2017

The Home Environment and Parenting Practices: Associations with Physical Activity and Sedentary Time in Preschool-age Children

Emily C. Huber
South Dakota State University

THE HOME ENVIRONMENT AND PARENTING PRACTICES: ASSOCIATIONS WITH PHYSICAL ACTIVITY AND SEDENTARY TIME IN PRESCHOOL-AGE CHILDREN

BY

EMILY C. HUBER

A dissertation submitted in partial fulfillment of the requirements for the

Doctor of Philosophy

Major in Nutrition, Exercise, and Food Science

Specialization in Exercise Science

South Dakota State University

2017

THE HOME ENVIRONMENT AND PARENTING PRACTICES: ASSOCIATIONS WITH PHYSICAL ACTIVITY AND SEDENTARY TIME IN PRESCHOOL-AGE CHILDREN.

EMILY C. HUBER

This dissertation is approved as a creditable and independent investigation by a candidate for the Doctor of Philosophy in Nutrition, Exercise, and Food Science degree and is acceptable for meeting the dissertation requirements for this degree. Acceptance of this does not imply that the conclusions reached by the candidate are necessarily the conclusions of the major department.

Jessica Meendering, Ph.D.
Dissertation Advisor Date

Kendra Kattelmann, Ph.D.
Head, Department of Health and
Nutritional Sciences Date

Dean, Graduate School Date

To Julie, who is the strongest and most courageous woman I know. She has taught me more about relentless perseverance, infinite selflessness, and unfailing faith within the last year than most people learn in a lifetime. I am unexplainably blessed, overwhelmingly thankful, and filled with pride to have her as my sister and ultimate inspiration.

To my mom and dad, who have always believed in my infinite potential, provided continual investment and support, and instilled in me the belief that I can accomplish anything with hard work and perseverance.

ACKNOWLEDGEMENTS

The completion of this dissertation and my doctoral degree would not have been possible without those that have played an integral role. First, I would like to express my most sincere gratitude to my major advisor, mentor, and friend, Dr. Jessica Meendering. Her patient encouragement, exemplary guidance, tireless work ethic, grit, and genuine empathy have made her a truly priceless mentor throughout my graduate school career. I am looking forward to continuing our relationship as colleagues, collaborators, and always, friends.

Secondly, I would like to recognize Dr. Matt Vukovich for his continual support, mentorship, and guidance throughout my time at South Dakota State University. I aspire to exude the same enthusiasm and commitment to leadership, higher education, and the advancement of knowledge in my professional career. I am forever grateful for all Dr. Vukovich has done to motivate, inspire, and assure me throughout graduate school.

My additional committee members have also been highly influential in my academic and scholarship development. Dr. Howard Wey has been instrumental in the growth of my understanding and execution of statistical analyses. I am incredibly thankful for his patience, time, and willingness to provide guidance. I appreciate Dr. Mary Bowne for her immense knowledge, valuable input, encouragement, and time. Additionally, I want to acknowledge Dr. Greg Peterson and Dr. Linda Kang for their time serving as the Graduate Faculty representatives for my doctoral work. While not a committee member, Dr. Lacey McCormack has provided valuable feedback and innovative collaboration.

My fellow graduate assistants are coworkers that turned into lifelong friends. These amazing, empathetic people played an important role in making data collection and

day-to-day work an enjoyable and unforgettable experience. Furthermore, I would like to offer my heartfelt appreciation to my family and friends for their encouragement, love, and positive support. Zach Johnson deserves special recognition for his saint-like patience, readiness to listen, and for being my “#1 fan”.

Financial support from the United States Department of Agriculture has been integral to my graduate education and research. Their assistance to fund my assistantship, doctoral dissertation, and other research projects have prepared me for success as a faculty member in academia. This material is based upon work that is supported by the National Institute of Food and Agriculture, United States Department of Agriculture, under award 2011-67002-30202. Finally, I am exceptionally grateful for the parents/guardians, children, and teachers who participated in the iGrow Readers study for which this dissertation is an analysis of a subset of data. Their cooperation and willingness to participate is greatly appreciated.

CONTENTS

ABBREVIATIONS

ACTS-MG	Activity Support Scale for Multiple Groups
BMI	body mass index
CDC	Centers for Disease Control and Prevention
CHES	Caregiver Comprehensive Home Environment Survey
cm	centimeters
IOM	Institute of Medicine
kg	kilograms
LPA	light physical activity
min/hr	minutes per hour
MPA	moderate physical activity
MVPA	moderate-to-vigorous physical activity
NASPE	The National Association for Sport and Physical Education
NHANES	National Health and Nutrition Examination Survey
PA	physical activity
ST	sedentary time
SD	standard deviation
TPA	total physical activity
VPA	vigorous physical activity
yrs	years

LIST OF FIGURES

LIST OF TABLES

ABSTRACT

THE HOME ENVIRONMENT AND PARENTING PRACTICES: ASSOCIATIONS WITH PHYSICAL ACTIVITY AND SEDENTARY TIME IN PRESCHOOL-AGE CHILDREN

EMILY C. HUBER

2017

Preschool-age children have the potential to be influenced by their physical home environment and their parents' physical activity (PA) practices more than older children as preschool-age children are more reliant on parents for PA opportunities. Previous research with this focus has relied predominantly on various subjective assessments of child activity, often resulting in overestimation of PA and underestimation of sedentary time (ST). Collectively, this dissertation project explored the associations among home environment factors, parent PA practices, parent satisfaction of children's body size and children's PA and ST by utilizing objective measures of activity and the full range of PA intensities in a cross-sectional sample of preschool-age children. Chapter 2 of this dissertation explored the relationships among home environment factors and child PA and ST. Parent role modeling PA and employing policies to support PA and monitor media were significantly associated with child activity.

Specific parent PA practices have been shown to be significantly related to PA and ST in older children and adolescents. In Chapter 3, associations among parent PA practices and PA and ST in preschool-age children were explored. Parent use of community resources and restricting sedentary activity, especially video game use, were found to be significantly associated with preschool-age child activity.

Previous research has reported body size satisfaction influences PA engagement in adults. Considering this knowledge in conjunction with the findings of the aforementioned chapters, Chapter 4 explored associations between parents' satisfaction of their children's body size and home environment factors, parent PA practices, and children's PA and ST. Parents that reported wanting their child to be larger was significantly associated with PA availability and parent PA role modeling.

As a whole, these data also highlighted a gender disparity with respect to the promotion and facilitation of PA opportunities between boy and girl preschool-age children. Education including the widespread benefits of PA, health consequences associated with excess accumulation of ST, and recommendations regarding modifying the home environment and parenting practices to create and foster PA opportunities, regardless of child gender, in preschool-age children should be included in childhood obesity prevention efforts.

Chapter 1

Introduction

Approximately 23% of preschool-age children in the United States are considered to be overweight or obese based on their body mass index (BMI).[1] Childhood obesity is a critical public health concern as it has been linked to an increased risk of hypertension, dyslipidemia, and impaired glucose tolerance as well as a heightened risk for obesity and coronary heart disease as an adult.[2-5] Additionally, evidence suggests overweight and/or obese preschool-age children are four times more likely to be overweight as adults.[5] Data from the National Health and Nutrition Examination Survey (NHANES) suggests there is a significant increase in the prevalence of overweight or obese children between the preschool group of two to five year-olds and the middle childhood-age group of six to 11 year-olds (37%).[1] These data showcase the importance of establishing positive physical activity (PA) habits in preschool-age children in order to combat an unhealthy increase in body weight as children age.

Physical activity is a fundamental component in the prevention and treatment of obesity.[6,7] Conversely, sedentary behavior is a key factor causing overweight and obesity.[8] In children, a substantial contributor to sedentary time (ST) is screen time in the form of television viewing, computers, or videogames.[9] Time spent watching television displaces time spent doing PA,[10] therefore, in addition to the promotion of PA, childhood obesity prevention strategies should also focus on reduction of ST.[11]

Childhood obesity and energy balance-related behaviors like PA and ST are multi-factorial in etiology. Factors pertaining specifically to the microsystem in which children spend substantial time, such as the home, childcare, and school, have been

shown to influence PA in older children and adolescents.[12] The home environment is a component of a child's microsystem that has been shown to facilitate or inhibit PA and ST behaviors in older children and adolescents through presence or absence of physical features of the home created by parents.[13-15] In addition to establishing the physical features of the home environment, parents also possess the ability to influence their children socially through specific parenting practices.[16]

Although home environmental factors and parenting have been researched in older children, there have been few studies exploring these outcomes in young, preschool-age children. Early childhood is a crucial time to promote PA behaviors as the preschool years have been shown to be foundational in the development of health behaviors.[17-20] PA behaviors develop and become habitual in childhood and are difficult to modify as children age.[20,21] Because PA is widely considered an important method of prevention and reduction of childhood obesity[7,22] and weight gain and resulting health problems start at an early age,[21,23] it is crucial to foster PA achieving practices in young children.

Understanding how the home environment that parents create as well as specific practices that parents exhibit are associated with activity in 3-5 year old children will provide information for researchers to share with parents and caregivers that want to foster a positive PA environment. We will examine this through the exploration of three projects that focus on: 1) home environment, 2) parent PA practices, and 3) parent satisfaction of child body size. Due to the diversity of family structures found in today's society, for the purpose of this study, the term "parent" refers to the parent and/or guardian that primarily cares for a child.

Study #1: Home Environment

Physical environmental factors in the home have been associated with PA in older children. Access to sports equipment like a basketball hoop has been positively associated with PA in middle-age children.[24] Barriers to active play for elementary school-age children in the home have been linked to lack of yard space and sedentary entertainment options in qualitative studies.[25-28] Having more screen time opportunities is associated with more ST in elementary school-age children.[29] Media equipment in the home and more specifically, in the bedroom, has been positively associated with ST in older children and adolescents.[13,24,30]

Limited research has been done exploring the home environment related to PA and ST in preschool-aged children. Physical attributes of the home environment including size of backyard and amount of active toys and outdoor play equipment are associated with more outdoor PA in preschool-aged children.[31] In addition, ST in five-year-old children has been associated with the number of televisions, computers, and game consoles in the home and child's bedroom.[31,32] Researchers in previous studies assessing home environment and preschool-age children PA have all used different surveys that evaluate various home environment components which limits consistency and generalizability of findings.[31-33] Additionally, only one study used an objective assessment of PA and ST while the other previous investigations relied on parent-reported PA and ST of child participants.[31,32] Parent-reported PA and ST of children often results in an overestimation of PA and an underestimation of ST.[34] Since the time those studies have been conducted, a comprehensive, valid, and reliable survey tool to evaluate the home environment has been published.[35] To date, this comprehensive tool has not

been used to assess physical and social home environment factors in relation to objectively measured PA and ST in preschool-aged children. By determining the specific physical home environment factors that may be associated to PA and ST in young children, including those related to media and screen-time, parents can modify and/or support the microsystem factors to better create a home environment that fosters PA and inhibits ST. Therefore, the following aim is proposed:

Specific Aim #1:

Identify home environment factors that are significantly associated with child PA and ST.

The working hypothesis of this aim proposes that objectively measured PA and ST in young children is significantly associated with home environment factors that facilitate PA and inhibit ST. The hypothesis will be explored through the collection of objectively measured PA and ST via accelerometer in 3-5 year old children and administration of the Caregiver Comprehensive Home Environment Survey (CHES).[35] Parent completion of the CHES will quantify the following home environment factors related to PA: availability, accessibility, role modeling, and supporting parental policies. Additionally, the CHES will quantify the following home environment factors related to ST: media availability, media role modeling, and parental policies to monitor media. Multiple multilevel mixed-effects linear regression analyses will be utilized to identify home environment factors assessed by the CHES that are significantly associated with the following outcomes of interest in preschool-age children: ST, light physical activity (LPA), moderate physical activity (MPA), vigorous physical activity (VPA), moderate-to-vigorous physical activity (MVPA), and total physical activity (TPA).

Study #2: Parent Physical Activity Practices

Children's health behaviors, including PA and ST behaviors, are highly dependent on parents' attitudes and habits related to PA.[36-42] Furthermore, parents have the opportunity to influence children PA and ST behaviors through specific parent PA practices. PA practices that have been shown to be associated with PA in older children and adolescents include parent involvement in PA,[43,44] activity with their children,[45] logistical support of providing transportation to organized activities,[45,46] and support of PA.[24,47-49] Little is known regarding the relationship among parent PA practices and PA and ST in preschool-age children. We argue that preschool-age children have the potential to be influenced by parent PA practices even more than older children and adolescents as preschool-age children are dependent on parents for providing PA opportunities. Therefore, the following aim is proposed:

Specific Aim #2:

Identify parent PA practices that are significantly associated with child PA and ST.

The working hypothesis of this aim proposes that objectively measured PA and ST in young children is significantly associated to parent PA practices. The hypothesis will be explored through the collection of objectively measured PA and ST via accelerometer in 3-5 year old children and assessment of parent PA practices through the administration of the parent completed Activity Support Scale for Multiple Groups (ACTS-MG)[50] survey. The ACTS-MG will quantify the parent PA practices subscales of logistic support of child PA, role modeling, use of community resources to promote child PA, and restriction of child sedentary activities. Multiple multilevel mixed-effects linear

regression analyses will be utilized to identify the parent PA practices that are significantly associated with the following outcomes of interest in preschool-age children: ST, LPA, MPA, VPA, MVPA, and TPA.

Study #3: Parent Satisfaction of Child Body Size

While parents are responsible for creating an environment that facilitates PA and inhibits ST and shaping their children's energy balance-related behaviors,[12,13,24,50] parents are also entrusted to recognize unhealthy weight and body size in their children.[51,52] Body size satisfaction is defined as the subjective, personal attitudinal evaluation of body size.[53]

In adults, research has shown body size satisfaction influences weight control practices[54] and health behaviors including PA engagement.[54-56] Kruger et al.[55] found that regardless of actual weight status, men and women that reported being satisfied with their body size were more likely to be regularly active than their dissatisfied counterparts. Similarly, Blake and colleages[56] reported weight satisfaction was associated with being more active in men and women. Alternately, body size dissatisfaction has been associated with engaging in less PA in adults.[54-56] To date, no studies have explored how parent satisfaction in their child's body size relates to the home environment, parent practices, or PA behaviors in their children. Considering the relationship between body size satisfaction and health behaviors in adults and the physical and social determinants of PA and ST in children, we argue that parent satisfaction of their child's body size, regardless of the child's actual weight status, may be associated with the home environment created by parents, certain parenting practices, and the amount of activity engaged in by children. Therefore, the following aim is proposed:

Specific Aim #3:

To explore associations between parent satisfaction of their child's body size and home environment factors, parent PA practices, and child PA and ST.

The working hypothesis of this aim proposes that parent satisfaction of child body size is significantly associated with home environment factors, parent PA practices, and child PA and ST. The hypothesis will be explored through the administration of a series of gender- and age-specific Collins' body figures.[57] The parent will circle the drawing of a gender-appropriate child figure that most closely resembles their perception of their child's current body size as well as a figure that resembles their perception of their child's ideal body size. Parent satisfaction of child body size will be determined by comparing the parent's selections of their child's current and ideal body size. Data will be examined in three categories: desire for child to be larger, satisfied, and desire for child to be smaller. Home environment factors and parent PA practices will be assessed through the administration of the survey tools described in aims one and two, respectively. Multiple multilevel mixed-effects logistic regression analyses will be used to determine if parent satisfaction of child body size is associated with home environment factors, parent PA practices, and child PA and ST.

Significance

Overview of the Childhood Obesity Epidemic

The prevalence of childhood obesity is a complex public health concern. A 2014 analysis of the National Health and Nutrition Examination Survey (NHANES), indicated that approximately 32% of children in the United States ages two to 19 are overweight or obese.[58] NHANES data suggests there is a significant increase in the prevalence of overweight or obese children between the preschool-age group of two to five year-olds (22.8%) and the middle childhood-age group of six to 11 year-olds (34.2%).[58] The preschool period has been identified as a critical time for the development of unhealthy weight gain[59] which highlights the importance of establishing healthy behaviors shown to prevent and treat overweight and obesity in preschool-age children.[60]

Overweight and obesity are most commonly classified utilizing body mass index (BMI). BMI is a value calculated by dividing weight (in kilograms) by height (in meters) squared (kg/m^2).[61] In children and teens, after BMI is calculated, it is expressed as an age- and sex-specific percentile.[61] To provide clarity in the categorization of weight status, this review of literature utilizes the terminology consistent with the Centers for Disease Control and Prevention (CDC) where overweight is defined as a BMI of $\geq 85^{th}$ percentile to $< 95^{th}$ percentile and obesity is defined as a BMI $\geq 95^{th}$ percentile.[61]

Health Consequences of Childhood Obesity

Childhood obesity has a variety of harmful effects on the body including an increased prevalence of risk factors for cardiovascular disease, especially hypertension and hypercholesterolemia.[62] Freedman and colleagues[62] found that 39% of children with a BMI greater than the 95^{th} percentile on the CDC BMI-for-age growth chart had at least

two risk factors for cardiovascular disease. Of those children studied with a BMI greater than the 99th percentile, 54% of them had at least two risk factors for cardiovascular disease.[62] Elevated cholesterol levels early in life play a role in the development of adult atherosclerosis.[2] Increased risk of impaired glucose tolerance, insulin resistance, and Type II diabetes are associated with children who are obese.[63] Obese children are more likely to have sleep apnea and asthma.[64,65] Additionally, health issues as a result excess weight can manifest as joint pain and musculoskeletal problems.[64,66] Taylor et al.[66] revealed that overweight children showed greater joint misalignment and reported a higher incidence of fractures, mobility impairment, and musculoskeletal discomfort than their normal weight counterparts. Furthermore, obese children are more likely to have fatty liver disease, gallstones, and gastroesophageal reflux disease.[63,64] Childhood obesity also has an effect on psychological health;[22] obese children and adolescents have an increased risk of low self-esteem and global self-worth and an increase in depression and anxiety.[63,67-69]

Association between Childhood Obesity and Adult Obesity

A strong association exists between childhood obesity and adult obesity.[70-77] An overweight or obese child is more likely to become an overweight or obese adult, especially when the child has a higher BMI.[75,76] Overweight preschool-age children are four times as likely to be obese adults compared with children with normal BMIs.[5] Over half of overweight adults were overweight as children and there is a significantly greater risk of adult obesity if one or both of a child's parents are obese.[72-74,76,78]

Parental obesity is represented as the most potent risk factor for childhood obesity due to a combination of genes and family environmental influence.[79] Whitaker et al.[76]

followed children from birth to age five and found 64% of children with overweight parents became overweight, while only 16% of children with normal-weight parents became overweight. Furthermore, the degree of severity of adulthood obesity is dependent on childhood obesity.[2] Baker et al.[73] showed that there was a positive relationship between higher childhood BMI and the risk of a coronary heart disease event in adulthood.[73] Health issues that manifest as a result of childhood overweight and obesity have a long-term, lasting effect on health into adulthood.[74]

Physical Activity in Children

Benefits of Physical Activity in Children

Physical activity (PA) is a fundamental component in the prevention and treatment of obesity as it serves as an energy balance regulator.[43,80,81] The preschool years are critical in establishing energy balance and evidence supports that PA is protective against obesity in preschool-age children.[82-86] In addition to being important in managing body mass, PA is one of the foremost factors influencing the promotion of healthy growth and development of children and adolescents.[87-89]

Regular engagement in PA during childhood results in an abundance of physiological benefits including the development of a healthy cardiovascular system and preventing cardiovascular disease.[90-96] Atherosclerotic lesions have been seen in children as young as two years old[2] and PA, especially aerobic activity, can delay advancement or play a role in the partial reversal of atherosclerotic lesions.[94,95] Regular PA improves endothelial function, insulin sensitivity, and glucose disposal and reduces blood pressure, dyslipidemia, and biomarkers of inflammation, including C-reactive protein.[81,94,95]

Adequate PA, if established during the early years of life and sustained into adulthood, may provide the greatest effect on mortality and longevity.[97]

Engaging in weight-bearing activity in children assists in building and maintaining bone and muscle tissue.[80,81] Children that engage in a low amount of PA at low intensity have significantly less bone mineral density and a relationship exists between childhood activity and adult bone density.[98,99] In fact, associations between PA and bone measures can be seen during preschool years, many years before the bulk of bone mass development in early adolescence.[100,101]

Participating in PA during childhood also results in a plethora of psychological and social outcomes.[17,102] In older children, a strong positive correlation between total daily PA and global self-worth, which includes scholastic competence, athletic competence, social acceptance, physical appearance, and behavioral conduct.[103,104] Contrastingly, a strong negative correlation exists between PA and depression, anxiety, and stress.[103,105] The CDC suggests that participation in PA also improves children's concentration and attentiveness in the classroom which thus improves academic achievement and grades.[106]

Physical Activity Behaviors in Children

Initial PA recommendations established by The National Association for Sport and Physical Education (NASPE) recommended that preschool-age children should engage in at least 60 minutes of PA and up to several hours of unstructured play every day.[107] Tucker[108] reviewed 39 studies from seven countries representing over 10,000 preschool-aged children. Only 54% of children in this age group met the NASPE PA guidelines determined by engaging in at least 60 minutes of moderate-to-vigorous PA

(MVPA) per day.[108] Within the last few years, independent expert organizations from four different countries have created similar guidelines recommending that preschool-age children should be active for at least 15 minutes per hour,[109] accumulating at least three hours of total PA per day.[110-112] Pate et al.[113] determined compliance with the Institute of Medicine (IOM) recommendation of engaging in light, moderate, or vigorous PA for at least 15 minutes per hour in two independent samples totaling over 600 children. Less than half of children met IOM PA guidelines when considering average time in total PA.[113] Hinkley and colleagues[17] assessed PA guideline compliance with the Australian recommendation of engaging in at least three hours of PA per day in over 1,000 3-5 year-old children. Only 5% of children met the Australian PA guidelines on an average day.[17] Collectively, a majority of preschoolers world-wide are not meeting PA guidelines. In light of the health benefits of PA, specifically related to treatment and prevention of obesity, there is a critical need to increase PA in preschoolers to combat the subsequent increase in obesity prevalence in the elementary-age population.

Movements of preschoolers when active are typically unstructured, brief, intermittent bouts and very little time is spent in continuous, high intensity activity.[102,108,114,115] Young children have short attention spans and lack the physical and motor development for continuous bouts of high intensity PA.[108,114] Similar to what is known about PA in older children, differences in PA in young children exist between sexes.[17,108,113,114] Preschool-age boys are more active than girls[17,20,108,113,114,116] and PA decreases as children age in both sexes.[17,20,117] Hinkley and colleagues[117] determined that in participants aged 3-5 years, preschoolers spend approximately 10% less time engaging in PA for each advancing year of age.

Race and ethnicity have been shown to be a variable that influences PA in older children.[118] The Youth Risk Behavior Survey Report[118] from 2009 stated that African American children are more likely to meet PA recommendations with moderate PA than White children. In preschool age children, the impact of race and ethnicity on PA has been indeterminate. Pate et al.[119] found that African American children are more active than White children and McKenzie et al.[120] and Sallis et al.[121] found that Hispanic children are less active than White children. However, Baranowski and colleagues[122] reported no race differences in PA among African American, Hispanic, and White preschool-age children.

Variation in amount of PA is evident between days of the week and seasons of the year in preschool-age children.[116] Brasholt et al.[116] found that young children are more active on weekdays than weekend days. Additionally, both boys and girls are less active in winter months and more active during spring, summer, and fall months.[116] In regards to sex, girls are most active in spring months and are more active than boys during winter months.[116] Alternately, boys are most active during spring and fall months.[116] PA is often correlated with time spent outside; therefore in geographical locations that undergo extreme temperature variations between seasons, it is natural that there would be a variation in the amount of PA accumulated.[123]

Differences in amount of time participating in PA have also been found between normal-weight and overweight/obese children.[102,116,124] Both boys[85] and girls[124] with higher BMI engage in less PA than their normal-weight counterparts. Whether obesity in children results in less PA participation or less PA participation results in unhealthy weight gain is unknown.

PA levels during preschool years tracks into older childhood.[20] Edwards et al.[20] studied PA in over 200 three-year-old children every four months over the course of four years. Boys who were more active at age three continued to be more active for the several subsequent years of the study.[20] Additionally, PA in older childhood can predict engagement in PA during adulthood.[125-127] Figure 1.1 showcases the relationships among PA in childhood and adolescence and PA and health in adulthood, further emphasizing the need to establish PA behaviors in young children as these behaviors can influence activity and health later in life.

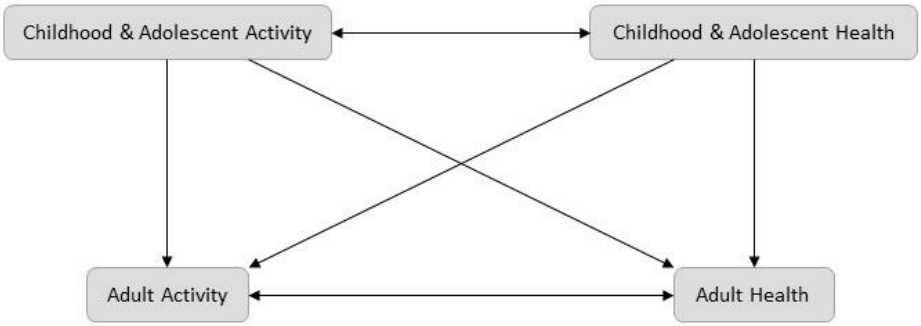


Figure 1.1 Potential relationships among activity in childhood and adolescence, health in childhood and adolescence, adult activity, and adult health.[128]

Sedentary Behavior

Sedentary behavior is a distinct class of behavior that is distinguished by very low energy expenditure and physical movement.[8,129-131] Sedentary behavior is defined as "any waking behavior characterized by an energy expenditure ≤ 1.5 METs while in a sitting or reclining posture".[132] Specific examples of sedentary behaviors include sitting, watching television, and computer usage.[8,129-131] Children, especially those in developed countries, accumulate high volumes of sedentary time (ST) from non-active entertainment, particularly screen time.[8,129-131] Screen time (i.e. television viewing, video games, and

computer activity) has increased ST to the point that today's children appear to be more sedentary than any previous generation.[8,130]

Health Consequences of Sedentary Behavior

Sedentary time is an independent risk factor for cardiovascular disease and all-cause mortality.[8,133] Individuals meeting PA recommendations are still at an increased risk for chronic disease if accumulating a high amount of ST during the day.[8,130,134] In the Australian Diabetes, Obesity, and Lifestyle Study by Dunstan et al.,[11] television viewing time was positively correlated with all-cause mortality and cardiovascular disease mortality.[11] A significant positive relationship between ST and BMI, waist circumference, blood pressure, and blood lipids has been found in longitudinal studies.[130,133] Additionally, a moderate inverse relationship is present between ST and aerobic fitness and bone mass.[130] Sedentary behavior is a key stakeholder in the issue of overweight and obesity.[8] Greater than 2-3 hours of inactivity per day is associated with increased overweight and obesity in preschool-age children.[135-139]

Children accumulate high volumes of ST from screen time (i.e. television viewing, video games, and computer activity).[8,129] The American Academy of Pediatrics recommend that children over the age of two should be limited to one to two hours of screen time a day.[140] Jackson et al.[141] concluded that each extra hour per day of watching television was associated with an extra one kilogram of body fat in preschool-age children. Additionally, Tremblay[142] showed that preschool-age children that watch more than three hours of television a day are 50% more likely to become obese than children that watch less than two hours a day. Time spent watching television displaces time spent

doing PA.[10] Furthermore, sedentary behaviors, such as television watching, promotes between meals snacking, which results in an increase of daily caloric intake.[10,143]

Viner[144] followed over 13,000 five-year-olds over the course of 25 years. For every hour of television viewed on the weekend at age five, there was a seven percent increase of obesity risk at age 30.[145] Results of this longitudinal study showcase that sedentary behaviors established in early childhood continue to influence BMI into adulthood.[145] Sedentary behavior is a critical modifiable factor capable of improving short and long-term health.[89]

Sedentary Behavior in Children

A secondary component of the NASPE PA guidelines for preschoolers recommends that 3-5 year-old children should not be sedentary for more than 60 consecutive minutes except when sleeping.[107] Preschool-age children have been found to be highly sedentary.[17,146-148] Colley et al.[146] and Byun[147] found that approximately half of preschooler's waking hours are spent sedentary. Van Cauwenberghe[148] reported that preschoolers engage in an average of five hours of ST per day.

