8-2014

Active Families in the Great Outdoors: A family-centered program to increase physical activity levels, perceptions, and behaviors

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To the Graduate Council:

I am submitting herewith a dissertation written by Jennifer Irene Flynn entitled "Active Families in the Great Outdoors: A family-centered program to increase physical activity levels, perceptions, and behaviors." I have examined the final electronic copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in Kinesiology and Sport Studies.

Dawn P. Coe, Major Professor

We have read this dissertation and recommend its acceptance:

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Active Families in the Great Outdoors:

A family-centered program to increase physical activity levels, perceptions, and behaviors

A Dissertation Presented for the

Doctor of Philosophy

Degree

The University of Tennessee, Knoxville

Jennifer Irene Flynn

August 2014

DEDICATION

To my family, for everything.

ACKNOWLEDGEMENTS

There are a number of individuals to whom I am forever thankful for. I would not have made it this far without the constant encouragement and support of each of these individuals.

My first acknowledgement is to Dr. Dawn Coe as my graduate advisor. Thank you for always having an open office door, open front door, and open mind. Your guidance throughout my Master's and Doctoral degrees has been everything I could have hoped for and more. It has been an adventure! Thank you for letting me be a part of it.

Secondly, I want to acknowledge my outstanding doctoral committee. Dr. Bassett, I will always cherish my time working with you and every one of our conversations. You've been an irreplaceable support throughout my degree and your enthusiasm for research and getting kids back outside has been a cornerstone for my excitement towards the field. Dr. Fouts, our conversations both in class and outside of class have provided prospective about childhood and families that I will appreciate for the rest of my career. Thank you for exposing me to childhood from a cultural perspective and for showing me how unique families can be. Dr. Thompson, you've been my mentor for a number of years – thank you for always having an answer, to providing valuable life lessons whenever possible, and for inspiring me to be analytical of everything I read. I feel very fortunate to have had your encouragement and support throughout my graduate school career as well the opportunity to be a part of your classroom.

Pam Andrews, Scotty Warden, Jane Johns, and Sarah Bicknell – thank you for making the logistic side of everything so much easier. I'll miss our conversations that typically resulted in laughter, and sharing irrelevant stories with you in order to delay work in the mornings as long as possible.

There are also a number of students that I've crossed paths with, and my graduate experience would not have been the same without each one of them. In particular, I want to acknowledge Dana Wolff, Brian Rider, Courtney Rider, Brittany Wilkerson, and Whitney Welch for their friendship, conversation, and encouragement. I also need to send huge thank you to all of the undergraduate and graduate students who helped me with data collection. In particular, Alex Matavosian, Michael McClannahan, Greg Grieco, thank you, thank you! We certainly could not have done this all without such a great team. Finally, Scott and Summer Conger, who's cross country hopping allowed me to build a relationship that I am forever appreciative. Your friendship has been unmatched, and I am thankful for the two of you in my life.

A special mention needs to go out to all of "my families". First, to the families that participated in this dissertation. The success of this dissertation was entirely due to your cooperation and honestly in all of the assessments. In the meantime, the times spent during data collection and getting to know each of you has a special place in my heart. Thank you for all of your eagerness to help, and for giving us a tiny glance into your lives.

Second, to my own family - thank you! I'm incredibly blessed to have a mom and dad who never said no to a bike ride or to letting us show off our latest discovery (likely alive or located 10 acres away) found while off exploring. Jim, forever my partner in all things related to fort-building and backyard adventure, our childhood is the foundation of my excitement and passion for promoting outdoor physical activity in children and for that I am eternally grateful. Lauren, our newest addition to the family – thank you for your endless encouragement and optimism. Finally, thank you Clare Kaufman, for removing the word "can't" from my personal vocabulary and for always supporting me as a friend, no matter how difficult I managed to make that task.

ABSTRACT

Physical activity levels of adults and children are low, and the amount of time children spend being active outdoors is decreasing. Parents play a critical role in developing health behaviors of children and ways to increase physical activity and encourage an active family culture are needed. Promotion of family outdoor physical activity, which includes at least one parent and one child from a home engaging in physical activity together, is understudied. Therefore, the purpose of this dissertation was to 1) describe the type, frequency, and duration of family physical activity, 2) determine whether changes in the duration and number of family outdoor physical activity bouts (min; number of bouts/week^{-1}), and 3) determine whether changes in parent and child physical activity perceptions (value, self-efficacy, enjoyment) and parent behaviors (support) occur as a result of a four-week family outdoor physical activity program. The four-week program, Active Families in the Great Outdoors, was designed to educate parents on the benefits of family outdoor physical activity and provide tools necessary to incorporate activity into daily home life. Participants completed family activity logs each week to document their time spent being active together. Parents completed pre/post assessments of knowledge, value, self-efficacy, and support. Children completed pre/post assessments of enjoyment, support, and self-efficacy. During the program, families increased their time spent being active together by an average of 111 minutes/week^{-1} (baseline, 216.1 ± 127.3 minutes/week^{-1}; week1, 316.1 ± 180.2 minutes/week^{-1}; week2, 351.1 ± 209.1 minutes/week^{-1}, week4, 317.5 ± 186.8 minutes/week^{-1}, $p<0.05$) however week 3 was not significantly higher than baseline (286.7 ± 177.6 minutes/week^{-1}). The number of bouts per week did not increase, but the average length of the bouts did increase above baseline (baseline, 60.2 ± 21.6 minutes/bout^{-1};

week 1, 98.6 ± 57.7 minutes/bout^{-1}; week 2, 114.6 ± 61.0 minutes/bout^{-1}, week 3, 91.1 ± 44.1 minutes/bout^{-1}; week 4, 101.2 ± 45.5 minutes/bout^{-1}, $p<0.05$). At follow-up, parent knowledge of physical activity guidelines and support through role modeling were higher. Child perceived support for physical activity was also higher at follow-up. This dissertation provides encouraging results on the usefulness of promoting family outdoor physical activity.

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Part I:
Introduction

Physical activity is one of the primary lifestyle factors related to obesity and chronic disease status. Currently, 58% of children and 80% of adults fail to meet the respective national physical activity guidelines.[1] Studies indicate that physical activity levels of children and adults in the United States are insufficient for acute and chronic health benefits.[2] As a result, one of main objectives of Healthy People 2020 is to increase the proportion of individuals who meet current national physical activity guidelines.[3] In both adults and children, low physical activity and increased weight status have a detrimental effect on blood glucose, blood pressure, triglycerides and high density lipoprotein levels, as well as psychosocial aspects of health such as depression.[4] There is evidence that the physical activity level and weight status of an individual track from childhood through adolescence to adulthood, indicating that childhood is a critical time for the establishment of healthy lifestyle behaviors to attenuate the risk and development of chronic diseases later in life.[5,6]

In conjunction with decreased overall physical activity levels, there is also a decline in the amount of time devoted to participation in outdoor activities. Reports suggest that from 2007 to 2009, the number of children ages 6-12 participating in outdoor recreation dropped nearly 21% (79% vs. 58%).[7] Limited outdoor physical activity has become a concern to the point that state government organizations, such as the Tennessee Department of Environment and Conservation, have made an effort to focus resources on better engaging children in nature through their 2020 People Outreach and Engagement Initiatives.[8] Outdoor physical activity has been associated with a number of health benefits in adults and children, including more favorable weight status, improved mental health and cognition,[9] better vision,[10] and higher vitamin D levels.[11] A study by Coombes et al.[12] identified that time spent in green space and parks was positively associated with vigorous intensity physical activity in children.

Additionally, it was shown that time spent indoors was associated with higher levels of light intensity physical activity, which is not sufficient intensity to help children meet physical activity recommendations. Cleland et al.[13] showed that each hour spent outdoors was associated with a 27 minutes per week increase in moderate-to-vigorous intensity physical activity. A recent study by Finkelstein et al.[14] found that outdoor physical activity could be increased in 6-12 year old children using an incentive-based pedometer program that focused primarily on engaging children in structured outdoor park activity. The authors reported that step counts in children significantly increased following a 9-month intervention compared to the control group (8660±567 steps per day vs. 7767±382 steps per day, $p<0.01$).[14] These results demonstrate potential for the use of outdoor physical activity programs as a method for increasing PA levels.

Unfortunately, the technological dependency of our culture presents a challenge to increasing the amount of time children spend both being physically active and engaging in outdoor environments. Current data suggest that 6-11 year old children are spending on average more than 6.0 hours·day^{-1} in sedentary activities such as watching television, playing video games, and electronic media use.[8] As a result of these findings, a second objective of Healthy People 2020 is to decrease the amount of time children spend engaging in sedentary, screen-based activities.[3] Additionally, American adults ages 20-49 accumulated approximately 7.5 hours·day^{-1} in sedentary activities.[8] These data highlight the need for an intervention aimed at transitioning sedentary time and increasing the amount of time both children and adults spend being active.

One type of intervention that has been utilized for the promotion of physical activity is the family-centered intervention.[15-19] The term "family-centered" is one that places an emphasis on the importance of factors influencing the daily routine of a family. A family-centered

intervention focuses on the child's needs while allowing for the entire family to benefit from the intervention simultaneously.[16,20] It is possible that targeting individuals using a multi-generational, family-centered, physical activity intervention may provide an opportunity to increase the physical activity levels of both adults and their children concurrently. The recent Physical Activity Guidelines for Americans Midcourse Report states that there is insufficient literature on the strategies for increasing physical activity in the family setting.[21] However, previous work has established the critical role that parents play in their child's development of behaviors.[22-24] It is well established that children are often more physically active when they have active parents[25] but also that children may negatively influence parental physical activity levels.[26,27] These influences at the family level are frequently due to barriers such as available time to allocate to physical activity, finding opportunities to be physically active, and costs associated with participating in organized sports.[28] However, it is possible that by engaging parents and children together in a family-centered intervention, that these barriers can be overcome.

When considering a child's health, it critical to consider family context because it is a necessary component of implementing behavior changes.[15] Previous studies have used the Family Ecological Model (FEM) as a framework for describing the factors that influence health behaviors in families. The FEM, which is based on the Ecological Systems Model, is a behavior change framework that states that an individual's health behaviors (i.e. physical activity levels, nutritional habits, etc.) cannot be fully understood, and therefore fully changed, without considering the context of the individual's environment.[15,29] The model identifies that increasing a physical activity outcome is dictated by improving upon key aspects of parenting such as parent attributes including perceptions and behaviors which will ultimately influence child

physical activity. Parent perceptions include self-efficacy for increasing a child's activity and value towards physical activity for health. Parent behaviors include support and encouragement for facilitating avenues to engage in healthy behaviors and modeling of desired behaviors.[15,29] Results of a study by Davison et al.[16] have suggested that principles from the FEM can be successfully implemented in a family-centered program. Pilot work demonstrates using an obesity intervention that incorporates components of the FEM resulted in less television viewing time and more time spent in light physical activity.[16] By incorporating the FEM into a family-centered, outdoor physical activity program, it is possible that the child's and family's physical activity levels can be improved.

Statement of the Problem

Although numerous physical activity intervention study designs have been attempted in the pediatric population, meta-analysis reviews have found that these programs have resulted in relatively low success rates.[30] These study designs have included both school- and community-based interventions. The use of a family-centered physical activity intervention may be successful in increasing the physical activity levels of parents and children simultaneously; however, there is a need for a better understanding of the most effective methods to implement interventions at the family level. U.S. data report that 50% of fathers and 68% of mothers feel they have time to spend engaged in "family time," indicating that an intervention that supports family physical activity together is feasible.[31] Parents are often viewed as gatekeepers for their child's physical activity. In addition to modeling healthy behaviors and providing encouragement and support for activity, parents also provide transportation. Furthermore, perceived safety is viewed as a barrier for physical activity, and therefore parent involvement in a physical activity intervention is necessary. Access to parks and other community recreational

spaces typically have family-oriented and cross-generational opportunities for physical activities. Additionally, the overarching role of parents as gatekeepers to physical activity opportunities, specifically during the childhood years, supports the need for improved resources to help parents identify opportunities for increasing activity of all family members in their own neighborhood and surrounding community.

One emerging strategy of family-centered interventions is the use of community specific resources to disseminate information and help introduce healthy behavior changes.[32,33] An outdoor physical activity program that includes local resources and offers parents an opportunity for increasing positive parenting attributes and practices may help parents to better generate ideas. These ideas may then result in increasing time spent being active together outdoors. An outdoor physical activity program grounded in the theory supporting the FEM and IMPAP may be a successful mode of increasing physical activity in a family and has not yet been assessed in the current physical activity or family literature.

Statement of Purpose

The purpose of this dissertation will be to pilot the effectiveness of a family-centered outdoor physical activity program that includes providing parents with information about how to be active outside as a family. The study will include one treatment group that will receive the full Active Families in the Great Outdoors (Active Families GO) program.

The primary aim of the study is to describe the type, frequency, and duration of physical activities of families during an outdoor physical activity program. The second aim of the study is to determine if changes in the number of reported family activity bouts (number of bouts/week) accumulated outdoors for parents and children can be observed. The hypothesis is

that the families will participate in an increased number of family activity bouts during the 4-week program. The third aim of the study is to determine if changes can be observed in the parent and child perceptions (i.e., value, self-efficacy, enjoyment) and parent behaviors (i.e., support) towards physical activity. The hypothesis is that both parents and children will have changes in perceptions and parents will have changes in behaviors towards physical activity following the 4-week program.

Significance of the Study

With the current levels of physical inactivity in children and adults, it is important to identify methods that can be used to engage parents and children in physical activity together. The use of a family-centered intervention may be a realistic way for parents, health-care professionals, and communities to increase physical activity and promote healthy behavior changes. This will allow for not only the prevention and treatment of adverse health outcomes associated with low physical activity levels, but may attenuate the decrease in physical activity that occurs as a child ages and moves towards adulthood. Additionally, by involving parents in the physical activity outings, the physical activity levels and health status of parents may also be positively influenced.

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Part II:
Review of Literature

The federal guidelines for physical activity recommend that children ages 6-12 years accumulate at least 60 minutes per day of developmentally appropriate, moderate-to-vigorous aerobic physical activity (MVPA) including muscle-and bone-strengthening activities on at least three days of the week.[1] Currently 42% of U.S. children ages 6-11 meet the national recommendations for aerobic physical activity (60 min·day^{-1} of MVPA).[2] These guidelines have been created using evidence-based research supporting the positive effects that physical activity can have on various health indicators.[3] It is important to note that, when comparing children to adults, there are a number of differences in type, duration, and intensity of physical activity recommendations, however the benefits are consistent across all ages. Physical activity is defined as any bodily movement produced by the skeletal muscle that expends energy beyond that of an individual's resting level. Exercise, on the other hand, is a specific type of physical activity that is planned, structured, repetitive, and performed with the intention of maintaining or improving health.[4] Children's physical activity is often times sporadic and is performed at a different tempo than adults, who more commonly engage in continuous bouts of structured exercise.[5] As expected, a majority of children are more likely to perform unstructured physical activity and this is often referred to as play.[6] Low levels of MVPA in children have been linked to low cardiovascular fitness, prevalence of obesity, dyslipidemia, high blood pressure, and metabolic syndrome.[7] Physical activity has also been found to significantly influence bone mineral density, mental health, and academic achievement/cognitive function in children.

Time spent engaging in sedentary behaviors is also an increasingly prevalent problem for school-aged children, and is considered an entire field of research separate from the study of physical activity in children. Recent data reports that 6-11 year old children are now spending an average of 6 hours a day engaging in sedentary activity.[8] The American Academy of

Pediatrics suggests that children engage in no more than two hours a day of screen-based activities[9]. Screen-based time is accumulated engaging in a number of activities including watching televisions, and using cell phones, tablets, video games, and computers. Engaging in increased amounts of sedentary time has been shown to have negative influences on a child's health. For example, children ages 11-13 years who engage in increased amounts of screen time have been shown to have lower fitness levels as measured by 20-meter shuttle run[10]. The need for physical activity and reduced sedentary behaviors to promote the adequate development and health of children and adults has been clearly established.

In addition, specific types of physical activity such as outdoor physical activity may significantly influence the health and wellbeing of a child by redirecting children from screen time related activities and promoting higher intensity bouts of activity.[11-13] There are a number of influences that play a role in child's physical activity levels at the community, school, and home levels. At home, parents are the most consistent influences of child health behaviors.[14] Conversely, the role of parenthood may challenge the physical activity behaviors of adults because of the potential shift in commitment to work/family obligations and away from leisure time endeavors.[15] Due to the low levels of physical activity among both children and adults, a family-centered physical activity intervention that focuses on increasing the amount of time families spend engaging in activity together may help to alleviate some of the barriers to physical activity.[14,16] The purpose of this review of literature is to highlight the published work addressing child outdoor physical activity, parenting perceptions and behaviors, and the use of a family-centered intervention in promoting physical activity.

Outdoor Physical Activity in Children

As previously mentioned, the lack of sufficient physical activity is currently of worldwide concern for children.[1,17] In the past, outdoor physical activity was a logical mode of physical activity for many children. Whether a backyard, park, or school playground, it is important to note that outdoor physical activity for children is not a novel concept. Sadly, participation in outdoor physical activity in the United States is on a steady decline (77% in 2006 versus 58% in 2008).[18] The primary physical activity outcome in this dissertation is time spent being active outside, and therefore this section will provide detail on the ways to measure outdoor physical activity, the importance of exposure to outdoor environments for child health, and the current status of outdoor physical activity promotion in the United States.

Measurement of Outdoor Physical Activity Levels

Similar to measurements of total physical activity, measuring specific types of physical activity during a child's day can present barriers. Nevertheless, it is critical that appropriate modes of measurement be utilized in order to determine the influences of outdoor time on child health outcomes.

Previous studies have usually relied on parent recall as a measure of outdoor physical activity in children. The two most commonly used parent recall tools are the Outdoor Playtime Checklist and the Outdoor Playtime Recall Questionnaire both developed by Burdette and colleagues[19]. The checklist is comprised of two questions that require parents to recall the amount of time their child spends during the day 1) playing in a yard or street around the house and 2) in a park, playground, or outdoor recreation area including while at daycare or preschool. The recall questionnaire is similar to the checklist but only asks parents the hours and minutes spent playing outdoors on week days and weekend days. In a study that assessed both tools,

parents participated in focus groups to develop the questions, and the children were asked to wear accelerometers (RT3 triaxial accelerometer) for two full weekdays and one full weekend day. The physical activity data provided by the accelerometer was used as criterion measure and was compared to parent report of the minutes spent outside from the checklist and recall questionnaire. The Outdoor Playtime Checklist and Recall was significantly correlated with the amount of time spent being active as measured by the accelerometer ($r=0.30$, $p<0.01$ and $r=0.20$, $p=0.003$, respectively).[19] Although both tools were significantly associated with the objective measure of physical activity, the study lacks an objective measure of outdoor-specific physical activity. This is primarily due to absence of technology capable of simultaneously assessing the environment (indoors vs. outdoors) and physical activity. Regardless, these tools are still heavily used in preschool and school-aged populations.

