children?	Yes	No
Have you read and received a copy of the Information Sheet?	Yes	No
Have you had an opportunity to ask questions and discuss the study?	Yes	No
Do you understand that you are free to refuse to participate or withdraw from the study at any time? You do not have to give a reason and it will not affect your child's health care.	Yes	No
Has the issue of confidentiality been explained to you? Do you understand who will have access to your child's personally identifiable health information?	Yes	No
Do you understand that if the data from this study are used in another study, this would only be done if research ethics approval were obtained?	Yes	No

I agree to have my child's information used for the Preschool Growth Assessment Study.

______________________________ Name of Child	____________ Date of Birth	

______________________________ Signature of Parent	____________ Date	________________________ Witness
______________________________ Printed Name		________________________ Printed Name

Would you be willing to be contacted in the future for further assessment of your child's growth?

If yes, please sign your name and indicate your address and a number where you may be reached.

____
Signature of Parent

____

____

Contact information: Address and phone number