Van Cauwenberghe and colleagues[148] studied patterns of sedentary behavior in over 700 children and determined that preschoolers engage in more ST on week days compared to weekend days. Disparities have been found between sexes involving sedentary behavior.[147,148] Van Cauwenberghe et al.[148] and Byun et al.[147,149] report that girls are more sedentary than boys.

Sedentary time in the form of television viewing during preschool years tracks into older childhood.[18] Certain and Kahn[18] investigated the amount of television viewed by young children aged 0-35 months. Young children that watched >2 hours of television

per day at age two were more likely to watch >2 hour per day at age six.[18] Results from this longitudinal study support the idea that health behaviors established in early childhood are critical as they persist into older childhood.

Home Environment

Childhood obesity and energy balance-related behaviors like PA and ST are multi-factorial in etiology. Due to the understanding that a complex set of personal and environmental factors interact to ultimately lead to unhealthy weight gain, researchers have begun conceptualizing childhood obesity determinants through ecologic systems framework.[150] Characteristics pertaining specifically to the microsystem in which children spend substantial time have been shown to influence PA in older children and adolescents.[14] The home environment is a component of children's microsystem that has been shown to facilitate or inhibit PA and ST behaviors in older children and adolescents through the presence or absence of physical features of the home created by parents.[14] Figure 1.2 illustrates the potential interaction potential interaction among physical activity and media home environment factors on child BMI.[35] The availability and accessibility of physical PA and media environment factors interact with social home environment factors practiced by parents which may influence children's PA and ST behaviors, ultimately influencing children's weight status. Parent modification of the home physical PA and media environment can influence the amount of PA and ST engaged in by children. An increase in PA and decrease in ST could favorably alter child BMI.

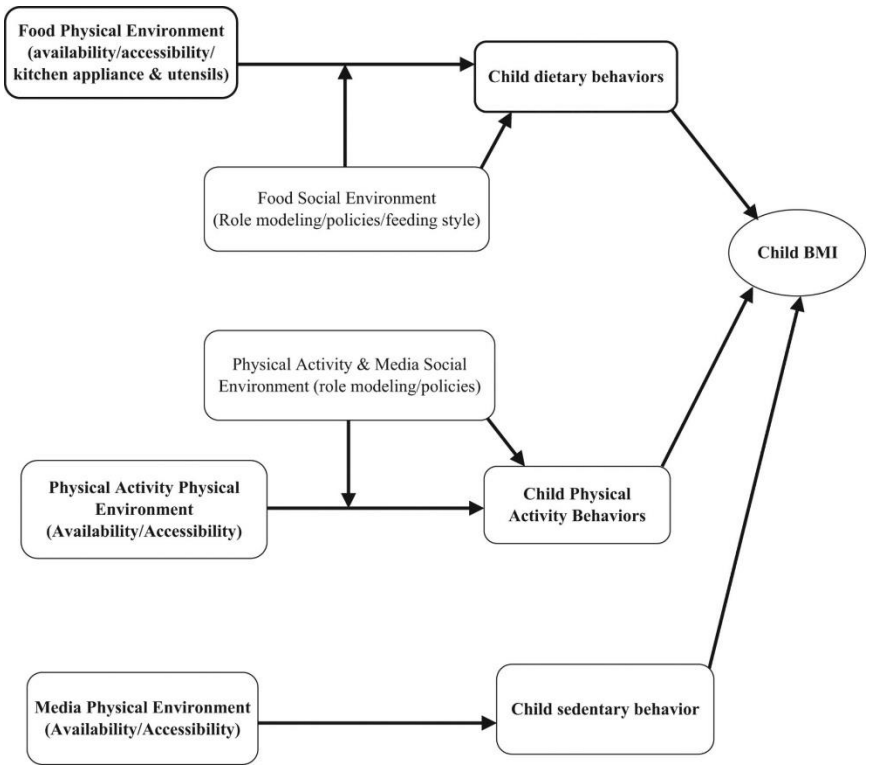


Figure 1.2 Model of the home environment and potential interaction among physical activity and media home environment factors on child BMI.[35]

Tandon and colleagues[24] assessed physical home environment factors in over 700 six to 11 year-old children in relation to PA and ST. The presence of a basketball hoop was positively associated with child PA.[24] Additionally, children with more fixed play equipment and fewer media devices in their bedrooms had significantly less ST.[24] Similarly, active toys and sports/PA equipment in the home was positively associated with PA in middle- to adolescent-age children.[151-155] Furthermore, the presence of PA equipment in the home is inversely associated with ST.[154-156]

Veitch[25] and Hesketh[26] have identified lack of yard space and available playgrounds to be barriers to active play for elementary school-age children in the home. Additionally, Sebire et al.[27] and Jago et al.[28] reported both children and parents cite sedentary screen time as a barrier to PA in elementary school-age children. Media

equipment in the home and more specifically, in the bedroom, is positively associated with ST in older children and adolescents.[24,30,154,157-162] Saelins et al.[29] found more screen time opportunities in the home is associated with more ST in 6-12 year-old children.

While correlations among physical home environment variables and PA and ST are well researched in older children and adolescents, little is known regarding the relationship among physical home environment variables and PA and ST in preschool-age children. Sallis and colleagues[121] investigated correlates of PA related to home environment. Environmental variables and directly-observed child PA were examined in approximately 300 Mexican and White four-year-old children.[121] Convenient play space and time and frequency in play spaces were correlated with higher levels of PA in the young children.[121] However, at the time the study was conducted, the importance of ST on health had not been established and therefore did not explore home environment factors association with preschoolers' ST.

Veldhuis et al.[32] assessed the association of physical home environment variables with screen time of over 3,000 five-year-old children. Home environment was measured via two questions inquiring about the number of TVs, computers, and game consoles in the house and child's bedroom.[32] Much like what has been established in older children, these findings showed higher number of electronic media devices in the household and in the child's bedroom was associated with more screen time in the preschool-age children.[32] However, Veldhuis only investigated screen time which is a component of ST, not ST as a whole, and did not directly measure PA to explore the possible relationship concerning household media equipment children's PA behaviors. The lack of direct

measurement of PA and ST would likely overestimate PA and underestimate ST in the participants.

Spurrier et al.[31] assessed home environment characteristics and parent-reported child PA and ST in 280 preschool children. Findings identified size of backyard and amount of outdoor play equipment as factors facilitating more outdoor play.[31] Additionally, presence of a game console was associated with more indoor ST.[31] However, Spurrier et al.[31] relied on subjective, parent-reported assessment of PA and ST in child participants, which often results in an overestimation of PA and an underestimation of ST.[34]

The only study to date to examine the association among physical home environment factors and objectively measured PA in preschoolers was conducted by Ostbye and colleagues.[33] However, this study's results may be misleading as the only component of the physical home environment that was assessed was accessibility of PA equipment and play spaces.[33] Additional factors such as PA availability and media equipment availability and accessibility are likely to influence preschoolers PA. Furthermore, the researchers used only moderate-to-vigorous physical activity (MVPA) measured across the whole day, as opposed to using all PA intensities limited to only time segments when the children were at home, to assess the effect of home environment on PA. Children in this age group spend a substantial portion of their day at preschool and/or daycare and including PA from the time segments of the day that the children were outside of the home could further explain the lack of significant results related to home environment on PA.

Previous studies assessing home environment and preschool-age children PA and ST have used different tools that evaluate various components within the home environment[31-33,121] and very few could be considered comprehensive.[14,21] Thus, a small number of studies have sought to determine the effect of physical home environment characteristics on PA and ST in preschool-age children; however, the limitations of those studies prevent accurate and comprehensive conclusions to be drawn. By identifying modifiable physical home environment factors that are significantly associated with PA and ST in preschool-age children, parents will be able to adjust factors to better create a home microsystem environment that fosters PA and inhibits ST.

Parent Physical Activity Practices

Beyond the physical characteristics of the home, parents are also responsible for establishing the social environment that influences health behaviors.[163] Children's health behaviors, including PA and ST behaviors, are highly dependent on parental attitudes and habits related to PA.[36-42] Furthermore, parents have the opportunity to influence children's PA and ST behaviors through specific parent PA practices including: signing up their children for organized activities, transporting their children to places they can be active, using their own behaviors to role model, and enforcing appropriate rules pertaining to ST.[37] PA and ST in older children and adolescents have been shown to be associated with caregiver PA practices.

Parent modeling of PA is a practice that is influential on PA engagement in middle- to adolescent-age children.[36,37,43,44] Davison et al.[37] assessed the contribution of PA-related parenting practices on PA in 180 nine-year-old girls. Parents that reported using their own behaviors to encourage their children to be active, especially fathers, had

daughters that participated in more PA.[37] Additionally, parent modeling of ST has been shown to be associated with sedentary behaviors of older children.[164] Salmon and colleages[164] reported that parent TV viewing and child perception of parent computer use was related to children watching ≥2 hours per day of TV and low levels of PA.

As children are dependent on their parents for transportation, one of the most frequently identified parent PA practice in older children and adolescents is logistical support of child PA. Parents providing transportation to organized activities and other PA opportunities is positively associated with more PA participation in middle- to adolescent-age children.[24,30,37,45,46,48,165] Additionally, Lloyd et al.[166] and Arredondo et al.[40] have shown that parent use of positive reinforcement of child PA was significantly associated with PA in elementary-age children.

Parent practices and their influence on older children and adolescent's PA and ST are well established, but less known about the relationship among parent PA practices and PA and ST in preschool-age children. Spurrier et al.[31] assessed the relationship among physical and social home environment factors and PA and dietary patterns in 280 preschool children. Children's PA was measured using a parent-completed 12-item questionnaire focusing amount of time their children spent playing outdoors and child screen time.[31] Parent PA practices were assessed indirectly through a physical home environment inventory completed via parent-report survey.[31] Having fewer rules about television viewing was associated with more indoor ST.[31] Although time spent playing outdoors has been validated against accelerometer data in preschool-age children,[123] it is necessary to note that this study was conducted in southern Australia where the climate is more temperate than that found in the Midwest United States. Therefore, using time

playing outdoors as a measure of PA may not be appropriate in geographical locations that undergo extreme temperature variations which may limit the generalizability of this study's findings to preschool populations in more severe climates.

Schoeppe and Trost[49] evaluated the influence of parent support for PA on children's PA. Support for PA was assessed using a 5-item scale and children's PA was measured using the same tool as Spurrier et al.[31,49] Findings indicated that maternal and paternal support for PA, including encouraging their children to do PA, playing outside with their children, and watching their children participate in PA, were positively associated with their preschooler's PA.[49] It can be argued that conclusions drawn from Spurrier et al.[31] and Schoeppe and Trost[49] may not be representative of the preschool population altogether considering the researchers' use of outdoor playtime as a proxy for PA as a whole.

Veldhuis et al.[32] explored the relationship among parent PA behaviors on preschooler screen time in over 3,000 families. Screen time and parent PA practices were assessed using parent-reported surveys.[32] Parents with established rules regarding screen time were associated with children watching TV <2 hours per day but engaging in >30 minutes per day of other screen time.[32] However, the authors only investigated screen time and did not directly measure ST or PA to explore the possible associations among parent PA practices and children's ST and PA behaviors.

Only two studies examining the role of parent PA practices on preschool children PA and ST used objectively measured child PA and ST.[33,167] Ostbye et al.[33] found parent policies supporting PA was associated with increased PA. However, PA in this study was summarized as minutes of MVPA; ST and LPA were not measured.[33] LPA is a notable

intensity of PA as it is important to replace sedentary behaviors like screen time with LPA. Additionally, the researchers used only MVPA measured across the whole day, as opposed to using all PA intensities limited to only time segments when the children were at home, to assess the effect of parent PA practices on child PA in the home. As preschool-age children may spend a substantial portion of their day outside of the home, including PA from the time segments of the day that the children were at daycare and/or preschool could misestimate the relationships among parent PA practices and child PA.

Vaughn and colleagues[167] evaluated parent PA practices and objectively measured child PA and ST in over 300 parent/preschooler dyads. Limiting screen time, using screen time to control behavior, exposure to TV, and parent modeling of PA were significantly associated with the young children's TV viewing.[167] Additionally, using PA to control behavior was associated with amount of time children spent outside and minutes of MVPA.[167] However, measurement of LPA was not included in this study's assessment of PA. We know that LPA is an integral PA intensity in young children as they spend very little time in continuous, vigorous intensity activity due to the lack physical and motor development characteristic of the preschool-age group.[102,108,114,115] Additionally, the study utilized MVPA measured across the whole day, including the time when the children would be in preschool or daycare, rather than limiting PA used in analysis to time segments that children were at home.

Of the studies that have assessed parent PA practices as determinants of PA and ST in preschool children, an assortment of methods were used to quantify child PA and ST and no studies employed the same measures to evaluate parent PA practices. A majority of studies assessing the association among parent PA practices on PA and ST in

preschoolers have relied on subjective, parent-reported measures to quantify child PA and ST[31,32,49] which likely misestimates PA and ST.[34] Although a small number of studies have sought to explore the relationships among parent PA practices and PA and ST in preschool-age children, the limitations of those studies prevent accurate and comprehensive conclusions to be drawn. By identifying the parent PA practices that are significantly associated with young children's PA and ST, parents and caregivers will be able to make adjustments to encourage PA and discourage ST in their preschool-age children.

Parent Satisfaction of Child Body Size

While parents are responsible for creating an environment that facilitates PA and discourages ST, parents are also entrusted to recognize unhealthy weight and body size in their children.[51,52] Parents are entrusted to recognize unhealthy weight and body size in their children.[51,52] Body size satisfaction is defined as the subjective, personal attitudinal evaluation of body size.[53] In adults, body size satisfaction influences health behaviors including dieting and physical activity (PA) engagement.[55,56] Kruger et al.[55] examined body size satisfaction and PA levels in more than 10,000 adults using the National Physical Activity and Weight Loss Survey data. Regardless of actual weight status, men and women that reported being satisfied with their body size were more likely to be regularly active than their dissatisfied counterparts.[55] Blake and colleages[56] reported similar findings from a study investigating weight satisfaction and health-related behaviors in 19,000 adults. Weight satisfaction was associated with being more active in both sexes.[56]

Only one study has explored parent satisfaction of child body size in young children.[168] Hager et al.[168] examined the accuracy of maternal perceptions of and satisfaction in toddler body size in 281 mother-toddler dyads. Almost 70% of mothers were satisfied with their toddler's body size while approximately 9% wanted their child to be smaller and approximately 20% wanted their child to be larger.

Due to the complex, multifactorial etiological nature of childhood obesity,[169] researchers have begun exploring the potential role of body size satisfaction in prevention of childhood overweight and obesity and promotion of healthful nutrition and PA.[170] PA is widely considered an important method of prevention and reduction of childhood obesity[7,22] and the preschool years have been shown to be foundational in the development of health behaviors.[17-20] PA behaviors developed in early childhood become habitual and are difficult to modify as a child ages.[20,21]

Rhee et al.[51] found that parents that perceive that their child's weight is a problem are more likely to modify their household environment. Considering the relationship between body size satisfaction and health behaviors in adults and the physical and social determinants of PA and ST in young children, we argue that parent satisfaction of their child's body size, regardless of the child's actual weight status, may be associated with the home environment created by parents, certain parenting practices, and the amount of activity engaged in by children. To date, no study has examined these potential relationships.

Summary

NHANES data report approximately 32% of children in the United States ages two to 19 are overweight or obese signifying that childhood obesity is a critical public health concern. Obesity during childhood has numerous health consequences.[171] Overweight and obese children have an increased prevalence of hypertension and hypercholesterolemia which, in turn, increases their risk for cardiovascular disease.[22]

Physical activity is a fundamental component in the treatment and prevention of childhood obesity.[43,80,81,172,173] By engaging in regular PA, healthy growth and development of the cardiovascular system decreases risk for various chronic diseases.[90-96] Current recommendations suggest that preschool-age children should engage in at least 15 minutes per hour,[109] or at least 3 hours,[110-112] of TPA. However, collectively, a majority of preschoolers world-wide are not meeting PA guidelines.

Evidence indicates that ST is its own risk factor for cardiovascular disease and all-cause mortality independent of PA.[8,133] Studies have shown a positive relationship between ST and BMI, waist circumference, blood pressure, and blood lipids.[130,133] Children accumulate high volumes of ST particularly from screen time.[8,129-131]

The preschool period has been found to be critical for the development of unhealthy weight gain[59] and it is therefore important to establish healthy PA and ST behaviors in preschool-age children in order to prevent and treat overweight and obesity.[60] The physical and social home environment that parents create have been shown to be associated with PA and ST behaviors in older children. However, very few studies have sought to explore the associations among home environment characteristics and parent PA practices with PA and ST in young children. Additionally, those studies that

have been conducted have methodology limitations that prevent the formation of valid implications. Additionally, no researchers have examined potential relationships among parent satisfaction of child body size and the physical and social environment the parent establishes in the home. By determining if PA and ST of preschool-aged children are associated with specific home environmental factors, parent PA practices, and parent satisfaction of their child's body size, recommendations can be provided to parents and caregivers regarding how they can modify physical and social home environment factors in order to facilitate PA and discourage ST in their preschool-age children and support behaviors leading to healthy weight.

References

1. Ogden C, Carroll M, Flegal K. Prevalence of childhood and adult obesity in the United States, 2011-2012. *JAMA : the journal of the American Medical Association.* 2014;311(8):806-814.

2. Freedman D, Khan L, Dietz W, Srinivasan S, Berenson G. Relationship of childhood overweight to coronary heart disease risk factors in adulthood: The Bogalusa Heart Study. *Pediatrics.* 2001;108:712-718.

3. Dietz WH. Health consequences of obesity in youth: Childhood predictors of adult disease. *Pediatrics.* 1998;101(3):518-525.

4. Magarey AM, Daniels LM, Boulton TJ, Cockington RA. Predicting obesity in early adulthood from childhood and parental obesity. *International Journal of Obesity.* 2003;27(4):505-513.

5. Freedman D, Kettel Khan L, Serdula M, Dietz W, Srinivasan S, Berenson G. The relation of childhood BMI to adult adiposity: The Bogalusa Heart Study. *Pediatr.* 2005;11:22-27.

6. Luttikhuis H, Stolk RP, Sauer PJJ. How do parents of 4-to 5-year-old children perceive the weight of their children? *Acta paediatrica.* 2010;99(2):263-267.

7. Hinkley T, Crawford D, Salmon J, Okely AD, Hesketh K. Preschool children and physical activity - A review of correlates. *American journal of preventive medicine.* 2008;34(5):435-441.

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

9. De Decker E, De Craemer M, De Bourdeaudhuij I, et al. Influencing factors of screen time in preschool children: an exploration of parents' perceptions through focus groups in six European countries. *Obes Rev.* 2012;13:75-84.

10. *Preventing Childhood Obesity: Evidence Policy and Practice.* West Sussex, UK: Blackwell Publishing; 2010.

11. Dunstan D, Barr E, Healy G, et al. Television viewing time and mortality: The Australian Diabetes, Obesity, and Lifestyle Study (AusDiab). *Circulation.* 2010;121(3):384-391.

12. Ferreira I, van der Horst K, Wendel-Vos W, Kremers S, van Lenth F, Brug J. Environmental correlates of physical activity in youth - a review and update. *Obesity reviews : an official journal of the International Association for the Study of Obesity.* 2006;8:129-154.

13. Maitland C, Stratton G, Foster S, Braham R, Rosenberg M. A place for play? The influence of the home physical environment on children's physical activity and sedentary behavior. *Int J Behav Nut Phys Act.* 2013;10(1):99.

14. Pinard C, Yaroch A, Hart M, Serrano E, McFerren M, Estabrooks P. Measures of the home environment related to childhood obesity: a systematic review. *Public health nutrition.* 2011;15(1):97-109.

15. Golan M, Weizman A. Familial approach to the treatment of childhood obesity: conceptual model. *J Nutr Educ.* 2001;33:102-107.

16. Rhee K. Childhood overweight and the relationship between parent behaviors, parenting style, and family functioning. *ANNALS AAPSS.* 2008;615(1):11-37.

17. Hinkley T, Salmon J, Okely A, Crawford D, Hesketh K. Preschoolers' physical activity, screen time, and compliance with recommendations. *Med Sci Sports Exerc.* 2012;44(3):458-465.

18. Certain L, Kahn R. Prevalence, correlates, and trajectory of television viewing among infants and toddlers. *Pediatrics.* 2002;109:634-642.

19. Pate R, Baranowski T, Dowda M, Trost S. Tracking of physical activity in young children. *Med Sci Sports Exerc.* 1996;28(1):92-96.

20. Edwards N, Khoury P, Kalkwarf H, Woo J. Tracking of accelerometer-measured physical activity in early childhood. *Pediatr Exerc Sci.* 2013;25:487-501.

21. Sleddens E, Kremers S, Hughes S, et al. Physical activity parenting: a systematic review of questionnaires and their associations with child activity levels. *Obesity Reviews.* 2012;13:1015-1033.

22. Centers for Disease Control and Prevention. *Overweight and obesity: Basics about childhood obesity.* Atlanta, GA: U.S. Department of Health and Human Services;2011.

23. Ogden C, Carroll M, Curtin L, McDowell M, Tabak C, Flegal K. Prevalence of overweight and obesity in the United States, 1999-2004. *JAMA : the journal of the American Medical Association.* 2006;295:1549-1555.

24. Tandon P, Grow H, Couch S, et al. Physical and social home environment in relation to children's overall and home-based physical activity and sedentary time. *Preventive medicine.* 2014;66(39-44).

25. Veitch J, Bagley S, Ball K, Salmon J. Where do children usually play? A qualitative study of parents' perceptions of influences on children's active free-play. *Health Place.* 2006;12(4):383-393.

26. Hesketh K, Waters E, Green J, Salmon L, Williams J. Healthy eating, activity and obesity prevention: a qualitative study of parent and child perceptions in Australia. *Health Promot Int.* 2005;20(1):19-26.

27. Sebire S, Jago R, Gorely T, Hoyos Cillero I, Biddle S. "If there wasn't the technology then I would be probably be out everyday": a qualitative study of children's strategies to reduce their screen viewing. *Preventive medicine.* 2011;53(4-5):303-308.

28. Jago R, Thompson J, Page A, Brockman R, Cartwright K, Fox K. Licence to be active: parental concerns and 10-11-year-old children's ability to be indpendently physically active. *J Public Health.* 2009;31(4):472-477.

29. Saelins B, Sallis J, Nader P, Broyles S, Berry C, Taras H. Home environmental influences on children's television watching from early to middle childhood. *J Dev Behav Pediatr.* 2002;23(3):127-132.

30. O'Connor T, Chen T, Baranowski J, Thompson D, Baranowski T. Physical activity and scree-media-related parenting practices have different associations with children's objectively measured physical activity. *Childhood obesity.* 2013;9(5):446-453.

31. Spurrier N, Magarey A, Golley R, Curnow F, Sawyer M. Relationships between the home environment and physical activity and dietary patterns of preschool children: a cross-sectional study. *Int J Behav Nut Phys Act.* 2008;5(31).

32. Veldhuis L, van Grieken A, Renders C, HiraSing R, Raat H. Parenting style, the home environment, and screen time of 5-year-old children; the 'Be Active, Eat Right' Study. *PloS one.* 2014;9(2):e88486.

33. Ostbye T, Malhotra R, Stroo M, et al. The effect of the home environment on physical activity and dietary intake in preschool children. *Int J Obes.* 2013;37:1314-1321.

34. Corder K, Crespo N, van Sluijs E, Lopez N, Elder J. Parent awareness of young children's physical activity. *Preventive medicine.* 2012;55(3):201-205.

35. Pinard C, Yaroch A, Hart M, Serrano E, McFerren M, Estabrooks P. The validity and reliability of the Comprehensive Home Environment Survey (CHES). *Health Promot Prac.* 2014;15(1):109-117.

36. Edwardson C, Gorely T. Activity-related parenting practices and children's objectively measured physical activity. *Pediatr Exerc Sci.* 2010;22:105-113.

37. Davison K, Cutting T, Birch L. Parents' activity-related parenting practices predict girls' physical activity. *Med Sci Sports Exerc.* 2003;35(9):1589-1595.

38. Rinard C, Yaroch A, Hart M, Serrano E, McFerren M, Estabrooks P. Measures of the home environment related to childhood obesity: a systematic review. *Public Health Nutrition.* 2011;15(1):97-108.

39. Sleddens E, Kremers S, Hughes S, et al. Physical activity parenting: a systematic review of questionnaires and their associations with child activity levels. *Obes Rev.* 2012;13:1015-1033.

40. Arredondo E, Elder J, Guadalupe X, Campbell N, Baquero B, Duerksen S. Is parenting style related to children's healthy eating and physical activity in Latino families? *Health education research.* 2006;21(6):862-871.

41. Bradley RH, McRitchie S, Houts RM, Nader P, O'Brien M. Parenting and the decline of physical activity from age 9 to 15. *Int J Behav Nutr Phys Act.* 2011;8:33.

42. Jakes RW, Day NE, Khaw KT, et al. Television viewing and low participation in vigorous recreation are independently associated with obesity and markers of cardiovascular disease risk: EPIC-Norfolk population-based study. *Eur J Clin Nutr.* 2003;57(9):1089-1096.

43. Trost S, Kerr L, Ward D, Pate R. Physical activity and determinants of physical activity in obese and non-obese children. *Int J Obes Relat Metab Disord.* 2001;25:822-829.

44. Vilhjalmsson R, Thorlindsson T. Factors related to physical activity: a study of adolescents. *Soc Sci Med.* 1998;47:665-675.

45. Verloigne M, Van Lippevelde W, Maes L, Brug J, De Bourdeaudhuij I. Family- and school-based correlates of energy balance-related behaviors in 10-12-year-old children: a systematic review within the ENERGY (EuropeaN Energy balance Research to prevent excessive weight Gain among Youth) project. *Public health nutrition.* 2012;15(8):1380-1395.

46. Sallis J, Alcaraz J, Mckenzie T, Howell M. Predictors of change in children's physical activity over 20 months: variations by gender and level of adiposity. *American journal of preventive medicine.* 1999;16:222-229.

47. Bungum T, Vincent M. Determinants of physical activity among female adolescents. *American journal of preventive medicine.* 1997;13:115-122.

48. Sallis J, Alcaraz T, McKenzie M, Hovell B, Kolody, Nader P. Parental behavior in relation to physical activity and fitness in 9-year-old children. *Am J Dis Child.* 1992;146:1383-1388.

49. Schoeppe S, Trost S. Maternal and paternal support for physical activity and healthy eating in preschool children: a cross-sectional study. *BMC Public Health.* 2015;15:971.

50. Davison K, Kaigang L, Baskin M, Cox T, Affuso O. Measuring parental support for children's physical activity in white and African American parents: The Activity Support Scale for Multiple Groups (ACTS-MG). *Preventive medicine.* 2011;52(39-43).

51. Rhee K, De Lago C, Arscott-Mills T, Mehta S, Krysko Davis R. Factors associated with parental readiness to make changes for overweight children. *Pediatr.* 2005;116:e94-101.

52. Parry L, Netuveli G, Parry J, Saxena S. A systematic review of parental perception of overweight status in children. *J Ambulatory Care Manage.* 2008;31(253-268).

53. Grogan S. Body image and health: contemporary perspectives. *Journal of health psychology.* 2006;11:523-530.

54. Millstein R, Carlson S, Fulton J, et al. Relationships between body size satisfaction and weight control practices among US adults. *Medscape J Med.* 2008;10(5):119.