Due to the limitations of child and parent recall of physical activity, various existing technology has been re-examined as potential tools for measuring outdoor physical activity. Currently, there are two primary devices utilized in the assessment of outdoor time, global positioning systems (GPS) and light sensors. Of the two, GPS are more commonly used and can be overlaid simultaneously with accelerometer data. However, it is important to note that at this time, GPS is used as a proxy for environment since it only provides location data resulting in inherently misclassified indoor and outdoor time. Still, the use of GPS has significantly pushed forward the field of outdoor physical activity measurement in children. Devices including the QStarz-BT-Q1000x and Garmin Forerunner are the most frequently identified in the literature. The QStarz-BT-Q1000x has been reported to have high accuracy of identifying spatial position across a variety of different indoor and outdoor conditions. Schipperijn et al.[20] most recently evaluated the accuracy of the device and found that 49.6% of the data points fell within 2.5

meters of the target location. Approximately 78.7% of the data points fell within 10 meters of the target location, and was identified as acceptable for use in health outcome studies that seek to evaluate environment. One of the biggest setbacks with GPS use is that the GPS signal may not be able to accurately differentiate between indoor and outdoor environments (*i.e.*, backyard or porch versus inside the house). Currently, no studies have examined the impact of attenuated GPS signals, but it is recognized as a limitation to GPS because if a GPS signal cannot properly connect, data are inaccurately recorded.[20,21]

Once GPS devices were deemed acceptable for use for detecting indoor and outdoor environments, many authors started to become very creative with their use of the two devices to simultaneously provide more detail about child physical activity context. One of the landmark studies to first utilize GPS and accelerometer data a study was the Personal and Environmental Associations with Children's Health (PEACH) in Bristol, UK. Cooper et al.[22] first evaluated the use of GPS with accelerometers by examining children who walked to school versus those who were driven to school. The study found that children who walked to school had significantly higher counts per minute than the children who were driven (878.8 ± 387.6 vs. 608.7 ± 264.1, $p<0.001$). The outdoor and simulated indoor conditions (i.e., car riding) were self-reported by the children and served as a criterion for determining if the GPS was accurately picking up the signal and was reported on the days evaluated. This study highlighted not only the use of the devices in combination, but also the contribution of active commuting to a child's daily physical activity level. Since this study, numerous additional studies have shown the feasibility of utilizing GPS and accelerometer devices concurrently.[12,21] These studies are discussed in more detail in the upcoming sections.

Most recently, the sole use of the ActiGraph GT3X+ has been suggested as a way to objectively measure outdoor physical activity due to the recent introduction of the light sensor feature. The light sensor feature was previously used for clinical sleep trials, but was found to be sensitive enough to identify indoor and outdoor conditions. Tandon et al.[23] was the first to propose the use of the light sensor housed with the ActiGraph GT3X+ as a useful tool to evaluate environment. The authors conducted two days of indoor and outdoor environment observations, and identified 110 lux as the optimal threshold for identifying indoor and outdoor environments using the light sensor (area under the curve =0.82, sensitivity=0.74, specificity=0.86). More recently, Flynn et al.[24] expanded on the identification of the threshold using the light sensor by performing a three-part study that included light sensor reliability, structured indoor and outdoor activities, and a free-living validation. The results from the study found that the cutoff of 240 lux was more appropriate for discriminating between indoor and outdoor environments with (area under the curve=0.96, sensitivity=0.92, specificity=0.88). The free-living validation yielded 97% accuracy for each of the environments.

Unfortunately, the GPS and activity monitor equipment needed to objectively assess outdoor physical activity is relatively expensive. Furthermore, devices also lack the ability to provide simultaneous contextual data about the physical activity bout, including the actual environment in which the activity was performed, what activity was being performed, and which members of the family were participating in the family activity bout. For this dissertation, outdoor physical activity will be assessed by using family physical activity logs. The logs are recorded by the parent/caregiver and provide detail on when the activity was performed, the duration of the activity, the type of activity, and who participated. These variables, which will be used to address Aim 1 and Aim 3 of the dissertation, are essential to the understanding of family

physical activity behaviors and provide the foundation for better promoting activities for the entire family unit.

Health Outcomes and Outdoor Physical Activity

Although the benefits of physical activity are well understood, there is evidence supporting the notion that the environment in which an individual engages in physical activity may be important as well.[13,25-27] Once the understanding of how outdoor physical activity is measured, more attention can be paid to the relevant health outcomes associated with outdoor-specific physical activity. A review conducted by McCurdy et al.[28] shows that physical activity performed specifically in outdoor spaces has been linked to decreased levels of myopia (nearsightedness), attention deficit/hyperactivity disorder symptoms, as well as obesity prevalence.

Physiological Health

Time spent outdoors is associated with higher intensity physical activity. Another study resulting from the PEACH data was published by Cooper et al.[21] and included 1010 children ages 10-11 and detected indoor and outdoor environment via GPS and estimated physical activity intensity using the hip mounted ActiGraph GT1M accelerometer. Results showed that while children were outside, physical activity levels were 2-3 times higher than while indoors (1345.8 ± 907.3 counts/min vs. 508.9 ± 282.9 counts/min, $F=783.2$, $p<0.001$).[21] This study highlights the feasibility of minute-by-minute data collection to examine how the environment influences physical activity levels of children. Cleland et al.[12] also assessed the associations of time spent outdoors with children's physical activity levels and weight status. Participants were 540 children ages 5-6 (younger children) and 10-12 years old (older children). Parents reported time spent outdoors and physical activity levels were assessed using the MTI uniaxial

accelerometer, which is one of the earlier versions of the ActiGraph accelerometer. Results for younger children found that every additional hour spent outdoors was associated with a 17 min·week^{-1} increase in MVPA for girls and 12 min·week^{-1} increase for boys during the weekdays. On the weekends, each hour was associated with approximately a 6 min·week^{-1} increase in MVPA for boys and girls. In 2011, Grigsby-Toussaint and colleagues [29] conducted a study to evaluate the influence of exposure to "green spaces" on outdoor physical activity levels of children. Results of the study showed that the level of neighborhood greenness was significantly associated with parent report of outdoor physical activity, specifically that increased greenness was related to increased outdoor physical activity. Furthermore, authors identified a dose-response relationship between time spent playing outside with parents (parent support) and child outdoor physical activity. Results of this study highlight the importance of providing children with green space to engage in and promote physical activity levels.

A more recent study by Coombes et al. [13] assessed the associations between physical activity intensity and the environment of the child as part of the Sport, Physical activity and Eating behaviors: Environmental Determinants in Young people (SPEEDY GPS) trial. The study included 100 children (ages 9-10) who wore the ActiGraph GT1M accelerometer and the Garmin Forerunner 205 GPS unit simultaneously for four consecutive days. The primary variable assessed was how much time children spent in activity while not in a building. Results of the study found that children who spent more time outdoors (>30% of their day) accumulated more MVPA than children who spent <30% of their day outside (45.1 3±8.3 min. vs. 27.7±38.3 min., $p<0.05$, respectively). Additionally, it was found that across both urban and rural children, time spent in MVPA was higher when children were in own neighborhood (25.7±27.1 and 23.1±35.4

min., respectively) compared to their surrounding community. These studies highlight the usefulness of outdoor environments as means for the promotion of MVPA.

Although the physiological benefits of outdoor physical activity can be partially explained by the positive health outcomes associated with higher intensity physical activity, engaging in physical activity outside is also heavily related to Vitamin D levels of children. Vitamin D is necessary for optimal skeletal muscle development,[30] and insufficient levels of Vitamin D have been suggested to play a potential role in the development of diabetes and cardiovascular disease. In the past, extreme conditions of vitamin D-deficient rickets were remedied through vitamin D fortification of foods as well as encouragement of sunlight exposure. Although rickets has nearly been eliminated, studies have provided evidence that vitamin D deficiency remains associated with negative health outcomes in youth.[31] In a 2009 study utilizing 2001-2004 National Health and Nutrition Examination Survey (NHANES) data by Reis et al.[31], the relationship between low serum vitamin D levels and cardiovascular disease risk factors was established. Results of the study showed that vitamin D levels varied across race/ethnicity groups, with African American youth having the lowest levels and Mexican Americans having the next lowest levels. Furthermore, adjusted odds ratios (AOR) showed that compared to the highest quartile of serum vitamin D levels, youth with lowest serum vitamin D levels were more likely to have an obese weight status (AOR=5.24, 3.47-7.91), high waist circumference (AOR=7.21, 4.36-11.94), hypertension (AOR = 2.36, 1.33-4.19), and fasting hyperglycemia (AOR =2.54, 1.01-6.04) Additionally, youth with the lowest serum vitamin D levels were more likely to have metabolic syndrome as defined by Cook et al. (AOR=3.88, 1.57-9.58).[31] The associations between serum vitamin D levels and cardiovascular disease risk factors identified by Reis et al.[31] highlight the need for further research on how vitamin D influences

youth health, and how outdoor physical activity may provide benefits for vitamin D deficient children.

Studies have evaluated the influence of outdoor physical activity on vitamin D levels in adults and few studies have evaluated the influence of outdoor-specific physical activity on vitamin D in children. [28,30-33] However, proxy measures of outdoor time such as sun exposure have been performed and have provided insight as to how being outside influences child health. A study by Al-Othman and colleagues [32] evaluated 331 vitamin D deficient Saudi children who were divided into three groups for sun exposure [no sun, daily (10-30 minutes daily) or weekly (40-160 minutes, but not daily] and three groups based on self-reported physical activity (inactive, moderately active, physically active). Results were that vitamin D levels increased as the amount of sun exposure and physical activity children obtained increased. Although these results do not demonstrate causation, the associations identified provide a foundation for further research on the benefits of outdoor physical activity and sun exposure for youth physiological health promotion.

The World Health Organization has placed myopia on the list as a top priority for the prevention of avoidable blindness.[28] Myopia, also referred to as the presence of nearsightedness, often requires short term treatment in the form of optical correction. Additionally, there may be long term complications of myopia including treatment for cataracts and glaucoma. In 2009, Vitale et al.[34] compared existing NHANES data on participates ages four and older from the 1971-1972 cohort and 1999-2004 cohorts to determine if the prevalence of myopia was increased in the US, and identified a significant increase in individuals ages 12 -54 who were myopic (25.0% vs. 41.6%, respectively). It has been suggested that close up work such as reading, and exposure to illuminated screens (*i.e.*, televisions, computers, tablets, phones) may contribute to

the development of myopia over time.[28,35] Time spent outdoors and sport participation have each been found to be associated with a lower prevalence of myopia in children, however the mechanisms for why the relatedness exists is not well understood. One of the earliest studies to examine how environmental exposures influenced the eye health of children was done in 2002 by Mutti et al.[36] The study included 366 8th grade children in Alabama, Texas, and California who were part of the Orinda Longitudinal Study of Myopia (OLSM), and measured refractive error, parent myopia status, hours per week engaging in near work such as reading and homework, and hours per week engaging in sports. Analyses revealed that those with myopia engaged in less time playing sports compared to those without myopia (7.8 ± 6.7 hours/week vs. 9.7 ± 6.2 hours/week).[36] Authors speculate a number of reasons why this association exists, including personality differences among children who have myopia, difficulties in sport engagement when wearing glasses, and lastly a protective effect of sport participation. A related study by the same group used more recent OLSM data to determine if the development of myopia could be predicted from parental myopia status, and the number of parent-reported hours each week their child engages in activities including: studying/reading for school, reads for fun, watches television, uses a computer/plays video games, and engages in outdoor and/or sport activities.[37] Results showed that children who had nearsighted parents were likely to develop myopia. Additionally, children who developed myopia spent less time engaging in outdoor and/or sport activities compared to children who did not develop myopia (7.98 ± 6.54 hours/week vs. 11.65 ± 6.97 hours/week, $p<0.001$, respectively).

More recently, Rose et al.[35] sought to identify the associations between the prevalence of myopia, also referred to as nearsightedness, and time spent engaged in outdoor activity in a large group of Australian children (age 6 = 1,765 children, age 12 = 2,367 children). Near work (i.e.,

activities performed at <50cm working distance including reading, homework, drawing, handheld computer) and midworking distance (*i.e.*, television watching, video game playing, computer use) were also assessed. Presence of myopia was determined by comprehensive eye exams. Questionnaires, completed by the parents of young children and self-reported by 12-year-olds, asked about the amount of time spent daily engaging in activities outdoors versus indoors. Authors found 12-year-olds in the highest tertile of outdoor physical activity ($\geq$ 2.8 hours/day) had a lower prevalence of myopia compared to the lowest tertile (<1.59 hours/day) of outdoor physical activity. Furthermore, children who were grouped according to combined highest tertile of near work/lowest tertile of outdoor physical were 2.6 times more likely to have myopia than children who were classified into the group that combined the lowest tertile of near work/highest tertile of outdoor physical activity (OR=2.6, 95%CI 1-2-6.0, p<0.02).

The only study that has identified how physical activity and screen time influence eye vasculature was published by Gopinath and colleagues in 2011.[38] The purpose of the study was to identify how parent-reported hours per day spent engaging in outdoor sporting activities, indoor sporting activities, sedentary behaviors, were related to retinal microvasculature. Retinal microvasculature was measured by photographing the optic disc and macula of the child's dilated eye. Time spent participating in outdoor sporting events was broken into tertiles (low, < 0.14 hours/day; moderate, 0.18-0.54 hours/day; high, $\geq$ 0.57 hours/day). Quartiles were developed for total screen time (1st quartile, <1.07 hours/day; 2nd quartile,1.14-1.64 hours/day; 3rd quartile, 1.71-2.29 hours/day; 4th quartile, $\geq$2.36 hours/day) and television time (1st quartile, <0.57 hours/day; 2nd quartile,0.79-1.14 hours/day; 3rd quartile, 1.29-1.29 hours/day; 4th quartile, $\geq$1.50 hours/day Results were that children in the highest tertile for outdoor sporting activities had smaller retinal arteriolar diameter compared to the lowest tertile of outdoor sporting activity

time [164.7 (95%CI 163-166.5) µm vs. 162.5 (95%CI 160.9-164.1) µm, p=0.004, respectively]. Furthermore, there were significant associations identified between total screen time and television time, specifically that children in the highest quantile of total screen time and television time has the most retinal narrowing compared to lowest quantile of time [total screen time, 161.6 (95%CI 160.2-163.0) µm vs. 164.1 (95%CI 162.7 – 165.4) µm, p<0.01; television time, 161.9 (95%CI 160.7-163.1) µm vs. 164.2 (95%CI 163.0-165.4), p<0.05, respectively]. The narrowed retinal arteriole that was exhibited in the lowest tertile of outdoor physical activity and highest tertile of total screen/television time has been identified in adults and children as an indicator for hypertension. The authors also propose that spending approximately 30 additional minutes outdoors a day could influence retinal health.[38]

Although no studies have provided detail on the mechanisms relating sport participation and outdoor physical activity to the presence of myopia, a number of reasons have been proposed. A study by Rose et al.[35] speculates that one of the most important factors contributing to the associations between myopia and outdoor physical activity is light intensity in indoor versus outdoor conditions. When exposed to outdoor environments, the pupil is often in a constricted state, resulting in a larger depth across the field of vision and possibly less image blur, however the exact mechanism is not well understood at this point.[35] Mutti et al.[36] suggests a protective effect of sport participation, which may be in part explained by outdoor light intensity exposure and the consideration that a large proportion of youth sport can be performed outside. Although promising, further research is needed to clearly identify the relationship between outdoor time and myopia prevalence.

Psychological Health and Well-Being

There have also been a small number of studies on outdoor physical activity in children that have focused on variations of psychological health and well-being. Specifically, research on children with symptoms of attention-deficit/hyperactivity disorder (ADHD) has been heavily associated with natural environments. A study by Kuo et al.[39] surveyed a group of 452 parents and asked them questions regarding their child's ADHD symptoms and exposure to natural environments. Results identified that children spending time in natural settings after school and on weekend significantly reduced ADHD symptoms of their child. In 2009, the same authors performed a follow-up study with a group of 17 children (ages 7-12) who participated in three different experimental groups (walk in park, walk in downtown of city, walk in neighborhood).[40] The results of the study were that children were able to better concentrate following a walk in the park compared to either of the urban walks. These results highlight the potential benefits of engaging in natural environments for a host of related psychological health outcomes including anxiety, depression, and general stress.

Although the research identifying positive physiological and psychological health outcomes associated with outdoor physical activity is in its infancy, the existing literature provides encouraging data on the measurement and subsequent benefits of engaging children in the outdoor environment. These findings provide the foundation for this dissertation and further research on modes in which to increase outdoor physical activity participation in children.

Promotion of Outdoor Physical Activity

The evidence available on the benefits of outdoor physical activity warrant the need for ways to increase child engagement in outdoor, natural environments, and local, state and national initiatives have all responded and set out to get children and adults back out in the outdoors. For

example, the First Lady's Lets Move! Outside [41], and the Children and Nature Network headed by Richard Louv have both set forth national efforts to re-engage children in the outdoors through the provision of family/caregiver and school toolkits and resources linked to local opportunities.[42-44] Furthermore, in the state of Tennessee, limited outdoor activity has become a concern to the point that the Tennessee Department of Environment and Conservation has refocused their efforts on better engaging children in nature. This has been a major revision of their 2020 People Outreach and Engagement Initiatives.[8] Locally, programs such as Girl Scouts, Boy Scouts, Girls Outside, and the Urban Wilderness Patch through Ijams Nature Center have spearheaded goals of reacquainting children with nature. Although local, statewide, and national programs have expressed interest and concern, few studies have focused on the promotion of outdoor physical activity as a method of improving the health of children and parents.

To date, only two interventions have been identified that specifically focused on the promotion of outdoor physical activity in children. Davison et al.[45] assessed the feasibility and efficacy of a program aimed to increase children's outdoor play and parent's physical activity, decreasing child and parent television viewing time, and improving parental self-efficacy for influencing physical activity by providing community resources specific to outdoor physical activity. Participants were 880 families (intervention, n=422, control, n=458) who were administered an "Active Families" intervention. Following the intervention, the intervention children were more likely than the control children to accumulate greater than 60 minutes outdoor play (OR=2.79, 95% CI (1.94-4.02), $p<0.001$). Intervention parents compared to control parents were more likely to watch less than 2 hours of television a day (OR=2.37, 95% CI (1.69-3.33), $p<0.001$). Intervention parents also were more likely to report confident in limiting children's television time (OR=3.32, 95% CI (2.17-5.07), $p<0.001$), although there were no

significant decreased odds of intervention children watching less than two hours a day of television. The results of the program evaluation showed that the most frequently used aspects of the intervention were the list of community events and maps provided to find places to take their child to be active.

The study by Finkelstein et al. [46] assessed 285 children (8.21±1.50 years) from 212 families who participated in an incentive-based outdoor physical activity program. The Omron HJ720-ITC pedometer was used to assess physical activity throughout a 9-month randomized controlled trial. Each of the families that were part of the intervention arm was given a pedometer and also information on structured weekend outdoor activities. The families of the intervention were encouraged to participate in at least 2 family activities a month, each of which lasted 2-3 hours each weekend. Following the intervention, results showed statistically significant differences between the control group and intervention group in the average total steps taken per week (7767 ± 382 step per day vs. 8660 ± 567 step per day, respectively, $p<0.01$). There were also differences in the average weekday steps (7826 ± 664 step per day vs. 8646 ± 447 step per day, respectively, $p<0.05$) and average weekend steps (7684 ± 664 step per day vs. 8779 ± 885 step per day, respectively, $p<0.05$). Results also showed that the children in the intervention group met their 8000 step per day goal more frequently than the control group (total week, 24.0% vs. 1.9%; weekday, 33.0% vs. 8.4%; and weekend, 50.0% vs. 12.6%, respectively, $p<0.01$,). The results of this study emphasize promising results from a pedometer-based, outdoor physical activity program.

The establishment of healthy lifestyle behaviors begins very early on in life, and therefore the school-aged child is a critical time to intervene. This dissertation will include the provision of information to parents on the importance of physical activity as a whole, as well emphasize

the importance of outdoor environment in a child's physical activity level in order potentially increase the physical activity levels of the child. Engagement in nature and the outdoors is a critical aspect of health and well-being for individuals, and offers a low to no-cost option and sustainable opportunity to be physically activity. The studies by Davison et al.[45] and Finkelstein et al.[46] provide encouraging results supporting interventions to promote outdoor physical activity. Although Davison et al.[45] included an evaluation of parenting self-efficacy, little other parenting outcomes were included, and no parent outcomes were reported from Finkelstein et al.[46] Based on the necessary involvement of parents to provide support and encouragement for outdoor physical activity, more information is needed on how these variables can be influenced through an outdoor physical activity intervention. This dissertation will expand on the findings from Davison et al.[45] and Finkelstein et al.[46] by being the first to provide an evaluation of pre and post parent perceptions and behaviors as they relate to child outdoor physical activity promotion. Additionally, this dissertation will include information for parents on local community trails and park that are already present and highly accessible. This topic has been well studied in the literature and is well-supported.