55. Kruger J, Lee C-D, Ainsworth B, Macera C. Body size satisfaction and physical activity levels among men and women. *Obesity.* 2008;16:1976-1979.

56. Blake C, Hebert J, Lee D, et al. Adults with greater weight satisfaction report more positive health behaviors and have better health status regardless of BMI. *J Obes.* 2013;2013.

57. Collins M. Body figure perceptions and preferences among preadolescent children. *Int J Eat Disord.* 1990;10(2):199-208.

58. Ogden C, Carroll M, Kit B, Flegal K. Prevalence of childhood and adult obesity in the United States, 2011-2012. *JAMA : the journal of the American Medical Association.* 2014;311(8):806-814.

59. Dietz W. Critical periods in childhood for the development of obesity. *The American journal of clinical nutrition.* 1994;59(5):955-959.

60. Gubbels J, Kremers S, Stafleu A, Goldbohm R, de Vries N, Thijs C. Clustering of energy balance-related behaviors in 5-year-old children: lifestyle patterns and their longitudinal association with weight status development in early childhood. *Int J Behav Nut Phys Act.* 2012;9(77).

61. Centers for Disease Control and Prevention. *About child and teen BMI.* Atlanta, GA: U.S. Department of Health and Human Services;2015.

62. Freedman D, Mei Z, Srinivasan S, Berenson G, Dietz W. Cardiovascular risk factors and excess adiposity among overweight children and adolescents: The Bogalusa Heart Study. *The Journal of pediatrics.* 2007;150(1):12-17.e12.

63. Whitlock E, Williams S, Gold R, Smith P, Shipman S. Screening and interventions for childhood overweight: A summary of evidence for the US Preventitive Services Task Force. *Pediatrics.* 2005;116(1):e125-144.

64. Han JC, Lawlor DA, Kimm SYS. Childhood obesity. *Lancet.* 2010;375(9727):1737-1748.

65. Sutherland E. Obesity and asthma. *Immunol Allergy Clin North Am.* 2008;28(3):589-602.

66. Taylor E, Theim K, Mirch M, et al. Orthopedic complications of overweight in children and adolescents. *Pediatrics.* 2006;117(6):2167-2174.

67. Parfitt G, Pavey T, Rowlands A. Children's physical activity and psychological health: the relevance of intensity. *Acta paediatrica.* 2009;98:1037-1043.

68. Dietz W. Health consequences of obesity in youth: Childhood predictors of adult disease. *Pediatrics.* 1998;101:518-525.

69. Swartz M, Puhl R. Childhood obesity: A societal problem to solve. *Obesity reviews : an official journal of the International Association for the Study of Obesity.* 2003;4(1):57-71.

70. Metcalf BS, Hosking J, Jeffery AN, Voss LD, Henley W, Wilkin TJ. Fatness leads to inactivity, but inactivity does not lead to fatness: a longitudinal study in children (EarlyBird 45). *Archives of Disease in Childhood.* 2011;96(10):942-U947.

71. Montoya C, Lobo ML. Childhood obesity: A Wilsonian concept analysis. *J Ped Nurs.* 2011;26(5):465-473.

72. Craigie AM LA, Kelly SA, Adamson AJ, Mathers JC. Tracking of obesity-related behavior from childhood to adulthood: A systematic review. *Maturitas.* 2011;70(3):266-284.

73. Baker JL, Olsen LW, Sorensen TIA. Childhood body-mass index and the risk of coronary heart disease in adulthood. *New England Journal of Medicine.* 2007;357(23):2329-2337.

74. Weiss R, Caprio S. The metabolic consequences of childhood obesity. *Best Pract Res Clin Endoc Metab.* 2005;19(3):405-419.

75. Biro F, Wien M. Childhood obesity and adult morbidities. *The American journal of clinical nutrition.* 2010;91(5):1499S-1505S.

76. Whitaker R, Wright J, Pepe M, Seidel K, Dietz W. Predicting obesity in young adulthood from childhood and parental obesity. *The New England journal of medicine.* 1997;337(13):869-873.

77. Serdula M, Ivery D, Coates R, Freedman D, Williamson D, Byers T. Do obese children become obese adults? A review of the literature. *Preventive medicine.* 1993;22:167-177.

78. Deshmukh-Taskar P, Nicklas T, Morales M, Yang S, Zakeri I, Berenson G. Tracking of overweight status from childhood to young adulthood: The Bogulsa Heart Study. *European journal of clinical nutrition.* 2006;60:48-57.

79. Agras W, Hammer L, McNicholas F, Kraemer H. Risk factors for childhood overweight: A prospective study from birth to 9.5 years. *The Journal of pediatrics.* 2004;145(1):20-25.

80. Centers for Disease Control and Prevention. *Adolescent and school health: Physical activity and the health of young people.* Atlanta, GA: U.S. Department of Health and Human Services;2011.

81. Centers for Disease Control and Prevention. *Physical activity and health: A report of the Surgeon General.* Atlanta, GA: United States Department of Health and Human Services;1996.

82. Reilly J. Physical activity, sedentary behaviour and energy balance in the preschool child: opportunities for early obesity prevention. *The Proceedings of the Nutrition Society.* 2008;67:317-325.

83. Moore L, Gao D, Bradlee M, et al. Does early physical activity predict body fat change thoughout childhood? *Preventive medicine.* 2003;37(1):10-17.

84. Davies P, Gregory J, White A. Physical activity and body fatness in preschool children. *Int J Obes Relat Metab Disord.* 1995;19(1):6-10.

85. Trost S, Sirard J, Dowda M, Pfeiffer K, Pate R. Physical activity in overweight and nonoverweight preschool children. *Int J Obes Relat Metab Disord.* 2003;27(7):834-839.

86. Klesges R, Klesges L, Eck L, Shelton M. A longitudinal analysis of accelerated weight gain in preschool children. *Pediatrics.* 1995;95(1):126-130.

87. McMinn D, Rowe DA, Stark M, Nicol L. Validity of the New Lifestyles NL-1000 Accelerometer for measuring time spent in moderate-to-vigorous physical activity in school settings. *Meas Phys Educ Exerc Sci.* 2010;14:67-78.

88. Kwak L, Kremers SPJ, Brug J, Van Baak MA. Measuring physical activity in field studies: Comparison of a questionnaire, 24-hour recall, and an accelerometer. *Eur J Sport Sci.* 2007;7(4):193-201.

89. Hills A, King N, Armstrong T. The contribution of physical activity and sedentary behaviours to the growth and development of dhildren and adolescents: Implications for overweight and obesity. *Sports Med.* 2007;37(6):533-545.

90. Carnethon M, Gidding S, Nehgme R, Sidney S, Jacobs D, Jr., Liu K. Cardiorespiratory fitness in young adulthood and the development of cardiovascular disease risk factors. *JAMA : the journal of the American Medical Association.* 2003;290:3092-3100.

91. Gutin B, Barbeau P, Owens S, et al. Effects of exercise intensity on cardiovascular fitness, total body composition, and visceral adiposity of obese adolescents. *The American journal of clinical nutrition.* 2002;75:818-826.

92. Balagopal P. Physical activity and cardiovascular health in children. *Pediatric Annals.* 2006;35(11):814-821.

93. Powers S, Lennon S, Quindry J, Mehta J. Exercise and cardioprotection. *Curr Opin Cardiol.* 2002;17(5):495-502.

94. Leon A. Biological mechanisms for the cardioprotective effects of aerobic exercise. *Am J Lifestyle Med.* 2009;3(1):32S-34S.

95. Leon A, Bronas U. Pathophysiology of coronary heart disease and biological mechanisms for the cardioprotective effects of regular aerobic exercise. *Am J Lifestyle Med.* 2009;3(5):379-385.

96. Petti YM, Cowell JM. An assessment of measures of body image, body attitude, acculturation, and weight status among Mexican American women. *J Am Acad Nurse Pract.* 2011;23(2):84-91.

97. Paffenbarger R, Hyde R, Wing A, Hsieh C. Physical activity, all-cause mortality, and longevity of college alumni. *The New England journal of medicine.* 1986;314:605-613.

98. Burrows M. Exercise and bone mineral accrual in children and adolescents. *J Sports Sci Med.* 2007;6:305-312.

99. Welten D, Kemper H, Post G, et al. Weight-bearing activity during youth is a more important factor for peak bone mass than calcium intake. *J Bone Miner Res.* 1994;9(1089-1096).

100. Janz K, Burns T, Torner J, et al. Physical activity and bone measures in young children: The Iowa Bone Development Study. *Pediatr.* 2001;107(6):1387-1393.

101. Specker B, Binkley T. Randomized trial of physical activity and calcium supplementation of bone mineral content in 3-to 5-year-old children. *J Bone Miner Res.* 2003;18(5):885-892.

102. Timmons B, Naylor P, Pfeiffer K. Physical activity for preschool children - how much and how? *Appl Physiol Nutr Metab.* 2007;32(Suppl. 2E):S122-S134.

103. Parfitt G, Eston R. The relationship between children's habitual activity level and psychological well-being. *Acta paediatrica.* 2005;94:1791-1797.

104. Shilton T, Naughton G. Physical activity and children: A statement of importance and call to action from the Heart Foundation. 2001; http://www.heartfoundation.com.au/downloads/Phys_Act_Children_CTA2001.pdf. Accessed December 3, 2011.

105. Dunn A, Trivedi M, O'Neal H. Physical activity dose-response effects on outcomes of depression and anxiety. *Med Sci Sports Exerc.* 2001;33(6):S587-S597.

106. Centers for Disease Control and Prevention. *The association between school based physical activity, including physical eduction, and academic performance.* Atlanta, GA: U.S. Department of Health and Human Services;2010.

107. National Association for Sport and Physical Education. *Active start: a statement of physical activity guidelines for children birth to five years.* Reston, VA: American Alliance for Health, Physical Education, Recreation and Dance;2002.

108. Tucker P. The physical activity levels of preschool-aged children: a systematic review. *Early Child Res Q.* 2008;23:547-558.

109. Institute of Medicine. *Early childhood obesity prevention policies.* Washington, DC2011.

110. Department of Health and Ageing. *National physical activity guidelines for Australians. Physical activity recommendations for 0-5 year olds.* Commonwealth of Australia: Canberra, Australia2010.

111. Department of Health PA, Health Improvement and Protection. *Start active, stay active: a report on physical activity for health from the four home countries' chief medical officers.* London: Department of Health, Physical Activity, Health Improvement and Protection;2011.

112. Canadian Society for Exercise Physiology. Canadian physical activity guidelines and Canadian sedentary behavior guidelines: your plan to get active every day. 2012; www.csep.ca/guidelines.

113. Pate R, O'Neill J, Brown W, Pfeiffer K, Dowda M, Addy C. Prevalence of compliance with a new physical activity guideline for preschool-age children. *Childhood obesity.* 2015;11(4):415-420.

114. Oliver M, Schofield G, Kolt G. Physical activity in preschoolers: understanding prevalence and measurement issues. *Sports Med.* 2007;37(12):1045-1070.

115. Bailey R, Olson J, Pepper S, Porszasz J, Barstow T, Cooper D. The level and tempo of children's physical activities: an observational study. *Med Sci Sports Exerc.* 1995;27:1033-1041.

116. Brasholt M, Chawes B, Kreiner-Moller E, Vahlkvist S, Sinding M, Bisgaard H. Objective assessment of levels and patterns of physical activity in preschool children. *Pediatr Res.* 2013;74(3):333-338.

117. Hinkley T, Salmon J, Okely A, Hesketh K, Crawford D. Correlates of preschool children's physical activity. *American journal of preventive medicine.* 2012;43(2):159-167.

118. Centers for Disease Control and Prevention. *Youth risk behavior surveillance--United States, 2009.* Atlanta, GA: U.S. Department of Health and Human Services;2010.

119. Pate R, Pfeiffer K, Trost S, Ziegler P, Dowda M. Physical activity among children attending preschools. *Pediatrics.* 2004;114:1258-1263.

120. McKenzie T, Sallis J, Elder J, et al. Anglo- and Mexican-American preschoolers at home and at recess: activity patterns and environmental influences. *Dev Behav Pediatr.* 1997;13:173-180.

121. Sallis J, Nader P, Broyles S, et al. Correlates of physical activity at home in Mexican-American and Anglo-American preschool children. *Health psychology : official journal of the Division of Health Psychology, American Psychological Association.* 1993;12:390-398.

122. Baranowski T, Thompson W, DuRant R, Baranowski J, Puhl J. Observations on physical activity in physical locations: age, gender, ethnicity, and month effects. *Research quarterly for exercise and sport.* 1993;64:127-133.

123. Burdette H, Whitaker R, Daniels S. Parental report of outdoor playtime as a measure of physical activity in preschool-aged children. *Archives of pediatrics & adolescent medicine.* 2004;158:353-357.

124. Vale S, Trost S, Ruiz J, Rego C, Moreira P, Mota J. Physical activity guidelines and preschooler's obesity status. *International journal of obesity.* 2013;37(10):1352-1355.

125. Telama R, Yang X, Laakso L, Viikari J. Physical activity in childhood and adolescence as predictor of physical activity in young adulthood. *American journal of preventive medicine.* 1997;13(4):317-323.

126. Telama R, Yang X, Viikari J, Valimaki I, Wanne O, Raitakari O. Physical activity from childhood to adulthood-A 21-year tracking study. *American journal of preventive medicine.* 2005;28(3):267-273.

127. Tammelin T, Nayha S, Hills A, Jarvelin M. Adolescent participation in sports and adult physical activity. *American journal of preventive medicine.* 2003;24(1):22-28.

128. Malina R. Physical activity and fitness: pathways from childhood to adulthood. *Am J Hum Biol.* 2001;13(2):162-172.

129. Reilly J, Penparaze V, Hislop J, Davies G, Grant S, Paton J. Objective measurement of physical activity and sedentary behaviour: Review with new data. *Archives of Disease in Childhood.* 2008;93:614-619.

130. Chinapaw MJM, Proper KI, Brug J, van Mechelen W, Singh AS. Relationship between young peoples' sedentary behaviour and biomedical health indicators: A systematic review of prospective studies. *Obesity reviews : an official journal of the International Association for the Study of Obesity.* 2011;12(7):e621-e632.

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

132. Tremblay M. Standardized use of the terms "sedentary" and "sedentary behaviours". *Appl Physiol Nutr Metab.* 2012;37(3):540-524.

133. Haskell W. Health consequences of physical activity: Understanding the challenges regarding dose response. *Med Sci Sports Exerc.* 1994;26:649-660.

134. Hancox R, Milne B, Poulton R. Association between child and adolescent television viewing and adult health: A longitudinal birth cohort study. *Lancet.* 2004;364(9430):257-262.

135. Janz K, Levy S, Burns T, Torner J, Willing M, Warren J. Fatness, physical activity, and television viewing in children during the adiposity rebound period: the Iowa Bone Development Study. *Preventive medicine.* 2002;35(6):563-571.

136. Proctor M, Moore L, Gao D, et al. Television viewling and change in body fat from preschool to early adolescence: The Framingham Children's Study. *Int J Obes Relat Metab Disord.* 2003;27(7):827-833.

137. Reilly J, Armstrong J, Dorosty A, et al. Early life risk factors for obesity in childhood: cohort study. *BMJ.* 2005;330(7504):1357.

138. Dennison B, Erb T, Jenkins P. Television viewing and televion in bedroom associated with overweight risk among low-income preschool children. *Pediatrics.* 2002;109(6):1028-1035.

139. Mendoza J, Zimmerman F, Christakis D. Television viewling, computer use, obesity, and adiposity in US preschool children. *Int J Behav Nut Phys Act.* 2007;4(1):44.

140. U.S. National Library of Medicine. Screen time and children. *MedlinePlus* 2015; https://www.nlm.nih.gov/medlineplus/ency/patientinstructions/000355.htm. Accessed November 16, 2015.

141. Jackson D, Djafarian K, Stewart J, Speakman J. Increased television viewing is associated with elevated body fatness but not with lower total energy expenditure in children. *The American journal of clinical nutrition.* 2009;89(4):1031-1036.

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

143. Blundell J, King N, Bryant E. *Interactions among physical activity, food choice, and appetitie control: Health message in physical activity and diet.* London: Taylor & Francis; 2005.

144. Viner RM, Cole TJ. Television viewing in early childhood predicts adult body mass index. *The Journal of pediatrics.* 2005;147(4):429-435.

145. Viner R, Cole T. Television viewing in early childhood predicts adult body mass index. *The Journal of pediatrics.* 2005;147(4):429-436.

146. Colley R, Garriguet D, Adamo K, et al. Physical activity and sedentary behavior during the early years in Canada: a cross-sectional study. *Int J Behav Nut Phys Act.* 2013;10(54).

147. Byun W, Dowda M, Pate R. Correlates of objectively measured sedentary behavior in US preschool children. *Pediatrics.* 2011;128(5):937-945.

148. Van Cauwenberghe E, Jones R, Hinkley T, Crawford D, Okely A. Patterns of physical activity and sedentary behaviour in preschool children. *Int J Behav Nut Phys Act.* 2012;9(138).

149. Byun W, Liu J, Pate R. Assocation between objectively measured sedentary behavior and body mass index in preschool children. *International journal of obesity.* 2013;37(7):961-965.

150. Lee R, Cubbin C. Striding toward social justice: the ecologic milieu of physical activity. *Exercise and Sport Science Reviews.* 2009;37(1):10-17.

151. Stucky-Ropp R, DiLorenzo T. Determinants of exercise in children. *Preventive medicine.* 1993;22(6):880-889.

152. Kerr J, Norman G, Sallis J, Patrick K. Exercise aids, neighborhood safety, and physical activity in adolescents and parents. *Med Sci Sports Exerc.* 2008;40:1244-1248.

153. Maddison R, Hoorn S, Jiang Y, et al. The environment and physical activity: the influence of psychosocial, perceived and built environmental factors. *Int J Behav Nut Phys Act.* 2009;6(19).

154. Rosenberg D, Sallis J, Kerr J, et al. Brief scales to assess physical activity and sedentary equipment in the home. *Int J Behav Nut Phys Act.* 2010;7(10).

155. Sirard J, Laska M, Patnode C, Farbakhsh K, Lytle L. Adolescent physical activity and screen time: associations with the physical home environment. *Int J Behav Nut Phys Act.* 2010;7(82).

156. Zabinski M, Norman G, Sallis J, Calfas K, Patrick K. Patterns of sedentary behavior among adolescents. *Health psychology : official journal of the Division of Health Psychology, American Psychological Association.* 2007;26:113-120.

157. Hesketh K, Ball K, Crawford D, Campbell K, Salmon J. Mediators of the relationship between maternal education and children's TV viewing. *American journal of preventive medicine.* 2007;33:41-47.

158. Hoyos Cillero I, Jago R. Sociodemographic and home environment predictors of screen viewing among Spanish school children. *J Public Health.* 2011;33:392-402.

159. Granich J, Rosenberg M, Knuiman M, Timperio A. Individual, social, and physical environment factors associated with electronic media use among children: sedentary behavior at home. *Journal of physical activity & health.* 2011;8:613-625.

160. Ramirez E, Norman G, Rosenberg D, et al. Adolescent screen time and rules to limit screen time in the home. *The Journal of adolescent health : official publication of the Society for Adolescent Medicine.* 2011;48:379-385.

161. Te Velde S, van der Horst K, Oenema A, Timperio A, Crawford D, Brug J. Parental and home influences on adolescents' TV viewing: a mediaiton analysis. *International journal of pediatric obesity : IJPO : an official journal of the International Association for the Study of Obesity.* 2011;6:364-372.

162. Delmas C, Platat C, Schweitzer B, Wagner A, Oujaa M, Simon C. Association between television in bedroom and adiposity thoughout adolescence. *Obesity.* 2007;15:2495-2503.

163. Gattshall M, Shoup J, Marshall J, Crane L, Estabrooks P. Validation of a survey instrument to assess home environments for physical activity and healthy eating in overweight children. *Int J Behav Nut Phys Act.* 2008;5(3).

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

165. Hennessy E, Hughes S, Goldberg J, Hyatt R, Economos C. Parent-child interactions and objectively measured child physical activity: a cross-sectional study. *Int J Behav Nut Phys Act.* 2010;7(71).

166. Lloyd A, Lubans D, Plotnikoff R, Collins C, Morgan P. Maternal and paternal parenting practices and their influence on chilren's adiposity, screen-time, diet and physical activity. *Appetite.* 2014;79:149-157.

167. Vaughn A, Hales D, Ward D. Measuring the physical activity practices used by parents of preschool children. *Med Sci Sports Exerc.* 2013;45(12):2369-2377.

168. Hager E, Candelaria M, Latta L, et al. Maternal perceptions of toddler body size. *Arch Pediatr Adolesc Med.* 2012;166(5):417-422.

169. Burgess JN, & Broome, M.E. Perceptions of weight and body image among preschool children: A pilot study. *Pediatric Nursing.* 2012;38(3):147-152.

170. Austin SB, Haines J, Veugelers PJ. Body satisfaction and body weight: gender differences and sociodemographic determinants. *BMC Public Health.* 2009;9(313):313.

171. Centers for Disease Control and Prevention. *Childhood obesity causes and consequences.* Atlanta, GA: U.S. Department of Health and Human Services;2015.

172. Ekelund U, Aman J, Yngve A, Renman C, Westerterp K, Sjostrom M. Physical activity but not energy expenditure is reduced in obese adolescents: A case-control study. *The American journal of clinical nutrition.* 2002;76:935-941.

173. Fogelholm M. Physical activity, fitness and fatness: Relations to mortality, morbidity and disease risk factors. A systematic review. *Obesity Reviews.* 2010;11(3):202-221.

Chapter 2

Associations among home environment factors and physical activity and sedentary time in preschool-age children

Emily C. Huber[1], Lacey A. McCormack[2], Jessica R. Meendering[2]

[1] Division of Molecular, Life, and Health Sciences, Loras College, Dubuque, IA 52002

[2] Department of Health and Nutritional Sciences, South Dakota State University, Brookings, SD 57007

This material is based upon work that is supported by the National Institute of Food and Agriculture, U.S. Department of Agriculture, under award number 2011-67002-30202.

Abstract

Purpose: To explore relationships among home environment factors and child physical activity (PA) and sedentary time (ST) by utilizing objective measures of activity and the full range of PA intensities in a cross-sectional sample of preschool children.

Methods: One hundred seventy-two primary parent (34±8 yrs,; 30 males, 137 females, 5 unreported)/child (4±1 yrs.; 80 boys, 92 girls) dyads participated in the study. PA was assessed for 7 days in preschool children via accelerometer (ActiGraph GT3X+ and wGT3X-BT) using age appropriate cut-points. Home environment factors were assessed via parent completion of the Comprehensive Home Environment Survey (CHES) using the PA and media portions of the CHES. Multiple multilevel mixed-effects linear regression analyses were utilized to identify home environment factors that were significantly associated with ST, light PA, moderate PA, vigorous PA, moderate-to-vigorous PA, and total PA in the whole sample and by child gender with statistical significance set at $p \leq 0.05$.

Results: PA availability was negatively associated with ST in boys ($p=0.03$). Parent PA role modeling was positively associated with moderate PA ($p=0.03$), vigorous PA ($p=0.01$), moderate-to-vigorous PA ($p=0.01$), and total PA ($p=0.04$) in boys. Parents reporting their gym attendance was positively associated with moderate PA ($p=0.01$), vigorous PA ($p<0.01$), moderate-to-vigorous PA ($p<0.01$), and total PA ($p=0.01$) in boys. Additionally, parental policies to support PA ($p=0.05$) and parental policies to monitor media ($p=0.04$) were positively associated with vigorous PA in boys. No associations were found between home environment factors and PA or ST in girls.

Conclusion: This study found parent role modeling PA and employing policies to support PA and monitor media may be of greatest importance to preschool-age child activity, especially in regard to boys. These data also highlight that home environment factors significantly associated with preschool-age child activity are different in boys and girls. Effort should be made to add recommendations to childhood obesity prevention efforts for parents regarding modifying social and physical home environment factors in order to promote healthy PA behaviors in young children.

Introduction

Childhood obesity is a significant health concern in the United States as approximately 23% of preschool-age children and more than one third of all US children and adolescents are considered to be overweight or obese.[1] The health consequences associated with childhood obesity include an increased risk of hypertension, dyslipidemia, and impaired glucose tolerance as well as a heightened risk for obesity and coronary heart disease as an adult.[2-5] NHANES data suggest there is a significant increase in the prevalence of overweight or obese children between the preschool-age group and the middle childhood age group of sex to 11 year-olds. (37%).[1] Establishing positive physical activity (PA) habits and discouraging sedentary behaviors during the preschool years is of utmost importance as PA behaviors develop and become habitual in early childhood and are difficult to modify as a child ages.[6,7] The preschool years have been shown to be essential in the development of health behaviors.[6-10]

Due to the understanding that a complex set of personal and environmental factors interact to ultimately lead to unhealthy weight gain, researchers have begun conceptualizing childhood obesity determinants through the ecologic systems framework.[11] Characteristics pertaining specifically to the microsystem in which children spend substantial time have been shown to influence PA in older children and adolescents.[12] The home environment is a component of a child's microsystem that has been shown to facilitate or inhibit PA and sedentary behaviors in older children and adolescents through the presence or absence of physical features of the home created by primary caregivers.[12] Having active toys and sports/PA equipment in the home has been shown to be positively associated with PA[13-17] and negatively associated with sedentary

time (ST) in middle- to adolescent-age children.[16-18] Additionally, children with media equipment in the home and more specifically, in the bedroom, has been positively associated with ST in older children and adolescents.[16,19-26]

While correlations among physical home environment variables and PA and ST have been established in older children and adolescents, less is known about the association of physical home environment variables with PA and ST in preschool-age children. Preschool-age children have the potential to be influenced by their home environment even more than older children as they are less independent than older children and adolescents and more reliant on their parents to create and modify their home environment. Previous research with this focus has predominantly relied on various subjective assessments of child PA and ST, including parent-reported PA[27], ST[27], and screen time[28], or did not assess ST[29] which often results in an overestimation of PA and an underestimation of ST.[30,31]

To date, one study that has examined the association of home environment factors on preschool children moderate-to-vigorous PA (MVPA) and ST used objective, accelerometer-measured child PA and ST.[32] Ostbye et al.[32] found that the social home environment, specifically parental policies supporting PA, was associated with increased MVPA. However, no association was found among physical home environment factors and child MVPA.[32] We postulate that using total PA (TPA), which includes light intensity PA (LPA), as opposed to MVPA, would be a better measure of preschool child PA as children in this age group typically spend little time in high intensity activity as they lack the physical and motor development for continuous, high intensity activity.[33-36] Furthermore, the updated PA guidelines for young children recommend that young

children engage in three hours of TPA per day, [37-39] making TPA more applicable than MVPA to measure in this population. The current study seeks to advance the current research by utilizing objective measures of activity and the full range of PA intensities to elucidate a possible relationship among home environment factors and preschool child PA and ST. By identifying home environment factors associated with PA and ST in young children, recommendations can be provided to parents regarding how they can adjust factors to better create a home microsystem environment that fosters PA and discourages ST in their preschool-age children.

Methods

Data for the current analyses is a subset of data from a multi-time point, longitudinal study that evaluated the efficacy of iGrow Readers, an interactive, literacy-based nutrition and physical activity curriculum for preschoolers developed by South Dakota State University Extension. The *iGrow Readers* program pairs 31 children's books with nutrition and PA information and activities. Books are read in preschool classrooms and accompanied by lessons that promote healthy eating and PA. All study procedures and materials were approved by the Human Subjects Institutional Review Board at South Dakota State University. Parents provided written informed consent and children provided verbal assent prior to participation.

Participants

Three to five year-old children and their primary parents were recruited from 14 preschools located in South Dakota, Nebraska, and Minnesota. The primary parent of the family unit was established by having the parent that spends the most time with the child

during a typical week to participate in the evaluations. The initial sample consisted of 293 children (137 boys, 156 girls) and their parents (50 males, 238 females, 5 unreported).