The Family Ecological Model

As the prevalence of the studies identifying correlates of childhood activity and the use of family-centered intervention continues to grow, so does the need for the development an improved framework to better inform interventions addressing family health behaviors. The Family Ecological Model (FEM), developed by Davison and Birch, establishes the levels of influences that should be considered while working with families and stems from the social ecological model. The family unit should be considered a unique population on its own, joining together the barriers to physical activity across two populations (adults and children) and

ultimately creating barriers of its own.[47] Just as with most behavioral models, the FEM identifies that an individual's health behaviors (i.e. physical activity levels, nutritional habits) cannot be fully understood without considered the context of the environment that individual is a part of. When considering a child's health, a deeper look into the family context becomes a critically important variable. In the book Obesity Prevention and Public Health, Davison and Campbell elaborate on the use of the FEM for effective interventions aimed to influence the health behaviors of a family.[48] This model indicates that in order to approach child specific outcomes such as child physical activity level, the context of parenting and the family's situation needs to be a focal point since a child's activities of daily living and caregiving patterns are dictated by a number of factors. [49] In the FEM, these factors are referred to as the "ecology of parenting" and include four key aspects. The first is the socio-ecological context of the family, which includes family demographics, and community and organizational factors. The second is the characteristics of the parent. Parent characteristics are multifaceted, and include parent attributes (i.e. parent enjoyment of activity, value of activity for health, self-efficacy) and parent views of their child competence to be active. Third is the parenting practices related to physical activity and may include providing logistic support for activity, role modeling of a physically active lifestyle, and fostering enjoyable physical activity experiences for the child. Finally, child level characteristics that influence physical activity should be considered. These include enjoyment of physical activity, self-efficacy towards being active, and motivation.

Despite the development of the model, few family-centered interventions have sought out a framework to base the design of the study are limited across all ages of youth. The FEM lead author, Dr. Kirsten Davison, has published widely on the FEM and utilized the model through the Communities for Healthy Living (CHL) program. The study evaluated a sample of 153

families of preschool aged children enrolled in Head Start.[49] This study utilized the FEM as the overarching theoretical framework, and added in aspects of the Empowerment Theory. Together, the combination of the two models was called the Family-Centered Action Model of Intervention Layout (FAMILI) [49]. A unique aspect of this study was the use of parents for intervention development and implementation. This is one of the primary reasons why the FEM can be considered an emerging framework for family-centered interventions; it uses techniques to engage the most direct influence at the home including parents. The CHL formed a community advisory board that included parents of the children, as well as local community members and stakeholders. Parents were engaged by asking them questions related to the sustainability of the program and the behavior changes the intervention was focusing on (diet and physical activity).

The intervention included a health communication campaign, letters mailed to families about the information being provided in the campaigns, a Head Start classroom-based nutritional counseling session, and a 6-week parent-led program, Parents Connect for Healthy Living, which included the promotion of parent networking, advocacy of healthy lifestyles and family-centered communication and conflict resolution skills. At follow-up, children in the intervention engaged in significantly more light intensity activity after the program (21.7±3.2 vs. 22.0±3.3 minutes, $p<0.05$). Children also spent less time watching television at the follow-up (141.9±77.9 vs. 71.3±40.5 minutes, $p<0.01$). The effectiveness of this program on sedentary pursuits such as watching television may be due in part to the structure of the intervention, which allowed for parents to take ownership of home-level changes. However, much research is still needed on how to best engage the parents in order to increase healthy behaviors in children.

Due to the limited but promising research available on the FEM, this dissertation will utilize the framework for intervention development. This dissertation will focus on how an intervention, grounded in the FEM, can be used to help inform a program designed to increase the amount of time parents and children spend being active together.

Parental Influences on Children's Physical Activity Levels

According to the 2010 United States Census, there are approximately 41,025,851 children ages 5-14 nationwide (13.3% of total population).[50,51] Due to the large proportion of the population that is school-aged children, it is important to assess the influence that parents/caregivers have on the child. Families offer a complex and unique population for increasing physical activity and a better understanding of these influences will help to design successful interventions that take into account the broader context of the family unit. The least explored of parenting factors are the perceptions related to physical activity behaviors, which include value or perceived importance of physical activity for health and self-efficacy for introduction physical activity and sedentary time behavior changes. These variables are often left out of assessments, but it is likely that these perceptions cognitively preclude a parent's physical activity behaviors. Parent behaviors such as role modeling and support for physical activity are heavily studied, and have been shown to be directly linked to child physical activity.

Based on the influential role parents play in a child's life, it is necessary that we explore how parent perceptions and behaviors relate to, and ultimately influences, child physical activity levels. This section of the literature review will discuss how parent value for physical activity, parent self-efficacy, parent role modeling, and parent support for physical activity are related to youth physical activity outcomes.

Value of Physical Activity for Health

The value, or level of importance, parents place on physical activity for health is one of the least studied aspects of parent perceptions. It has been suggested that value for physical activity precedes parent physical activity behaviors. However, there are few select studies that have included this measure.

A study Adamo et al. [52] performed telephone-based surveys in Canadian parents to examine how value influenced physical activity levels of children. Results showed that 98.9% of parents reported that physical activity was important for their child's health and that value for physical activity was positively associated with parental report of their child's physical activity.[52] These findings have been reflected in a study by Dempsey et al.[53] which used a detailed parent questionnaire and asked parents about value of physical activity for health. The study used a 4-point Likert scale ranging from 1 (strongly disagree) to 4 (strongly agree) to assess parent view of three different statements concerning the value of physical activity [i.e. "It is important that my child participate regularly (at least three times per week) in exercise."].[53] and found that higher parent value was positively correlated with parental report of their child's physical activity level ($r=0.24$, $p<0.05$).

Trost et al.[54] determined value of physical activity for adolescents by asking parents a single question of "How important is it for your child to participate in physical activities and/or sports?," as part of a detailed questionnaire. Interestingly, authors found that not only was value related to parent support for physical activity, but that support was then in turn related to child physical activity levels. This study by Trost et al.[54] was one of the first to identify the two part relationship between parent perception, parent behavior, and child physical activity levels and is one of the landmark studies for the design of the Active Families GO program.

Few studies have included detailed surveys that include a range of one to three questions addressing value of physical activity for youth health. Horn et al. [55] used a very detailed questionnaire to assess parental value of MVPA for adolescents. The questionnaire, the Reasons for Children's Fitness Participation Scale, addressed value in extensive detail, and asked parents why fitness and activity are important for a child's health, and to what extent the parent feels that importance exists. Results showed that life skills development, physical health, mental health, preparation for sport, weight control, and fun were highly valued reasons for being active but there were no associations identified between each of the survey items and their child's physical activity. A second study by Heizler et al. [56] examined the perceptions of parents and self-reported physical activity levels of 9-13 year old children. Results were that children who had parents that felt that it was important for their child to participate in physical activity had children who were more likely to participate physical activity organized physical activity [organized activity, OR = 1.19 (1.09 – 1.31); free-time physical activity, OR = 1.24 (1.10 – 1.40)] compared to children of parents who valued physical activity less.

It is clear from the lack of literature on the value of physical activity for health that more research is needed to better understand how parental views of physical activity influence their child's health. This dissertation will utilize the four detailed questions developed and published by Heitzler et al.[6] to assess parental value for physical activity. The questions have been previously used and provide items related to not only health, but also self-confidence, school behaviors, and future health status.

Parent Self-Efficacy

Parenting self-efficacy has also been associated with children's physical activity levels, and behavior modification at the family level. Parenting self-efficacy refers to the mother or

father's perception of their own ability to perform a task effectively. In the case of child physical activity, parenting self-efficacy is most often associated with a parent's confidence to introduce physical activity behavior changes at the child or family level.[57] Within both the Theory of Planned Behavior and the Family Ecological Model frameworks, self-efficacy is a desired aspect to be improved upon. Despite the necessity for parental self-efficacy, only a few studies have reported assessment of parent self-efficacy for school-aged and adolescent physical activity.[58,59]

A study by Kendall et al. [57] created and validated the Tools for Assessing Parent Self-Efficacy (TOPSE) survey. Focus groups were conducted with parents to help inform the questionnaire development. There were nine domains of parenting identified in the focus group including play and enjoyment, discipline and boundary setting, and learning and knowledge domains. A recent study by Smith et al.[58] utilized the TOPSE in order to determine the effect of a community-based intervention to improve weight status of children. The study assessed the self-efficacy of 240 parents of overweight and obese children (6.1±0.8 years). The study found that parenting self-efficacy was improved during the study. Specifically, Smith et al. [58] compared pre intervention and post intervention assessments and found that parental efficacy play and enjoyment increased (48.6±10.4 vs. 51.6±9.1, respectively, $p<0.0001$), discipline and boundary setting efficacy improved (42.0±11.9 vs. 47.3±9.7, respectively, $p<0.0001$) and learning and knowledge scores improved (48.7±9.2 vs. 51.1±8.3, respectively, $p<0.0001$).

A study by Remmers et al.[59] evaluated the parent perceptions and physical environment of the home as they relate to child outdoor physical activity levels. Outdoor physical activity was reported by parents using the Outdoor Physical Activity Recall questionnaire, and parent self-efficacy was measured using the question 'It is difficult to let my child engage in more outside play' which is reflective of a parent's perceived difficulty in improving outdoor play

participation. Results showed that 5-year-old children of parents with lower perceived difficulty engaged in an average of 16 minutes more of outdoor physical activity compared to children with parents who have a high perceived difficulty. At age 7, the difference was even more dramatic, with children of low perceived difficulty parents engaging in approximately 22 minutes more of daily outdoor physical activity compared to high perceived difficulty children. These results emphasize the importance of parent self-efficacy on creating outdoor physical activity opportunities, and suggest self-efficacy variables should be considered as part of outdoor physical activity program study design.

Previous studies have shown that parental self-efficacy is significantly related to physical activity levels, however little work has been done in elementary school children. It is clear from the literature that valid tools for assessing parent self-efficacy are limited, however there is a need for tools to evaluate the perceived abilities of parents to implement and manage changes in their children. However, the best strategies for increasing self-efficacy have yet to be identified.

Parent Role Modeling

In child and family-centered literature, parent role modeling is almost exclusively assessed as parent physical activity levels. This variable has been identified as a key correlate of physical activity in children and the importance of the variable hinges on the fact that parents set an example for their children by the types of lifestyle behaviors in which they engage. However, the relationship between parent and child physical activity levels has been found to be relatively inconsistent across different ages of children.

Self-report measures of parent and child physical activity have been widely used to identify the associations between physical activity levels. The associations of parent and child

physical activity levels from seven European countries were evaluated using a seven-day recall. Results identified positive associations between parent and son activity levels in Belgium (maternal, β=0.19, paternal, β=0.17, $p<0.05$), Greece (paternal, β=0.13, $p<0.01$), the Netherlands (paternal, β=0.23, $p<0.01$), and Spain (maternal, β=0.16, paternal, β=0.14, $p<0.05$). Parent and daughter physical activity levels were also positively associated in Belgium (maternal, β=0.19, paternal, β= 0.16, $p<0.05$), Greece (β=0.20, 0.20, $p<0.01$), Spain (β=0.17, 0.18, $p<0.05$), Slovenia (β=0.12, 0.13, $p<0.05$) and Norway (maternal, β=0.12, 0.10 $p<0.01$). Fogelholm et al. [60] assessed parent and child physical activity using the three-day self-recall of physical activity. The results showed positive associations between parent self-report and child self-reported physical activity. Although there have been positive findings identified between self-reported physical activity levels of parents and children, studies have also identified no association among the variables.[53-55,61-66] The lack of consistent, strong findings between parent and child physical activity shows the need for more robust measures of physical activity to better tease out the associations among family members.

Another interesting aspect of role modeling that has been minimally explored in the literature is how gender roles influence physical activity levels of children. Davison et al. [67] studied parent-daughter dyads in an effort to better understand how family-level role modeling influences physical activity levels of children. The results showed that daughters' self-report of physical activity were positively associated with fathers' self-reported physical activity. However, no associations were identified with mothers' physical activity. Karppanen et al. [68] assessed the associations between parent (mothers and fathers) and child physical activity levels and found that mothers' physical activity was associated with the children's physical activity levels ($r=0.36$, $p<0.001$) but not father's activity levels. Sallis et al. [69] examined the physical

activity levels of parents and children using the seven-day physical activity recall and found that there were no significant correlations between fathers and children. There was a significant correlation between physical activity levels of mothers and children ($r=0.20$, $p<0.01$).

Only three studies have used objective measures of physical activity to assess associations between parent and child, and the results were conflicting. Jacobi et al.[70] used a pedometer to assess step counts of parents and children during a one-week time frame. There were significant positive associations between physical activity levels of mothers and daughters ($r=0.24$, 95%CI: 0.12-0.36) and mothers and sons ($r=0.18$, 95% CI: 0.05-0.31). A study by Fuemmeler et al.[71] used the ActiGraph 7164 accelerometer for four days (Thursday– Sunday) to measure parent-child physical activity associations. Results showed fathers' and mothers' physical activity levels and sedentary time were positively associated with children's physical activity/sedentary time. Specifically, for fathers there were associations with children's physical activity on the weekend (MVPA, $r=0.56$; sedentary time, $r=0.40$, $p<0.01$) and weekdays (MVPA, $r=0.31$; sedentary time, $r=0.041$, $p<0.01$). Mothers' physical activity and sedentary behaviors were associated with the child's physical activity and sedentary time as well on weekends (MVPA, $r=0.43$; sedentary time, $r=0.45$, $p<0.01$) and weekdays (MVPA, $r=0.39$; sedentary time, $r=0.34$, $p<0.01$). Freedson et al. [72] used a Caltrac accelerometer to assess parent-child physical activity levels. The study found that there was a 67% resemblance in father-child physical activity levels ($\chi 2=5.81$, $p<0.05$). There was also a nearly 73% resemblance in mother-child physical activity levels ($\chi 2=6.72$, $p<0.05$). These studies suggest that both self-reported and objectively measured physical activity role modeling may be different depending on gender.

The inconsistency across ages and gender roles of parent and children show the need for future research to examine how the transition from childhood into adolescence shifts the

influence of parent physical activity on the behaviors of the child. Furthermore, differences between mothers and fathers in the home necessitate a need for additional research examining how gender roles effect youth physical activity behaviors. This dissertation will seek a wide age range of children (7-17) and include equal representations of mothers and fathers in order to potentially address some of these questions.

Parent Support and Encouragement

Support and encouragement of physical activity is quickly becoming one of the primary parent behaviors of focus in relation to children's physical activity levels. School-aged children typically have a high dependency on their parents for aspects of physical activity participation including transportation and enrollment in games. Therefore, it is essential that we better understand how support and encouragement variables influence physical activity levels of children.

Only select studies have examined the association between parent support for physical activity and objective measures of child physical activity. Sallis et al.[64] assessed physical activity using both child self-report and physical activity measured via accelerometer for seven days. Parental support was assessed by asking about the frequency of engaging with, encouraging during and transporting their child to physical activity opportunities. Results identified positive associations with support and both girls' (β=0.20, $p<0.05$) and boys' (β=0.21, $p<0.01$) self-reported physical activity levels; no significant associations between support and accelerometer-measured physical activity. Adkins et al. [73] and Beets et al. [74] assessed parent support as it related to child physical activity measured via. Adkins et al. [73] used an accelerometer to continuously assess children's physical activity over three days. Results found no association between parent support and child physical activity. Beets et al. [74] used a pedometer to track

children's daily steps taken over a seven-day period. There were no positive associations between parent report for their support for activity and children's daily step totals. Arrendondo et al. [75] and Sallis et al. [76] both assessed child physical activity using parent estimations and the studies reported conflicting results. Arendondo et al. [75] found positive associations between parent support and child activity levels, and Sallis et al. [76] found no association. Conversely, studies have also resulted in no association between parent support and physical activity levels.[62]

Similar to the findings with role modeling, there have been mixed results for associations between children and mothers and fathers separately. A study by Davison et al. [67] identified that only mother's self-report for support for activity was positively associated with child self-report of physical activity levels, indicating that mothers and fathers have separate roles. However, gender role differences have also been identified for support and daughter/son physical activity levels. Hoefer et al. [77] identified that parent support for physical activity was significantly associated with daughter's physical activity ($R^2 = 0.035$, $p<0.001$) and identified no associations for sons' physical activity levels. These findings have been confirmed by other studies and propose that there may be differences in the types of support that should be provided to girls and boys.[76,78]

Support for adolescence physical activity also raises a different question about the role of parents because there may be more freedom for the child to provide his/her own logistic support to and from physical activity engagements. Still, associations have been identified for parent support and physical activity among older children. Sallis et al.[79] assessed the associations of parent support (questionnaire) and youth self-reported physical activity and found that parent positively predicted the physical activity levels of adolescent boys' (partial r=0.173-0.149, $p<0.05$) and girls' (partial r=0.161-0.375, $p<0.05$) physical activity levels. Similar results were

shown by Trost et al.[54] who reported positive associations for weekly frequency of encouragement, transportation and watching activity and child physical activity (β=0.24, $p<0.001$). Encouragement through positive praise was also found to significantly influence physical activity levels of youth of different racial backgrounds. McGuire et al. [80] examined differences in parental correlates of activity for Caucasian and African-American boys and found that encouragement for physical activity was positively associated with activity for Caucasian boys ($r=0.39$, $p<0.01$) and African-American boys ($r=0.26$, $p<0.007$) .

A study by Davison et al.[81] surveyed 202 middle-school boys (12.7±0.8 years) and girls (12.5±0.8 years) about their physical activity levels using three different self-report surveys (Children's Physical Activity scale, an activity checklist, and a subscale of the Physical Self-Description Questionnaire) and their perceived physical activity support using the Activity Support Scale. The Activity Support Scale, developed by Davison and colleagues, is commonly used in parent-child physical activity studies, and includes questions that assess the general familial social support for physical activity as well as individual peer, sibling, maternal and paternal support for physical activity. The study found that general familial support was significantly correlated with paternal and maternal logistic support, and paternal and maternal modeling of physical activity (0.44, 0.39, 0.57, and 0.48, $p < 0.001$, respectively). Additionally, there was a significant association between physical activity level and general family support. Specifically, girls in the high physical activity group reported higher family support for physical activity than the girls in the low physical activity group ($F = 7.97$, $p<0.01$).[81]

With respect to outdoor physical activity and family physical activity time, only one study was identified that discussed parent support for outdoor physical activity. A study by Grigsby-Toussaint et al.[29] identified positive associations between the amount of support

provided to a child by parents, and the amount of time spent engaging in outdoor physical activity. Physical activity was reported by parents using the Outdoor Physical Activity Recall questionnaire. Results showed that children whose parents engaged in less time spent playing outside with them (low support group) engaged in approximately 35 minutes of MVPA which was significantly less than medium support group (40.6 minutes of MVPA) and high support group (46.5 minutes). Similarly, results by Vander Ploeg et al. [82] found that parental support parental support through joint-engagement in physical activity with their child was positively associated with the child's physical activity level (β=0.33, 95%CI: 0.28-0.37). These associations specific to outdoor physical activity and joint-family time engagement provide foundational support for the use of family physical activity programming to increase outdoor physical activity levels of children.

Overall, it can be generalized that parent perceptions and behaviors regarding physical activity influence child physical activity outcomes. Further research is needed to identify how each of these variables can be positively influenced using family-centered intervention programs to increase outdoor physical activity as no longitudinal studies have been identified. This dissertation will evaluate how providing a family-centered physical activity program emphasizing family time can impact parent perceptions and behaviors.

Effects of Parenthood on Adult Physical Activity Levels

Just as parents have been found to have a significant influence on a child's physical activity behaviors, the same can be said for the toll of being a parent on adult physical activity levels. It has also been suggested that parenthood may substantially influence the physical activity levels of an adult as the role of being a parent requires a large time commitment and

reorganization of priorities.[83] The most frequent reasons reported for lack of physical activity were child-care responsibilities and balancing the role of work and home life.[27,84]

A recent study by Rhodes et al.[15] assessed how physical activity levels changed in three cohorts of couples (not expecting, expecting first child, expecting second child) across 12 months. Participants were men and women (n=157 common law/married couples, 314 individuals) ages 25 – 40 years old. Physical activity and sedentary behaviors were assessed using the ActiGraph GT1M physical activity monitor for seven consecutive days in six month intervals (baseline/pregnancy, six months, 12 months). At baseline, 53.9% of couples without children were meeting the physical activity guidelines, compared to 45.7% of couples expecting their first child and 34.2% expecting their second. For sedentary behaviors, the study found couples who were expecting their first child engaged in significantly more sedentary behavior than couples expecting a second child (husband $\beta = 0.30$, wife $\beta = 0.34$, $p<0.001$). Additionally, couples who were not expecting a child spent significantly less time engaging in sedentary behaviors than the couples who were expecting their second child (husband $\beta = -0.36$, wife $\beta = -0.25$, $p<0.001$). The first-time mothers also decreased their sedentary time compared to women who were not expecting children ($\beta = -0.22$, $p<0.001$). For physical activity, the results of the study found that first time mothers significantly increased the amount of time they spent in light intensity activity compared to women without children ($\beta = 0.21$, $p<0.001$). Specifically for MVPA, the biggest changes were observed when comparing non-parents to first time parents. Couples without children accumulated more MVPA than couples with a second child (husband $\beta = -0.23$, wife $\beta = -0.20$, $p<0.001$). Again, first time mothers also showed the most dramatic decrease in the physical activity levels compared to their non-parent counterparts ($\beta = -0.17$, $p<0.05$) but first-time fathers showed no decrease in MVPA ($\beta = 0.09$). The results of this study

highlight the various ways in which physical activity and sedentary behaviors can be influenced by the introduction of a child to the family. Also, how those changes can be influenced by gender. It is clear that physical activity interventions are necessary to help attenuate the decline in MVPA that is observed in parents, and a family-centered program may be a potential intervention strategy.

A more recent study by Hull et al.[85] used a prospective study design to address the effects marriage and parenthood on physical activity in adults. The authors surveyed 638 adults two years apart using the Past Year Leisure Time Physical Activity Questionnaire [86] and found significant reductions among physical activity levels among those who had become parents compared to those who had remained childless. Once stratified by sex, similar to Nomaguchi et al.[83], authors found that there were no significant reductions in physical activity among women who had children compared to women who were childless (-0.11± 6.4 vs. -2.4±3.0 hours/week, $p< 0.26$). However, fatherhood influenced the physical activity levels of males, with results showing a significant reduction among men who had children compared to those who remained childless (-5.0± 6.8 vs. -1.5±8.0 hours/week, $p< 0.05$).

A study by Nomaguchi et al.[83] assessed the relationships of marriage, parenthood and time spent exercising (hours per two weeks) in 13,496 men and women who completed the 1995 National Health Interview Survey. Results showed that parents spent significantly less time exercising compared to nonparents (4.58 hours per two weeks vs. 5.35 hours per two weeks, $p < 0.001$). There were no significant differences specifically among women who had children compared to those who did not (4.15 hours per two weeks vs. 4.42 hours per two weeks). However, there were significant differences among men who had children compared to those who did not (5.08 hours per two weeks vs. 6.20 hours per two weeks, $p < 0.001$).[83] These results

not only showcase the differences among adults who have children compared to nonparents, but also suggest that fatherhood may negatively influence the exercise behaviors of men.

Based on previous literature, it is clear that parenthood influences the physical activity levels of an adult. However, there are several limitations to the current work that is published on this topic. These studies have failed to incorporate an objective measure of physical activity as their method of assessing levels of physical activity. It is possible that as a child ages, there are more opportunities for parents to be physically active either individually or with their child. Finally, as these studies have shown, there seems to be more of a relationship between fatherhood and reductions in physical activity. This dissertation will add to the body of literature on parenthood and physical activity by providing information on how parents and children can be engaged in activity bouts together, which allows for potential alleviation of aspects of time barriers. Additionally, this dissertation will provide information on how parent value, self-efficacy, and support can potentially be influenced by a family-centered program.

Home - Based Family Interventions

As expected, there have been a number of different avenues identified for increasing the physical activity levels of children. However, a recent meta-analysis by Metcalf et al.[87] found that interventions aimed to increase the physical activity levels of children have a relatively small effect. The earliest avenues for increasing childhood physical activity were in the schools, where daily opportunities such as physical education and recess were targeted.[14] The school-based interventions are the most commonly found in child intervention literature, and as discussed in the Midcourse Report: Strategies for Increasing Physical Activity in Youth, multi-component school interventions to have the most sufficient body of literature supporting their use. However, few school studies have been able to elicit changes at the family level. Although community-

based, large scale programs are one of the many goals of child health researchers and practioners, to date, very few studies have reported the success of interventions with family components at the community level.[14,88]

The recent Physical Activity Guidelines for Americans Midcourse Report: Strategies to Increase Physical Activity Among Youth states that there is insufficient evidence of strategies to increase physical activity in the family- and home-based settings.[14] Unfortunately, the family components included in school- and community-based interventions have encountered a number of barriers. This may be due to the lack of in-depth focus on the home environment and behavior changes at the family level, which is primarily facilitated by the parents. Home-based interventions have more recently become utilized as a mode of increasing physical activity in families as they provide a more approachable way to engage parents as a captive audience. Although limited, the high level of importance placed on changing the home environment to foster increased physical activity has resulted in somewhat promising results. A family-centered intervention is not simply an intervention that involves parents and children, but includes a number of influences that are critical to the health of a child. Typically, in order to be family-centered, the intervention should include a competency-based approach, in which decision making, capabilities and competencies of care providers are enhanced through the provision of resources and support networks to help the family reach their goals.[89] Although the needs of the child are the primary focus of a family-centered intervention, this approach allows for the improvement of healthy behavior outcomes of the parent and the whole family as well.[47]

The home-based family interventions that have been published have reported a wide range of results and involve a wide variety of study designs, methodologies and outcome measures which makes the overall evaluation of family intervention effectiveness very difficult.

Additionally, few home-based interventions have attempted to implement studies in school-aged and adolescent children. This section will highlight the use of home-based interventions to improve physical activity levels of children ages 7-17 years of age.

An intervention in Australia by Morgan et al.[90] developed and implemented the "Healthy Dads, Healthy Kids" specifically for weight loss in overweight fathers. The main goal of the program was to focus on instilling healthy behavior patterns into the lives of their children by way of engaging the fathers and children together. Preliminary results published by Lubans et al.[91] assessed the mediators of weight loss in the overweight fathers. The protocol utilized the Yamax 200 pedometer to objectively assess the step counts of the fathers and children at three different time points (baseline, three months and six months). These monitors have been previously validated for use in both children and adults. Results of the pilot testing showed that both fathers and children had an increase in the number of steps per day from baseline to six months (2769±750 steps·day^{-1} and 1486±521 steps·day,$^{-1}$ p<0.01, respectively) [91]. The results of this study demonstrate the use of a family-centered intervention for the promotion of physical activity in the parent, specifically the father, and the child simultaneously. This study teased out a very underrepresented population, the fathers, and tailored a program to fit the father-child relationship within a family. The intervention design included material for the fathers and children ("Manual for Dads," "Dad's Log Book," "Website User Guide," and "Kid's Handbook") which helped participants to stay engaged in the intervention.

Smith et al. [58] recently published data from the Mind, Exercise, Nutrition…Do it! (MEND) study which examined the effectiveness of an intervention that provided families with information on healthy eating, physical activity, and parent strategies for integrating healthy behaviors into the family. Participants were 440 children (6.1±0.8 years) and their parents or

caregivers who participated in a 10-week program that included weekly group sessions that focused on positive parenting. Each session contained four components: "Power Time", "Healthy Families", "Active Play" and "Parent/caregiver workshop." The "Power Time" component was designed to help parents introduce healthy nutrition changes and the "Healthy Families" component focused on promoting skills for increasing play and active family lifestyles in their home. The "Active Play" and "Parent/Caregiver Workshop" were simultaneously performed. Children participated in a 60-minute active play session while parents attended a workshop. Physical activity related aspects of the workshops included family rules and routines for reducing screen-time and increasing physical activity as well as overcoming barriers associated with their family's participation in physical activities. Physical activity was assessed using parental estimation of children's physical activity. A survey adapted from the Outdoor Playtime Checklist [19] was used to determine the number of hours a week children spent outdoors participating in physical activity and engaging in sedentary behaviors. The results of the MEND study found that following the 10-week intervention, children were participating in increased amounts of physical activity post intervention compared to pre-intervention (15.1±8.8 vs. 18.0±9.4 $h \cdot week^{-1}$, $p<0.01$, respectively). Children also participated in less sedentary activity pre-intervention compared to post-intervention (17.5±10.8 vs. 21.6±12.8 $h \cdot week^{-1}$, $p<0.001$, respectively) and less television time (13.2±9.0 vs. 16.6±10.9 $h \cdot week^{-1}$, $p<0.001$, respectively).

The Hunter Illawarra Kids Challenge Using Parent Support (HIKCUPS) study utilized three different treatment arms aimed at improving the weight status of overweight and obese 5-9 year old children [92]. The first group was a parent-centered nutrition change program which included parent face-to-face sessions, parent homework, and follow-up sessions. This aspect of the study involved the Health Belief Model and was meant to help parents instill healthy

behavior changes in their family. The second group was a child-centered physical activity change program that included group activity sessions, child homework, and follow-up sessions. The third group was a combined nutrition and physical activity program in which parents went to the nutrition change program while children participated in the physical activity program. Results of the study found that children in the parent-only, child-only and combine groups had a significant reduction in their daily energy expenditure (total energy expenditure, -113.4 vs. -66.9 vs. –74.3 $kJ \cdot kg^{-1} \cdot d^{-1}$, $p < 0.001$, respectively). There were also significant differences from baseline to 24-month follow up physical activity, however results went in the negative direction indicating that children got less active as the intervention progresses across the parent-only, child-only, and combined groups (total physical activity, -91.9 vs. -39.7 vs. -46.6 $counts \cdot min^{-1}$, p=0.02, respectively).[93]

The HIKCUP trial is one of the few physical activity related studies that attempted to address some of the controversy about the standard protocol that should be used when addressing childhood weight status, nutrition, and physical activity; the use of parent-only versus child-only versus parent and child combined interventions [92] This study's results are important because it highlights that all treatment arms elicited some type of change, and therefore there is still more information needed as to which mode is the most effective.

Although very limited, there are also studies that support the use of a family-centered intervention on parental outcome variables such as weight loss. A study by Cousins et al. [94] assessed the weight loss outcomes of 168 obese Mexican American women following a 12 month intervention. The aim of the study was to determine which method of intervention resulted in increased weight loss; an individualized group or a family approach. The individual group took part in an intervention that included 24 weekly courses that also included group

exercise, nutrition education and cooking demonstrations. Following the 24 weekly courses were a series of six monthly maintenance meetings. These meetings focused on strategies for preventing relapse. The family group took part in the same intervention but with a modification to the manual that provided information on partner support for healthy lifestyles. The manual also provided additional information on parenting strategies for increasing the exercise and eating behaviors of the children in the family. Although data was not provided, the family group was given the opportunity to have spouses attend meetings and bring children along to participate in a heart-healthy education program aimed at preschool children. The study by Cousins et al. [94] reported a trend towards increased effectiveness of the weight-loss intervention in the family group, however there were no significant differences in weight loss between the individualized and family group. These results suggest that a family-centered intervention may be useful not only for increasing the health outcomes of a child, but of the parent involved as well.

Currently, very few strictly home-based physical activity interventions have been implemented for the middle childhood and adolescent age ranges as a majority of the interventions center on preschool aged children.[95] However, the results of the existing literature are encouraging due to the success of specific components of the intervention such as providing families with materials and promoting changes in parenting practices. Due to the complexity of family life, there are a number of strategies that have not yet been assessed to increase parent and child physical activity. This dissertation will shed light on the usefulness of a novel family-centered program that promotes local resources and joint family activity as potential way to better engage families at home. This may provide for a more successful family component that

could serve as a standalone program, or be added to school- and community-based programming components.

Use of Family Time to Increase Physical Activity

One aspect of the family-focused intervention that is scarce in the literature is the use of multi-generational physical activities that parents and children can perform together.[89,96] As suggested in the Physical Activity Guidelines for Americans, family time is a great opportunity to engage in physical activity and outdoor physical activities allow for low and no-cost resources available for family physical activity including public parks, community fields, courts, and recreational spaces [97]. A cross-sectional study by Jago et al.[98] qualitatively assessed the needs of parents who were working to improve the physical activity levels of their children. Parents reported that they would find resources such as ideas about being active and transitioning sedentary time, and places to be active in the community helpful. A study by Dunton et al.[99] highlighted the association of parent and child physical activity levels, and parent and child proximity during physical activity. The cross-sectional study included 291 parent-child (average child age, 11.2 years, range 8-14 years) dyads who wore both an ActiGraph GT2M accelerometer and a BT-355 Bluetooth global positioning system (GPS) device. Both devices were worn at the level of the hip for a full seven day monitoring period. Joint physical activity was defined as a distance of 50 meters or less separating the parent and child. Overall, children spent an average of 19.5±15.5 min·day^{-1} in MVPA and 170.7±53.53 min·day^{-1} in sedentary behavior. Parents spent an average of 11.7±11.7 min·day^{-1} in MVPA and 191.0±55.5 min·day^{-1} in sedentary behavior. Approximately 89% of the parent-child dyads spent time participating in MVPA together, however the minutes accumulated of MVPA together were only 2.4±4.1 min·day^{-1} engaging in MVPA together. Furthermore, 100% of parent-child dyads spent time

together in sedentary behaviors. Children and parents spent an average of 92.9±40.1 min·day^{-1} engaging in sedentary behaviors together. There was an association between age and joint sedentary behavior. Older children with older parents engaged in significantly more sedentary time (p<0.05). There were also significant associations between more time spent in joint MVPA and parent age, specifically that younger parents were more active. Findings show that families do spend a large amount of time together outside of the school and work day, and that a majority of that time is spent being sedentary.

In addition to cross-sectional findings on the usefulness of joint family physical activity, longitudinal study designs have also been designed and implemented. The "Generations Exercise To Improve Fitness Together (GET FIT)" study by Ransdell et al. [100] was one of the first studies to incorporate a multi-generational physical activity program. The study included three generations of women (grandmothers (n=11), mothers (n=13), and daughters(n=13)) who were recruited to participate in a six-month home-based physical activity program that included lifestyle, aerobic, muscular strength, and flexibility-related activities. Following the intervention, participants in the intervention group had increased their daily steps (pre, 8422.9 ± 4304.7 vs. post, 11517.4 ± 3563.7 steps/day, p<0.001) compared to the control group (pre, 9411.2 ± 4029.3 vs. post, 8511.8 ± 3712.2 steps/day, p<0.001). This study was the first intervention to test the effectiveness of a joint family physical activity prescription on physical activity levels. Although the authors did not directly measure joint family time, all activity prescriptions were designed to include daughter, mother, and grandmother, and provided a critical foundation for the usefulness of promoting active time spent together.

A more recent study by Rhodes et al. [16] implemented a family physical activity planning intervention in 65 families of 4-10 year old children. Joint family physical activity was assessed

using journals completed by the parents. Results of the pilot study found that following a 4-week period, the intervention group exhibited significant increases in family physical activity frequency (2.6±1.4 vs. 4.1±1.7 bouts, $F = 5.31$, $n2 = 0.08$, $p<0.05$), and increases in total family physical activity minutes each week (135.2±82.5 vs. 234.2±100.5 minutes, $F = 4.26$, $n2 = 0.06$, $p<0.05$). This study demonstrates that an intervention that focuses on the promotion of family-centered physical activity bouts can be successful in increasing the amount of time spent engaging in activities as a family.

Although minimal, these studies support the use of a joint family physical activity prescription that aims to improve the physical activity behaviors of parents and children, as well as the provision of resources to help parents identify activity opportunities. The current study will build upon the results identified by Ransdell et al.[100] and Rhodes et al.[16] by utilizing measurements of joint family physical activity that provide detail on duration, type, location, and family member participation. Furthermore, this dissertation will include more detailed parent and child assessments of self-efficacy, support/encouragement, and enjoyment for physical activity.

Conclusions

A multi-generational approach to physical activity may be useful for increasing physical activity levels within the family. Based on the aforementioned studies reporting the barriers to outdoor play, it is possible that outdoor physical activity time with parents and children may help attenuate low levels of outdoor physical activity. Today's youth face a number of barriers to physical activity that makes the promotion of a family-centered intervention a logical approach.

The goal of this dissertation will be to utilize a family-centered physical activity intervention, grounded in the FEM that promotes active family time outside as an avenue for joint parent-child physical activity. The intervention will focus on providing educational resources on the physical activity recommendations for adults and children, the importance of physical activity and outdoors for health, and spaces in the local Knoxville community to be active as a family. Additionally, the dissertation will determine how providing these resources influence physical activity perceptions and behaviors of parents and children.

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Part III:
Active Families in the Great Outdoors: A Program to Promote Outdoor Family Physical Activity.

Abstract

The purpose of this study was to determine whether an outdoor physical activity program would result in a change in the duration and frequency of family outdoor physical activity bouts. **METHODS:** Participants were 25 parents and 27 children (16 families) enrolled in a 4-week program to encourage families to spend time engaging in outdoor activity together. Materials were provided to parents about ways to increase outdoor activity, where to be active, and ideas for outdoor activities that the entire family would enjoy. Family outdoor physical activity was measured using family activity logs to determine the duration and number of bouts per week. In addition, the types of activities, locations, and family members in attendance were also determined from the logs. A pre/post outdoor physical activity knowledge survey was used to determine the effectiveness of providing educational resources and community maps to parents on their ability to locate parks and greenways. Paired samples t-tests were used to examine changes in dependent variables during the program. Frequency analyses were used to describe family bout characteristics and outdoor physical activity knowledge results. **RESULTS:** Compared to baseline, family outdoor physical activity (min per week) for weeks 1, 2, and 4 were all significantly greater. There were no changes in the frequency of bouts per week (baseline, 3.93 ± 2.09 bouts; week 1, 3.64 ± 2.06 bouts; week 2, 3.57 ± 2.44 bouts, week 3, 3.50 ± 1.70 bouts; week 4, 3.64 ± 1.98 bouts, $p<0.05$) Average bout length was significantly greater (baseline, 60.2 ± 21.6 minutes per bout; week 1, 98.6 ± 57.7 minutes per bout; week 2, 114.6 ± 61.0 minutes per bout, week 3, 91.1 ± 44.1 minutes per bout; week 4, 101.2 ± 45.5 minutes per bout, $p<0.05$). Outdoor physical activity knowledge data showed 92% of parents could identify new parks and 50% could identify new greenways following the program. **CONCLUSION:** A novel family outdoor physical activity program is effective at increasing family physical activity levels and improving parents' ability to locate parks and greenways near their homes.