Research Protocol

Trained research personnel traveled to each preschool to meet face-to-face with all study participants, collect anthropometric data, hand out materials for PA and ST monitoring, and distribute survey packets. Survey assessments were sent home with parents, completed at their convenience, and returned to the preschool following the PA assessment wear period.

Anthropometrics. Height was measured to the nearest 0.1 cm with an Adult/Child Shorrboard stadiometer (Weight and Measure, LLC, Olney, MD) and body weight was measured to the nearest 0.01 kg with an Electronic Seca Scale 890 (Seca, Vogel & Halke, Hamburg, Germany) in parent and child participants. Height and weight measurements were taken twice; a third measurement was taken if the first two measurements differed by >0.5 cm for height and >0.5 kg for weight. The average of the two measurements within this acceptable range was used in data analyses. BMI for parents[40] and BMI percentile and BMI z-scores for children[41] were calculated and evaluated using references from the CDC. Children whose BMI percentile-for-age and -gender was in the 85th percentile or greater were classified as overweight or obese, including children over the 95th percentile classification for obesity.

Physical activity and sedentary time assessment. Physical activity and ST were assessed for one week via accelerometers (GT3X+ or wGT3X-BT, ActiGraph, Pensacola, FL) in child participants. The children wore the device on an elastic belt and were instructed to wear the belt at all times, from when they got up in the morning until they

went to bed at night, with the exception of bathing or any other time the instrument could become submerged in water. Throughout the activity monitor wear time, reminder emails, phone calls, and/or text messages were made to the parents to optimize compliance.

The accelerometers were initialized to collect raw data at a sample rate of 30 Hz using ActiLife software (ActiGraph, Pensacola, FL). Following the week of participant wear, monitors were downloaded using ActiLife and an epoch length of 10 seconds was used.[42-44] Data was imported into SAS (version 9.3, SAS Institute, Cary, NC) to filter and remove participating children who did not meet compliance standards of wear time. Compliance standards required minimum wear time to include three valid week days and one valid weekend day. A day was considered valid if the subject had a minimum of 8 hours of wear time during waking hours.[45] Non-wear time was defined as at least 60 consecutive minutes of zero activity counts.[46] Daily mean minutes of sedentary time (ST), light PA (LPA), moderate PA (MPA), vigorous PA (VPA), and TPA (sum of light, moderate, and vigorous PA) during waking hours for the full week, week days, and weekend days were calculated using age-appropriate Pate et al.[47] cut points. Data was then further divided into preschool and outside of preschool sections of time and the outside of preschool data was sued for the current statistical analyses. All ST and PA data is presented as average minutes per hour.

Home environment assessment. Home environment was assessed by the parent participant's completion of the Comprehensive Home Environment Survey (CHES).[48] The CHES is a 12-part questionnaire assessing home food, PA, and media environment. For this study, only the PA and media portions of the CHES were used. The following

subscales related to PA were quantified: availability, accessibility, role modeling, and supporting parental policies. Additionally, the following home environment subscales related to ST were quantified: media availability, media role modeling, and parental policies to monitor media.

Demographics. Parent participants identified age, gender, and race/ethnicity for themselves and their children. Due to a largely homogenous population, race was dichotomized as white or non-white. Annual household income and highest level of parent education was indicated on a demographics form. Parental education was categorized as 1) less than bachelor's degree, 2) a bachelor's degree, and 3) higher than a bachelor's degree. Household income was dichotomized as 1) < $9,999-$59,999 and 2) ≥ $60,000.

Statistical Analysis

Descriptive statistics were calculated for anthropometric, PA, and ST characteristics and stratified by gender. T-tests were used to evaluate differences in anthropometric measurements between boys and girls. Multiple multilevel mixed-effects linear regression analyses were utilized to identify home environment factors that were significantly associated with ST, LPA, MPA, VPA, MVPA, and TPA in the whole sample and by child gender. Appropriate normality, linearity, and heteroscedasticity checks were conducted for each regression model. Regression models controlled for the following confounding variables: BMI z-score, child gender, child age, child race, annual household income, parental education, and parent race. All analyses were conducted using Stata (Stata/IC 14, College Station, TX). The criterion for statistical significance was set at $p \leq 0.05$. Data are presented as mean ± SD.

Results

Descriptive analysis of anthropometrics and demographics

Of the initial sample of 293 children, 249 wore accelerometers and 215 children had compliant accelerometer data (86.3% of children that wore accelerometers). Reasons children from the initial sample did not wear accelerometers included child refusal to wear the device and parents not present at data collection to receive devices for their children. Case-wise deletion removed an additional 43 participants due to incomplete CHES data, thus the final sample size used for analyses was 172 children (n = 80 boys, 92 girls). Children were, on average, 3.6 ± 0.69 years of age, 103.59 ± 6.87 cm tall, and weighed 17.31 ± 2.76 kg. No significant differences were seen in height or weight between genders. Eighty-two percent of children (n=139) were categorized as normal weight as indicated by BMI percentile while the remaining 18% were categorized as overweight or obese. Girls accumulated more minutes of ST per hour compared to boys ($p=0.01$). Boys accumulated more minutes of MPA, VPA, MVPA, and TPA per hour compared to girls ($p\leq0.05$, Table 2.1) No significant differences were seen in home environment subscales between genders.

Associations between sedentary time, activity, and home environment

Significant associations were found between home environment factors and objectively measured child ST and PA (Table 2.2). Parent PA role modeling was negatively associated with child ST ($p=0.03$) and positively associated with MPA ($p=0.03$), VPA ($p=0.03$), MVPA ($p=0.01$), and TPA ($p=0.04$). Parental policies to support PA was positively associated with child VPA ($p=0.02$). Additionally, parental

policies to monitor media was positively associated with child VPA (p=0.05), MVPA (0.02), and TPA (p=0.05).

When separated by child sex, significant associations were found between home environment factors and ST and PA in boys (Table 2.3). PA availability was negatively associated with ST in boys (p=0.03). Parent PA role modeling was positively associated with MPA (p=0.03), VPA (p=0.01), MVPA (p=0.01), and TPA (p=0.04) in boys. Parents reporting their gym attendance was positively associated with MPA (p=0.01), VPA (p<0.01), MVPA (p<0.01), and TPA (p=0.01) in boys. Additionally, parental policies to support PA (p=0.05) and parental policies to monitor media (p=0.04) were positively associated with VPA in boys. No associations were found between home environment factors and PA or ST in girls (Table 2.4).

Discussion

Considering the obesity prevalence and the foundational development of health behaviors during early childhood, establishing positive PA habits in preschool-age children is of utmost importance in order to combat the unhealthy increase in body weight seen as children age. Physical and social home environment factors have been shown to be associated with PA and ST in older children and adolescents, however, the majority of evidence to date in preschool-age children has relied on subjective-reported, rather than objectively-measured, MVPA and ST. To our knowledge, this is the first study to investigate the possible relationship among home environment factors and objectively-measured preschool child PA and ST using a full range of PA intensities. Including TPA is especially applicable in the preschool-age population as PA guidelines for young children recommend three hours of TPA per day.[37-39]

The primary findings of the present study indicate parent PA role modeling is significantly associated with preschool-age child activity, suggesting that the children of parents that role model PA accumulate less ST and engage in more MPA, VPA, MVPA, and TPA than those children of parents that do not role model PA. These findings are consistent with the results of previous studies that have explored the association between parent PA practices and child activity. Parents modeling PA by using their own behavior to encourage their child to be active is a practice that is associated with more participation in PA by middle-to adolescent-age children.[49-52] Furthermore, parent modeling of ST has been shown to be associated with sedentary behaviors of older children[53] and parent modeling of PA to be associated with PA in preschool children.[54] However, a noteworthy and unique finding emerged when looking deeper at differences between boys and girls in this preschool age group. Parent PA role modeling, in addition to parent-reported gym attendance, were significantly associated with MPA, VPA, MVPA, and TPA in boys but similar associations were not found in girls. These findings suggest that preschool-age boys may be more positively impacted by their parents' activity levels than their female peers.

The results of the present study reveal that using parental policies to support PA is positively associated with preschool-age child activity, suggesting that the children of parents that utilize parental policies to support PA are engaging in more VPA than those children whose parents are not using parental policies to support PA. These findings are also consistent with previous literature in older children and adolescents. Parental supporting practices including providing transportation to organized activities and other PA opportunities[19,20,49,55-58] and using positive reinforcement of child PA[59,60] have been

shown to be positively associated with PA in middle- to adolescent-age children. Similarly, in preschool-age children, Ostbye et al.[32] found that parental policies supporting PA was associated with increased MVPA and Schoeppe and Trost[61] found a positive association between parental policies supporting PA and amount of time spent playing outside. However, when looking at significant home environment factors in boys and girls, parental policies to support PA was positively associated with VPA in boys but no associations were found in girls. These findings suggest that parents providing more logistical and emotional support for boys may lead to increased PA participation.

Findings of the present study also indicate that using parental policies to monitor media is positively associated with preschool-age child activity. While previous studies have found an association between parent established rules regarding media and amount of time engaged in screen time,[28,54] our findings suggest that the children of parents that monitor media use in their children are engaging in more VPA, MVPA, and TPA than children of parents that engage in less monitoring. Additionally, parental policies monitoring media was positively associated with VPA in boys but not girls. Considering the findings of previous studies on ST and findings of the present study on PA, it can be argued that implementing policies to monitor media is of utmost importance to preschool-age child activity and parents should be encouraged to employ this practice.

Previously, Spurrier[27] identified a positive association between size of backyard and amount of outdoor play equipment and outdoor play in preschool children and Sallis[29] found a positive relationship between convenient play space and higher levels of PA. However, our findings also revealed a negative association between PA availability and ST in boys, suggesting that boys with more active toys and sports and PA equipment

in the home, as well as adequate indoor and outdoor play spaces, engage in less ST. Collectively, these findings highlight the opportunity to foster PA and discourage ST in preschool-age children by creating a home environment with adequate available play space and equipment.

In contrast to our findings, Veldhuis et al.[28] found that media availability, including the number of electronic media devices in the household and in the child's bedroom was associated with more screen time in preschool-age children. Additionally, Spurrier et al.[27] identified the presence of a game console in the home was associated with more indoor ST in preschool children. The difference in findings may be attributed to methods used to assess activity and home environment. Veldhuis[28] investigated parent-reported child screen time and home environment was measured via two questions inquiring about the number of TVs, computers, and game consoles in the house and child's bedroom.[28] Spurrier[27] utilized parent-reported child PA and ST that focused on the amount of time the child spent playing outdoors and child screen time. Subjective assessments of PA and ST, including parent report, often results in an overestimation of PA and an underestimation of ST.[62] Our use of objective, accelerometer-measured PA and ST as well as a comprehensive home environment survey may result in a more accurate representation of the relationship among home environment factors and child PA and ST.

Notably, the findings of this study suggest that physical and social home environment factors that are significantly associated with activity in preschool-age children are different for boys and girls. While our results indicating boys are more active than girls are well supported in previous literature,[7,8,34,35,63,64] we also found significant

associations between various home environment factors and ST and PA in boys but not girls. Parents may be unconsciously creating and fostering more PA opportunities for boys and more ST opportunities for girls based on typical gender-normal activities. Parents should be encouraged to consciously create and foster PA opportunities for their girls by providing more logistical support by signing girls up for activities and taking them places to be active, emotional support by positively reinforcing participation in activity, and creating a physical home environment with adequate active toys, equipment, and play space.

While it can be argued that a child's home environment has the potential to impact activity regardless of where the child is, we sought to limit the possible impact of other microenvironments (i.e. preschool and/or daycare) in our investigation of home environment factors and child activity. A strength of this study was the use of objectively-measured PA and ST filtered to time outside of preschool and/or daycare in the exploration of associations between home environment factors with child activity. Other strengths include the adjustment for significant confounders in the regression models and the use of a comprehensive survey to measure home environment factors. However, the study is not without limitations. PA data used for analyses was collected at the baseline time point of the multi-time point study and the CHES home environment assessment was completed at the follow-up time point. While preliminary findings indicate that children's PA behaviors did not significantly change as a result of the curriculum, it is possible that PA and/or home environment factors may have changed over the course of the study duration due to seasonal influences and is a potential

limitation of the study. Lastly, the homogeneity and general lack of diversity within our sample limits the generalizability of our findings.

Despite these limitations, the current study adds empirical evidence and strengthens knowledge by utilizing objective measures of activity and considering the full range of PA intensities to understand the relationships among home environment factors and preschool child PA and ST. This observation suggests that parent role modeling PA and employing policies to support PA and monitor media is of greatest importance to preschool-age child activity, especially in regard to boys. These data also highlight different methods may need to be used with respect to the promotion and facilitation of PA opportunities in boy and girl preschool-age children. These discoveries are crucial as recommendations to parents regarding modifying social and physical home environment factors should be added to childhood obesity prevention efforts and encouraged in parents in order to promote healthy behaviors and weight in young children.

References

1. Ogden C, Carroll M, Flegal K. Prevalence of childhood and adult obesity in the United States, 2011-2012. *JAMA : the journal of the American Medical Association.* 2014;311(8):806-814.

2. Freedman D, Khan L, Dietz W, Srinivasan S, Berenson G. Relationship of childhood overweight to coronary heart disease risk factors in adulthood: The Bogalusa Heart Study. *Pediatrics.* 2001;108:712-718.

3. Dietz WH. Health consequences of obesity in youth: Childhood predictors of adult disease. *Pediatrics.* 1998;101(3):518-525.

4. Magarey AM, Daniels LM, Boulton TJ, Cockington RA. Predicting obesity in early adulthood from childhood and parental obesity. *International Journal of Obesity.* 2003;27(4):505-513.

5. Freedman D, Kettel Khan L, Serdula M, Dietz W, Srinivasan S, Berenson G. The relation of childhood BMI to adult adiposity: The Bogalusa Heart Study. *Pediatr.* 2005;11:22-27.

6. Sleddens E, Kremers S, Hughes S, et al. Physical activity parenting: a systematic review of questionnaires and their associations with child activity levels. *Obesity Reviews.* 2012;13:1015-1033.

7. Edwards N, Khoury P, Kalkwarf H, Woo J. Tracking of accelerometer-measured physical activity in early childhood. *Pediatr Exerc Sci.* 2013;25:487-501.

8. Hinkley T, Salmon J, Okely A, Crawford D, Hesketh K. Preschoolers' physical activity, screen time, and compliance with recommendations. *Med Sci Sports Exerc.* 2012;44(3):458-465.

9. Certain L, Kahn R. Prevalence, correlates, and trajectory of television viewing among infants and toddlers. *Pediatrics.* 2002;109:634-642.

10. Pate R, Baranowski T, Dowda M, Trost S. Tracking of physical activity in young children. *Med Sci Sports Exerc.* 1996;28(1):92-96.

11. Lee R, Cubbin C. Striding toward social justice: the ecologic milieu of physical activity. *Exercise and Sport Science Reviews.* 2009;37(1):10-17.

12. Pinard C, Yaroch A, Hart M, Serrano E, McFerren M, Estabrooks P. Measures of the home environment related to childhood obesity: a systematic review. *Public health nutrition.* 2011;15(1):97-109.

13. Stucky-Ropp R, DiLorenzo T. Determinants of exercise in children. *Preventive medicine.* 1993;22(6):880-889.

14. Kerr J, Norman G, Sallis J, Patrick K. Exercise aids, neighborhood safety, and physical activity in adolescents and parents. *Med Sci Sports Exerc.* 2008;40:1244-1248.

15. Maddison R, Hoorn S, Jiang Y, et al. The environment and physical activity: the influence of psychosocial, perceived and built environmental factors. *Int J Behav Nut Phys Act.* 2009;6(19).

16. Rosenberg D, Sallis J, Kerr J, et al. Brief scales to assess physical activity and sedentary equipment in the home. *Int J Behav Nut Phys Act.* 2010;7(10).

17. Sirard J, Laska M, Patnode C, Farbakhsh K, Lytle L. Adolescent physical activity and screen time: associations with the physical home environment. *Int J Behav Nut Phys Act.* 2010;7(82).

18. Zabinski M, Norman G, Sallis J, Calfas K, Patrick K. Patterns of sedentary behavior among adolescents. *Health psychology : official journal of the Division of Health Psychology, American Psychological Association.* 2007;26:113-120.

19. Tandon P, Grow H, Couch S, et al. Physical and social home environment in relation to children's overall and home-based physical activity and sedentary time. *Preventive medicine.* 2014;66(39-44).

20. O'Connor T, Chen T, Baranowski J, Thompson D, Baranowski T. Physical activity and scree-media-related parenting practices have different associations with children's objectively measured physical activity. *Childhood obesity.* 2013;9(5):446-453.

21. Hesketh K, Ball K, Crawford D, Campbell K, Salmon J. Mediators of the relationship between maternal education and children's TV viewing. *American journal of preventive medicine.* 2007;33:41-47.

22. Hoyos Cillero I, Jago R. Sociodemographic and home environment predictors of screen viewing among Spanish school children. *J Public Health.* 2011;33:392-402.

23. Granich J, Rosenberg M, Knuiman M, Timperio A. Individual, social, and physical environment factors associated with electronic media use among children: sedentary behavior at home. *Journal of physical activity & health.* 2011;8:613-625.

24. Ramirez E, Norman G, Rosenberg D, et al. Adolescent screen time and rules to limit screen time in the home. *The Journal of adolescent health : official publication of the Society for Adolescent Medicine.* 2011;48:379-385.

25. Te Velde S, van der Horst K, Oenema A, Timperio A, Crawford D, Brug J. Parental and home influences on adolescents' TV viewing: a mediaiton analysis.

International journal of pediatric obesity : IJPO : an official journal of the International Association for the Study of Obesity. 2011;6:364-372.

26. Delmas C, Platat C, Schweitzer B, Wagner A, Oujaa M, Simon C. Association between television in bedroom and adiposity thoughout adolescence. *Obesity.* 2007;15:2495-2503.

27. Spurrier N, Magarey A, Golley R, Curnow F, Sawyer M. Relationships between the home environment and physical activity and dietary patterns of preschool children: a cross-sectional study. *Int J Behav Nut Phys Act.* 2008;5(31).

28. Veldhuis L, van Grieken A, Renders C, HiraSing R, Raat H. Parenting style, the home environment, and screen time of 5-year-old children; the 'Be Active, Eat Right' Study. *PloS one.* 2014;9(2):e88486.

29. Sallis J, Nader P, Broyles S, et al. Correlates of physical activity at home in Mexican-American and Anglo-American preschool children. *Health psychology : official journal of the Division of Health Psychology, American Psychological Association.* 1993;12:390-398.

30. Prince SA, Adamo KB, Hamel ME, Hardt J, Connor Gorber S, Tremblay M. A comparison of direct versus self-report measures for assessing physical activity in adults: a systematic review. *International Journal of Behavioral Nutrition and Physical Activity.* 2008;5:56.

31. Troiano RP, Berrigan D, Dodd KW, Masse LC, Tilert T, McDowell M. Physical activity in the United States measured by accelerometer. *Medicine and Science in Sports and Exercise.* 2008;40(1):181-188.

32. Ostbye T, Malhotra R, Stroo M, et al. The effect of the home environment on physical activity and dietary intake in preschool children. *Int J Obes.* 2013;37:1314-1321.

33. Timmons B, Naylor P, Pfeiffer K. Physical activity for preschool children - how much and how? *Appl Physiol Nutr Metab.* 2007;32(Suppl. 2E):S122-S134.

34. Tucker P. The physical activity levels of preschool-aged children: a systematic review. *Early Child Res Q.* 2008;23:547-558.

35. Oliver M, Schofield G, Kolt G. Physical activity in preschoolers: understanding prevalence and measurement issues. *Sports Med.* 2007;37(12):1045-1070.

36. Bailey R, Olson J, Pepper S, Porszasz J, Barstow T, Cooper D. The level and tempo of children's physical activities: an observational study. *Med Sci Sports Exerc.* 1995;27:1033-1041.

37. Department of Health and Ageing. *National physical activity guidelines for Australians. Physical activity recommendations for 0-5 year olds.* Commonwealth of Australia: Canberra, Australia2010.

38. Institute of Medicine. *Early childhood obesity prevention policies.* Washington, DC2011.

39. Department of Health PA, Health Improvement and Protection. *Start active, stay active: a report on physical activity for health from the four home countries' chief medical officers.* London: Department of Health, Physical Activity, Health Improvement and Protection;2011.

40. Centers for Disease Control and Prevention. *About adult BMI.* Atlanta, GA: U.S. Department of Health and Human Services;2015.

41. Centers for Disease Control and Prevention. *About child and teen BMI.* Atlanta, GA: U.S. Department of Health and Human Services;2015.

42. Colley R, Harvey A, Grattan K, Adamo K. Impact of accelerometer epoch length on physical activity and sedentary behavior outcomes for preschool-aged children. *Health reports.* 2014;25:3-9.

43. Nettlefold L, Naylor P, Warburton D, Bredin S, Race D, McKay H. The influence of epoch length on physical activity patterns varies by child's activity level. *Research quarterly for exercise and sport.* 2016;87(1):110-123.

44. Kim Y, Beets M, Pate R, Blair S. The effect of reintegrating Actigraph accelerometer counts in preschool children: comparison using different epoch lengths. *Journal of Science and Medicine in Sport.* 2013;16(2):129-134.

45. Colley R, Connor Gorber S, Tremblay M. Quality control and data reduction procedures for accelerometry-derived measures of physical activity. *Statistics Canada, Catalogue no 82-003-X.* 2010;21(1).

46. Chinapaw M, de Niet M, Verloigne M, De Bourdeaudhuij I, Brug J, Altenburg T. From sedentary time to sedentary patterns: accelerometer data reduction decisions in youth. *PloS one.* 2014;9(11).

47. Pate R, Almeida M, McIver K, Pfeiffer K, Dowda M. Validation and calibration of an accelerometer in preschool children. *Obesity.* 2006;14(11):2000-2006.

48. Pinard CA, Yaroch AL, Hart MH, Serrano EL, McFerren MM, Estabrooks PA. The Validity and reliability of the Comprehensive Home Environment Survey (CHES). *Health Promot Pract.* 2014;15(1):109-117.

49. Davison K, Cutting T, Birch L. Parents' activity-related parenting practices predict girls' physical activity. *Med Sci Sports Exerc.* 2003;35(9):1589-1595.

50. Edwardson C, Gorely T. Activity-related parenting practices and children's objectively measured physical activity. *Pediatr Exerc Sci.* 2010;22:105-113.

51. Vilhjalmsson R, Thorlindsson T. Factors related to physical activity: a study of adolescents. *Soc Sci Med.* 1998;47:665-675.

52. Trost S, Kerr L, Ward D, Pate R. Physical activity and determinants of physical activity in obese and non-obese children. *Int J Obes Relat Metab Disord.* 2001;25:822-829.

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

54. Vaughn A, Hales D, Ward D. Measuring the physical activity practices used by parents of preschool children. *Med Sci Sports Exerc.* 2013;45(12):2369-2377.

55. Verloigne M, Van Lippevelde W, Maes L, Brug J, De Bourdeaudhuij I. Family- and school-based correlates of energy balance-related behaviors in 10-12-year-old children: a systematic review within the ENERGY (EuropeaN Energy balance Research to prevent excessive weight Gain among Youth) project. *Public health nutrition.* 2012;15(8):1380-1395.

56. Sallis J, Alcaraz J, Mckenzie T, Howell M. Predictors of change in children's physical activity over 20 months: variations by gender and level of adiposity. *American journal of preventive medicine.* 1999;16:222-229.

57. Sallis J, Alcaraz T, McKenzie M, Hovell B, Kolody, Nader P. Parental behavior in relation to physical activity and fitness in 9-year-old children. *Am J Dis Child.* 1992;146:1383-1388.

58. Hennessy E, Hughes S, Goldberg J, Hyatt R, Economos C. Parent-child interactions and objectively measured child physical activity: a cross-sectional study. *Int J Behav Nut Phys Act.* 2010;7(71).

59. Arredondo E, Elder J, Guadalupe X, Campbell N, Baquero B, Duerksen S. Is parenting style related to children's healthy eating and physical activity in Latino families? *Health education research.* 2006;21(6):862-871.

60. Lloyd A, Lubans D, Plotnikoff R, Collins C, Morgan P. Maternal and paternal parenting practices and their influence on chilren's adiposity, screen-time, diet and physical activity. *Appetite.* 2014;79:149-157.

61. Schoeppe S, Trost S. Maternal and paternal support for physical activity and healthy eating in preschool children: a cross-sectional study. *BMC Public Health.* 2015;15:971.

62. Corder K, Crespo N, van Sluijs E, Lopez N, Elder J. Parent awareness of young children's physical activity. *Preventive medicine.* 2012;55(3):201-205.

63. Pate R, O'Neill J, Brown W, Pfeiffer K, Dowda M, Addy C. Prevalence of compliance with a new physical activity guideline for preschool-age children. *Childhood obesity.* 2015;11(4):415-420.

64. Brasholt M, Chawes B, Kreiner-Moller E, Vahlkvist S, Sinding M, Bisgaard H. Objective assessment of levels and patterns of physical activity in preschool children. *Pediatr Res.* 2013;74(3):333-338.

Table 2.1: Descriptive Statistics Stratified by Gender –Mean (SD)

	All (n=172)	**Boys (n=80)**	**Girls (n=92)**	*p*
Height (cm)	103.59 (6.87)	103.64 (7.23)	103.55 (6.87)	0.93
Weight (kg)	17.30 (2.76)	17.20 (2.50)	17.39 (2.97)	0.67
BMI z-score	0.20 (1.01)	0.04 (1.03)	0.33 (0.99)	0.06
ST (min/hr)	49.82 (3.52)	49.05 (4.27)	50.48 (2.54)	0.008*
LPA (min/hr)	4.45 (1.11)	4.54 (1.19)	4.38 (1.04)	0.34
MPA (min/hr)	3.74 (1.31)	4.03 (1.51)	3.48 (1.05)	0.006*
VPA (min/hr)	2.38 (1.21)	2.60 (1.48)	2.20 (0.88)	0.03*
MVPA (min/hr)	5.61 (2.21)	6.12 (2.65)	5.16 (1.64)	0.004*
TPA (min/hr)	10.06 (3.15)	10.66 (3.65)	9.54 (2.54)	0.02*

p = independent sample t-tests for anthropometrics and activity differences between genders.

* = significant difference ($p \leq 0.05$)

SD, standard deviation; cm, centimeters; kg, kilograms; ST, sedentary time; LPA, light physical activity; MPA, moderate physical activity; VPA, vigorous physical activity; MVPA, moderate-to-vigorous physical activity; TPA, total physical activity; min/hr, minutes per hour

Table 2.2: Associations between CHES scales and child activity

	ST	LPA	MPA	VPA	MVPA	TPA
Physical activity availability	-0.08 (0.22)	-0.00 (0.85)	0.01 (0.75)	0.02 (0.37)	0.03 (0.51)	0.02 (0.70)
Physical activity accessibility	0.82 (0.33)	-0.20 (0.45)	-0.24 (0.45)	0.04 (0.89)	-0.28 (0.60)	-0.48 (0.53)
Physical activity role modeling	-0.71 (0.03)*	0.10 (0.35)	0.27 (0.03)*	0.25 (0.03)*	0.51 (0.01)*	0.61 (0.04)*
Gym attendance	-0.85 (0.35)	0.33 (0.28)	0.53 (0.12)	0.44 (0.16)	0.87 (0.13)	1.20 (0.15)
Parental policies to support physical activity	-0.38 (0.13)	-0.00 (0.97)	0.10 (0.30)	0.20 (0.02)*	0.21 (0.19)	0.20 (0.38)
Media availability	-0.16 (0.47)	0.07 (0.36)	0.07 (0.40)	0.05 (0.49)	0.09 (0.50)	0.16 (0.43)
Media role modeling	0.76 (0.44)	0.05 (0.88)	-0.03 (0.94)	-0.39 (0.26)	-0.14 (0.82)	-0.09 (0.92)
Parental policies to monitor media	-0.22 (0.23)	0.07 (0.26)	0.13 (0.06)	0.12 (0.05)*	0.26 (0.02)*	0.33 (0.05)*

Regression coefficients in minutes of activity/hour with *p* value in parentheses.
* = significant association ($p \leq 0.05$).
ST, sedentary time; LPA, light physical activity; MPA, moderate physical activity; VPA, vigorous physical activity; MVPA, moderate-to-vigorous physical activity; TPA, total physical activity.

Table 2.3: Associations between CHES scales and activity in boys

	ST	LPA	MPA	VPA	MVPA	TPA
Physical activity availability	-0.26 (0.03)*	0.03 (0.40)	0.03 (0.44)	0.04 (0.37)	0.06 (0.42)	0.09 (0.39)
Physical activity accessibility	-0.32 (0.85)	0.25 (0.61)	0.48 (0.42)	0.89 (0.10)	1.03 (0.31)	1.28 (0.37)
Physical activity role modeling	-1.00 (0.08)	0.14 (0.39)	0.41 (0.03)*	0.46 (0.01)*	0.83 (0.01)*	0.97 (0.04)*
Gym attendance	-2.23 (0.17)	0.53 (0.25)	1.42 (0.01)*	1.42 (0.00)*	2.73 (0.00)*	3.26 (0.01)*
Parental policies to support physical activity	-0.63 (0.15)	0.05 (0.71)	0.19 (0.20)	0.27 (0.05)*	0.36 (0.17)	0.41 (0.27)
Media availability	0.09 (0.84)	0.04 (0.72)	0.03 (0.85)	-0.01 (0.96)	0.02 (0.95)	0.06 (0.87)
Media role modeling	1.19 (0.51)	0.02 (0.97)	-0.24 (0.70)	-0.49 (0.39)	-0.37 (0.73)	-0.36 (0.81)
Parental policies to monitor media	-0.17 (0.63)	0.09 (0.36)	0.15 (0.22)	0.22 (0.04)*	0.34 (0.09)	0.43 (0.13)

Regression coefficients in minutes of activity/hour with *p* value in parentheses.
* = significant association ($p \leq 0.05$).
ST, sedentary time; LPA, light physical activity; MPA, moderate physical activity; VPA, vigorous physical activity; MVPA, moderate-to-vigorous physical activity; TPA, total physical activity.

Table 2.4: Associations between CHES scales and activity in girls

	ST	LPA	MPA	VPA	MVPA	TPA
Physical activity availability	0.06 (0.40)	-0.04 (0.11)	-0.02 (0.46)	-0.00 (0.99)	-0.02 (0.70)	-0.06 (0.40)
Physical activity accessibility	0.90 (0.27)	-0.34 (0.29)	-0.46 (0.17)	-0.13 (0.65)	-0.54 (0.31)	-0.90 (0.28)
Physical activity role modeling	-0.30 (0.40)	0.08 (0.57)	0.15 (0.30)	0.03 (0.82)	0.22 (0.34)	0.30 (0.40)
Gym attendance	0.26 (0.79)	0.28 (0.47)	-0.17 (0.67)	-0.26 (0.44)	-0.52 (0.43)	-0.26 (0.79)
Parental policies to support physical activity	-0.01 (0.98)	-0.04 (0.69)	0.02 (0.84)	0.11 (0.25)	0.04 (0.84)	0.01 (0.98)
Media availability	-0.25 (0.24)	0.09 (0.26)	0.10 (0.24)	0.09 (0.22)	0.16 (0.27)	0.25 (0.24)
Media role modeling	-0.63 (0.56)	0.18 (0.67)	0.32 (0.47)	-0.13 (0.72)	0.48 (0.50)	0.63 (0.56)
Parental policies to monitor media	-0.21 (0.25)	0.04 (0.58)	0.09 (0.22)	0.04 (0.48)	0.17 (0.16)	0.21 (0.25)

Regression coefficients in minutes of activity/hour with *p* value in parentheses.
* = significant association ($p \leq 0.05$).
ST, sedentary time; LPA, light physical activity; MPA, moderate physical activity; VPA, vigorous physical activity; MVPA, moderate-to-vigorous physical activity; TPA, total physical activity.

Chapter 3

Associations among physical activity parenting practices and physical activity and sedentary time in preschool-age children

Emily C. Huber[1], Lacey A. McCormack[2], Jessica R. Meendering[2]

[1] Division of Molecular, Life, and Health Sciences, Loras College, Dubuque, IA 52002

[2] Department of Health and Nutritional Sciences, South Dakota State University, Brookings, SD 57007

This material is based upon the work that is supported by the National Institute of Food and Agriculture, U.S. Department of Agriculture, under award number 2011-67002-30202.

Abstract

Purpose: To explore relationships among parenting physical activity (PA) practices and child PA and sedentary time (ST) by utilizing objective measures of activity and the full range of PA intensities in a cross-sectional sample of preschool children.

Methods: One hundred sixty-nine primary parent (34±8 yrs.; 30 males, 134 females, 5 unreported)/child (4±1 yrs.; 80 boys, 89 girls) dyads participated in the study. PA was assessed for 7 days in preschool children via accelerometer (ActiGraph GT3X+ and wGT3X-BT) using age appropriate cut-points. Parent PA practices were assessed via parent completion of the Activity Support Scale for Multiple Groups (ACTS-MG). Multiple multilevel mixed-effects linear regression analyses were utilized to identify parent PA practices that were significantly associated with ST, light PA, moderate PA, vigorous PA, moderate-to-vigorous PA, and total PA in the whole sample and by child gender. ACTS-MG question-by-question analyses were also completed by rescaling ACTS-MG item responses. Statistical significance was set at $p \leq 0.05$.

Results: Parents that agreed with the statement "I limit how long my child plays video games" was negatively associated with child ST ($p=0.05$) and positively associated with child MPA ($p=0.04$), VPA ($p=0.01$), MVPA ($p=0.02$), and TPA ($p=0.03$). Child MPA was positively associated with the parenting PA practice of restricting sedentary activities ($p=0.05$). Child VPA was positively associated with the parenting PA practice of use of community resources ($p=0.02$) and negatively associated with parents that reported "I take my child to places where he/she can be active" ($p=0.04$). When separated by child sex, use of community resources was positively associated with VPA ($p=0.02$) and MVPA (0.04) in boys. Parents that agreed with the statement "I take my child to places

where he/she can be active" was negatively associated with VPA (p=0.01) and MVPA (p=0.05) in boys. Parents that agreed with the statement "I enroll my child in community-based programs (such as Girls and Boys Club, YMCA) where he/she can be active" was positively associated with VPA (p=0.05) in boys. Parents that agreed with the statement "I limit how long my child plays video games" was positively associated with VPA (p=0.03) in girls.

Conclusion: This study found that the practices of using community resources and restricting sedentary activities may be of greatest importance to preschool-age child activity. These practices should be encouraged in parents in order to promote health behaviors and weight in young children. This discovery is crucial as recommendations to parents regarding PA practices should be added to childhood obesity prevention efforts.

Introduction

Approximately 23% of preschool-age children in the United States are considered to be overweight or obese based on their body mass index (BMI).[1] Childhood obesity is a critical public health concern as overweight and/or obese preschool children are four times more likely to be overweight as adults.[2] Data from the National Health and Nutrition Examination Survey suggests there is a significant increase in the prevalence of overweight or obese children between the preschool group of two to five year-olds and the middle childhood-age group of six to 11 year-olds (37%).[1] Early childhood is a crucial time to promote physical activity (PA) behaviors as the preschool years have been shown to be foundational in the development of health behaviors.[3-6] PA behaviors develop and become habitual in childhood and are difficult to modify as a child ages.[6,7] These data showcase the importance of establishing positive PA habits in preschool-age children in order to combat the unhealthy increase in body weight seen as children age.

Physical activity and sedentary time (ST) in older children and adolescents have been shown to be associated with parent PA practices. Parents providing transportation to organized activities and other PA opportunities was positively associated with more PA participation in middle- to adolescent-age children.[8-14] Additionally, parental use of positive reinforcement of child PA was significantly associated with PA in elementary-age children.[15,16] Parents modeling PA by using their own behavior to encourage their child to be active is a practice that was associated with more participation in PA by middle-to adolescent-age children.[8,17-19] Furthermore, parent modeling of ST has been shown to be associated with sedentary behaviors of older children.[20]

Although, parent PA practices and their influence on older children and adolescent PA and ST have been studied, less is known about the associations between parent PA practices on PA and ST in preschool-age children. It can be argued that preschool-age children have the potential to be influenced by parent PA practices even more than older children and adolescents as preschool-age children are more dependent on parents for providing PA opportunities. Previous research with this focus has predominately relied on various subjective assessments of child PA, including parent-reported outdoor playtime,[21,22] and screen time[21,23] which often results in an overestimation of PA and an underestimation of ST.[24,25]

To date, only two studies examining the role of parent PA practices on preschool children moderate-to-vigorous PA (MVPA) and ST used objectively measured child PA and ST.[26,27] Ostbye et al.[26] found that parental policies supporting PA was associated with increased MVPA. Additionally, Vaughn and colleagues[27] revealed the parental practices of limiting screen time, using screen time to control behavior, exposure to TV, and modeling of PA were significantly associated with the young children's TV viewing and using PA to control behavior was associated with amount of time children spent outside and minutes of MVPA.[27] While those studies provided valuable findings, we postulate that using total PA (TPA), which includes light intensity PA (LPA), as opposed to MVPA would be a better measure of preschool child PA as children in this age group typically spend little time in high intensity activity as they lack the physical and motor development for continuous, high intensity activity.[28-31] The current study seeks to advance the field by utilizing objective measures of activity and the full range of PA intensities to elucidate a possible relationship among parent PA practices and preschool

child PA and/or ST. By identifying parent PA practices associated with PA and ST in young children, recommendations can be provided to parents regarding how they can best encourage PA and discourage ST in their preschool-age children.

Methods

Data for the current analyses is a subset of data from a multi-time point, longitudinal study that evaluated the efficacy of *iGrow Readers,* an interactive, literacy-based nutrition and PA curriculum for preschoolers developed by South Dakota State University Extension. The *iGrow Readers* program pairs 31 children's books with nutrition and PA information and activities. Books are read in preschool classrooms and accompanied by lessons that promote healthy eating and PA. All study procedures and materials were approved by the Human Subjects Institutional Review Board at South Dakota State University. Parents provided written informed consent and children provided verbal assent prior to participation.

Participants

Three to five year-old children and their primary parents were recruited from 14 preschools located in South Dakota, Nebraska, and Minnesota. The primary parent of the family unit was established by having the parent that spends the most time with the child during a typical week to participate in the evaluations. The initial sample consisted of 293 children (137 boys, 156 girls) and their parents (50 males, 238 females, 5 unreported).

Research Protocol

Trained research personnel traveled to each preschool to meet face-to-face with all study participants, collect anthropometric data, hand out materials for PA and ST monitoring, and distribute survey packets. Survey assessments were sent home with

parents, completed at their convenience, and returned to the preschool following the PA assessment wear period.

Anthropometrics. Height was measured to the nearest 0.1 cm with an Adult/Child Shorrboard stadiometer (Weight and Measure, LLC, Olney, MD) and body weight was measured to the nearest 0.01 kg with an Electronic Seca Scale 890 (Seca, Vogel & Halke, Hamburg, Germany) in parent and child participants. Height and weight measurements were taken twice; a third measurement was taken if the first two measurements differed by >0.5 cm for height and >0.5 kg for weight. The average of the two measurements within this acceptable range was used in data analyses. BMI for parents[32] and BMI percentile and BMI z-scores for children[33] were calculated and evaluated using references from the CDC. Children whose BMI percentile-for-age and -gender was in the 85th percentile or greater were classified as overweight or obese, including children over the 95th percentile classification for obesity. Parents whose BMI was above 25.0 were classified as overweight or obese, including parents with BMI over 30.0 classification for obesity.

Physical activity and sedentary time assessment. Physical activity and ST were assessed for one week via accelerometers (GT3X+ or wGT3X-BT, ActiGraph, Pensacola, FL) in child participants. The children wore the device on an elastic belt and were instructed to wear the belt at all times, from when they got up in the morning until they went to bed at night, with the exception of bathing or any other time the instrument could become submerged in water. Throughout the activity monitor wear time, reminder emails, phone calls, and/or text messages were made to the parents to optimize compliance.

The accelerometers were initialized to collect raw data at a sample rate of 30 Hz using ActiLife software (ActiGraph, Pensacola, FL). Following the week of participant wear, monitors were downloaded using ActiLife and an epoch length of 10 seconds was used.[34-36] Data was imported into SAS (version 9.3, SAS Institute, Cary, NC) to filter and remove participating children who did not meet compliance standards of wear time. Compliance standards required minimum wear time to include three valid week days and one valid weekend day. A day was considered valid if the subject had a minimum of 8 hours of wear time during waking hours.[37] Non-wear time was defined as at least 60 consecutive minutes of zero activity counts.[38] Daily mean minutes of sedentary time (ST), light PA (LPA), moderate PA (MPA), vigorous PA (VPA), and TPA (sum of light, moderate, and vigorous PA) during waking hours for the full week, week days, and weekend days were calculated using age-appropriate Pate et al.[39] cut points. Data was then further divided into preschool and outside of preschool sections of time and the outside of preschool data was sued for the current statistical analyses. All ST and PA data is presented as average minutes per hour.

Parent physical activity practices. Parent PA practices were assessed by the parent participant's completion of the Activity Support Scale for Multiple Groups (ACTS-MG)[40] survey. The ACTS-MG is a 12-item tool with Likert scale responses ranging from "strongly disagree" (1) to "strongly agree" (4).[40] The four parent PA practices scales quantified by the ACTS-MG and used for the current study include: logistical support of child PA (3 items), role modeling (3 items), use of community resources to promote child PA (3 items), and restricting child sedentary activities (3 items).[40]

Demographics. Parent participants identified age, gender, and race/ethnicity for themselves and their children. Due to a largely homogenous population, race was dichotomized as white or non-white. Annual household income and highest level of parent education was indicated on a demographics form. Parental education was categorized as 1) less than bachelor's degree, 2) a bachelor's degree, and 3) higher than a bachelor's degree. Household income was dichotomized as 1) < $9,999-$59,999 and 2) ≥ $60,000.

Statistical Analysis

Descriptive statistics were calculated for anthropometric, PA, and ST characteristics and stratified by gender. T-tests were used to evaluate differences in anthropometric measurements between boys and girls. Multiple multilevel mixed-effects linear regression analyses were utilized to identify which parent PA practices were associated with ST, LPA, MPA, VPA, MVPA, and TPA in the whole sample and by child gender. Further ACTS-MG question-by-question analyses were completed by rescaling ACTS-MG item responses from the 4-point Likert scale to dichotomized such that agree and strongly agree were combined into agree and disagree and strongly disagree were combined into disagree. Multiple linear regression analyses were utilized to identify which ACTS-MG items were associated with ST, LPA, MPA, VPA, MVPA, and TPA in the whole sample and by child gender. Appropriate normality, linearity, and heteroscedasticity checks were conducted for each regression model. Regression models controlled for the following confounding variables: BMI z-score, child gender, child age, child race, annual household income, parental education, and parent race. All analyses

were conducted using Stata (Stata/IC 14, College Station, TX). The criterion for statistical significance was set at $p \leq 0.05$. Data are presented as mean ± SD.

Results

Descriptive analysis of anthropometrics and demographics

Of the initial sample of 293 children, 249 wore accelerometers and 215 children had compliant accelerometer data (86.3% of participants that wore accelerometers). Reasons children from the initial sample did not wear accelerometers included child refusal to wear the device and parents not present at data collection to receive devices for their children. Case-wise deletion removed an additional 46 participants due to incomplete parent PA practices data, thus the final sample size used for analyses was 169 children (n = 80 boys, 89 girls). Children were, on average, 3.6 ± 0.69 years of age, 103.71 ± 6.84 cm tall, and weighed 17.34 ± 2.75 kg. No significant differences were seen in height or weight between genders. Eighty-two percent of children (n=137) were categorized as normal weight as indicated by BMI percentile while the remaining 18% were categorized as overweight or obese. Girls accumulated more minutes of ST per hour compared to boys (p=0.01). Boys accumulated more minutes of MPA, VPA, MVPA, and TPA per hour compared to girls ($p \leq 0.05$, Table 3.1). No significant differences were seen in parent PA practices between genders.

Associations between sedentary time, activity, and parenting physical activity practices

The associations between parenting PA practices and objectively measured child ST and PA revealed significant associations (Table 3.2). Child MPA was positively associated with the parenting PA practice of restricting sedentary activities (p=0.05). Child VPA was positively associated with the parenting PA practice of use of community

resources (p=0.02). When separated by child sex, use of community resources was positively associated with VPA (p=0.02) and MVPA (0.04) in boys (Table 3.3). No parent PA practices were significantly associated with ST or PA in girls (Table 3.4).

Associations between sedentary time, activity, and ACTS-MG items

Parents that agreed with the statement "I limit how long my child plays video games" was negatively associated with child ST (p=0.05) and positively associated with child MPA (p=0.04), VPA (p=0.01), MVPA (p=0.02), and TPA (p=0.03) (Table 3.2). Additionally, parents that agreed with the statement "I take my child to places where he/she can be active" was negatively associated with child VPA (p=0.04). When separated by child sex, parents that agreed with the statement "I take my child to places where he/she can be active" was negatively associated with VPA (p=0.01) and MVPA (p=0.05) in boys (Table 3.3). Parents that agreed with the statement "I enroll my child in community-based programs (such as Girls and Boys Club, YMCA) where he/she can be active" was positively associated with VPA (p=0.05) in boys. Parents that agreed with the statement "I limit how long my child plays video games" was positively associated with VPA (p=0.03) in girls (Table 3.4).

Discussion

Establishing positive PA habits in preschool-age children is of utmost importance in order to combat the unhealthy increase in body weight seen as children age. Parent PA practices have been shown to be associated with PA and ST in older children and adolescents, however, the majority of evidence to date in preschool-age children has relied on subjective-reported, rather than objectively-measured, MVPA and ST. To our knowledge, this is the first study to investigate the possible relationship among parent PA

practices and objectively-measured preschool child PA and ST using a full range of PA intensities, including TPA.

The primary findings of the present study indicate using community resources is significantly positively associated with preschool-age children activity, suggesting that the children of parents utilizing these community-based resources are engaging in more VPA than those children whose parents are not taking advantage of these resources. Use of community resources has not been assessed as a potential correlate of preschooler activity in prior studies utilizing either subjectively- or objectively-measured child PA and ST.[21-23,26,27]

When looking deeper at significant parent PA practices in boys and girls and the individual ACTS-MG items that were used to quantify the use of community resources PA practice, two items were significant in boys. The statement "I take my child to places where he/she can be active" was negatively associated with VPA and MVPA in boys, however, the statement "I enroll my child in community-based programs (such as Girls and Boys Club, YMCA) where he/she can be active" was positively associated with VPA in boys. These findings suggest that it may not be sufficient to just take boys to places to be active but parents must enroll them in organized programming at those sites to encourage active play.

The results of the present study also reveal that restricting sedentary activities is positively associated with preschool-age child activity, suggesting that the children of parents that restrict sedentary activities are engaging in more MPA than those children whose parents are not restricting sedentary activities. In our study, of the ACTS-MG items that were used to quantify the restricting sedentary activities PA practice, the

statement "I limit how long my child plays video games" was significantly associated with less ST and more MPA, VPA, MVPA, and TPA in preschoolers. These findings are consistent with the results of previous studies that explored the association between limiting sedentary activities and preschoolers' activity. Spurrier et al.[21] found that having fewer rules about television viewing was associated with more indoor ST. Similarly, Veldhuis et al.[23] showed that parents with established rules regarding screen time as associated with children watching TV <2 hours per day. Additionally, Vaughn and colleagues[27] found that limiting screen time, using screen time to control behavior, and exposure to TV were associated with preschool-age child TV viewing. Also, we observed the statement "I limit how long my child plays video games" was positively associated with VPA in girls. Considering the findings of the present study as well as previous studies, it appears that the practice of restricting sedentary activities, specifically limiting video game play, appears to be of utmost importance to preschool-age child activity and parents should be encouraged to employ this practice.

In contrast to our findings, Schoeppe and Trost[22] found that maternal and paternal support for PA, including encouraging their child to do PA, playing outside with their child, and watching their child participate in PA, were positively associated with their preschooler's PA. This difference in findings may be attributed to methods used to assess activity. Schoeppe and Trost[22] assessed child PA using a parent-completed questionnaire concentrating on amount of time their child spent playing outdoors and child screen time while the current study utilized objective accelerometer-assessed PA measures. While time spent by preschool children playing outdoors has been validated against accelerometer data,[41] the previous study was conducted in southern Australia where

climate is more temperate than that found in the Midwestern United States. Generalizing findings from Schoeppe[22] using time playing outdoors as a measure of PA may not be appropriate in geographical locations that undergo extreme temperature variations. In regards to the findings from Schoeppe[22] and Vaughn,[27] not all time spent outside is active nor is all TV time sedentary, especially considering the preschool-age population. Furthermore, parents self-reporting their parenting practices and subjectively reporting their child's PA are inherently more likely to be associated as they are both based on parental perception. It can be argued that if a parent thinks they practice certain supportive or controlling behaviors, they would be more likely to report their child's behavior as being associated with these practices. However, by objectively assessing child's activity, we have removed this potential bias.

Our findings contrast the two previous studies using objective PA assessment. Ostbye et al.[26] found that parental policies supporting PA was positively associated with preschool-age child MVPA. Additionally, Vaughn and colleagues[27] reported that parent modeling of PA was positively associated with time spent outside and negatively associated with child TV time. Our contradictory findings may be, in part, because the previous studies used only MVPA measured across all waking hours of the day, including time the child may not have been at home. Whereas the present study investigated all PA intensities and limited activity to time segments when the children were not in preschool or daycare to assess the relationship among parent PA practices and child PA in the home. As preschool-age children may spend a substantial portion of their day outside of the home, including PA from the time segments of the day that the children were at daycare and/or preschool misestimate the association of caregiver PA practices on child

PA. Another reason for these differences in findings could be attributed to the different surveys used to assess parent PA practices and interpretations or conceptualizations of support and modeling.

A strength of this study was the use of objectively-measured PA and ST filtered down to time outside of preschool and/or daycare in the exploration among parent PA practices and preschool-age child activity. Other strengths include the adjustment for significant confounders in the regression models and the use of reliable and valid scale measuring parent PA practices. However, the study is not without limitations. PA data used for analyses was collected at the baseline time point of the multi-time point study and the ACTS-MG parent PA practices assessment was completed at the follow-up time point. While preliminary findings indicate that children's PA behaviors did not significantly change as a result of the curriculum, it is possible that PA and/or parent PA practices may have changed over the course of the study duration due to seasonal influences and is a potential limitation of the study. Lastly, the overall lack of diversity within our sample limits the generalizability of the results.

Despite these limitations, the current study adds empirical evidence and strengthens knowledge by utilizing objective measures of activity and considering the full range of PA intensities to understand the relationships among parent PA practices and preschool child PA and ST. This observation suggests that the practices of using community resources and restricting sedentary activities is essential and these practices should be encouraged in parents in order to promote healthy behaviors and weight in young children. This discovery is crucial as recommendations to parents regarding PA practices should be added to childhood obesity prevention efforts.

References

1. Ogden C, Carroll M, Flegal K. Prevalence of childhood and adult obesity in the United States, 2011-2012. *JAMA : the journal of the American Medical Association.* 2014;311(8):806-814.

2. Freedman D, Kettel Khan L, Serdula M, Dietz W, Srinivasan S, Berenson G. The relation of childhood BMI to adult adiposity: The Bogalusa Heart Study. *Pediatr.* 2005;11:22-27.

3. Hinkley T, Salmon J, Okely A, Crawford D, Hesketh K. Preschoolers' physical activity, screen time, and compliance with recommendations. *Med Sci Sports Exerc.* 2012;44(3):458-465.

4. Certain L, Kahn R. Prevalence, correlates, and trajectory of television viewing among infants and toddlers. *Pediatrics.* 2002;109:634-642.

5. Pate R, Baranowski T, Dowda M, Trost S. Tracking of physical activity in young children. *Med Sci Sports Exerc.* 1996;28(1):92-96.

6. Edwards N, Khoury P, Kalkwarf H, Woo J. Tracking of accelerometer-measured physical activity in early childhood. *Pediatr Exerc Sci.* 2013;25:487-501.

7. Sleddens E, Kremers S, Hughes S, et al. Physical activity parenting: a systematic review of questionnaires and their associations with child activity levels. *Obesity Reviews.* 2012;13:1015-1033.

8. Davison K, Cutting T, Birch L. Parents' activity-related parenting practices predict girls' physical activity. *Med Sci Sports Exerc.* 2003;35(9):1589-1595.

9. O'Connor T, Chen T, Baranowski J, Thompson D, Baranowski T. Physical activity and scree-media-related parenting practices have different associations with children's objectively measured physical activity. *Childhood obesity.* 2013;9(5):446-453.

10. Verloigne M, Van Lippevelde W, Maes L, Brug J, De Bourdeaudhuij I. Family- and school-based correlates of energy balance-related behaviors in 10-12-year-old children: a systematic review within the ENERGY (EuropeaN Energy balance Research to prevent excessive weight Gain among Youth) project. *Public health nutrition.* 2012;15(8):1380-1395.

11. Sallis J, Alcaraz J, Mckenzie T, Howell M. Predictors of change in children's physical activity over 20 months: variations by gender and level of adiposity. *American journal of preventive medicine.* 1999;16:222-229.

12. Sallis J, Alcaraz T, McKenzie M, Hovell B, Kolody, Nader P. Parental behavior in relation to physical activity and fitness in 9-year-old children. *Am J Dis Child.* 1992;146:1383-1388.

13. Tandon P, Grow H, Couch S, et al. Physical and social home environment in relation to children's overall and home-based physical activity and sedentary time. *Preventive medicine.* 2014;66(39-44).

14. Hennessy E, Hughes S, Goldberg J, Hyatt R, Economos C. Parent-child interactions and objectively measured child physical activity: a cross-sectional study. *Int J Behav Nut Phys Act.* 2010;7(71).

15. Arredondo E, Elder J, Guadalupe X, Campbell N, Baquero B, Duerksen S. Is parenting style related to children's healthy eating and physical activity in Latino families? *Health education research.* 2006;21(6):862-871.

16. Lloyd A, Lubans D, Plotnikoff R, Collins C, Morgan P. Maternal and paternal parenting practices and their influence on chilren's adiposity, screen-time, diet and physical activity. *Appetite.* 2014;79:149-157.

17. Edwardson C, Gorely T. Activity-related parenting practices and children's objectively measured physical activity. *Pediatr Exerc Sci.* 2010;22:105-113.

18. Vilhjalmsson R, Thorlindsson T. Factors related to physical activity: a study of adolescents. *Soc Sci Med.* 1998;47:665-675.

19. Trost S, Kerr L, Ward D, Pate R. Physical activity and determinants of physical activity in obese and non-obese children. *Int J Obes Relat Metab Disord.* 2001;25:822-829.

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

21. Spurrier N, Magarey A, Golley R, Curnow F, Sawyer M. Relationships between the home environment and physical activity and dietary patterns of preschool children: a cross-sectional study. *Int J Behav Nut Phys Act.* 2008;5(31).

22. Schoeppe S, Trost S. Maternal and paternal support for physical activity and healthy eating in preschool children: a cross-sectional study. *BMC Public Health.* 2015;15:971.

23. Veldhuis L, van Grieken A, Renders C, HiraSing R, Raat H. Parenting style, the home environment, and screen time of 5-year-old children; the 'Be Active, Eat Right' Study. *PloS one.* 2014;9(2):e88486.