Introduction

Currently, only 42% of American children ages 6-12, and 12% of adolescents ages 12-18 accumulate the recommended levels of physical activity for health benefits.[1] *The Physical Activity Guidelines for Americans Midcourse Report: Strategies for Increasing Physical Activity in Children* identifies the home environment as a logical place to implement interventions aimed at increasing children's activity levels. However, the nature of a family life is multifaceted and unique, and best practices for engaging the family at home have yet to be identified.[2] Family and home-based interventions can offer a variety of components including providing educational information to parents to improve behavioral and social aspects of parenting, or environmental changes that include creating a more inviting atmosphere for engaging in physical activity. The lack of data regarding the effectiveness of home-based interventions establishes the need to determine what components of family life can be utilized to best enhance the home physical activity environment.[2]

The report also identifies a need to better understand how to develop programs that effectively engage children in outdoor environments, and how to effectively engage community stakeholders.[2,3] Outdoor physical activity has been linked to a number of associations with positive health outcomes for adults and children including eye and lung health, vitamin D levels, stress, and anxiety.[4-11] Only a few of interventions thus far that have attempted to increase outdoor physical activity in children. A study by Davison et al. [12] provided a group of mothers who were participating in the Women, Infant, Children (WIC) program with resources on outdoor areas in the community where their young children (birth – five years old) could be active (i.e., park maps). The WIC mothers in the control group received no educational materials. All mothers reported their child's physical activity at baseline and one year later at a

follow-up appointment. At follow-up, children who received the intervention were 2.79 times more likely to engage in at least 60 minutes of outdoor physical activity daily compared to the control group.[12] More recently, Finkelstein et al.[13] conducted a 9-month incentive-based outdoor physical activity intervention where school-aged children were given pedometers and encouraged to be active in park spaces. Following the intervention, there were significant differences between the control group and intervention group in the average total steps taken per day (7767±382 vs. 8660±567, respectively, $p<0.01$).[13]

Based on encouraging results from these outdoor physical activity interventions, it is possible that the family environment could create more opportunities for children to be active outdoors. Varieties of outdoor physical activities are accessible, low-cost, and often facilitate engagement in activities that can be performed across a life-span. Flett et al.[14] conducted focus groups to identify how the natural environment could be used to connect children and parents. Both parents and children reported interest in family-based outdoor physical activity, and parents valued the fact that it allowed for both parents and children to have family time together and engage in healthy behaviors.[14] This study provides a foundation for family-centered interventions that focus on engaging parents and children in increased outdoor physical activity together. Currently, only one study exists that addresses short-term changes in family physical activity bouts. Rhodes et al.[15] found that providing families with resources for planning family physical activity bouts resulted in an increase in total physical activity time of 100 minutes per week, and an increase in frequency of family outdoor activities of two bouts per week.

Although these studies suggest the usefulness of intervention strategies promote outdoor physical activity, there are little existing data on contextual detail about the physical activity behaviors of parents and children during family time. Previous studies on family physical

activity do not address the question of where families are active together, which family members participate in activity together, and the types of activities families are likely to perform. In order to develop community programing that integrates family members and outdoor physical activity, more information is needed on the context of family activity, and how it can be influenced through the provision of educational materials. Therefore, the purpose of this study was to evaluate a pilot outdoor family-centered physical activity program and its impact on the type, frequency, and duration of physical activities of families during an outdoor physical activity program and the number of family outdoor physical activity bouts (number of bouts per week) and times (minutes per week) would occur as a result of a 4-week program.

Methods

Participants

To be eligible to participate in the study, at least one parent (>18 years of age) and one child (7-17 years of age) had to be willing to participate in the program; a family was defined as at least one parent and at least one child. To be eligible, participants must be free of any injuries/conditions that inhibit participation in physical activity, speak and write English, have transportation to program, and reside in the same house for the duration of the study. This study was approved by the university's Institutional Review Board. All parents provided informed consent and parent permission for their children to participate in the study. All children provided written assent to participate in the study.

Program Design

The purpose of the Active Families in the Great Outdoors (GO), a family-centered outdoor physical activity program, was to promote family physical activity by educating parents

on the importance of physical activity and the outdoors for health, ways to increase their confidence in promoting outdoor activity in their family, and ways to better support their children being active outdoors. Active Families GO involved a 4-week family physical activity program that provided resources for engaging in family-oriented outdoor physical activity. The program is grounded in the Family Ecological Model [16] and emphasized providing materials targeted to improve parent knowledge, value, self-efficacy, and support for child physical activity.

The primary stakeholder in the program was the non-profit organization, Legacy Parks Foundation. The group's efforts focus on creating recreational opportunities in the Knoxville area. The Legacy Parks Foundation is considered a stakeholder as it provides leadership for both Outdoor Knoxville and the Knoxville Urban Wilderness. The Outdoor Knoxville initiative encompasses three components to help promote outdoor physical activity culture in the local community. The components include: maintaining www.outdoorknoxville.com, the Outdoor Knoxville Adventure Center, and the annual Outdoor Knoxfest. The Urban Wilderness is a recreational space in south Knoxville that currently expands across over 42 miles of trails including the South Loop Trails (12.5 miles) that connect local parks, a nature center, and a wildlife management area. The additional 30 miles of trails are intertwined throughout the space. The purpose of the Urban Wilderness is to provide spaces where adults and children can experience recreational activities such as hiking and explore ecosystems unique to east Tennessee.

Families were asked to attend three face-to-face meetings with the program coordinator. These meetings were the baseline meeting (week 0), a group meeting to deliver the program (week 1), and an end of the program meeting and group family outdoor physical activity (week

4). At the baseline (week 0) visit, the program coordinator explained the protocol to the parent/legal guardian and child. Additionally, during the baseline meeting, anthropometric assessments were performed, demographic surveys were taken, and parent/child perception and behavior surveys were completed. Parent survey questions included items about knowledge of the adult and child physical activity guidelines, value of physical activity for health, self-efficacy for increasing physical activity in their family, support for child physical activity behaviors, and the program evaluation. For children, self-efficacy for physical activity, enjoyment of physical activity, and perceived support for physical activity were assessed. Families were also given instructions for the use of the family activity logs. Family activity logs were used at baseline and during the four weeks of the program to track changes in physical activity. For each bout, families were asked to record the activity, the location, of the activity, the start time, stop time, and family member participation.

The 4-week program consisted of a self-study guide (i.e. family resource manual) that included weekly topics relating to family physical activity and outdoor opportunities (see Table 3.1). The self-study guide included materials for the 4-week program, as well as additional information to increase family physical activities (i.e., brainstorming activities, family game ideas, and community maps showing parks, greenways, and hiking trails). Embedded within each week were materials specific to parent self-efficacy, value towards physical activity, modeling, and support for physical activity. Each week, families were asked to read and participate in the short "Think Tank" activity provided in the manual, in order to help facilitate and plan family bouts of physical activity.

Following baseline assessments, families were asked to attend a group meeting (week 1). The group meeting was held at the stakeholder headquarters (Outdoor Knoxville Adventure

Center), and the program coordinator provided an overview of the self-study guide for the families. The families were instructed that for the next four weeks, their goal was to accumulate more outdoor physical activity than what they had accumulated during baseline. Families were allotted time to ask questions regarding the program. Over the next four weeks of the program, families continued to complete the family activity logs and return them to the primary investigator at 1-week intervals via their preferred method (email or US mail).

After four weeks of the program, families were asked to attend a final Active Families GO meeting (week 4), which was held at a local nature center. After filling out follow-up surveys, families were invited to participate in a group family outdoor physical activity.

Table 3.1 Description of Active Families GO weekly materials

Week	Topic	Parent Perception and Behavioral Component	Think Tank
1	"Selecting Family Outdoor Activities"	Knowledge, value, self-efficacy	Families asked to identify some activities their entire family currently residing in the home might enjoy playing together.
2	"Games for Everyone"	Knowledge, self-efficacy/support	Parents and children encouraged to look through a number of different games and activities provided, or to make up their own games to play as a family.
3	"Your Neighborhood: Finding New Parks and Playgrounds"	Knowledge, self-efficacy/support	Based on the neighborhood, families were asked to use the maps to identify neighborhood physical activity opportunities and fun activities to do together close to home.
4	"Outdoor Knoxville and the Urban Wilderness"	Knowledge, self-efficacy, support	Families were asked to identify some of the spaces in the Urban Wilderness that they would like to find out more about. These ideas will be brought to the final meeting where those activities were encouraged after parents and children finished assessments.

Demographic and Anthropometric Variables

At baseline (week 0), parents were asked to self-report their marital status, race/ethnicity, highest education level completed, whether their family qualified for free/reduced lunch, and how many adults and children were residing in the home. Parent and child's standing height and weight were assessed using standard procedures.[17] Body Mass Index (BMI) was calculated and used to classify each person as below normal weight, normal weight (BMI<24.99), overweight (25<BMI<29.9), or obese (BMI>30.0).[18] The Centers for Disease Control BMI-for-age and sex growth charts and percentiles were used to determine BMI and classify children as <85th percentile (healthy weight), 85th - 95th percentile (overweight), and >95th percentile (obese).[18]

Outdoor Family Physical Activity Assessments

The primary outcome variable, duration of family outdoor physical activity bouts and frequency of family outdoor physical activity bouts, were captured using the family activity logs. At baseline (week 0), the parents were given instructions on how to use the logs. These logs provided a detailed analysis of the activities, location of activity, who participated in each activity, and the length of the bout. The logs were completed by the family and mailed to the program coordinator each week of the program (week 1-4). For the purpose of this study, an "outdoor family physical activity bout" was defined as one where at least one parent and one child in the family participated in physical activity together outdoors.

The characteristics including type of activity, location of activity, and parent involvement of each activity were also obtained from the family activity logs. Parent participation was coded as one parent or both parents. One parent bouts were coded into mother or father participation. Mother participation was defined as "just mother and child bout" and father participation was defined as "just father and child bouts". Full parent participation was defined as having all

parents currently residing the household participate in the family bout, whether that be single mothers, single fathers, or participation involving both parents in the household.

Outdoor Physical Activity Knowledge Survey

An outdoor physical activity knowledge survey was used before and after the program to evaluate the impact of the materials provided. This survey included questions regarding information that the program intended to deliver on outdoor opportunities in the local community. Outcome variables from the survey included: benefits of being active outdoors for children, games, park information, greenway information, and details on the services provided by Outdoor Knoxville and the purpose of Urban Wilderness spaces in Knoxville, TN. The number of benefits, games, parks, and greenways at baseline and follow-up, the percentage of parents who identified new benefits, parks, and greenways, the percentage of parents who knew the services provided by Outdoor Knoxville and the purpose of Urban Wilderness.

Statistical Analyses

Means and frequencies were calculated for all demographic and anthropometric data. Total weekly family activity was defined as the total number of minutes accumulated each week (min per week) being active outdoors as a family. The total frequency of family activity bouts was defined as the total number of bouts (number per week) families performed outdoors as a family. The mean duration of the family bouts was computed by dividing the total weekly family activity by the total frequency of family activity bouts. Paired sample t-tests were used to determine changes in family-reported physical activity levels for weeks 1 to 4, compared to baseline. Frequencies of activities performed, location, and family member participation were calculated. Analyses were conducted to determined associations among family physical activity characteristics. The proportion of the number of specific activities, locations, and outdoor

activity bouts involving full parent participation were calculated, and walk scores for each family were determined using www.walkscore.com to provide detail on family's neighborhood walkability and potential for participating in physical activity (i.e. proximity to greenways, parks). Spearman's rho correlations were used to identify significant associations between activity, location, and family member participation. Frequencies were also calculated for the program evaluation. A *p* value of 0.05 was set for statistical significance. All statistical analyses were conducted using IBM SPSS Statistics 21.0 (Armonk, NY).

Results

Participants were 25 parents and 27 children (16 families) who participated in the entire 4-week program. Parent reported demographic data are provided in Table 3.2. Table 3.3 highlights the anthropometric data for all participants. The program began with 38 families who were screened and eligible to participate in the program. Of the 38 families, 9 were screened but reported that the program was too involved and no longer wanted to participate, 10 were scheduled for baseline assessments but did not keep the appointment, and 3 were lost to drop-out after the program began. This left 16 families that completed the entire program.

Outdoor Family Physical Activity Bouts

At baseline, the average frequency of bouts per week was 3.9 ± 2.1 bouts per week. There were no significant differences in frequency of bouts per week across the program weeks. The family physical activity minutes changes from baseline through each week of the program are shown in Figure 3.1. As a result of the program, families reported increasing the total weekly family activity (minutes per week) above baseline. In addition, the average length of the family outdoor physical activity bout was significantly higher than baseline for each of the four weeks of the program (baseline, 60.2 ± 21.6 minutes per bout; week 1, 98.6 ± 57.7 minutes per bout;

week 2, 114.6 ± 61.0 minutes per bout, week 3, 91.1 ± 44.1 minutes per bout; week 4, 101.2 ± 45.5, $p<0.05$).

Family Activity Bout Type, Location, and Family Member Participation

Table 3.4 shows the characteristics of the family outdoor physical activity bouts during the intervention. Walk scores were significantly associated with visits to downtown Knoxville (0.804, $p<0.05$) and visits to Great Smoky Mountain National Park (0.745, $p<0.021$). The proportion of family bouts accumulated playing tag were significantly associated with mother participation ($r=0.676$, $p<0.05$). The proportion of family bouts accumulated biking was significantly associated with father participation ($r=0.641$,$p<0.05$). Full family member participation was significantly associated with the activities tag (-0.621, $p<0.018$), walking ($r=0.704$, $p<0.05$), and running ($r=-0.572$, $p<0.05$).

For activities, hiking was significantly associated with visits to the Urban Wilderness (0.548, $p<0.05$) and visits to the Great Smoky Mountain National Park (0.727, $p<0.05$). The activity called "exploring" was significantly associated with visits to the Great Smoky Mountain National Park (0.713, $p<0.05$).

Additionally, there were some location uses that were found to be related. Visits to the Great Smoky Mountain National Park were associated with visits to the Urban Wilderness (0.704, $p<0.05$) and downtown Knoxville (0.858, $p<0.05$). The backyard location was associated with school location visits (0.770, $p<0.001$) and neighborhood (0.836, $p<0.001$). There were significant negative correlations identified between BMI and backyard use ($r=-0.715$, $p<0.05$) and park use ($r=-0.829$, $p<0.05$).

Outdoor Physical Activity Knowledge

The program also included pre- and post-evaluations to examine the effectiveness of the program on making parents more aware of the local opportunities for outdoor physical activity their neighborhood and the surrounding community. Following the program, 92% of parents were able to identify at least one new park where their family could be active (pre, 4.0±2.7 parks vs. post, 6.9±3.0 parks, $p<0.05$, respectively) and 50% of parents could identify at least one new greenway (pre, 1.9±1.8 greenways vs. post, 2.2±2.0 greenways, $p<0.05$, respectively). Furthermore, more parents were able to identify what the Urban Wilderness was (pre, 28.0% vs. post, 78.6%, $p<0.05$, respectively) and the services provided by Outdoor Knoxville (pre, 20.0% vs. post, 64.3%, $p<0.05$, respectively). Table 3.5 provides the results of the Active Families GO outdoor physical activity knowledge survey.

Table 3.2: Demographic Data of Parents (n=25)	
Race Ethnicity (%)	
Caucasian	89.3
African American	7.1
Asian	3.6
Marital Status (%)	
Single, never married	3.6
Married	78.6
Member of an unmarried couple	3.6
Separated	3.6
Divorced	10.7
Parent Education	
Less than high school	0
High school or equivalent	10.7
Some college	10.7
College graduate	46.4
Post graduate	32.1
Free/Reduced Lunch	
Yes	14.3
No	78.6
Chose not to answer	7.1
Adults in Home [mean ± sd, (range)]	1.9 ± 0.38 (1-3)
Children in Home [mean ± sd, (range)]	2.3 ± 1.48 (1-5)

Table 3.3: Physical Characteristics of Parents (n=25)	
Sex (% male)	40.0
Age (years)	41.5 (7.9)
Height (cm)	170.8 (10.4)
Weight (kg)	76.4 (21.7)
BMI (kg/m2)	27.3 (5.1)
% Normal Weight (n=10)	40.0
% Overweight (n=8)	32.0
% Obese (n=7)	28.0
Physical Characteristics of Children (n=27)	
Sex (% male)	48.1
Age (years)	10.7 (3.3)
Height (cm)	143.8 (19.6)
Weight (kg)	39.1 (17.2)
BMI (kg/m2)	17.9 (3.2)
BMI Percentile	60.3 (32.0)
% Normal weight (n=19)	70.4
% Overweight (n=4)	14.8
% Obese (n=4)	14.8

Table 3.4: Frequencies of joint family outdoor physical activities performed, location of activities, and family member participation (n = 274)

Activity	Total Number	Percent of Total
Tag	5	1.8%
Hide-and-seek	4	1.5%
Kickball	1	0.4%
Soccer	23	8.4%
Tennis	2	0.7%
Disc Golf	4	1.5%
Baseball	1	0.4%
Basketball	4	1.5%
Volleyball	1	0.4%
Bike Rides	16	5.8%
Walk	112	40.9%
Hike	12	4.4%
run	3	1.1%
Swim	11	4.0%
Playground Equipment	51	18.6%
Explore	5	1.8%
Trampoline	9	3.3%
Hacky Sack	1	0.4%
Calisthenics	5	1.8%
Gardening	2	0.7%
Scavenger Hunt	2	0.7%
Location	**Total Number**	**Percent of Total**
Backyard	36	13.1%
Local Park	96	35.0%
Church Grounds	4	1.5%
Neighborhood	66	24.1%
Neighborhood Pool	11	4.0%
School Grounds	25	9.1%
Downtown Knoxville	11	4.0%
Greenway	8	2.9%
Urban Wilderness	6	2.2%
Knoxville Zoo	4	1.5%
Great Smokey Mtn. National Park	7	2.6%
Family Member Participation	**Total Number**	**Percent of Total**
One Parent Participation		
% Mother Participation (n=15)	148	54.0%
% Father Participation (n=10)	46	16.8%
Full Parent Participation		
Single Mothers (n=2)	24	8.7%
Mother/Father (n=13)	56	20.4%

Table 3.5: Evaluation of Active Families GO outdoor physical activity knowledge at baseline and follow-up (n=25)

Evaluation Component	Baseline	Follow-Up
Benefits of outdoor physical activity (number of benefits listed)	4.9 (2.1)	5.4 (2.0)
Parents provide at least 1 new benefit at follow-up	--	50.0
Outdoor Games (number of games identified)	2.96 (0.20)	3.0 (0.0)
Parks (number of parks identified)	4.0 (2.7)	6.9 (3.0)*
Parents provide at least 1 new park at follow-up (%)	--	92.9
Greenways (number of greenways identified)	1.9(1.8)	2.2 (2.0)*
Parents provide at least 1 new greenway at follow-up (%)	--	50.0
Knoxville Urban Wilderness (% of parents who identified the purpose of Urban Wilderness)	28.0	78.6
Outdoor Knoxville (% of parents who identified the services of Outdoor Knoxville	20.0	64.3

* denotes significant differences between baseline and follow-up values ($p<0.05$).

Discussion

Few studies have examined family-based outdoor physical activity interventions. The results of the present study indicate that families increased their total time being active together, and the average length of the bouts, during the 4-week program, however the frequency of weekly bouts did not increase. Furthermore, the study provides detail on the type, location, and family involvement in the family activity bouts. By the end of the study, parents were also able to better identify local opportunities for their family to be active.

Family physical activity bouts are currently understudied in child physical activity research.[19] Objective monitors such as pedometers or accelerometers, while having some benefits, currently provide minimal detail on the context of activity being performed (i.e. type, location, group composition). The results of this study showed that at baseline, children in the sample were engaging in approximately 216 minutes a week (4 hours) of physical activity with at least one parent. Across the study, families were able to significantly increase their family physical activity by an average of approximately 111.0 minutes per week above baseline.