24. Prince SA, Adamo KB, Hamel ME, Hardt J, Connor Gorber S, Tremblay M. A comparison of direct versus self-report measures for assessing physical activity in adults: a systematic review. *International Journal of Behavioral Nutrition and Physical Activity.* 2008;5:56.

25. Troiano RP, Berrigan D, Dodd KW, Masse LC, Tilert T, McDowell M. Physical activity in the United States measured by accelerometer. *Medicine and Science in Sports and Exercise.* 2008;40(1):181-188.

26. Ostbye T, Malhotra R, Stroo M, et al. The effect of the home environment on physical activity and dietary intake in preschool children. *Int J Obes.* 2013;37:1314-1321.

27. Vaughn A, Hales D, Ward D. Measuring the physical activity practices used by parents of preschool children. *Med Sci Sports Exerc.* 2013;45(12):2369-2377.

28. Timmons B, Naylor P, Pfeiffer K. Physical activity for preschool children - how much and how? *Appl Physiol Nutr Metab.* 2007;32(Suppl. 2E):S122-S134.

29. Tucker P. The physical activity levels of preschool-aged children: a systematic review. *Early Child Res Q.* 2008;23:547-558.

30. Oliver M, Schofield G, Kolt G. Physical activity in preschoolers: understanding prevalence and measurement issues. *Sports Med.* 2007;37(12):1045-1070.

31. Bailey R, Olson J, Pepper S, Porszasz J, Barstow T, Cooper D. The level and tempo of children's physical activities: an observational study. *Med Sci Sports Exerc.* 1995;27:1033-1041.

32. Centers for Disease Control and Prevention. *About adult BMI.* Atlanta, GA: U.S. Department of Health and Human Services;2015.

33. Centers for Disease Control and Prevention. *About child and teen BMI.* Atlanta, GA: U.S. Department of Health and Human Services;2015.

34. Colley R, Harvey A, Grattan K, Adamo K. Impact of accelerometer epoch length on physical activity and sedentary behavior outcomes for preschool-aged children. *Health reports.* 2014;25:3-9.

35. Nettlefold L, Naylor P, Warburton D, Bredin S, Race D, McKay H. The influence of epoch length on physical activity patterns varies by child's activity level. *Research quarterly for exercise and sport.* 2016;87(1):110-123.

36. Kim Y, Beets M, Pate R, Blair S. The effect of reintegrating Actigraph accelerometer counts in preschool children: comparison using different epoch lengths. *Journal of Science and Medicine in Sport.* 2013;16(2):129-134.

37. Colley R, Connor Gorber S, Tremblay M. Quality control and data reduction procedures for accelerometry-derived measures of physical activity. *Statistics Canada, Catalogue no 82-003-X.* 2010;21(1).

38. Chinapaw M, de Niet M, Verloigne M, De Bourdeaudhuij I, Brug J, Altenburg T. From sedentary time to sedentary patterns: accelerometer data reduction decisions in youth. *PloS one.* 2014;9(11).

39. Pate R, Almeida M, McIver K, Pfeiffer K, Dowda M. Validation and calibration of an accelerometer in preschool children. *Obesity.* 2006;14(11):2000-2006.

40. Davison K, Kaigang L, Baskin M, Cox T, Affuso O. Measuring parental support for children's physical activity in white and African American parents: The Activity Support Scale for Multiple Groups (ACTS-MG). *Preventive medicine.* 2011;52(39-43).

41. Burdette H, Whitaker R, Daniels S. Parental report of outdoor playtime as a measure of physical activity in preschool-aged children. *Archives of pediatrics & adolescent medicine.* 2004;158:353-357.

Table 3.1: Descriptive Statistics Stratified by Gender –Mean (SD)

	All (n=169)	**Boys (n=80)**	**Girls (n=89)**	*p*
Height (cm)	103.71 (6.84)	103.65 (7.24)	103.76 (6.52)	0.92
Weight (kg)	17.34 (2.75)	17.20 (2.50)	17.45 (2.95)	0.56
BMI z-score	0.19 (1.02)	0.04 (1.03)	0.33 (0.99)	0.06
ST (min/hr)	49.74 (3.51)	49.01 (4.26)	50.39 (2.53)	0.01*
LPA (min/hr)	4.48 (1.11)	4.56 (1.19)	4.41 (1.05)	0.39
MPA (min/hr)	3.76 (1.31)	4.04 (1.50)	3.51 (1.04)	0.008*
VPA (min/hr)	2.40 (1.20)	2.59 (1.48)	2.24 (0.86)	0.05*
MVPA (min/hr)	5.66 (2.21)	6.14 (2.64)	5.22 (1.63)	0.006*
TPA (min/hr)	10.14 (3.14)	10.70 (3.64)	9.63 (2.53)	0.03*

p = independent sample t-tests for anthropometrics and activity differences between genders.

* = significant difference ($p \leq 0.05$)

SD, standard deviation; cm, centimeters; kg, kilograms; ST, sedentary time; LPA, light physical activity; MPA, moderate physical activity; VPA, vigorous physical activity; MVPA, moderate-to-vigorous physical activity; TPA, total physical activity; min/hr, minutes per hour

Table 3.2: Associations between parent physical activity practices and ACTS-MG items and child activity

	ST	LPA	MPA	VPA	MVPA	TPA
Logistical support	-0.65 (0.29)	0.13 (0.52)	0.09 (0.70)	0.27 (0.19)	0.17 (0.65)	0.30 (0.59)
I enroll my child in sports teams and clubs such as soccer, basketball, and dance.	0.22 (0.76)	-0.14 (0.55)	-0.30 (0.25)	-0.06 (0.79)	-0.48 (0.28)	-0.61 (0.34)
I take my child to places where he/she can be active.	0.18 (0.73)	-0.08 (0.64)	-0.17 (0.40)	-0.38 (0.04)*	-0.43 (0.21)	-0.51 (0.31)
I watch my child play sports or participate in other activities such as martial arts or dance.	0.08 (0.92)	-0.13 (0.61)	-0.22 (0.45)	0.05 (0.86)	-0.28 (0.57)	-0.42 (0.56)
Modeling	-0.27 (0.53)	0.07 (0.63)	0.19 (0.23)	0.12 (0.40)	0.34 (0.21)	0.40 (0.30)
I encourage my child to be physically active by leading by example (role modeling).	-1.04 (0.19)	0.38 (0.15)	0.49 (0.10)	0.15 (0.58)	0.76 (0.13)	1.14 (0.12)
I exercise or am physically active on a regular basis.	-0.51 (0.46)	0.17 (0.45)	0.24 (0.36)	-0.05 (0.82)	0.25 (0.56)	0.42 (0.50)
I enjoy exercise and physical activity.	0.44 (0.53)	0.07 (0.76)	0.16 (0.55)	0.16 (0.52)	0.35 (0.44)	0.42 (0.52)
Use of community resources	-0.57 (0.24)	0.01 (0.93)	0.18 (0.33)	0.37 (0.02)*	0.43 (0.16)	0.44 (0.32)
I encourage my child to use resources in our neighborhood to be active (such as the park and the school).	-2.03 (0.24)	0.27 (0.62)	0.69 (0.28)	0.40 (0.49)	1.21 (0.26)	1.48 (0.34)
I enroll my child in community-based programs (such as Girls and Boys Club, YMCA) where he/she can be active.	-0.28 (0.60)	0.11 (0.55)	0.17 (0.41)	0.28 (0.13)	0.30 (0.38)	0.40 (0.41)
I find ways for my child to be active when school is out by, for example, enrolling him/her in summer camp and after school programs.	-1.14 (0.12)	0.27 (0.24)	0.28 (0.30)	0.34 (0.16)	0.44 (0.33)	0.71 (0.27)
Restricting sedentary activities	-0.83 (0.07)	0.26 (0.07)	0.33 (0.05)*	0.09 (0.56)	0.36 (0.20)	0.62 (0.13)
I limit how long my child plays video games.	-2.25 (0.05)*	0.55 (0.14)	0.91 (0.04)*	1.01 (0.01)*	1.68 (0.02)*	2.23 (0.03)*
I limit how long my child can watch TV or DVDs each day (including educational and non-educational programs).	-1.12 (0.17)	0.42 (0.10)	0.47 (0.12)	0.31 (0.26)	0.70 (0.17)	1.12 (0.13)
I limit how long my child can use the computer for things other than homework (such as playing computer games and surfing the internet.	-1.46 (0.19)	0.44 (0.21)	0.59 (0.16)	0.69 (0.06)	1.09 (0.12)	1.53 (0.13)

Regression coefficients in minutes of activity/hour with *p* value in parentheses.
* = significant association ($p \leq 0.05$).
ST, sedentary time; LPA, light physical activity; MPA, moderate physical activity; VPA, vigorous physical activity; MVPA, moderate-to-vigorous physical activity; TPA, total physical activity.

Table 3.3: Associations between parent physical activity practices and ACTS-MG items and activity in boys

	ST	LPA	MPA	VPA	MVPA	TPA
Logistical support	-1.41 (0.18)	0.37 (0.21)	0.40 (0.27)	0.43 (0.21)	0.68 (0.29)	1.04 (0.24)
I enroll my child in sports teams and clubs such as soccer, basketball, and dance.	-0.22 (0.85)	-0.07 (0.83)	-0.12 (0.76)	0.03 (0.94)	-0.22 (0.75)	-0.28 (0.76)
I take my child to places where he/she can be active.	0.32 (0.76)	-0.20 (0.49)	-0.56 (0.11)	-0.83 (0.01)*	-1.19 (0.05)*	-1.40 (0.10)
I watch my child play sports or participate in other activities such as martial arts or dance.	-0.62 (0.65)	0.08 (0.83)	0.10 (0.83)	0.31 (0.48)	0.33 (0.68)	0.41 (0.72)
Modeling	-0.50 (0.51)	0.21 (0.31)	0.40 (0.12)	0.34 (0.17)	0.71 (0.11)	0.93 (0.14)
I encourage my child to be physically active by leading by example (role modeling).	-1.48 (0.31)	0.63 (0.13)	0.77 (0.13)	0.39 (0.40)	1.16 (0.18)	1.78 (0.14)
I exercise or am physically active on a regular basis.	-0.53 (0.68)	0.35 (0.33)	0.27 (0.54)	-0.12 (0.77)	0.21 (0.78)	0.56 (0.59)
I enjoy exercise and physical activity.	1.25 (0.36)	0.15 (0.69)	0.43 (0.36)	0.49 (0.26)	0.78 (0.33)	0.94 (0.41)
Use of community resources	-0.97 (0.23)	0.22 (0.33)	0.49 (0.08)	0.60 (0.02)*	0.97 (0.04)*	1.20 (0.08)
I encourage my child to use resources in our neighborhood to be active (such as the park and the school).	-1.37 (0.65)	0.20 (0.81)	0.36 (0.73)	0.38 (0.70)	0.64 (0.72)	0.84 (0.74)
I enroll my child in community-based programs (such as Girls and Boys Club, YMCA) where he/she can be active.	-0.26 (0.80)	0.25 (0.37)	0.49 (0.16)	0.61 (0.05)*	0.93 (0.11)	1.18 (0.15)
I find ways for my child to be active when school is out by, for example, enrolling him/her in summer camp and after school programs.	-2.09 (0.14)	0.60 (0.13)	0.87 (0.07)	0.60 (0.19)	1.21 (0.15)	1.82 (0.12)
Restricting sedentary activities	-0.53 (0.54)	0.26 (0.28)	0.34 (0.25)	0.05 (0.87)	0.31 (0.55)	0.58 (0.42)
I limit how long my child plays video games.	-2.52 (0.31)	0.73 (0.30)	1.05 (0.22)	1.12 (0.15)	1.98 (0.17)	2.72 (0.18)
I limit how long my child can watch TV or DVDs each day (including educational and non-educational programs).	-0.87 (0.57)	0.55 (0.21)	0.39 (0.47)	-0.08 (0.87)	0.37 (0.68)	0.92 (0.47)
I limit how long my child can use the computer for things other than homework (such as playing computer games and surfing the internet.	-1.58 (0.48)	0.57 (0.37)	0.71 (0.36)	0.76 (0.29)	1.28 (0.33)	1.85 (0.32)

Regression coefficients in minutes of activity/hour with *p* value in parentheses.
* = significant association ($p \leq 0.05$).
ST, sedentary time; LPA, light physical activity; MPA, moderate physical activity; VPA, vigorous physical activity; MVPA, moderate-to-vigorous physical activity; TPA, total physical activity.

Table 3.4: Associations between parent physical activity practices and ACTS-MG items and activity in girls

	ST	LPA	MPA	VPA	MVPA	TPA
Logistical support	0.59 (0.38)	-0.15 (0.56)	-0.28 (0.31)	0.10 (0.67)	-0.47 (0.29)	-0.59 (0.38)
I enroll my child in sports teams and clubs such as soccer, basketball, and dance.	1.08 (0.23)	-0.27 (0.45)	-0.56 (0.12)	-0.02 (0.95)	-0.86 (0.14)	-1.08 (0.23)
I take my child to places where he/she can be active.	0.07 (0.89)	-0.06 (0.76)	0.02 (0.92)	-0.11 (0.57)	0.00 (0.99)	-0.07 (0.89)
I watch my child play sports or participate in other activities such as martial arts or dance.	1.25 (0.14)	-0.31 (0.35)	-0.53 (0.13)	-0.31 (0.28)	-0.98 (0.08)	-1.25 (0.14)
Modeling	0.10 (0.83)	-0.06 (0.72)	-0.02 (0.93)	-0.11 (0.46)	-0.04 (0.88)	-0.10 (0.83)
I encourage my child to be physically active by leading by example (role modeling).	-0.33 (0.69)	0.08 (0.81)	0.14 (0.68)	-0.16 (0.57)	0.22 (0.68)	0.33 (0.69)
I exercise or am physically active on a regular basis.	0.01 (0.99)	-0.08 (0.76)	0.08 (0.78)	-0.15 (0.55)	0.06 (0.90)	-0.01 (0.99)
I enjoy exercise and physical activity.	-0.29 (0.68)	0.10 (0.72)	0.06 (0.84)	0.01 (0.95)	0.18 (0.70)	0.29 (0.68)
Use of community resources	0.33 (0.55)	-0.20 (0.35)	-0.15 (0.51)	0.16 (0.40)	-0.15 (0.69)	-0.33 (0.55)
I encourage my child to use resources in our neighborhood to be active (such as the park and the school).	-1.25 (0.50)	0.09 (0.90)	0.66 (0.39)	0.09 (0.89)	1.13 (0.36)	1.26 (0.50)
I enroll my child in community-based programs (such as Girls and Boys Club, YMCA) where he/she can be active.	0.11 (0.85)	0.04 (0.87)	-0.06 (0.79)	0.04 (0.83)	-0.15 (0.69)	-0.11 (0.85)
I find ways for my child to be active when school is out by, for example, enrolling him/her in summer camp and after school programs.	-0.18 (0.80)	0.06 (0.82)	-0.01 (0.96)	0.34 (0.16)	0.10 (0.83)	0.18 (0.80)
Restricting sedentary activities	-0.71 (0.12)	0.30 (0.10)	0.29 (0.12)	0.09 (0.56)	0.28 (0.34)	0.71 (0.12)
I limit how long my child plays video games.	-1.59 (0.13)	0.37 (0.38)	0.71 (0.10)	0.77 (0.03)*	1.19 (0.09)	1.59 (0.13)
I limit how long my child can watch TV or DVDs each day (including educational and non-educational programs).	-0.66 (0.41)	0.18 (0.58)	0.29 (0.38)	0.35 (0.20)	0.47 (0.37)	0.66 (0.41)
I limit how long my child can use the computer for things other than homework (such as playing computer games and surfing the internet.	-0.95 (0.37)	0.29 (0.48)	0.38 (0.38)	0.45 (0.22)	0.63 (0.37)	0.95 (0.37)

Regression coefficients in minutes of activity/hour with *p* value in parentheses.
* = significant association ($p \leq 0.05$).
ST, sedentary time; LPA, light physical activity; MPA, moderate physical activity; VPA, vigorous physical activity; MVPA, moderate-to-vigorous physical activity; TPA, total physical activity.

Chapter 4

Parent satisfaction of child body size and associations with the home environment, physical activity parenting practices, and physical activity and sedentary time in preschool-age children

Emily C. Huber[1], Lacey A. McCormack[2], Jessica R. Meendering[2]

[1] Division of Molecular, Life, and Health Sciences, Loras College, Dubuque, IA 52002

[2] Department of Health and Nutritional Sciences, South Dakota State University, Brookings, SD 57007

This material is based upon the work that is supported by the National Institute of Food and Agriculture, U.S. Department of Agriculture, under award number 2011-67002-30202.

Abstract

Purpose: To explore possible associations between parent satisfaction of their child's body size and parent physical activity (PA) practices, home environment factors, and child PA and sedentary time (ST).

Methods: One hundred sixty-four primary parent (34±8 yrs.; 29 males, 130 females, 5 unreported)/child (4±1 yrs.; 77 boys, 87 girls) dyads participated in the study. Parent satisfaction of child body size was assessed using gender- and age-specific Collins' body figures and determined by comparing parent's selection of their child's current and ideal body size. Parent PA practices were assessed by parent completion of the Activity Support Scale for Multiple Groups survey. Home environment was assessed via parent completion of the Comprehensive Home Environment Survey using the PA and media portions. Child PA and ST was assessed for 7 days via accelerometer (ActiGraph GT3X+ or wGT3X-BT) using age appropriate cut-points. Multiple multilevel mixed-effects logistic regression analyses were utilized to identify if parent satisfaction of child body size was associated with parent PA practices, home environment factors, or child PA or ST in the whole sample and by child gender. Statistical significance was set at $p \leq 0.05$.

Results: Parents reporting wanting their child to be larger was negatively associated with PA availability ($p=0.02$). Additionally, parents reporting wanting their boy to be larger was positively associated with parent PA role modeling ($p=0.01$) and parents reporting wanting their girl to be larger was negatively associated with parent PA role modeling ($p=0.01$).

Conclusion: This observation suggests that parents that are dissatisfied with their child's body size and want their child to be larger may be providing less active toys, equipment, and active play spaces for their children in comparison to parents that are satisfied with

their child's body size. Additionally, parents that want their boys to be larger may be role modeling their own positive PA behaviors more while parents that want their girls to be larger may be role modeling their PA behaviors less than parents that are satisfied with their children's body size. Parents should be encouraged to model healthy PA behaviors to their children regardless of child gender or the parent's satisfaction of their child's body size.

Introduction

Childhood obesity is a critical public health concern as approximately 23% of preschool-age children in the United States are overweight or obese.[1] Obesity in children has been linked to an increased risk of hypertension, dyslipidemia, and impaired glucose tolerance as well as a heightened risk for obesity and coronary heart disease as an adult.[2-5] Additionally, evidence suggests overweight and/or obese preschool children are four times more likely to be overweight as adults.[5]

Parents are entrusted to recognize unhealthy weight and body size in their children.[6,7] Body size satisfaction is defined as the subjective, personal attitudinal evaluation of body size.[8] In adults, body size satisfaction influences health behaviors including dieting and physical activity (PA) engagement.[9,10] Kruger et al.[9] found that regardless of actual weight status, men and women that reported being satisfied with their body size were more likely to be regularly active than their dissatisfied counterparts. Similarly, Blake and colleages[10] reported weight satisfaction was associated with being more active in men and women. Hager et al.[11] examined the accuracy of maternal perceptions of and satisfaction in toddler body size in mother-toddler dyads and reported almost 70% of mothers were satisfied with their toddler's body size.

Due to the complex, multifactorial etiological nature of childhood obesity,[12] researchers have begun exploring the potential role of body size satisfaction in prevention of childhood overweight and obesity and promotion of healthful nutrition and PA.[13] PA is widely considered an important method of prevention and reduction of childhood obesity[14,15] and the preschool years have been shown to be foundational in the

development of health behaviors.[16-19] PA behaviors developed in early childhood become habitual and are difficult to modify as a child ages.[19,20]

Health behaviors of young children, including objectively-measured PA and sedentary time (ST), are associated with physical and social home environment factors and parent PA practices.[21,22] Rhee et al.[6] found that parents that perceive that their child's weight is a problem are more likely to modify their household environment. Considering the relationship between body size satisfaction and health behaviors in adults and the physical and social determinants of PA and ST in young children, we argue that parent satisfaction of their child's body size, regardless of the child's actual weight status, may be associated with the home environment created by parents, certain parenting practices, and the amount of activity engaged in by children. Therefore, the purpose of this study is to explore possible associations between parent satisfaction of their child's body size and parent PA practices, home environment factors, and child PA and ST.

Methods

Data for the current analyses is a subset of data from a multi-time point, longitudinal study that evaluated the efficacy of *iGrow Readers*, an interactive, literacy-based nutrition and physical activity curriculum for preschoolers developed by South Dakota State University Extension. The *iGrow Readers* program pairs 31 children's books with nutrition and PA information and activities. Books are read in preschool classrooms and accompanied by lessons that promote healthy eating and PA. All study procedures and materials were approved by the Human Subjects Institutional Review Board at South Dakota State University. Parents provided written informed consent and children provided verbal assent prior to participation.

Participants

Three to five year-old children and their primary parents were recruited from 14 preschools located in South Dakota, Nebraska, and Minnesota. The primary parent of the family unit was established by having the parent that spends the most time with the child during a typical week to participate in the evaluations. The initial sample consisted of 293 children (137 boys, 156 girls) and their parents (50 males, 238 females, 5 unreported).

Research Protocol

Trained research personnel traveled to each preschool to meet face-to-face with all study participants, collect anthropometric data, hand out materials for PA and ST monitoring, and distribute survey packets. Survey assessments were sent home with parents, completed at their convenience, and returned to the preschool following the PA assessment wear period.

Anthropometrics. Height was measured to the nearest 0.1 cm with an Adult/Child Shorrboard stadiometer (Weight and Measure, LLC, Olney, MD) and body weight was measured to the nearest 0.01 kg with an Electronic Seca Scale 890 (Seca, Vogel & Halke, Hamburg, Germany) in parent and child participants. Height and weight measurements were taken twice; a third measurement was taken if the first two measurements differed by >0.5 cm for height and >0.5 kg for weight. The average of the two measurements within this acceptable range was used in data analyses. BMI percentile and BMI z-scores for children[23] were calculated and evaluated using references from the CDC. Children whose BMI percentile-for-age and -gender was <85th percentile were categorized as normal weight, including children under the 5th percentile classification for underweight. Children whose BMI percentile-for-age and -gender was in the 85th percentile or greater

were categorized as overweight or obese, including children over the 95th percentile classification for obesity.

Parent satisfaction of child body size assessment. Parent satisfaction of child body size was assessed using gender- and age-specific Collins' body figures.[24] Body sizes were represented by line drawings depicting seven body sizes, with an assigned numerical identity, ranging from very thin (1) to very fat (7). Collins' figures have been shown to be a reliable and valid tool to measure parent satisfaction of preschool-age child body size.[25] Parent participants were presented with two identical sets of gender-appropriate child figures as a component of a packet of questionnaires given to parents during their data collection appointment with the research team. Using one set of figures, parents were asked to circle the specific figure that most closely resembled their perception of their child's current body size. On the second set of figures, parents were asked to circle the specific figure that most closely resembled their perception of their child's ideal body size. Parent satisfaction of their child's body size was determined by comparing the parent's selection of their child's current and ideal body size and responses were stratified into three categories: satisfied, wanted their child to be smaller, and wanted their child to be larger.

Physical activity and sedentary time assessment. Physical activity and ST were assessed for one week via accelerometers (GT3X+ or wGT3X-BT, ActiGraph, Pensacola, FL) in child participants. The children wore the device on an elastic belt and were instructed to wear the belt at all times, from when they got up in the morning until they went to bed at night, with the exception of bathing or any other time the instrument could become submerged in water. Throughout the activity monitor wear time, reminder

emails, phone calls, and/or text messages were made to the parents to optimize compliance.

The accelerometers were initialized to collect raw data at a sample rate of 30 Hz using ActiLife software (ActiGraph, Pensacola, FL). Following the week of participant wear, monitors were downloaded using ActiLife and an epoch length of 10 seconds was used.[26-28] Data was imported into SAS (version 9.3, SAS Institute, Cary, NC) to filter and remove participating children who did not meet compliance standards of wear time. Compliance standards required minimum wear time to include three valid week days and one valid weekend day. A day was considered valid if the subject had a minimum of 8 hours of wear time during waking hours.[29] Non-wear time was defined as at least 60 consecutive minutes of zero activity counts.[30] Daily mean minutes of sedentary time (ST), light PA (LPA), moderate PA (MPA), vigorous PA (VPA), and TPA (sum of light, moderate, and vigorous PA) during waking hours for the full week, week days, and weekend days were calculated using age-appropriate Pate et al.[31] cut points. Data was then further divided into preschool and outside of preschool sections of time and the outside of preschool data was sued for the current statistical analyses. All ST and PA data is presented as average minutes per hour.

Parent physical activity practices assessment. Parent PA practices were assessed by the parent participant's completion of the Activity Support Scale for Multiple Groups (ACTS-MG)[32] survey. The ACTS-MG is a 12-item tool with Likert scale responses ranging from "strongly disagree" (1) to "strongly agree" (4).[32] The four parent PA practices scales quantified by the ACTS-MG and used for the current study include: logistical support of child PA (3 items), role modeling (3 items), use of community

resources to promote child PA (3 items), and restricting child sedentary activities (3 items).[32]

Home environment assessment. Home environment was assessed by the parent participant's completion of the Comprehensive Home Environment Survey (CHES).[33] The CHES is a 12-part questionnaire assessing home food, PA, and media environment. For this study, only the PA and media portions of the CHES were used. The following subscales related to PA were quantified: availability, accessibility, role modeling, and supporting parental policies. Additionally, the following home environment subscales related to ST were quantified: media availability, media role modeling, and parental policies to monitor media.

Demographics. Parent participants identified age, gender, and race/ethnicity for themselves and their children. Due to a largely homogenous population, race was dichotomized as white or non-white. Annual household income and highest level of parent education was indicated on a demographics form. Parental education was categorized as 1) less than bachelor's degree, 2) a bachelor's degree, and 3) higher than a bachelor's degree. Household income was dichotomized as 1) < $9,999-$59,999 and 2) ≥ $60,000.

Statistical Analysis

Descriptive statistics were calculated for anthropometric, parent satisfaction of child body size, PA and ST, parent PA practices, and home environment subscales and stratified by gender. T-tests were used to evaluate differences in continuous measurements between boys and girls. Multiple multilevel mixed-effects logistic regression analyses were utilized to identify if parent satisfaction of child body size was

associated with ST, PA, parent PA practices, or home environment factors. The "satisfied" category served as the base outcome. Regression models controlled for the following confounding variables: child BMI category, child gender, child age, child race, annual household income, parental education, and parent race. All analyses were conducted using Stata (Stata/IC 14, College Station, TX). The criterion for statistical significance was set at $p \leq 0.05$. Data are presented as mean ± SD.

Results

Descriptive analysis of anthropometrics and demographics

Of the initial sample of 293 children, 239 had parent satisfaction of child body size data. Case-wise deletion removed an additional 35, 4, and 35 participants due to incomplete PA, parent PA practices, and home environment data, respectively. Thus, the final sample size used for analyses was 164 children (n = 77 boys, 87 girls). Children were, on average 3.6 ± 0.68 years of age, 103.65 ± 6.88 cm tall, and weighed 17.36 ± 2.76 kg. No significant differences were seen in height, weight, or BMI percentile between genders. Eighty-one percent of children (n=132) were categorized as normal weight as indicated by BMI percentile while the remaining 19% were categorized as overweight or obese. Seventy-six percent of parents (n=124) reported being satisfied with their child's body size, 7% reported wanting their child to be smaller, and 17% reported wanting their child to be larger. Additionally, parents that reported wanting their child to be smaller was positively associated with having an overweight and/or obese boy (p=0.03) or girl (p=0.009).