Rhodes et al.[15] was the only study identified that examined changes in family physical activity bouts. Their intervention resulted in families engaging in an additional 100 minutes of active time, by the end of the intervention. The researchers found that the number of bouts performed by families each week was increased (2.57±1.38 vs. 4.07±1.68 bouts, $F = 5.31$, $n2 = 0.08$, $p<0.05$).[15] The results of the current study did not show increases in the frequency of family outdoor physical activity bouts, but there was a significant increase in the average bout length from baseline to follow-up. This is likely due to the differences in material provided to parents. Rhodes et al.[15] provided parents with materials to better plan and schedule outdoor family activity bouts into their week, resulting in parents increasing the number of times they

engaged in physical activity together. The Active Families GO program focused more on providing parents with materials to promote outdoor physical activity through role modeling and logistic support to-and-from spaces, which explain why we only saw increases in outdoor activity bout duration. The lack of significant increase above baseline for week 3 is likely due to changes in weather. This study was performed in the South during the spring, and week 3 coincided with significant changes in weather on four of the seven days of the week. The changes included 20ºF temperature fluctuations and rain/snow accumulation, which resulted in high variability of outdoor family time for that week.

This is the first study to report contextual data on what families do together for outdoor physical activity, and Table 3 highlights the characteristics activity, location, and group composition. Descriptions of what families do together is a critical component of effective family-centered program design, as it provides insights into what is feasible and most likely to performed by families during the course of an intervention. Walking comprised 30% of reported family activity and soccer (between parent and child) accounted for an additional 30% of the activity. As for the location, Table 3 also shows where family activity was performed. Previous research has shown that one of the most active settings reported for children is outdoor recreation spaces and local parks.[21,22] The current study found that 35% of family activity was performed at a local park, and approximately 24% in the family's immediate neighborhood.

However, there were few associations identified for the types of activities performed in the different spaces. As expected, hiking and exploring were associated with the Urban Wilderness and Great Smoky Mountain National Park, indicating these activities may be better facilitated in larger outdoor spaces. The associations identified amongst locations closer to home highlighted the grouping of activities that may occur in various areas. Specifically, reporting

backyard locations was positively correlated with school and neighborhood locations. However, visits to the Great Smoky Mountain National Park were associated with visits to the Urban Wilderness. It may be possible that some families drove to outdoor physical activity opportunities (i.e. National Park, downtown) more often and other families chose stay closer to home for a majority of their outdoor physical activity bouts. These results provide important contextual data about the environments family seek out to be physically active together and the type of activities certain families are willing to travel to perform.

Finally, Table 3 also highlights one of the least understood aspects of parent-child physical activity, which is group composition of activity bouts. The results showed that mothers were most often the sole adult in 2-parent households who engaged in the family outdoor activity bouts (54.4% of bouts) and fathers in 2-parent households engaged in less family outdoor activity bouts (20.4% of bouts). Full parent participation was observed in 16.8% of bouts. Single moms were involved in 8.7% of the family outdoor activity bouts. The question of who participates in activity with children is the fundamental aspect of promoting family outdoor time.

Results of this study showed that mother participation (in married and single-parent families) accounted for most of the outdoor activity bouts with the children. Additionally, activities including tag, bike riding, and walking were shown to be positively associated with mother participation, father participation, and full parent participation, respectively. However, fathers made up 40% of the parent population, and the ratio of father participation per bout was half of what the mothers participated in. These findings highlight that some types of activities may be better promoted by different family members.

In addition to the physical activity time and characteristics, this study also sought to evaluate the impact of the materials provided by through the program. The program was

effective at educating parents on locations of park space and greenways where they could be active with their children. Additionally, the program appeared to be successful at educating parents about the community-level spaces developed to create opportunities for children and adults to be active outdoors. The Outdoor Knoxville program, developed by the Legacy Parks Foundation and local Knoxville stakeholders has created the Urban Wilderness space. Programs like this Active Families GO can help families become more active outdoors, by making them aware of the park space. The results of the program evaluation emphasize the effectiveness of providing parents and children with family activity resource books including park maps to families as program materials.

This study highlights the use of family physical activity program as an effective way to increase the amount of time that parents and children spend together in the outdoors. Future studies aiming to increase physical activity levels in families should consider including resources that focus on outdoor, local opportunities for physical activity and include both parents and children. Future research should also aim to include methods that allow for the long term assessment of behavior changes.

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Part IV:
Perceptions and behaviors of parents and children following a family-centered outdoor physical activity program

Abstract

PURPOSE: To determine whether changes in parent and child perceptions and parent behaviors can be observed following a family outdoor physical activity program. **METHODS:** Participants were enrolled in a four week program designed to increase the amount of time families spend engaging in activity together. Materials were provided to inform parents on ways to increase activity, where to be active, and ideas for activities the entire family would enjoy. Knowledge and value were assessed with questions about the physical activity guidelines for adults and children, and previously validated surveys on the importance of physical activity for child health. Self-efficacy was assessed using the Tools to Measure Parenting Self-Efficacy questionnaire and parent support for physical activity was assessed using the Activity Support Scale for Multiple Groups (ACTS-MG). Related-samples Wilcoxon Signed Rank tests were used to determine changes in parent and child perceptions and behaviors that resulted from the program. **RESULT:** Participants were 25 parents and 27 children. At follow-up, knowledge of child physical activity guidelines increased. Parent support through encouragement by role modeling and enjoyment of exercise all were greater at follow-up. Child perceived support for physical activity also increased. **CONCLUSIONS:** Novel use of family physical activity program to foster increases in knowledge and support appears to be effective. Further research is needed to better understand how family time can be incorporated into multi-component interventions that seek to improve the health status of adults and children.

Introduction

The majority of American youth fail to meet the current aerobic physical activity recommendations (60 minutes of moderate-to-vigorous intensity physical activity per day).[1] [2] Currently, 42% of children ages 6-12 and 12% of adolescents ages 13-18 meet the recommended amount of physical activity for health benefits, indicating that as children age, there is a decline in activity levels.[1] There is supporting evidence that physical activity patterns track not only from childhood into adolescence[3], but into adulthood.[4] This suggests that early intervention for children may help to limit the reductions in physical activity levels as children age. Outdoor physical activity provides opportunities for parents and children to be active together, and is conducive for engaging a range of ages and ability/fitness levels. Additionally, outdoor physical activity endeavors typically can utilize existing green spaces (i.e. backyards, parks) for activity.

Research has identified that children are active at a higher intensity while playing outdoors, and there have been a number of physiological and psychological health outcomes identified to be positively associated with outdoor physical activity.[5-11] Time spent outdoors has been shown to be associated with higher intensity physical activity and vitamin D levels, both of which are related to better metabolic health status and lower cardiovascular disease risk. Outdoor physical activity has also been linked with eye and lung health, motor skill development as well as decreased stress, anxiety, and attentional deficit hyperactivity disorder symptoms.[10-12] Furthermore, the identification of low cost, highly accessible modes of physical activity are needed to ensure that families are given as many opportunities to maintain as a healthy lifestyle as possible.

Ideally, children should have the opportunity to engage in outdoor physical activity through a number of avenues during the day. School (i.e. physical education, recess) and home

environments (i.e. neighborhoods, backyards) each provide opportunities for children to be active. However, these opportunities are often limited by barriers such as prioritization of time and perceived safety. Therefore, providing opportunities for children at the community, school, and home levels is critical to helping youth meet the physical activity recommendations. The *Physical Activity Guidelines for Americans Midcourse Report: Strategies for Increasing Physical Activity in Youth* states that insufficient data are available on the effectiveness of family- and home-based physical activity interventions.[13] This point is further emphasized through the recent publication of the *United States' 2014 Report Card on Physical Activity for Children and Youth*, which states there is a lack of nationally representative data that shows consistent findings on parental influences on physical activity in youth.[14] Both reports stress the need for additional research on how family-level strategies can be used to increase physical activity in youth.

Despite the minimal data on the impact of family-centered interventions, the home and family unit are logical places to create opportunities for increased physical activity. Studies assessing familial influences on physical activity have identified the significant role parents play in the physical activity behaviors of their children. The term "family-centered" is one that places an emphasis on the importance of recognizing the factors influencing the daily routine of a family. A family-centered intervention focuses on the child's needs while allowing for the entire family to benefit from the intervention simultaneously.[16,20] It is possible that targeting individuals using a cross-generational, family-centered, physical activity intervention may provide an opportunity to increase the physical activity levels of both adults and their children concurrently. Previous work has established the critical role that parents play in their child's development of behaviors.[22-24] However, few models exist that help researchers to navigate the important aspects of family context that may influence behavior changes.[15]

Previous studies have used the Family Ecological Model as a framework for describing the factors that influence health behaviors in families. The Family Ecological Model, which is based on the Ecological Systems Model, is a behavior change framework that states that an individual's health behaviors (i.e. physical activity levels, nutritional habits) cannot be fully understood, and therefore fully changed, without considering the context of the individual's environment.[15] The new model identifies that increasing a physical activity outcome is dictated by improving upon key aspects of parenting such as parent attributes and parent practices which will ultimately influence child physical activity. Parent attributes include self-efficacy for increasing a child's activity and value towards physical activity for health. Parent practices include support and encouragement for facilitating avenues to engage in healthy behaviors and modeling of desired behaviors.[15,29] By incorporating the Family Ecological Model into a family-centered, outdoor physical activity program, it is possible that the child's and family's physical activity levels can be improved.

In today's society, parents are often viewed as the gate keepers to youth physical activities due to barriers such as time, perceived safety, and transportation needs.[15] As a result, the parental perceptions and behaviors discussed in the Family Ecological Model play a large role in influencing child outdoor physical activity levels. Parental physical activity related perceptions include knowledge of the physical activity guidelines, the value a parent places on physical activity for health, and self-efficacy for providing physical activity opportunities all serve as a foundation for creating avenues for children to be active outdoors. Parent perceptions also likely to precede parent behaviors such as role modeling[16] and support for their child's physical activity endeavors.[17] Additionally, a recent study found that higher parent self-confidence and lower perceived difficulty for promoting outdoor physical activity is associated

with increased child outdoor physical activity participation.[18] Based on the influential role parent perceptions and behaviors have been shown to have on child physical activity levels, it is critical that these variables are examined to determine how interventions to increase outdoor physical activity should be shaped when parents are involved.

As previously mentioned, child physical activity levels track through time. However, it is possible that changes in child psycho-social outcomes such as self-efficacy, enjoyment, and perceived support for activity may also be influenced as a result of an intervention. Psycho-social variables have been identified as significant predictors of child physical activity, and should be considered a necessary intervention component. Self-efficacy, or a child's confidence in their ability to overcome barriers associated with engaging in physical activity, has been shown to be related to weight status and physical activity levels.[19-21] Trost et al.[21] examined self-efficacy of normal weight and obese children and found that obese children spend significantly less time engaging in physical activity, and have a lower perceived confidence for performing physical activities.[21] Suton et al.[20] also examined physical activity as it relates to self-efficacy and found that children with higher self-efficacy reported engaging in more days of physical activity than children with lower self-efficacy (3.4 ± 2.0 days vs. 5.4 ± 1.8 days, respectively, $p<0.001$).

Enjoyment of physical activity is another key influence on youth structured and unstructured physical activity levels.[22,23] Dishman et al.[22] identified through a school-based intervention that self-efficacy and enjoyment both partially mediated increases in physical activity. Each of these variables is likely to contribute to the relative success of participants in physical activity interventions; however future research is needed to best understand how they can be improved.[24] One of the psycho-social variables that is most heavily studied in family-

based research is perceived support for physical activity.[25] Support can be demonstrated in various ways, including transportation to and from physical activity opportunities, providing equipment, and expressing encouragement and praise. These behaviors can also be articulated by a variety of people such as family members, teachers, and peers.[26] In school-aged children, support from family becomes increasingly important as parents are often viewed as the gatekeepers to children's physical activity opportunities.[26,27] There is a need to identify how self-efficacy, enjoyment, and perceived support are associated with outdoor physical activity participation, and how programming to increase the amount of time children spend outdoors may also positively influence psycho-social variables.

One avenue for outdoor physical activity promotion that has been studied in limited detail is the use of family physical activity programming in which parents and children are encouraged to be active together. These interventions provide families with resources for being active in their local community, and give parents and children the freedom to schedule fun activities to better accumulate more time being physically active outside together.[28] It is possible that a family-centered program may help to positively influence physical activity perceptions and behaviors of parents by providing parents with educational materials and resources to create a more physically active family culture. One of the least utilized methods for promoting physical activity is through family physical activity. A study by Rhodes et al.[28] examined the effectiveness of a family planning intervention. Following the four week intervention, parents who received materials about how to plan and schedule family activity bouts reported an increased frequency and duration of family bouts of physical activity compared to the control group. However, no significant changes were reported in parental perceived control or intention to plan activities. Although results from Rhodes et al.[28] are encouraging, further research is

needed to identify which methods of intervention delivery are best for simultaneously engaging parents and children in physical activity together, while also improving upon parent perceptions and behaviors.

A better understanding of parent and child perceptions and behaviors that result from an outdoor physical activity program may help to better identify successful home-based intervention strategies. Therefore, the purpose of the study was to determine whether increases in the parent perceptions and behaviors towards physical activity (i.e., value, self-efficacy, support) and child perceptions (i.e. self-efficacy, enjoyment, and support) can be observed following a 4-week program designed to promote parents and children being active together outside.

Methods

Participants

In order to be eligible for the study, at least one parent (>18 years of age) and one child (7-17 years of age) had to be willing to complete in the program. A family was defined as at least one parent and at least one child for the purposes completing the family activity logs. Participants must be free of any injuries/conditions that inhibit participation in physical activity, speak and write English, have transportation to program, and reside in the same house for the duration of the study. This study was approved by the university's Institutional Review Board and all parents provided informed consent /permission for their children to participate in the study. All children also completed written assent to participate in the study.

Program Design

The purpose of the Active Families in the Great Outdoors (GO), a family-centered outdoor physical activity program, was to promote family physical activity by educating parents on (1) the importance of physical activity and the outdoors for health, (2) ways to increase their

confidence in promoting outdoor activity in their family, and (3) ways to better support their children being active outdoors. Active Families GO involved a 4-week family physical activity program supplemented with educational materials and resources for engaging in family-oriented outdoor physical activity. The program is grounded in the Family Ecological Model [29] and emphasized providing materials targeted to improve parent knowledge, value, self-efficacy, and support for child physical activity.

The families were asked to attend three face-to-face meetings with the program coordinator. These meetings were the baseline meeting (week 0), a group meeting to deliver the program (week 1), and an end of the program meeting and group family outdoor physical activity (week 4). At the baseline (week 0) visit, the program coordinator explained the protocol to the parent/legal guardian and child. Additionally, during the baseline meeting, anthropometric assessments were performed, demographic surveys were taken, and parent/child perception and behavior surveys were completed. Parent survey questions included items about knowledge of the adult and child physical activity guidelines, value of physical activity for health, self-efficacy for increasing physical activity in their family, support for child physical activity behaviors, and the program evaluation. For children, self-efficacy for physical activity, enjoyment of physical activity, and perceived support for physical activity were assessed.[24] Families were also given instructions for the use of the family activity logs. Family activity logs were used at baseline and during the four weeks of the program to track physical activity. For each bout, families were asked to record the type activity, the location of the activity, the start time, stop time, and family member participation.

The 4-week program included weekly topics relating to family physical activity and outdoor opportunities which were delivered using a family resource manual (see Table 4.1).

This manual included materials for the 4-week program, as well as additional information to increase family physical activities (i.e., brainstorming activities, family game ideas, community maps). Embedded within each week were materials specific to parent self-efficacy, value towards physical activity, modeling, and support for physical activity. Each week, families were asked to read and participate in the short "Think Tank" activity provided in the manual in order to help facilitate family bouts of physical activity.

Following baseline assessments, families were asked to attend a group meeting (week 1). The group meeting was held at the stakeholder headquarters (Outdoor Knoxville Adventure Center). During the meeting the program coordinator went through the manual page by page to deliver the program to the families. The baseline family activity logs were discussed and families were instructed that for the following four weeks, their goal was to accumulate more outdoor physical activity than they had accumulated during baseline. Families were allotted time to ask questions regarding the program. Over the next four weeks of the program, families continued to complete the family activity logs and return them to the primary investigator for each of the four weeks of the program via their preferred method (email or US mail). After four weeks of the program, families were asked to attend a final Active Families GO meeting (week 4), which was held at a local nature center. After filling out follow-up surveys, families were invited to participate in a group family outdoor physical activity.

Demographic and Anthropometric Variables

At baseline (week 0), parents were asked to self-report their marital status, race/ethnicity, highest education level completed, whether their family qualified for free/reduced lunch, and how many adults and children were residing in the home. Parent and child's standing height and weight were assessed using standard procedures.[30] Body Mass Index (BMI) was calculated and

classified for adults and children.[31] Body Mass Index (BMI) was calculated and used to classify each person as below normal weight, normal weight (BMI<24.99), overweight (25<BMI<29.9), or obese (BMI>30.0).[31] The CDC BMI-for-age and sex were used to classify children as <85th percentile (healthy weight), 85th -95th percentile (overweight), and >95th percentile (obese).[32]

Table 4.1 Description of Active Families GO weekly materials

Week	Topic	Parent Perception and Behavioral Component	Think Tank
1	"Selecting Family Outdoor Activities"	Knowledge, value, self-efficacy	Families asked to identify some activities their entire family currently residing in the home might enjoy playing together.
2	"Games for Everyone"	Knowledge, self-efficacy/support	Parents and children encouraged to look through a number of different games and activities provided, or to make up their own games to play as a family.
3	"Your Neighborhood : Finding New Parks and Playgrounds"	Knowledge, self-efficacy/support	Based on the neighborhood, families were asked to use the maps to identify neighborhood physical activity opportunities and fun activities to do together close to home.
4	"Outdoor Knoxville and the Urban Wilderness"	Knowledge, self-efficacy, support	Families were asked to identify some of the spaces in the Urban Wilderness that they would like to find out more about. These ideas will be brought to the final meeting where those activities were encouraged after parents and children finished assessments.

Outdoor Family Physical Activity Assessments

The study included an assessment of outdoor physical activity captured using the family activity logs. At baseline (week 0), the parents were given instructions on how to use the logs. These logs provided a detailed analysis of the activities, location of activity, who participated in each activity, and the length of the bout. The logs were completed by the family and mailed to the program coordinator each week of the program (week 1-4). The characteristics including type of activity, location of activity, and parent involvement of each activity were also obtained from the family activity logs. For the purpose of this study, an "outdoor family physical activity bout" was defined as one in which at least one parent and one child in the family participated in physical activity together outdoors.

Parent Perception and Behavior Assessments

At baseline (week 0), each parent enrolled in the study was asked to complete detailed questionnaires. The survey included three sections. The first section assessed parental knowledge of the adult and child physical activity guidelines and the value of physical activity for health. These questions addressed the knowledge of recommendations for moderate intensity aerobic physical activity each week for adults (150 min/week) and the daily recommendation for children (60 minutes of moderate-to-vigorous intensity aerobic physical activity per day). Value of physical activity was assessed using four questions. The questions have been used previously, and encompass how physical activity influences health, self-confidence, school behavior, and becoming a healthy adult.[33] Parents were asked to use a Likert scale to rate their value of physical activity for each variable from 1 (strongly disagree) to 4 (strongly agree).

The second section of the survey measured parenting self-efficacy using the Tool to Measure Parenting Self-Efficacy (TOPSE).[34] The sections of the TOPSE that best represented

perceptions on physical activity related behaviors were selected and included play and enjoyment, discipline and setting boundaries, and learning and knowledge. Each of the 18 questions were scored from 0 (completely disagree) -10 (completely agree) and is valid for parents of child ages 6-18.

The third section assessed parent perceived support and enjoyment for physical activity using the Activity Support Scale for Multiple Groups (ACTS-MG).[17] The scale addresses a number of realms of parent support including enrolling and encouraging children to participate in physical activity related programs, transportation, role modeling, parental enjoyment of exercise. Each of the 12 questions were scored from 1 (strongly disagree) – 4 (strongly agree). This scale has also been validated and used previously.[17,26]

Child Perception Assessments

Children were asked to complete a survey that was divided into three sections at baseline (week 0) and at week 4. The first section assessed perceived self-efficacy for physical activity and included eight questions that were scored 1 (disagree) – 3 (agree). The second section assessed enjoyment of physical activity and included seven questions that were scored on a scale of 1 (disagree a lot) – 5 (agree a lot). The third section assessed perceived support for physical activity from family and friends. The survey included 13 questions that were framed to ask children "during a typical week, how often…" and were scored from 1 (never) – 3 (everyday). The scales have been validated and previously used to assess self-efficacy, enjoyment, and perceived support of physical activity in children.[24] Children were paired with a research assistant who was available to read and assist with the questionnaires when needed.

Statistical Analyses

Frequencies were calculated for all demographic data. Means and standard deviations were calculated for anthropometric assessments, and all parent survey data. Independent samples Mann-Whitney U tests were used to identify whether or not differences existed between mothers and fathers and across BMI categories. The Shapiro-Wilk test was used to determine whether or not data were normally distributed. All data were identified as non-parametric and therefore Related-Samples Wilcoxon Signed Rank Tests were used to determine differences in parent and child survey data from baseline to follow-up. Spearman's rho correlations were used to determine associations among variables. All analyses were performed using IBM SPSS Statistics 21.0 software (Armonk, NY).

Results

Sixteen families, which included 25 parents and 27 children, participated in the study. Parent demographic data are shown in Table 4.2 and anthropometric data of parents and children are shown in Table 4.3. The program began with 38 families who were screened and eligible to participate in the program. Of the 38 families, nine who were screened reported the program was too involved and no longer wanted to participate, 10 who scheduled for baseline and assessments and failed to keep the appointment, and 3 who were lost to drop out once the program began.

Outdoor Family Physical Activity Assessment

At baseline, the families participated in an average of 3.9 family outdoor physical activity bouts per week. There were no significant differences in frequency of bouts per week during the 4-week program. The family physical activity minutes changed from baseline through each week of the program (baseline, 216.1 ± 127.3 minutes per week; week 1, 316.1 ± 180.2 minutes per

week; week 2, 351.1 ± 209.1 minutes per week, week 4, 317.5 ± 186.8 minutes per week, $p<0.05$). As a result of the program, families reported increasing the total weekly family activity (minutes per week) above baseline. In addition, the average length of the family outdoor physical activity bout was significantly higher than baseline for each of the four weeks of the program (baseline, 60.2 ± 21.6 minutes per bout; week 1, 98.6 ± 57.7 minutes per bout; week 2, 114.6 ± 61.0 minutes per bout, week 3, 91.1 ± 44.1 minutes per bout; week 4, 101.2 ± 45.5, $p<0.05$).

Parent Perceptions and Behaviors

At baseline, only 21.4% of parents reported the correct adult physical activity guidelines. At follow-up, 36.4% of parents were able to correctly report the guidelines. At baseline, 14.3% of parents could accurately report the child physical activity guidelines, and following the intervention, 54.5% of parents could accurately report the child physical activity guidelines. Only one question regarding value ("Kids who do regular physical activity are healthy") trended towards significant increases from baseline to follow-up (3.1 vs. 3.9, $p=0.07$). All other questions regarding value remained unchanged and relatively high (Table 4.4) and there were no significant differences in knowledge among BMI categories. There were also no significant changes in self-efficacy (Table 4.5) following the program.

There were differences identified for parental support. Wilcoxon Signed Rank tests indicated significant differences in four of the support items including encouraging children to be physically active by role modeling (3.27 ± 0.77 vs 3.71 ± 0.47, $p<0.01$), exercising on a regular basis (3.29 ± 0.73 vs 3.71 ± 0.47, $p<0.01$), and limiting video games (3.29 ± 0.61 vs 3.57 ± 0.65, $p<0.05$) and television watching (3.29 ± 0.61 vs 3.57 ± 0.65, $p<0.05$) at follow-up. There were also trends towards significance identified for taking a child to a location to be active (3.50 ±

0.65 vs 3.71 ± 0.47, p=0.082) and for parental enjoyment of physical activity (3.29 ± 0.73 vs 3.50 ± 0.76, p=0.82). Table 4.6 provides the support questions asked and the scores for each respective question at baseline and follow-up. There were also significant associations identified for specific parent support and self-efficacy items. Parent support through encouraging child to use neighborhood resources such as parks and the school to be active was associated with parent play and enjoyment self-efficacy subscale score (rho=0.640, $p<0.05$). Support for using resources was also associated with self-efficacy to learn and use new ways to deal with their child (rho=0.551, $p<0.05$) and being able to reason with my child (rho=0.675, $p<0.05$). Parent support expressed through limiting video game, television and computer used were also associated with the parent play and enjoyment self-efficacy subscale score (rho=0.708, $p<0.05$).

Child Perception

There were no differences between boys and girls for any anthropometric or survey data. At follow-up, there were no significant differences in child scores for self-efficacy or enjoyment. Table 4.7 highlights the questions and mean scores at both time points.

There were significant increases from baseline to follow-up in perceived support for physical activity. The questions and mean scores for perceived support are shown in Table 4.8. Additionally, there were significant associations identified among perceived support questions. Associations were found between the two items that changed from baseline to follow-up. There were positive correlations for child report of how frequently someone had done physical activity or played sports with them and (1) family member encouragement of child physical activity (rho=0.845, $p<0.05$), (2) friend and family member participation in physical activity (rho=0.599 and 0.610, $p<0.05$, respectively), and (3) positive praise from friends (rho=0.582, $p<0.05$) and family members (rho=0.600, $p<0.05$).

The second item that changed from baseline regarded how frequently someone provided transportation to places where the child could be physically active. Significant positive associations were found for transportation and (1) child encouragement for physical activity for their friends and family members (rho=0.548 and 0.784, $p<0.05$, respectively), (2) family member encouragement of child physical activity (rho=0.518, $p<0.05$), and (3) positive praise from family members (rho=0.873, $p<0.05$).

Table 4.2: Demographic Data of Parents (n=25)	
Race Ethnicity (%)	
Caucasian	89.3
African American	7.1
Asian	3.6
Marital Status (%)	
Single, never married	3.6
Married	78.6
Member of an unmarried couple	3.6
Separated	3.6
Divorced	10.7
Parent Education	
Less than high school	0
High school or equivalent	10.7
Some college	10.7
College graduate	46.4
Post graduate	32.1
Free/Reduced Lunch	
Yes	14.3
No	78.6
Chose not to answer	7.1
Adults in Home [mean ± sd, (range)]	1.9 ± 0.38 (1-3)
Children in Home [mean ± sd, (range)]	2.3 ± 1.48 (1-5)

Table 4.3: Physical Characteristics of Parents (n=25)	
Sex (% male)	40.0
Age (years)	41.5 (7.9)
Height (cm)	170.8 (10.4)
Weight (kg)	76.4 (21.7)
BMI (kg/m^2)	27.3 (5.1)
% Normal Weight (n=10)	40.0
% Overweight (n=8)	32.0
% Obese (n=7)	28.0
Physical Characteristics of Children (n=27)	
Sex (% male)	48.1
Age (years)	10.7 (3.3)
Height (cm)	143.8 (19.6)
Weight (kg)	39.1 (17.2)
BMI (kg/m^2)	17.9 (3.2)
BMI Percentile	60.3 (32.0)
% Normal weight (n=19)	70.4
% Overweight (n=4)	14.8
% Obese (n=4)	14.8

Table 4.4: Baseline and Follow-Up Parent Value of Physical Activity Scores (n=25)		
Value of Physical Activity for Health (scale, 0-4)	**Baseline**	**Follow-Up**
Kids who do regular physical activity are healthy	3.31 ± 1.12	3.92 ± 0.28
Kids who do physical activity have problems in school	1.62 ± 0.96	1.31 ± 0.48
Kids who do regular physical activity have more self-confidence	3.77 ± 0.44	3.77 ± 0.44
Kids who do regular physical activity will be healthier adults	3.85 ± 0.38	3.77 ± 0.44

Table 4.5: Baseline and Follow-Up Parent Self-Efficacy Scores (n=25)		
Self-Efficacy: Play and Enjoyment (0-10)	**Baseline**	**Follow-Up**
I am able to have fun with my child.	9.18 ± 0.98	9.46 ± 0.82
I am able to enjoy each stage of my child's development	9.18 ± 1.08	8.64 ± 1.1
I am able to have nice days with my child.	9.18 ± 1.08	9.46 ± 0.69
I can plan activities that my child will enjoy.	8.73 ± 1.42	9.00 ± 1.26
Playing with my child comes easily.	8.00 ± 1.34	8.00 ± 1.18
I am able to help my child reach their full potential.	7.46 ± 1.44	8.27 ± 1.10
Total Play and Enjoyment Score (0-60)	51.7 ± 5.73	52.8 ± 3.76
Self-Efficacy: Discipline and Setting Boundaries		
Setting limits and boundaries is easy for me.	7.36 ± 1.69	7.55 ± 1.86
I am able to stick to the rules I set for my child.	7.73 ± 1.42	7.73 ± 1.27
I am able to reason with my child.	7.73 ± 1.42	8.00 ± 1.00
I can find ways to avoid conflict.	7.00 ± 1.61	6.82 ± 1.33
I am consistent in the way I use discipline.	7.46 ± 1.44	7.91 ±1.38
I am able to discipline my child without feeling guilty.	7.36 ± 1.75	7.91 ± 1.70
Total Discipline and Setting Boundaries Score (0-60)	44.64 ± 7.17	45.91 ± 5.87
Self-Efficacy: Learning and Knowledge		
I am able to recognize developmental changes in my child.	8.36 ± 1.29	8.64 ± 1.29
I can share ideas with other parents.	8.36 ± 1.28	8.81 ± 0.98
I am able to learn and use new ways of dealing with my child.	8.09 ± 1.38	8.82 ± 1.09
I am able to make the changes needed to improve my child's behavior.	8.10 ± 0.94	8.46 ± 0.82
I can overcome most problems with a bit of advice.	8.00 ± 0.89	8.00 ± 1.34
Knowing that other people have similar difficulties with their children makes it easier for me.	9.00 ± 1.34	9.10 ± 1.04
Total Learning and Knowledge Score (0-60)	49.91 ± 5.01	51.82 ± 4.60

Table 4.6: Baseline and Follow-Up Scores for Parent Support Behaviors for Child Physical Activity (n=25)

Support for Child Physical Activity (scale 0-4)	Baseline	Follow-Up
I enroll my child in sports teams and clubs such as soccer, basketball, and dance	3.18 ± 1.25	3.55 ± 1.04
I take my child places where he/she can be active	3.55 ± 0.69	3.73 ± 0.47
I watch my child play sports or participate in other activities such as martial arts or dance	3.40 ± 0.97	3.70 ± 0.47
I encourage my child to be physically active by leading by example (by role modeling)	3.27 ± 0.65	3.73 ± 0.47*****
I exercise or am physically active on a regular basis	3.36 ± 0.67	3.73 ± 0.47*****
I enjoy exercise and physical activity	3.36 ± 0.67	3.64 ± 0.67
I encourage my child to use resources in our neighborhood to be active (such as the park and the school)	3.46 ± 0.52	3.55 ± 0.52
I enroll my child in community-based programs (such as Girls and Boys Club, YMCA) where he/she can be active	2.91 ± 1.04	3.09 ± 1.04
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	3.36 ± 1.03	3.73 ± 0.47
I limit how long my child plays video games (including PlayStation, Xbox, and Gameboys).	3.27 ± 0.65	3.55 ± 0.69
I limit how long my child can watch TV or DVDs each day (including educational and non-educational programs)	3.27 ± 0.65	3.55 ± 0.69
I limit how long my child can use the computer for things other than homework (such as playing computer games and surfing the internet)	3.27 ± 0.79	3.55 ± 0.69

* denotes significant differences between baseline and follow-up values ($p<0.05$).

Table 4.7: Baseline and Follow-Up Scores for Child Self-Efficacy and Enjoyment (n=27)

Self-Efficacy	Baseline	Follow-Up
I can be physically active on most days of the week.	2.64 (0.67)	2.82 (0.40)
I can ask my parents or other adults to do active things with me.	2.82 (0.40)	2.73 (0.47)
I can be physically active on most days, even if it is very hot or very cold outside.	2.82 (0.60)	2.82 (0.60)
I can do active things because I know how to do them.	2.91 (0.30)	3.00 (0.00)
I can be physically active, even at home.	2.73 (0.65)	2.82 (0.40)
I can be physically active on most days, even if I could watch TV or play video games instead.	2.55 (0.69)	2.46 (0.69)
I can ask my parents to be physically active with me on most days	2.50 (0.71)	2.60 (0.52)
I have the skill to be active in my free time.	2.82 (0.40)	3.00 (0.00)
Enjoyment		
When I am active, I feel bored.	2.18 (1.57)	1.36 (0.67)
When I am active, I dislike it.	2.27 (1.62)	1.64 (1.02)
What I am active, it is no fun at all.	1.54 (1.21)	1.64 (1.21)
When I am active, it makes me depressed.	1.27 (0.65)	1.18 (0.40)
When I am active, if frustrates me.	1.55 (0.93)	1.36 (0.50)
When I am active, it is not interesting at all.	1.46 (0.93)	1.36 (0.92)
When I am active, I feel as though I would rather be doing something else.	1.82 (1.40)	1.82 (1.25)

Table 4.8: Baseline and Follow-Up Scores for Child Perceived Support for Physical Activity (n=27)

During a typical week, how often:	Baseline	Follow-Up
do you encourage your friends to do physical activities or play sports?	2.18 (0.60)	2.18 (0.60)
do you encourage your family to do physical activities or play sports?	2.00 (0.45)	2.18 (0.40)
do your friends encourage you to do physical activities or play sports?	2.36 (0.50)	2.36 (0.50)
do your family members encourage you to do physical activities or play sports?	2.00 (0.63)	2.27 (0.65)
do your friends do physical activities or play sports with you?	2.27 (0.78)	2.46 (0.69)
do your family members do physical activities or play sports with you?	2.27 (0.47)	2.00 (0.44)
do your friends tell you that you are doing a good job at physical activities or playing sports?	2.09 (0.70)	2.27 (0.65)
do your family member tell you that you are doing a good job at physical activities or playing sports?	2.46 (0.52)	2.46 (0.52)
has someone encouraged you to do physical activities or play sports?	2.00 (0.45)	2.10 (0.30)
has someone done a physical activity or played sports with you?	2.09 (0.30)	2.36 (0.50)*****
has someone provided transportation to a place where you can do physical activities or play sports?	1.90 (0.57)	2.40 (0.52)*****
has someone watched you participate in physical activities or sports?	2.36 (0.67)	2.27 (0.47)
has someone told you that you are doing well in physical activities or sports?	2.18 (0.60)	2.18 (0.60)

* denotes significant differences between baseline and follow-up values ($p<0.05$).

Discussion

Parents have often been identified as the gate-keepers of children's physical activity opportunities, and contribute substantially to their family's development of healthy behaviors. Furthermore, psycho-social variables, such as self-efficacy, enjoyment, and support, are important correlates of physical activity in youth. The purpose of this study was to determine whether increases in the family outdoor physical activity, parent perceptions and parent behaviors towards physical activity (i.e., knowledge, value, support, self-efficacy) and child perceptions (i.e., self-efficacy, enjoyment, perceived support) could be observed following the 4-week program to promote family outdoor physical activity. Following four weeks, parent knowledge of physical activity increased and there were significant changes in key concepts regarding parent support. There were no significant differences over the course of the program for parent or child self-efficacy or child enjoyment of physical activity. Following the program, the children reported higher scores on items related to perceived parental support for physical activity. These items included how often someone performed a physical activity or sport with them and how often someone transported them to an area where they could be active. These findings are encouraging, and suggest the potential usefulness of prescribing family physical activity bouts to partially improve parent and child perceptions and parent behaviors towards physical activity.

The primary parent perception and behavior findings from the study are from the support measures. There were significant increases in parent encouragement of children being active through parent role modeling. Parent role modeling, more commonly assessed through direct parent physical activity levels, is a key influencing behavior on child physical activity levels. Increases in parent self-reported role modeling was expected, as the program promoted family

time spent being physically active together. These findings partially explain the success of the program, but also provide an open door for further research addressing how family physical activity suggestions can improve parent's ability to lead by example.

The Family Ecological Model highlights that parent perceptions towards physical activity related behaviors are precursors to the modeled behaviors. Therefore, it is necessary that not only parent behaviors such as role modeling be assessed, but also the precursors of the behaviors including knowledge, value, and self-efficacy. The study results identify increases in parental knowledge of the physical activity guidelines following the delivery of intervention material. Few studies have assessed parental knowledge of the physical activity guidelines for adults and children. Morrow et al.[1] conducted a phone survey of 1,998 US adults and found that 68% of participants could accurately report the 1993 physical activity guidelines. This dissertation found that following the program, approximately 36% of parents could accurately report the guidelines for adults and that nearly 55% could report the child guidelines. Although there were no significant associations identified between knowledge, value, and parent support variables, the encouraging results illustrated that most parents placed a high value on physical activity for health prior to participating in the program. The importance of knowledge and value are highlighted in the Family Ecological Model as key perceptions associated with parent physical activity behaviors, and future research should seek to include these variables, as well as identify to what extent they each play a role in influencing child physical activity outcomes.

Self-efficacy encompasses an individual's own perception of their ability to competently carry out a task.[2] For parent's, self-efficacy may manifest in a number of ways from limiting television viewing to time devoted to providing physical activity opportunities for their children. Several cross-sectional studies have reported associations between high parent self-efficacy and

favorable physical activity and exercise behaviors.[3] However few interventions have evaluated changes in parent self-efficacy. In the current study, components of self-efficacy were shown to increase from baseline to follow-up, primarily with respect to parent play and enjoyment constructs. Specifically, parents reported an increase in their ability to have fun with their child and enjoy their child's stage of development, which is the foundation for successful health behavior changes at the family level according to Family Ecological Model. Specific to outdoor physical activity, only one study has evaluated changes in parent self-efficacy following an intervention. Davison et al.[4] implemented a one-year intervention that involved providing mothers participating in Women, Infants, and Children (WIC) program with resources for community physical activity opportunities such as maps. Parents reported the number of hours per day their child spent watching television, whether their child had a television in the bedroom, and how many minutes of time the child spends outdoors being active using the Outdoor Physical Activity Checklist.[4,5] At one year follow-up, mothers who received intervention materials were over three times more likely to report that they were confident they could limit their child's television watching (OR=3.32, 95%CI 2.17-5.17, $p<0.001$). Furthermore, children whose mother participated in the intervention were more likely to accumulate at least 60 minutes per day of outdoor physical activity compared to those children who were not part of the intervention (OR=2.79, 95%CI 1.94-4.02, $p<0.001$).[4]

As shown in Table 4.5, self-efficacy for setting limits and boundaries did not show any change from baseline to follow-up in parents. However, there were significant associations identified between parent play and enjoyment self-efficacy subscale with parent setting limits on video game, television computer use as measured with the support scale. This is a promising finding regarding the use of family time, because setting limits on sedentary endeavors such as

video game use, television time, and non-school related computer time have been shown to be heavily associated with increased physical activity levels, decreased screen time behaviors, and more favorable weight status in youth.[6] Based on these findings, improving parental self-efficacy for setting limits and boundaries at home should be a goal of future family-centered interventions. Introducing limits to activities that children likely enjoy may be met with some resistance from children. It may be possible that the severity of the arguments may be lessened by promoting family bouts outside where there are no opportunities to use televisions or other electronic devices, and the child is being fully engaged by the parent. As previously mentioned, knowledge, and perceptions of self-efficacy and value are shown to influence parent physical activity behaviors including role modeling and support. Therefore, it is necessary that interventions include assessments of parent perceptions and behaviors to tease out the best methods of increasing parent outcomes and subsequent child physical activity behaviors.