Associations between parent satisfaction of child body size and sedentary time, physical activity, parent physical activity practices, and home environment

Significant associations were found between parent satisfaction of child body size and home environment factors. Parents that reported wanting their child to be larger was negatively associated with PA availability (p=0.02) (Table 4.2). Parents that reported wanting their boy to be larger was positively associated with parent PA role modeling (p=0.01) while parents that reported wanting their girl to be larger was negatively associated with parent PA role modeling (p=0.01, Tables 4.3 & 4.4). No other significant associations were found between parent satisfaction of child body size and ST, PA, parent PA practices (Tables 4.2, 4.3, & 4.4).

Discussion

Considering the prevalence of childhood obesity and the foundational development of health behaviors during early childhood, establishing positive PA behaviors in preschool-age children is of crucial importance. Body size satisfaction has been found to be associated with health behaviors in adults.[9,10] However, this study is the first to explore associations between parents' satisfaction of preschool-age children's body size and child PA, ST, and other determinants of child PA including parent PA practices and home environment factors.

The findings of the present study indicate PA availability is negatively associated with parents wanting their children to be larger, suggesting that the children of parents that want their child to be larger have less active spaces, toys, and sports and PA equipment in the home than the children of parents that are satisfied with their child's body size. Our findings also indicate parent PA role modeling is significantly associated

with parents wanting their sons and daughters to be larger. However, these findings are contrasting in child genders. Parents that want their boy children to be larger have been found to report practicing more PA role modeling than parents that are satisfied with their sons' body size. Alternately, parents that want their girl children to be larger have been found to report practicing significantly less PA role modeling than parents that are satisfied with their daughters' body size.

These results suggest a noteworthy finding in parent PA modeling in boys and girls based on body size satisfaction. This finding regarding PA modeling may be driven and supported by the findings of Aim 1 of this dissertation project. Several home environment factors, including PA modeling, were found to be significantly associated with activity in boys but not girls. The findings of the present study strengthen the claim that physical and social home environment that are significantly associated with activity in preschool-age children are different in boys and girls. Parents may be unconsciously creating and fostering more PA opportunities for boys based on typical gender-normal activities. Parents should be encouraged to create and foster more PA opportunities for their girls regardless of their satisfaction in their child's body size.

Collectively, results from this study also indicate that parents that want their children to be larger may be less concerned about weight and weight-related behaviors, including providing active play equipment and spaces for their children as well as using their activity as a model for their children. It is relevant to highlight that our significant findings were associated with parents wanting their child to be larger; we found no significant associations in parents wanting their children to be smaller in relation to the physical and social home environment created by parents or child activity. While the

purpose of this study was to explore parent satisfaction of child body size regardless of actual child weight, these lack of findings pertaining to parents wanting their child to be smaller could be attributed to previous research that indicated parents report little concern in their child's body size even if their own child is overweight or obese.[34] Hager et al.[11] found that 70% of all mothers and approximately 80% of mothers of overweight toddlers were satisfied with their child's body size. Furthermore, parents typically only become concerned about their child's weight when it coincides with serious weight-related health consequences.[35] Commonly, parents assume that their preschool-aged child will "outgrow" overweight or obesity or that their child is simply "big-boned".[36] Ultimately, parents that perceive their child's weight is a problem and are therefore dissatisfied with their child's body size may be more likely to modify their household environment.[6]

An inherent strength of this study is the novelty of investigating associations of parent satisfaction of child body size. Another strength of the study was the use of objectively-measured PA and ST and the use of a comprehensive survey to measure home environment factors. Other strengths include the adjustment for significant confounders in the regression models. While the current study used a large sample of parent-child dyads from various geographical locations in the Midwest ranging in population size, there is a general homogeneity and lack of diversity within our sample which may limit the generalizability of our findings. Additionally, parent satisfaction of child body size assessment and PA data used for analyses was collected at the baseline time point of the multi-time point study and the CHES home environment and ACTS-MG parent PA practices assessments were completed at the follow-up time point. While preliminary findings indicate that children's PA behaviors did not significantly change as

a result of the curriculum, it is possible that PA, parent satisfaction of child body size, home environment factors, and/or parent PA practices may have changed over the course of the study duration due to seasonal influences and is a potential limitation of the study.

The current study adds new and innovative empirical evidence to the body of knowledge related to the transdisciplinary and complex nature of childhood obesity. This observation suggests that parents that are dissatisfied with their child's body size and want their child to be larger may be providing less active toys, equipment, and active play spaces for their children in comparison to parents that are satisfied with their child's body size. Additionally, these data also highlight using gender-specific practices in respect to the promotion and facilitation of PA opportunities in preschool-age children. Parents should be encouraged to model healthy PA behaviors to their children regardless of child gender or the parent's satisfaction of their child's body size.

References

1. Ogden CL, Carroll MD, Kit BK, Flegal KM. Prevalence of childhood and adult obesity in the United States, 2011-2012. *JAMA : the journal of the American Medical Association.* 2014;311(8):806-814.

2. Freedman D, Khan L, Dietz W, Srinivasan S, Berenson G. Relationship of childhood overweight to coronary heart disease risk factors in adulthood: The Bogalusa Heart Study. *Pediatrics.* 2001;108:712-718.

3. Dietz WH. Health consequences of obesity in youth: Childhood predictors of adult disease. *Pediatrics.* 1998;101(3):518-525.

4. Magarey AM, Daniels LM, Boulton TJ, Cockington RA. Predicting obesity in early adulthood from childhood and parental obesity. *International Journal of Obesity.* 2003;27(4):505-513.

5. Freedman D, Kettel Khan L, Serdula M, Dietz W, Srinivasan S, Berenson G. The relation of childhood BMI to adult adiposity: The Bogalusa Heart Study. *Pediatr.* 2005;11:22-27.

6. Rhee K, De Lago C, Arscott-Mills T, Mehta S, Krysko Davis R. Factors associated with parental readiness to make changes for overweight children. *Pediatr.* 2005;116:e94-101.

7. Parry L, Netuveli G, Parry J, Saxena S. A systematic review of parental perception of overweight status in children. *J Ambulatory Care Manage.* 2008;31(253-268).

8. Grogan S. Body image and health: contemporary perspectives. *Journal of health psychology.* 2006;11:523-530.

9. Kruger J, Lee C-D, Ainsworth B, Macera C. Body size satisfaction and physical activity levels among men and women. *Obesity.* 2008;16:1976-1979.

10. Blake C, Hebert J, Lee D, et al. Adults with greater weight satisfaction report more positive health behaviors and have better health status regardless of BMI. *J Obes.* 2013;2013.

11. Hager E, Candelaria M, Latta L, et al. Maternal perceptions of toddler body size: accuracy and satisfaction differ by toddler weight status. *Archives of pediatrics & adolescent medicine.* 2012;166(5):417-422.

12. Burgess JN, & Broome, M.E. Perceptions of weight and body image among preschool children: A pilot study. *Pediatric Nursing.* 2012;38(3):147-152.

13. Austin SB, Haines J, Veugelers PJ. Body satisfaction and body weight: gender differences and sociodemographic determinants. *BMC Public Health.* 2009;9(313):313.

14. Hinkley T, Crawford D, Salmon J, Okely AD, Hesketh K. Preschool children and physical activity - A review of correlates. *American journal of preventive medicine.* 2008;34(5):435-441.

15. Centers for Disease Control and Prevention. *Overweight and obesity: Basics about childhood obesity.* Atlanta, GA: U.S. Department of Health and Human Services;2011.

16. Hinkley T, Salmon J, Okely A, Crawford D, Hesketh K. Preschoolers' physical activity, screen time, and compliance with recommendations. *Med Sci Sports Exerc.* 2012;44(3):458-465.

17. Certain L, Kahn R. Prevalence, correlates, and trajectory of television viewing among infants and toddlers. *Pediatrics.* 2002;109:634-642.

18. Pate R, Baranowski T, Dowda M, Trost S. Tracking of physical activity in young children. *Med Sci Sports Exerc.* 1996;28(1):92-96.

19. Edwards N, Khoury P, Kalkwarf H, Woo J. Tracking of accelerometer-measured physical activity in early childhood. *Pediatr Exerc Sci.* 2013;25:487-501.

20. Sleddens E, Kremers S, Hughes S, et al. Physical activity parenting: a systematic review of questionnaires and their associations with child activity levels. *Obesity Reviews.* 2012;13:1015-1033.

21. Ostbye T, Malhotra R, Stroo M, et al. The effect of the home environment on physical activity and dietary intake in preschool children. *Int J Obes.* 2013;37:1314-1321.

22. Vaughn A, Hales D, Ward D. Measuring the physical activity practices used by parents of preschool children. *Med Sci Sports Exerc.* 2013;45(12):2369-2377.

23. Centers for Disease Control and Prevention. *About child and teen BMI.* Atlanta, GA: U.S. Department of Health and Human Services;2015.

24. Collins M. Body figure perceptions and preferences among preadolescent children. *Int J Eat Disord.* 1990;10(2):199-208.

25. Rich SS, Essery, E.V., Sanborn, C.F., DiMarco, N.M., Morales, L.K., & LeClere, S.M. Predictors of body size stigmatization in Hispanic preschool children. *Obesity.* 2008;16(2):11-17.

26. Colley R, Harvey A, Grattan K, Adamo K. Impact of accelerometer epoch length on physical activity and sedentary behavior outcomes for preschool-aged children. *Health reports.* 2014;25:3-9.

27. Nettlefold L, Naylor P, Warburton D, Bredin S, Race D, McKay H. The influence of epoch length on physical activity patterns varies by child's activity level. *Research quarterly for exercise and sport.* 2016;87(1):110-123.

28. Kim Y, Beets M, Pate R, Blair S. The effect of reintegrating Actigraph accelerometer counts in preschool children: comparison using different epoch lengths. *Journal of Science and Medicine in Sport.* 2013;16(2):129-134.

29. Colley R, Connor Gorber S, Tremblay M. Quality control and data reduction procedures for accelerometry-derived measures of physical activity. *Statistics Canada, Catalogue no 82-003-X.* 2010;21(1).

30. Chinapaw M, de Niet M, Verloigne M, De Bourdeaudhuij I, Brug J, Altenburg T. From sedentary time to sedentary patterns: accelerometer data reduction decisions in youth. *PloS one.* 2014;9(11).

31. Pate R, Almeida M, McIver K, Pfeiffer K, Dowda M. Validation and calibration of an accelerometer in preschool children. *Obesity.* 2006;14(11):2000-2006.

32. Davison K, Kaigang L, Baskin M, Cox T, Affuso O. Measuring parental support for children's physical activity in white and African American parents: The Activity Support Scale for Multiple Groups (ACTS-MG). *Preventive medicine.* 2011;52(39-43).

33. Pinard CA, Yaroch AL, Hart MH, Serrano EL, McFerren MM, Estabrooks PA. The Validity and reliability of the Comprehensive Home Environment Survey (CHES). *Health Promot Pract.* 2014;15(1):109-117.

34. Lampard A, Byrne S, Zubrick S, Davis E. Parents' concern about their children's weight. *International journal of pediatric obesity : IJPO : an official journal of the International Association for the Study of Obesity.* 2008;3:84-92.

35. Thompson LS, & Story, M. Perceptions of overweight and obesity in their community: Findings from focus groups with urban, African American caretakers of preschool children. *Journal of the National Black Nurses Association.* 2003;14(1):28-37.

36. Rich SS, DiMarco, N.M., Huettig, C., Essery, E.V., Anderson, E., & Sanborn, C.F. Perceptions of health status and play activities in parents of overweight Hispanic toddlers and preschoolers. *Family and Community Health.* 2005;28(2):130-141.

Table 4.1: Descriptive Statistics Stratified by Gender –Mean (SD)

	All (n=164)	**Boys (n=77)**	**Girls (n=87)**	*p*
Age (yrs)	3.61 (0.68)	3.56 (0.66)	3.66 (0.70)	0.36
Height (cm)	103.65 (6.88)	103.63 (7.32)	103.67 (6.52)	0.98
Weight (kg)	17.36 (2.76)	17.26 (2.51)	17.45 (2.97)	0.66
BMI z-score	0.22 (1.02)	0.08 (1.03)	0.34 (0.99)	0.09
p = independent sample t-tests for anthropometric differences between genders. * = significant difference (p≤0.05) SD, standard deviation; cm, centimeters; kg, kilograms; yrs, years				

Table 4.2: Associations between parent satisfaction of child body size and parent physical activity practices, home environment factors, and child activity

	Dissatisfied: Wants Child to be Smaller	Dissatisfied: Wants Child to be Larger
Logistical support	0.03 (0.96)	0.24 (0.68)
Modeling (ACTS-MG)	0.08 (0.88)	-0.15 (0.71)
Use of community resources	0.32 (0.60)	0.58 (0.17)
Restricting sedentary activities	0.25 (0.66)	-0.18 (0.67)
PA availability	-0.16 (0.08)	-0.14 (0.03)*
PA accessibility	-0.17 (0.87)	-0.92 (0.27)
PA role modeling (CHES)	-0.47 (0.28)	0.03 (0.93)
Gym attendance	1.72 (0.13)	0.43 (0.62)
Parental policies to support PA	-0.13 (0.68)	0.25 (0.29)
Media availability	0.13 (0.66)	-0.11 (0.55)
Media role modeling	-0.91 (0.52)	-0.82 (0.38)
Parental policies to monitor media	-0.10 (0.64)	-0.16 (0.34)
ST (min/hr)	-0.08 (0.42)	0.06 (0.37)
LPA (min/hr)	0.24 (0.48)	-0.27 (0.22)
MPA (min/hr)	0.26 (0.35)	-0.05 (0.80)
VPA (min/hr)	0.49 (0.13)	0.19 (0.34)
MVPA (min/hr)	0.18 (0.30)	0.03 (0.79)
TPA (min/hr)	0.12 (0.33)	-0.02 (0.80)
Regression coefficients with *p* value in parentheses. Reference category: Parents satisfied with child body size. * = significant difference (p≤0.05). ST, sedentary time; LPA, light physical activity; MPA, moderate physical activity; VPA, vigorous physical activity; MVPA, moderate-to-vigorous physical activity; TPA, total physical activity; min/hr, minutes per hour.		

Table 4.3: Associations between parent satisfaction of child body size and home environment factors in boys

	Dissatisfied: Wants Child to be Smaller	Dissatisfied: Wants Child to be Larger
Logistical support	-0.31 (0.77)	0.04 (0.95)
Modeling (ACTS-MG)	0.84 (0.27)	0.47 (0.42)
Use of community resources	1.25 (0.17)	0.84 (0.14)
Restricting sedentary activities	0.82 (0.35)	0.29 (0.61)
PA availability	-0.29 (0.08)	-0.20 (0.06)
PA accessibility	0.18 (0.91)	-1.57 (0.27)
PA role modeling (CHES)	-0.41 (0.51)	1.14 (0.01)*
Gym attendance	1.68 (0.32)	0.86 (0.47)
Parental policies to support PA	0.05 (0.92)	0.53 (0.11)
Media availability	1.03 (0.07)	-0.08 (0.79)
Media role modeling	-1.48 (0.45)	-1.38 (0.30)
Parental policies to monitor media	-0.43 (0.28)	-0.16 (0.52)
ST (min/hr)	-0.07 (0.55)	0.02 (0.81)
LPA (min/hr)	0.14 (0.74)	-0.12 (0.67)
MPA (min/hr)	0.39 (0.29)	0.18 (0.42)
VPA (min/hr)	0.73 (0.08)	0.26 (0.29)
MVPA (min/hr)	0.30 (0.19)	0.15 (0.27)
TPA (min/hr)	0.17 (0.30)	0.06 (0.53)

Regression coefficients with *p* value in parentheses.
Reference category: Parents satisfied with child body size.
* = significant difference ($p \leq 0.05$).
ST, sedentary time; LPA, light physical activity; MPA, moderate physical activity; VPA, vigorous physical activity; MVPA, moderate-to-vigorous physical activity; TPA, total physical activity; min/hr, minutes per hour.

Table 4.4: Associations between levels of parent satisfaction of child body size and home environment factors in girls

	Dissatisfied: Wants Child to be Smaller	Dissatisfied: Wants Child to be Larger
Logistical support	-0.14 (0.89)	0.99 (0.43)
Modeling (ACTS-MG)	-1.48 (0.13)	-0.68 (0.26)
Use of community resources	-2.13 (0.18)	0.44 (0.54)
Restricting sedentary activities	-0.49 (0.57)	-0.53 (0.42)
PA availability	-0.14 (0.34)	-0.12 (0.14)
PA accessibility	-0.43 (0.77)	-0.62 (0.58)
PA role modeling (CHES)	-0.39 (0.59)	-1.42 (0.01)*
Gym attendance	3.44 (0.13)	-0.20 (0.88)
Parental policies to support PA	-0.43 (0.46)	-0.06 (0.87)
Media availability	-0.32 (0.42)	-0.10 (0.70)
Media role modeling	-0.40 (0.87)	-0.10 (0.94)
Parental policies to monitor media	0.21 (0.52)	-0.23 (0.35)
ST (min/hr)	-0.06 (0.76)	0.19 (0.23)
LPA (min/hr)	0.37 (0.48)	-0.57 (0.17)
MPA (min/hr)	0.10 (0.84)	-0.57 (0.13)
VPA (min/hr)	-0.12 (0.88)	0.24 (0.54)
MVPA (min/hr)	-0.00 (0.99)	-0.23 (0.32)
TPA (min/hr)	0.06 (0.77)	-0.19 (0.22)

Regression coefficients with *p* value in parentheses.
Reference category: Parents satisfied with child body size.
* = significant difference ($p \leq 0.05$).
ST, sedentary time; LPA, light physical activity; MPA, moderate physical activity; VPA, vigorous physical activity; MVPA, moderate-to-vigorous physical activity; TPA, total physical activity; min/hr, minutes per hour.

Chapter 5

Discussion and Overall Conclusion

Childhood obesity and energy balance-related behaviors like physical activity (PA) and sedentary time (ST) are multifactorial in etiology. Early childhood is a crucial time to promote PA behaviors as the preschool years have been shown to be foundational in the development of health behaviors.[1-4] PA behaviors develop and become habitual in childhood and are difficult to modify as a child ages.[4,5] Therefore, there is a critical need to identify modifiable physical and social environmental determinants that promote or discourage PA and ST in preschool-age children. The purpose of this dissertation was to explore potential relationships among home environment factors, parenting practices, and PA and ST in preschool-age children.

The current project found, in the preschool-age population, boys that had more active play spaces, toys, and sports and PA equipment in their home accumulated less ST. Additionally, parents that engaged in PA role modeling, established policies to support PA, and monitored media use had boys that accumulated more PA. Furthermore, parents that report using community resources, specifically programs such as Girls and Boys Club and YMCA, had boys that accumulated more PA.

Although the Comprehensive Home Environment Survey (CHES) used in Chapter 2 and the Activity Support Scale for Multiple Groups (ACTS-MG) used in Chapter 3 assessed three equivalent social parenting practices, the current project found differences in significant findings between the survey tools used. The CHES and ACTS-MG both found having policies to monitor media (CHES) and restricting sedentary activities, specifically video game use (ACTS-MG) was negatively associated with

children's ST and positively associated with PA. However, we found parental role modeling of PA and parent gym attendance were significantly associated with children's PA when assessed by the CHES but the equivalent practice from the ACTS-MG was not. Additionally, we found parental policies to support PA assessed by the CHES was significantly associated with children's PA but the equivalent parenting practice measured by the ACTS-MG was not.

These differences in findings of comparable social parenting practices between the survey tools is potentially due to the greater number of all-inclusive questions included in the CHES in comparison to the questions in the ACTS-MG. The ACTS-MG asked parents to indicate their level of agreement to statements related to specific behaviors. Alternately, the CHES provided the parents completing the survey with a thoughtful prompt to consider the types of things done during leisure time and parenting related to PA and asked parents to indicate how often they exhibited specific behaviors. The use of prompts to indicate context and guide parents completing the CHES and difference in wording may have encouraged parents to think more deeply about the items presented, thus eliciting more accurate responses. Additionally, there was a difference in scoring of comparable parenting practices between the survey tools. The ACTS-MG quantified parenting PA practices by using the mean of three related items. The CHES quantified parenting PA practices by calculating the sum of six items for PA role modeling and seven items for parental policies to support PA. In light of this difference in scoring, it may have been easier to find significant associations due to the greater range of parenting PA practices scores calculated with the CHES compared to the inherently

smaller range of ACTS-MG scores. Further research should be done to determine which survey is more valid in assessing parent PA practices.

The current project also found that parents who were dissatisfied with their children's body size and wanted their children to be larger reported having less active spaces, toys, and sports and PA equipment in the home. Furthermore, we found that parents who wanted their boys to be larger reported practicing significantly more PA role modeling whereas parents who wanted their girls to be larger reported practicing significantly less PA role modeling. It is interesting to note that our significant findings pertaining to parent satisfaction of child body size were associated with parents wanting their child to be larger. We found no significant associations in parents wanting their children to be smaller in relation to the physical and social home environment created by parents.

Previous research has indicated that parents that perceive their children's weight is a problem are more likely to modify their home environment. However, previous findings also indicate that parents typically only become concerned about their children's weight when it coincides with serious weight-related health consequences. Altogether, it is possible that our subsample of parents that were dissatisfied with their child's body size and wanted their children to be smaller may not view their children's weight as a problem, and as a result, are not modifying their home environment to promote PA. In light of these findings, we need to educate parents on the benefits of PA engagement in children beyond weight control including promotion of healthy growth and development of bone mineral density, gross motor skills, mental health, and concentration and attentiveness. Therefore, even if parents are not concerned about their children's weight

status, by highlighting additional influential benefits of PA outside of its fundamental role in energy balance, parents may be more willing to make an effort to promote PA in their children. Moreover, parents may not know how to go about promoting PA in their home. Consequently, we need to educate parents on strategies to promote PA and discourage ST within their home through modification of the physical home environment and their parenting practices.

A majority of previous studies used a variety of subjective or alternative methods to assess child PA and/or ST including parent-report, measuring amount of time children spent playing outdoors as a proxy for PA, and/or measuring screen time as a proxy of ST. With the current project's use of accelerometers, we were able to objectively assess child ST and the whole range of PA intensities. We postulated that using total PA (TPA), which includes light intensity PA (LPA), as opposed to moderate-to-vigorous PA (MVPA) would be a better measure for preschool-age children considering this age group's physical and motor development. While we did not find anything significant across our studies with regards to LPA specifically, we did find that TPA was positively associated with PA role modeling, parents reporting gym attendance, and parental policies to monitor media from the CHES and reporting limiting video game use from the ACTS-MG. These findings indicate the favorable use of TPA and future studies involving preschool-age children should consider assessing and analyzing the full range of PA intensities.

Collectively, the three studies in this dissertation suggested a noteworthy finding in regards to home environment factors and parenting practices that are significantly associated with child activity. Our results that indicated boys are more active than girls

are well supported in previous literature. However, our findings also suggested that the home environment factors and parent PA practices significantly associated with preschool-age child PA and ST are different in boys and girls. These findings indicate that parents may be creating and fostering more PA opportunities for boys and more ST opportunities for girls. A possible explanation may be that gender-typical behaviors for boys involve more active play where gender-typical behaviors for girls are more sedentary in nature. Regardless of their children's gender, parents should be encouraged to promote and foster PA opportunities while limiting sedentary behaviors for their children. However, parents of girls may consider adopting a proactive attitude to creating and fostering PA opportunities by providing more active play spaces, toys, and sport equipment, role modeling PA behavior, and using community resources by taking girls places where they can be active in an effort to lessen the disparity in PA accumulation between boys and girls.

As a whole, the findings of this dissertation project provide empirical evidence to support our research hypotheses that proposed significant associations exist among the home environment, parenting practices, and parent satisfaction of their child's body size and PA and ST in preschool-age children. Additionally, these data that different home environment factors and parenting PA practices are significant in boys and girls. This can be addressed by encouraging parents to be cognizant of fostering PA opportunities in their children regardless of their children's gender. Parent education including the widespread of benefits of PA and health consequences associated with excess accumulation of ST should be included in childhood obesity prevention efforts in order to encourage parents to promote PA and discourage ST in their preschool-age children.

Furthermore, this education needs to include recommendations regarding modifying the home environment and parenting practices to create and foster PA opportunities for their children.

References

1. Hinkley T, Salmon J, Okely A, Crawford D, Hesketh K. Preschoolers' physical activity, screen time, and compliance with recommendations. *Med Sci Sports Exerc.* 2012;44(3):458-465.

2. Certain L, Kahn R. Prevalence, correlates, and trajectory of television viewing among infants and toddlers. *Pediatrics.* 2002;109:634-642.

3. Pate R, Baranowski T, Dowda M, Trost S. Tracking of physical activity in young children. *Med Sci Sports Exerc.* 1996;28(1):92-96.

4. Edwards N, Khoury P, Kalkwarf H, Woo J. Tracking of accelerometer-measured physical activity in early childhood. *Pediatr Exerc Sci.* 2013;25:487-501.

5. Sleddens E, Kremers S, Hughes S, et al. Physical activity parenting: a systematic review of questionnaires and their associations with child activity levels. *Obesity Reviews.* 2012;13:1015-1033.

APPENDIX

Caregiver Comprehensive Home Environment Survey (CHES)

PART A: Caregiver and home information. Please answer the following demographic and home information questions to the best of your knowledge. Demographics are characteristics that describe you.

1. What is your age: _____

2. How would you describe *your* race? (please circle your response)

Black or African American	White	American Indian/Alaskan Native	Asian	Mixed Race	Native Hawaiian or Other Pacific Islander	Not sure	Other: _____

3. How would you describe *your* ethnicity? (please circle your response)

Hispanic or Latino Not Hispanic or Latino Not Sure

4. What is your height: _____

5. What is your weight: _____

6. How many children (under 18 years of age) live in your home? _____

Instructions: Please answer the questions in reference to the child that is with you at the time you enrolled in the study.

7. What is your relationship with this child _____

8. How would you describe the race of *the child*? *(please circle your response)*

Black or African American	White	American Indian/Alaskan Native	Asian	Mixed Race	Native Hawaiian or Other Pacific Islander	Not sure	Other: _____

9. How would you describe the ethnicity of *the child*? *(please circle your response)*

Hispanic or Latino Not Hispanic or Latino Not Sure

10. What is your family's annual household income? *(please circle your response)*

Less than 10,000	$10,000 - $19,000	$20,000 - $50,000	$50,000 - $100,000	Greater than $100,000

11. Which of the following best describes your occupation *(please circle your response)*

Full time working outside the home	P/T working outside the home	Working from home for a salary	Stay at home mom/dad

12. What percent of the time does your child live with you? *(please circle your response)*

Less than 25%	Between 25% and 50%	Between 50% and 75%	More than 75% but less than 100%	100%

13. Think about who prepares the food in your home, which of the following best indicates your role? *(please circle your response)*

Food preparation is primarily my responsibility	I prepare food sometimes but it is not primarily my responsibility	I share food preparation equally with another family member	I rarely prepare food in our house

14. Think about who plans family activities in your home, which of the following best reflects your role? *(please circle your response)*

Activity planning is primarily my responsibility	I plan family activities but it is not primarily my responsibility	I share family activity planning equally with another family member	I rarely plan family activities

15. Think about the foods your child eats, which of the following best describes you? *(please circle your response)*

I am the one who has the most knowledge about what my child eats	I have some knowledge about what my child eats but *I am not* the one who knows the most	I share equally in my knowledge of what my child eats with another family member	I do not usually know what my child eats

16. Think about the activities your child participates in, which of the following best describes you? *(please circle your response)*

I am the one who has the most knowledge about my child's activities	I have some knowledge about my child's activities but *I am not* the one who knows the most	I share equally in my knowledge of my child's activities with another family member	I do not usually know about most of my child's activities

17. What best describes your home? *(please circle your response)*

Apartment | Condominium | Multi-family house | Single Family House | Mobile Home | Shelter

18. How many staircases do you have in your home? *(please circle your response)*

0 | 1 | 2 | 3

19. How often does your family eat fruits and vegetables that you have grown? *(please circle your response)*

Not at all | Rarely | Some of the time | Most of the time | All of the time

20. What is the average time that you spend preparing the evening meal? *(please circle your response)*

0-15 minutes | 16-30 minutes | 31-45 minutes | 46-60 minutes | >60 minutes

21. Where do you typically shop for your groceries? *(circle all that apply)*

Corner Store | Farmers Market | Grocery Store (e.g., Kroger) | Other: _____

22. Which of these statements best describes the food eaten in your household in the last 12 months? *(please circle your response)*

Often we don't have enough to eat	Sometimes we don't have enough to eat	We have enough to eat but not always the kinds of food we want	We always have enough to eat and the kinds of food we want

23. How often during the last 12 months have you been hungry because your family couldn't afford more food? *(please circle your response)*

Almost every month | Some months, but not every month | Only 1-2 months | I have not been hungry for this reason

PART B: Think about the things **that are currently in your home** and **circle your response** for each question.

1. Please indicate if you have the following areas in or around your home. If you have an area but it is **not suitable** for your child to play/exercise in please mark "No"

Inside playroom/area	Yes	No
Workout/exercise room	Yes	No
Sandbox	Yes	No
Outside Play area/yard	Yes	No

2. What is the approximate size of your yard? *(please circle your response)*

We do not have a yard | Small | Medium | Large

3. Which of the following things does **your child** have? *(please circle your response)*

Jungle-gym/swing set	Yes	No		
	If yes, is it in working condition?		Yes	No
Size-appropriate bicycle	Yes	No		
	If yes, is it in working condition?		Yes	No
Rollerblades/skates	Yes	No		
	If yes, are they in working condition?		Yes	No
Skateboard/scooter	Yes	No		
	If yes, is it in working condition?		Yes	No
Jump rope	Yes	No		
	If yes, is it in working condition?		Yes	No
Basketball hoop	Yes	No		
	If yes, is it in working condition?		Yes	No
Baseball equipment (At least one of the following: ball, bat or mitt)	Yes	No		
	If yes, is it in working condition?		Yes	No
	Yes	No		

Tennis/racquetball racket	*If yes, is it in working condition?*			Yes	No
Hockey Equipment (at least a hockey stick)	Yes	No			
	If yes, is it in working condition?			Yes	No
Ball of any kind (Volleyball, soccer, football, fitness ball, foam balls etc.)	Yes	No			
	If yes, is it in working condition?			Yes	No
Pedometer (step counter)	Yes	No			
	If yes, is it in working condition?			Yes	No
Winter Sports Equipment (at least one of the following: sled, skis, snowboard, ice skates)	Yes	No			
	If yes, is it in working condition?			Yes	No
Home aerobic equipment (e.g., treadmill, cycle)	Yes	No			
	If yes, is it in working condition?			Yes	No
Yoga/exercise mat	Yes	No			
	If yes, is it in working condition?			Yes	No
Hiking shoes	Yes	No			
	If yes, are they in working condition?			Yes	No
Running shoes (athletic or “tennis” shoes)	Yes	No			
	If yes, are they in working condition?			Yes	No
Sandbox	Yes	No			
	If yes, is it in working condition?			Yes	No
Trampoline	Yes	No			
	If yes, is it in working condition?			Yes	No

Yard Game (e.g., croquet, horseshoes etc.)	Yes	No			
	If yes, is it in working condition?			Yes	No
Pool (in ground or above)	Yes	No			
	If yes, is it in working condition?			Yes	No
Weight lifting equipment, toning devices (e.g., free weights)	Yes	No			
	If yes, is it in working condition?			Yes	No
An active video game like Wii Fit?	Yes	No			
	If yes, is it in working condition?			Yes	No
Hula Hoop	Yes	No			
	If yes, is it in working condition?			Yes	No
Swimming gear – bathing suits, goggles etc	Yes	No			
	If yes, is it in working condition?			Yes	No
	Yes	No			
Other equipment Please list: _____ _____	*If yes, is it in working condition?*			Yes	No

Considering the things that you said you have in the question above…

PART C: In **the past 30 days**, think about the types of things you did in your leisure time and you parenting related to physical activity. Please check the appropriate box for each question

1. How often did your child <u>see you</u>… *(please circle your responses below)*

	Never	Rarely	Sometimes	Frequently	Always
Doing something that was physically active (e.g., walking, biking, playing sports)?	0	1	2	3	4
Doing moderately active housework or yard-work?	0	1	2	3	4
Use physical activity for relaxation or stress relief?	0	1	2	3	4

2. How often… *(please circle your responses below)*

	All	Most	Some	Very few	None
4. How much of it is stored in an area that your child uses regularly?	1	2	3	4	5
5. How much of it is stored someplace where your child would need help getting out before he/she can use them.	1	2	3	4	5
6. How much of it is stored out of sight when he/she is not using them.	1	2	3	4	5

	Never	Rarely	Sometimes	Frequently	Always
Did your child hear you talk about participating in a sport or being physical active?	0	1	2	3	4
Did your child hear you say that you were too tired to do something active?	0	1	2	3	4
Were you physically active with your child or did you play sports with him/her?	0	1	2	3	4
Did you verbally encourage your child to be physically active or play sports?	0	1	2	3	4
Did you transport your child to a place where he/she can be physically active or play sports?	0	1	2	3	4
Did you send your child outside to play when the weather was nice?	0	1	2	3	4
Did you give your child options to new physical activities to try?	0	1	2	3	4
Did you praise your child when they were physically active?	0	1	2	3	4
Did you watch your child practice or perform a dance routine?	0	1	2	3	4
Did you watch your child practice for sports?	0	1	2	3	4
Did you watch your child play sports?	0	1	2	3	4

3. How often, in an average week, do you attend a gym, YMCA, or community center to exercise? *(please circle your response)*

Not at all 1 time 2 times 3 times 4 times 5 times More than 5 times

---

PART D: Think about the media equipment that is currently in your home and circle your response for each question

---

1. How many TVs do you have in your home? _____ **(If none, skip to <u>question 7</u>)**

2. Do you have a digital TV recorder (e.g., TiVo, Replay TV, Sonic Blue) *(please circle your response)*
   Yes No Don't know

3. What best describes your television service for the primary television in the home? *(please circle your response)*
   No TV in the home | No cable | Basic cable | Cable + premium channels | Satellite/Dish

4. Do you have exercise equipment (such as stationary bikes, treadmills) in your main TV viewing area? *(please circle your response)*
   Yes No

5. Does your main TV viewing area have adequate space for your child to play or exercise while watching TV/Videos? *(please circle your response)*
   Yes No

6. Does your child have a TV in his/her bedroom? *(please circle your response)*
   Yes No

7. Does your child have a video game station or computer? *(please circle your response)*
   Yes No Don't know

8. Do you have a desktop or laptop computer in your home? *(please circle your response)*
   Yes No Don't know

9. Does your child have a PSP, Nintendo DS, iTouch or any other handheld video game? *(please circle your response)*
   Yes No Don't know

10. Do you have video games on your phone? *(please circle your response)*
    Yes No Don't know

11. Approximately how many video games and computer games are in your home? (Include items that are owned, rented and borrowed) *(please circle your response)*
    0 1-10 11-20 21-30 31-40 41-50 >50

12. How often is your television left on, whether or not it is being watched? *(please circle your response)*
    Never Rarely Sometimes Frequently Always

13. How often does your child see you… *(please circle your response)*

	Never	Rarely	Sometimes	Frequently	Always
On the computer?	0	1	2	3	4
Watching TV/movies?	0	1	2	3	4
Playing video games	0	1	2	3	4

PART F: Based on the last 30 days, thinking about your parenting regarding time spent watching television, playing video games, and on the computer, please circle your answers.

1. Do you have any firm limits or agreements with your child about how much he/she can watch TV or Videos?
   ○ No (If no, go to Question 2) ○ Yes (If yes, go to Question 1a)

   1a. How much time are they allowed to watch Television or Videos per day?

   _____

   1b. How often are these limits enforced? *(please circle your response)*

   Never Rarely Sometimes Frequently Always

2. Do you have any firm limits or agreements with your child about how much time he/she is allowed to play on the computer or use it to communicate with friends?
   ○ No (If no, go to Question 3) ○ Yes (If yes, go to Question 2a)

   2a. How much time is allowed to play or talk with friends on the computer per day?
   _____

   2b. How often are these limits enforced? *(please circle your response)*

   Never Rarely Sometimes Frequently Always

3. Do you have any firm limits, or agreements, about how much time your child can play video games?
   ○ No (If no, go to question 4) ○ Yes (If yes, go to Question 3a)

   3a. How much time are they allowed to play video games per day? _____

   3b. How often are these limits enforced? *(please circle your response)*

   Never Rarely Sometimes Frequently Always

4. How often do you discipline your child for playing video games or watching TV without permission? *(please circle your response)*

   Never Rarely Sometimes Frequently Always

5. How often does your child eat in front of the TV? *(please circle your response)*

   Never | 1 time or less per week | 2-3 times per week | 4-5 times per week | Everyday

6. Do you have the following TV rules…. *(please circle your response)*

No TV/DVD before homework	Yes	No
No computer before homework	Yes	No
No internet without permission	Yes	No

PART G: Thinking of **the past 30 days,** please answer the following questions about the types of **foods you had in your house.** Please circle the appropriate number for each food item.

1. How often did you have the following fruits (fresh, canned, or frozen) in your house? (*please circle your response)*

	Never	Rarely	Sometimes	Frequently	Always
Apples	0	1	2	3	4
Oranges	0	1	2	3	4
Bananas	0	1	2	3	4
Grapes	0	1	2	3	4
Pears	0	1	2	3	4
Strawberries	0	1	2	3	4
Blueberries/ blackberries	0	1	2	3	4
Kiwi	0	1	2	3	4
Cantaloupe/Melon	0	1	2	3	4
Pineapple	0	1	2	3	4
Peaches/ nectarines	0	1	2	3	4
Plum	0	1	2	3	4
Applesauce	0	1	2	3	4
Fruit Salad	0	1	2	3	4
Watermelon	0	1	2	3	4
Mango	0	1	2	3	4
Other:_____	0	1	2	3	4

2. How often did you have the following vegetables (fresh, canned, or frozen) in your house? *(please circle your response)*

	Never	Rarely	Sometimes	Frequently	Always
Asparagus	0	1	2	3	4
Beans (baked, lentils, kidney, etc.)	0	1	2	3	4
Beets	0	1	2	3	4
Bell Pepper (red, green, or yellow)	0	1	2	3	4
Broccoli	0	1	2	3	4
Brussel Sprouts	0	1	2	3	4
Cabbage	0	1	2	3	4
Carrots	0	1	2	3	4
Cauliflower	0	1	2	3	4
Celery	0	1	2	3	4
Corn	0	1	2	3	4
Cucumber	0	1	2	3	4
Green Beans	0	1	2	3	4
Greens (mustard, collard, kale, spinach, swiss chard etc.)	0	1	2	3	4
Lettuce	0	1	2	3	4
Mixed vegetables	0	1	2	3	4
Mushroom	0	1	2	3	4
Onion (green, red, white, yellow)	0	1	2	3	4
Peas	0	1	2	3	4
Potatoes	0	1	2	3	4
Squash (acorn, zucchini etc.)	0	1	2	3	4
Sweet Potatoes/ Yams	0	1	2	3	4

Tomatoes	0	1	2	3	4
Other:_____	0	1	2	3	4

3. Would you say the amount of fresh fruit and vegetables you currently have in your home is… *(please circle your response)*

more than usual less than usual about the same

4. How often did you have the following juices in your house (fresh, frozen, bottled, or canned)? *(please circle your response)*

	Never	Rarely	Sometimes	Frequently	Always
Apple juice	0	1	2	3	4
Grape juice	0	1	2	3	4
Orange juice	0	1	2	3	4
Fruit juice blend	0	1	2	3	4
Vegetable juice (e.g., V8, tomato juice)	0	1	2	3	4
Other: Specify _____	0	1	2	3	4

5. How often did you have the following snack items in your house? *(please circle your response)*

	Never	Rarely	Sometimes	Frequently	Always
Chips	0	1	2	3	4
Popcorn	0	1	2	3	4
Nuts	0	1	2	3	4
Crackers	0	1	2	3	4
Pretzels	0	1	2	3	4

Sunflower Seeds	0	1	2	3	4
Other: Specify _____	0	1	2	3	4

6. How often did you keep the following drinks (boxed, canned, powdered) in your house? *(please circle your response)*

	Never	Rarely	Sometimes	Frequently	Always
Sugared Drinks (Sports drinks, Kool-aid®, boxed or bottled fruit flavored drinks, sweetened teas)	0	1	2	3	4
Non-diet Soft Drinks (ie. Soda, Carbonated beverages)	0	1	2	3	4
Other: Specify _____	0	1	2	3	4

7. How often did you have the following sweets/dessert foods in your house? *(please circle your response)*

	Never	Rarely	Sometimes	Frequently	Always
Candy	0	1	2	3	4
Cookies	0	1	2	3	4
Cakes/Snack cakes	0	1	2	3	4
Ice Cream, Sherbet, Frozen Yogurt or Sugared Popsicles	0	1	2	3	4
Chocolate/Chocolate bars	0	1	2	3	4
Other: Specify _____	0	1	2	3	4

PART H. Based on **the past 30 days**, thinking about where you like to store food, please circle the appropriate response for each statement

(please circle your response)

	Never	Rarely	Sometimes	Frequently	Always
1. Fruits and vegetables in a place where they could be seen and easily reached.	0	1	2	3	4
2. Can the child get a soda without the help or permission of an adult	0	1	2	3	4
3. Can the child get snack foods without the help or permission of an adult	0	1	2	3	4

PART I: Based on **the past 30 days**, thinking about your food and meal behaviors, please circle the appropriate response for each statement

1. How often did you… *(please circle your response)*

	Never	Rarely	Sometimes	Frequently	Always
Eat healthy meals or snacks while your child was around? ("healthy" defined as fruits, vegetables, low-fat foods, lean meats, whole grains etc.)	0	1	2	3	4
Eat meals in the living room or TV room?	0	1	2	3	4
Take a second helping during meals?	0	1	2	3	4
Eat unhealthy snacks around your children?	0	1	2	3	4
Drink sugared drinks or non-diet soda around your children?	0	1	2	3	4
Avoid going to cafes or restaurants with your children which sell unhealthy foods?	0	1	2	3	4
Avoid buying sweets and chips or salty snacks and bringing them into the house	0	1	2	3	4
Not buy foods that you would like because you do not want your children to have them?	0	1	2	3	4

2. How often did your child see you…. *(please circle your response)*

	Never	Rarely	Sometimes	Frequently	Always
Eat while standing?	0	1	2	3	4
Eat straight from the pot/pan/bowl?	0	1	2	3	4
Eat while watching television, reading, or working?	0	1	2	3	4
Eat when you were bored?	0	1	2	3	4
Eat when you were angry or in a bad or sad mood?	0	1	2	3	4
Eat late in the evening or at night?	0	1	2	3	4
Eat while driving	0	1	2	3	4

3. Are you or anyone else in the home following a weight loss diet?
(please circle your response)
Yes No Don't know

4. How many days of the week do your family sit at a table and eat dinner together?
This includes when it is just you and your child(ren). *(please circle your response)*

One day or less | 2 days | 3 days | 4 days | 5 days | 6 days | 7 days

5. How often do you take your child with you grocery shopping? *(please circle your response)*

Never Rarely Sometimes Frequently Always

PART J: Based on the last 30 days, thinking about your parenting regarding food, please circle your answers.

1. How often did you… *(please circle your response)*

	Never	Rarely	Sometimes	Frequently	Always
Use food as a reward for your child?	0	1	2	3	4
Use food as a punishment for your child?	0	1	2	3	4
Prepare meals with your child?	0	1	2	3	4
Plan meals/menus with your child?	0	1	2	3	4

Offer healthy snacks when your child was hungry?	0	1	2	3	4
Eat breakfast with your child?	0	1	2	3	4
Eat dinner with your child?	0	1	2	3	4
Have regularly scheduled meals and snacks with your family?	0	1	2	3	4
Allow your child eat snacks or sweets without permission?	0	1	2	3	4
Allow your child to take soft drinks whenever he/she wants	0	1	2	3	4
Give my child soft drinks or snacks if (s)he asks	0	1	2	3	4
Give your child something else if they did not like what was prepared	0	1	2	3	4

2. Do you have the following food rules in your home…. *(please circle your response)*

How many servings of fruit and vegetables your child should eat	Yes	No
How many snacks is your child allowed to eat	Yes	No
When to snack	Yes	No
Which snacks to eat	Yes	No
No second helpings at meals	Yes	No
Limited portion sizes at meals	Yes	No
No dessert except fruit	Yes	No
No sweet snacks	Yes	No
No fried snacks at home (such as potato chips)	Yes	No
Avoid going to cafes or restaurants with your children which sell unhealthy foods?	Yes	No
Avoid buying sweets and chips or salty snacks and bringing them into the house	Yes	No

3. When it is mealtime and your child is not hungry what would you usually do? *(please circle your response)*

Suggest the child sit down at the table but not eat	Suggest the child eat later	Suggest the child sit down at the table but eat less	Convince the child to eat a full meal with the family	It never happens, the child is always hungry

4. Do you buy food upon your child's request? (*please circle your response)*
   a. Fruits and vegetables:
      Not at all Rarely Sometimes Quite A Bit Very Much

   b. Snacks or sugary cereal:
      Not at all Rarely Sometimes Quite A Bit Very Much

Part K. Please complete the following questions thinking about your opinion of your child's weight and your parenting regarding food.

1. How concerned are you…. *(please circle your response)*

	Unconcerned	A little concerned	Concerned	Fairly Concerned	Very Concerned
About your child eating too much when you are not around him/her?	0	1	2	3	4
About your child having to diet to maintain a desirable weight?	0	1	2	3	4
Are you about your child becoming over weight?	0	1	2	3	4

2. How much do you agree/disagree? *(please circle your response)*

	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree
I have to be sure that my child does not eat too many sweets (candy, ice cream, cake, or pastries)	0	1	2	3	4
I have to be sure that my child does not eat too much	0	1	2	3	4
I have to be sure that my child does not eat too much of his/her favorite foods	0	1	2	3	4

I intentionally keep some foods out of my child's reach	0	1	2	3	4
If I did not guide or regulate my child's eating, (s)he would **eat too many** junk foods	0	1	2	3	4
If I did not guide or regulate my child's eating, she would **eat too many** of his/her favorite foods	0	1	2	3	4

3. How much do you agree/disagree? *(please circle your response)*

	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree
My child should always eat all of the food on his/her plate	0	1	2	3	4
I have to be especially careful to make sure my child **eats enough**	0	1	2	3	4
If my child says "I am not hungry", I try to get him/her to eat anyway	0	1	2	3	4
If I did not guide or regulate my child's eating, (s)he would eat **much less** than she should	0	1	2	3	4

PART L: Based on your kitchen in the past 30 days, please circle your answers.

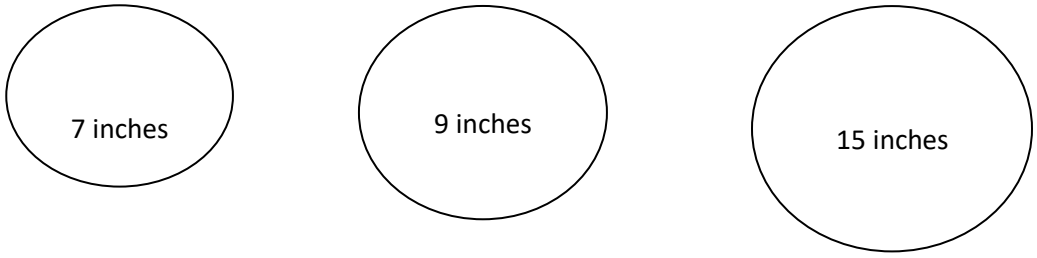
1. In your kitchen do you have… *(please circle your response)*

adequate counter space to prepare food?	Yes	No
adequate refrigerator and freezer space?	Yes	No
adequate cupboard storage space?	Yes	No
a microwave?	Yes	No
a toaster?	Yes	No
a steamer?	Yes	No

a stove Top?	Yes	No
an oven?	Yes	No

2. How much do you use cooking equipment for food preparation (such as oven, microwave, food processor, electric mixer)? *(please circle your response)*
   Not at all Rarely Sometimes Quite A Bit Very Much

3. What size plate does your family typically use for meals? (See examples below)



Small Medium Large

4. How confident are you that you have accurately reported your child's home environment on this survey? *(please circle your response)*

Not at all	A little	Moderately	Quite Completely

Part M. For each category, circle the description that best fits your child or your family. It is important to indicate the ***most common or typical pattern*** and not what you would like to happen.

In a typical week…				
1. Does your family eat dinner while watching television?	Yes		No	
2. Do you use food as a reward for good behavior?	Yes		No	
3. Do you restrict how much your child eats potato chips, cookies, and candy?	Yes		No	
4. Do you have a routine or schedule for bedtime for your child?	Yes		No	
5. How many hours of sleep does your child usually get each night?	<8	8-9	9-10	>10
6. How many hours of television does your child watch?	<7	7-14	>14	

7. How many hours does your child spend on the computer or video games?	<7	7-14	>14	
8. Does your child have a television in his or her bedroom?	Yes		No	
9. Do you monitor the amount of television your child watches?	Yes		No	
10. How often does your child eat breakfast?	Almost never	Sometimes	Often	Almost always
11. How often does your family eat at least one meal together each day?	Almost never	Sometimes	Often	Almost always
12. How often does your family eat fast food during the week?	Almost never	Sometimes	Often	Almost always
13. How often does your family eat fruits and/or vegetables with your main meal?	Almost never	Sometimes	Often	Almost always
14. How often do you use prepackaged foods (like frozen pizza) for your main meal?	Almost never	Sometimes	Often	Almost always
15. How often does your family freshly prepare food (like chicken, pasta) for your main meal?	Almost never	Sometimes	Often	Almost always
16. How often does your family drink soda pop or Kool-Aid at snacks and meals?	Almost never	Sometimes	Often	Almost always
17. How often does your family drink 100% fruit juice or low fat milk at snacks and meals?	Almost never	Sometimes	Often	Almost always
18. How often do you participate in at least 30 minutes of physical activity per day?	Almost never	Sometimes	Often	Almost always
19. How often does your family play games outside, ride bikes, or walk together?	Almost never	Sometimes	Often	Almost always
20. How often does your child participate in physical activity during their free time?	Almost never	Sometimes	Often	Almost always

21. In the past year how many organized sports with a coach or leader (e.g. soccer) or in organized group activities involving physical activity (e.g. swim lessons) has your child participated in?

0-1 1-2 3-4 5+

PART P. WHAT YOU DO FOR ACTIVITY

1. Thinking of your typical leisure-time exercise habits….

a. During a typical **7-Day period** (a week), how many times on the average do you do the following kinds of exercise for **more than 15 minutes** during your free time (write on each line the appropriate number)

Times Per Week

i. **STRENUOUS EXERCISE**
(HEART BEATS RAPIDLY)
(e.g., running, jogging, hockey, football, soccer, squash, basketball, cross country skiing, judo, roller skating, vigorous swimming, vigorous long distance bicycling) _____

ii. **MODERATE EXERCISE**
(NOT EXHAUSTING)
(e.g., fast walking, baseball, tennis, easy bicycling, volleyball, badminton, easy swimming, alpine skiing, popular and folk dancing) _____

iii. **MILD EXERCISE**
(MINIMAL EFFORT)
(e.g., yoga, archery, fishing from river bank, bowling, horseshoes, golf, snow-mobiling, easy walking) _____

1. When you are at work which of the following best describes what you do? *(please circle your response)*

Mostly sitting/standing Mostly walking Mostly heavy labor

2. Thinking about the time you spend watching TV, playing video games, and on the computer please answer the following questions. In your free time on an average weekday (Monday-Friday), how many hours do you spend **watching TV & videos?** *(please circle your response)*

0 ½ hour 1 hour 2 hours 3 hours 4+ hours

In your free time on an average weekday (Monday-Friday), how many hours do you spend **playing active video games such as Wii Fit or DDR?** *(please circle your response)*

0 ½ hour 1 hour 2 hours 3 hours 4+ hours

In your free time on an average weekday (Monday-Friday), how many hours do you spend **playing other video games?** *(please circle your response)*

0 ½ hour 1 hour 2 hours 3 hours 4+ hours

In your free time on an average weekday (Monday-Friday), how many hours do you spend **playing or doing work on the computer at home?** *(please circle your response)*

0 ½ hour 1 hour 2 hours 3 hours 4+ hours

During a typical week, how often have you or an adult member of your household:
(please circle your response)

A. Encouraged your child to do physical activities of play sports?	None
	Once
	Sometimes
	Almost every day
	Every day
B. Done a physical activity or played sports with your child?	None
	Once
	Sometimes
	Almost every day
	Every day
C. Provided transportation to a place where your child can do physical activities or play sports?	None
	Once
	Sometimes
	Almost every day
	Every day
D. Watched your child participate in physical activities or sports?	None
	Once
	Sometimes
	Almost every day
	Every day

E. Told your child that they are doing well in physical activities or sports?	None
	Once
	Sometimes
	Almost every day
	Every day

43. Which choice listed below best describes where your child lives?

 In town 1-5 miles outside of the nearest town 6 -10 miles outside of the nearest town

 11-15 miles from the nearest town 16-20 miles from the nearest town

 21 miles or more from the nearest town

44. Do you and/or your spouse farm as a primary occupation?

 Yes (If answering Yes, please proceed to questions 45-47.) No (If answering No, skip questions 45-47.)

45. If yes to question 44, which of the following best describes your farming operation?

 Livestock only Livestock and field crops Field crops only

46. How often does your child usually participate in farm related chores?

 Daily 4-6 times a week 2-3 times a week Weekends only Never

47. How physically demanding are the farm related chores your child usually participates in?

 Light (requiring mostly walking at a slow to moderate pace, some light lifting, carrying, pulling, or shoveling)

 Moderate (requiring a faster walking or running pace, heavier lifting, carrying, pulling, or shoveling)

 Heavy (requiring a very fast walking or running pace, very heavy lifting, carrying, pulling, or shoveling)

Activity Support Scale for Multiple Groups (ACTS-MG)

Please circle the answer that most closely describes your practices.

1. I enroll my child in sports teams and clubs such as soccer, basketball, and dance.	Strongly disagree Disagree Agree Strongly agree

2. I take my child to places where he/she can be active.	Strongly disagree Disagree Agree Strongly agree

3. I watch my child play sports or participate in other activities such as martial arts or dance.	Strongly disagree Disagree Agree Strongly agree

4. I encourage my child to be physically active by leading by example (by role modeling).	Strongly disagree Disagree Agree Strongly agree

5. I exercise or am physically active on a regular basis.	Strongly disagree Disagree Agree Strongly agree

6. I enjoy exercise and physical activity.	Strongly disagree Disagree Agree Strongly agree

7. I encourage my child to use resources in our neighborhood to be active (such as the park and the school).	Strongly disagree Disagree Agree Strongly agree

8. I enroll my child in community-based programs (such as Girls and Boys Club, YMCA) where he/she can be active.	Strongly disagree
	Disagree
	Agree
	Strongly agree

9. I find ways for my child to be active when school is out by, for example, enrolling him/her in summer camp and after school programs.	Strongly disagree
	Disagree
	Agree
	Strongly agree

10. I limit how long my child plays video games (including PlayStation, Xbox, and Gameboys).	Strongly disagree
	Disagree
	Agree
	Strongly agree

11. I limit how long my child can watch TV or DVDs each day (including educational and non-educational programs).	Strongly disagree
	Disagree
	Agree
	Strongly agree

12. I limit how long my child can use the computer for things other than homework (such as playing computer games and surfing the internet).	Strongly disagree
	Disagree
	Agree
	Strongly agree

Collins' Figures