This study was also the first to assess child-specific outcomes as a result of a family-centered outdoor physical activity program. Although there were no changes in self-efficacy during the course of the program, the scores in the present study are similar to self-efficacy scores in other studies. The lack of significant change in self-efficacy across the program may be explained primarily by the program design. Studies have shown that children with higher self-efficacy for physical activity perform more activity than children with low self-efficacy.[7-9] Self-efficacy has been found to be linked to a child's individual desire to want to be active[10], and based on the large role self-efficacy plays on influencing a child's physical activity, the question of how to increase self-efficacy and how long it takes should be examined in more detail. Few studies have examined changes in child self-efficacy for activity across time. A study by Sherman et al.[9] suggests that interventions focused on changing self-efficacy should focus on

changing the child's beliefs about what they are capable of performing and that adults can assist in this endeavor by helping children to reach their full potential by helping them to improve existing skills and learn new ones. Although there were no changes in child self-efficacy with the current program, it is possible that increases child self-efficacy may occur because of the high parent-child contact promoted through a family physical activity program. However, the length of the current study (four weeks) may not have s been sufficient to allow parents the opportunity to perform physical activities with their child that would improve their skill or confidence in performing certain activities.

Child enjoyment of physical activity can be argued to be one of the most important correlates of youth physical activity. If a child does not enjoy the activity, it is unlikely that he or she will continue to engage in that activity or perform it in the future. Therefore, it is critical that the programs designed to increase child physical activity maintain a high level of child enjoyment.[10] Child enjoyment of physical activity at baseline for the current study was relatively high and remained unchanged at follow-up. Although this variable remained unchanged, this positive finding shows that a novel family outdoor physical activity program may be a fun way to engage children in activity with their parents.

These findings related to perceived parental support are encouraging, and are the first to be reported as a result of a family outdoor physical activity program. At follow-up, children reported higher frequency of someone participating in activity with them, as well as someone transporting them to and from places to be active. This type of support is often referred to as logistic support, and can encompass activities such as enrolling children in programs and transporting children to and from practices, games, and/or events.[11] Logistic support has long been considered a key influence on child physical activity levels and the Active Families GO

program was designed to include components that would help improve parent's ability to locate places to take their children to be active outdoors. The Family Ecological Model highlights that parent behaviors are the most direct influence on child physical activity levels, and the associations between specific family level encouragement for physical activity and someone participating in activity and transporting children to spaces where they can be active highlights heavy influence of parents on their child's physical activity behaviors. A study by Jago et al.[12] surveyed 790 children (ages 10-11) and their parents on physical activity levels, parenting styles, and parenting practices including support. Results showed that higher logistic support was associated with increased physical activity levels and that there were also parent role differences. Specifically, logistic support from mothers was associated with increased physical activity in girls, and increased physical activity levels in boys were associated with logistic support from fathers.[12] These findings suggest the need to develop interventions that incorporate the provision of logistic support to children. Family outdoor physical activity has the potential to offer some remedy if lack of logistic support is present because it requires families to find or create opportunities for activity together.

The Active Families GO program was also successful in increasing child's perception of someone performing physical activity with them compared to baseline. This was a primary aim of the study, as the program's main focus was to increase the amount of time parents and children spend together. Additionally, the results of the child-level outcomes are confirmed by the parent-level outcomes for certain support variables. Specifically at follow-up, parents reported a higher frequency of role modeling, and children reported higher levels of individuals being active with them. These findings also fit into the proposed Family Ecological Model by showing that parent outcomes and child outcomes have the potential to be concomitantly

influenced as the result of a family-centered program. Specifically, parenting self-efficacy and parenting support variables were found to be associated and child perceived support through critical parenting behaviors such as giving positive encouragement and praise were also associated with child reported transportation and family member physical activity participation. Based on the findings from this study, it is possible that family physical activity interventions have the potential to increase important components of parent and child perceived support for physical activity. These findings not only confirm the model, but also provide valuable information on the usefulness of family outdoor physical activity programming.

Limitations to this study include a small sample size and selected population. Families were recruited through convenient sampling methods. Although there was a 29% prevalence of overweight/obese weight status in children, the data include limited race/ethnicity and income diversity and therefore not generalizable to all populations. Furthermore, this study took place during the spring in the South during a four-week period and it therefore the results of the study cannot be generalized to other regions or seasons. It is possible from the small weather influences exhibited during the program may also occur during colder seasons as well as hot southern summers. Future studies should include a larger, more diverse sample and follow-up assessments that are spread out across the calendar year to determine how seasonal differences influence child self-efficacy, support, and enjoyment outcomes

In conclusion, this family centered outdoor physical activity program was successful in increasing the amount of time parents and children spend engaging in outdoor physical activity together. Furthermore, the program was effective at increasing key support outcomes for children. Additionally, there were no significant decreases in any self-efficacy or enjoyment outcomes that occurred as a result of introducing an outdoor-focused program. Future

interventions should consider utilizing family outdoor physical activity prescriptions as part of their family-centered intervention as we found this type of program to increase aspects of knowledge, perceptions, and behaviors in both parents and children. In conclusion, this dissertation contributes significantly to and aligns with the existing research on parent and child perceptions and behaviors following a family-centered physical activity intervention. The novel use of a family physical activity prescription to foster increases in parent knowledge, value, self-efficacy, and support appeared to be effective. Further research is needed to better understand how family time can be incorporated into multi-component interventions that seek to improve the health status of adults and children.

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Part V:
Conclusions

This study was implemented to determine the effectiveness of a family-centered program to increase joint family outdoor physical activity. The specific aims of the study were to describe the type, frequency, and duration of physical activities of families during a joint family outdoor physical program, determine whether increases in the number of family activity bouts (number of bouts per week) and time spent being active outdoors each week (min per week) can be observed. Additionally, the study sought to determine whether increases in the parent and child physical activity related perceptions and behaviors can be observed.

This study showed that encouraging family outdoor physical activity time was successful in increasing the amount of time families spent together engaging in outdoor physical activities. Furthermore, this study is the first to describe the characteristics of family activity bouts. The study also showed that a family-centered outdoor physical activity study is effective at increasing parent support for physical activity through role modeling, and child perceived support for physical activity. The results of this study can be used to further develop effective family-centered interventions to increase physical activity levels of parents and children.

Appendices

Appendix A:
Part III-IV Informed Consent

Parental Permission/Informed Consent to Take Part in a Research Study

Title: Active families in the great outdoors: A family-centered intervention to increase physical activity.

Investigator Contact Information:
Jennifer Flynn, M.S.
University of Tennessee, Dept. of Kinesiology, Recreation, and Sport Studies
1914 Andy Holt Ave., HPER 322
Knoxville, TN 37996
Phone (865) 974-5091 Email: jflynn6@utk.edu
You and your child are being invited to take part in a research study. This consent form talks about the purpose and requirements of the study. Please read this form carefully. You will be given a chance to ask questions. If you decide to participate and allow your child to be in the study, you will be given a copy of this form.

Why is this study being done?
Little research has been done on how to get parents and children active together while engaging in outdoor play. The purpose of this study is to determine the combined effects of a 4-week physical activity program [Active Families in the Great Outdoors (GO)] on increasing the physical activity levels of a family. Active Families GO consists of meetings and an information book with parent activities and resources for physical activity support and opportunities. In order for you and your child to be eligible for this study, you must be over the age of 18 and he/she must be between the ages of 7 and 17 years. You must both be healthy and be able to complete the activities in the study, be able to read/write English, and you and your child must be living in the same house for the duration of the study.

How long will the study last?
You and your child's participation will include three visits to the recreation center over a 4-week program and the 6-week follow-up, totaling 10 weeks.

How many people will be in the study?
About 40 families the surrounding Knoxville area will be included in the study.

What will my child do during the study?
Your family has been asked to participate in the Active Families GO program. The program is designed to help families increase the amount of time they spent outdoors being active together. For the program, you and your child(ren) will be given information on outdoor physical activities and a pedometer. You will be asked to attend three (3) meetings: a baseline meeting, a group meeting, and a final meeting. On the baseline visit, you and your child's height and weight will be assessed and you will both be fitted with a pedometer and provide instructions on how to use it. The pedometer is a small device worn at your hip with a belt or clip. It can also be worn in the pocket. You and your child will be asked to wear this pedometer for the entire study and record your family's step counts each day. During this visit, you will also complete series of two (2) questionnaires regarding physical activity for yourself and your child. Your child will also complete a short questionnaire. _____ Parent Initials

The second meeting will be a group meeting. This meeting will be held at the Outdoor Knoxville Adventure Center (900 Volunteer Landing Lane, Knoxville, TN, 37915). At this meeting, your family will receive instructions for the program. You will also be given instructions on using the Family Activity Log. The log will be sent to the researcher weekly using pre-paid envelopes or email based on your preference. The program will include 4 weeks of family physical activity resources.

After the 4 weeks the program, your family will be asked to attend a final meeting, held at the Ijams Nature Center (2915 Island Home Ave, Knoxville, TN, 37920). You and your child will be asked to complete the same surveys you did at the baseline meeting again. Following the program, you will be asked to fill out the Family Activity Logs for an additional six weeks.

What are the risks to my child as a participant in the study?
Risks associated with this study are minimal and are similar to what you or your child would experience during typical physical activity and playground activity. Additionally, you and your child may experience mild discomfort from wearing the pedometer on a belt. This discomfort could be from the monitor itching or irritating your child. If they become uncomfortable, the belt or clip can be adjusted or removed to ensure you and your child's comfort.

Are there benefits to you and your child for taking part in the study?
You will also be presented with information about you and your child's weight status (body mass index) should you desire it. Upon completion of the study, we hope to gain new information about ways to engage your family in physical activity and about local and/or university physical activity opportunities for parents and children.

What happens if you or your child gets hurt?
The University of Tennessee does not "automatically" reimburse subjects for medical claims or other compensation. If physical injury is suffered in the course of research, or for more information, please notify the investigator in charge, Jennifer Flynn, M.S., (865) 974-5091.

Who do you call if you have questions about the study?
If you have questions at any time about the study or what you during the study, (or you experience adverse effects as a result of participating in this study,) you may contact the researcher, Jennifer Flynn, M.S., at 1914 Andy Holt Ave., 314 HPER Building, Knoxville, TN 37996, (865) 974-5091 (phone), or jflynn6@utk.edu (email). If you have questions about your rights as a participant, contact the Office of Research Compliance Officer at (865) 974-3466.

What will it cost you to be in the study?
There will be no cost to you or your child to be in the study.

Will anyone know you are in the study and how are your identities being protected?
A record of your family's participation in the study will be kept private and all data will be kept in a confidential file in a locked cabinet in a locked University of Tennessee faculty office for 3 years following completion of the study. After that, your family's data will be destroyed. Only

_____ Parent Initials

the co-investigators will have access to your family's data. Study results will be prepared for presentation at professional meetings and publication in journals. However, none of your family's personal information will be revealed. Therefore, your family will not be identified in any reports. Participants will be referred to by code numbers instead of names in order to ensure the confidentiality of each parent and child who participates in the study.

What if you do not want to be in the study?
Your family's participation in this study is voluntary. Your decision whether or not to allow your family to be in this study will not affect your family's current or future relations with the researchers or the University of Tennessee. If you decide to allow your family to be, you are free to withdraw your family from the study at any time without affecting those relationships. If you withdraw from the study before data collection is completed your data will be returned to you or destroyed.

PERMISSION OF PARENT OR GUARDIAN:

I have read the above information. I have received a copy of this form. I,

_____ (parent's name) agree to participate in this study, and allow

for my child(ren) _____

to participate in the study.

_____

Printed Name of Parent/Legal Guardian

_____ _____

Signature of Parent/Guardian **Date**

_____

Printed name of Investigator

_____ _____

Signature of Investigator **Date**

Appendix B:
Part III-IV Informed Assent

Active families in the great outdoors: a family-centered intervention for increasing physical activity.

☐ The assent discussion was initiated on _____(date) at _____(time).

The information was presented in age-appropriate terms.

The minor:_____(Subject's Name)

☐ Agreed to take part in the study on _____(date) at _____ (time).

☐ An assent discussion was not initiated with the minor for the following reason(s):

- ☐ Minor is physically incapacitated
- ☐ Minor is cognitively or emotionally unable to participate in an assent discussion
- ☐ Minor refused to take part in the discussion
- ☐ Other_____

RESEARCHER/DESIGNEE STATEMENT: I hereby certify that I have discussed the research project with the research participant and/or his/her parent(s) or legal guardian(s). I have explained all the information contained in the informed consent document, including any risks that may be reasonably expected to occur. I further certify that the research participant was encouraged to ask questions and that all questions were answered.

_____

Researcher/Designee Printed Name

_____ _____

Researcher/Designee Signature Date

_____

Minor Subject Printed Name

_____ _____

Minor Subject Signature (7-17 years) Date

Appendix C:
Part III-IV Recruitment Flyer

Parents!!!

Are you interested in getting your family more active together??

If so, your family may qualify for a fun, new study at the University of Tennessee.

Qualifications

(1) At least one child between the ages of 7 and 17 years old.

(2) Be free of any injuries that restrict physical activity.

(3) Be able to speak and write English

If you meet the criteria, your family will have the opportunity to participate in a family-centered, outdoor physical activity program.

Please contact Jenny at (865) 974 - 5091 or jflynn6@utk.edu for more details!

Appendix D:
Part III-IV Parent Surveys

Please circle all that apply.

1. **What is your gender?** Female Male

2. **What is your current marital status?**

Single, never married	Married	Member of an unmarried couple
Separated	Divorced	Widowed

3. **What is your race/ethnicity?**

White	Hispanic	African American
Native American	African American	Other

4. **What is your highest education level?**

Less than High School	High School or equivalent	Some college
College graduate	Post graduate/professional degree	

5. **Does your child qualify for free/reduced lunch?** Yes No

6. **How many adults currently live in your household? _____**

7. **How many children live in your household? _____**

8. **Please list the age and sex of each child living in the household?**

_____

Parent Survey 2

Section 1:

1. **Do you know that the United States has established federal guidelines (Physical Activity Guidelines for Americans) for recommended amounts of physical activity per week for adults?**

   YES NO

2. **How many minutes of moderate intensity activity are recommended per week to achieve health benefits for adults?**

   _____

3. **Do you know that the United States has established federal guidelines (Physical Activity Guidelines for Americans) for recommended amounts of daily physical activity for children?**

   YES NO

4. **How many days of the week should a child be physically active?**

   _____

5. **How many minutes of moderate-to-vigorous physical activity that children should achieve daily?**

   _____

6. **Kids who do regular physical activity are healthy**

1	2	3	4
Strongly Disagree	Somewhat Disagree	Somewhat Agree	Strongly Agree

7. **Kids who do physical activities have problems in school**

1	2	3	4
Strongly Disagree	Somewhat Disagree	Somewhat Agree	Strongly Agree

8. **Kids who do regular physical activities have more self-confidence**

1	2	3	4
Strongly Disagree	Somewhat Disagree	Somewhat Agree	Strongly Agree

9. Kids who do regular physical activities will be healthier adults

1	2	3	4
Strongly Disagree	Somewhat Disagree	Somewhat Agree	Strongly Agree

Section 2:

10. I enroll my child in sports teams and clubs such as soccer, basketball and dance.

1	2	3	4
Strongly Disagree	Disagree	Agree	Strongly Agree

11. I take my child places where he/she can be active.

1	2	3	4
Strongly Disagree	Disagree	Agree	Strongly Agree

12. I watch my child play sports or participate in other activities such as martial arts or dance.

1	2	3	4
Strongly Disagree	Disagree	Agree	Strongly Agree

13. I encourage my child to be physically active by leading by example (by role modeling).

1	2	3	4
Strongly Disagree	Disagree	Agree	Strongly Agree

14. I exercise or am physically active on a regular basis.

1	2	3	4
Strongly Disagree	Disagree	Agree	Strongly Agree

15. I enjoy exercise and physical activity.

1	2	3	4
Strongly Disagree	Disagree	Agree	Strongly Agree

16. I encourage my child to use resources in our neighborhood to be active (such as the park and the school).

1	2	3	4
Strongly Disagree	Disagree	Agree	Strongly Agree

17. I enroll my child is community-based programs (such as Girls and Boys Club, YMCA) where he/she can be active.

1	2	3	4
Strongly Disagree	Disagree	Agree	Strongly Agree

18. 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	2	3	4
Strongly Disagree	Disagree	Agree	Strongly Agree

19. I limit how long my child plays video games (including playstation, Xbox, and gameboys).

1	2	3	4
Strongly Disagree	Disagree	Agree	Strongly Agree

20. I limit how long my child can watch TV or DVDs each day (including educational and non-educational programs).

1	2	3	4
Strongly Disagree	Disagree	Agree	Strongly Agree

21. 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	2	3	4
Strongly Disagree	Disagree	Agree	Strongly Agree

Section 3:

22. I am able to have fun with my child.

0	1	2	3	4	5	6	7	8	9	10
Completely Disagree				Moderately Agree					Completely Agree	

23. I am able to enjoy each stage of my child's development.

0	1	2	3	4	5	6	7	8	9	10
Completely Disagree				Moderately Agree					Completely Agree	

24. I am able to have nice days with my child.

0	1	2	3	4	5	6	7	8	9	10
Completely Disagree				Moderately Agree					Completely Agree	

25. I can plan activities that my child will enjoy.

0 1 2 3 4 5 6 7 8 9 10

Completely Disagree Moderately Agree Completely Agree

26. Playing with my child comes easily.

0 1 2 3 4 5 6 7 8 9 10

Completely Disagree Moderately Agree Completely Agree

27. I am able to help my child reach their full potential.

0 1 2 3 4 5 6 7 8 9 10

Completely Disagree Moderately Agree Completely Agree

28. Setting limits and boundaries is easy for me.

0 1 2 3 4 5 6 7 8 9 10

Completely Disagree Moderately Agree Completely Agree

29. I am able to stick to the rules I set for my child.

0 1 2 3 4 5 6 7 8 9 10

Completely Disagree Moderately Agree Completely Agree

30. I am able to reason with my child.

0 1 2 3 4 5 6 7 8 9 10

Completely Disagree Moderately Agree Completely Agree

31. I can find ways to avoid conflict.

0 1 2 3 4 5 6 7 8 9 10

Completely Disagree Moderately Agree Completely Agree

32. I am consistent in the way I use discipline.

0 1 2 3 4 5 6 7 8 9 10

Completely Disagree Moderately Agree Completely Agree

33. I am able to discipline my child without feeling guilty.

0 1 2 3 4 5 6 7 8 9 10

Completely Disagree Moderately Agree Completely Agree

34. I am able to recognize developmental changes in my child.

0 1 2 3 4 5 6 7 8 9 10

Completely Disagree Moderately Agree Completely Agree

35. I can share ideas with other parents.

0 1 2 3 4 5 6 7 8 9 10

Completely Disagree Moderately Agree Completely Agree

36. I am able to learn and use new ways of dealing with my child.

0 1 2 3 4 5 6 7 8 9 10

Completely Disagree Moderately Agree Completely Agree

37. I am able to make the changes needed to improve my child's behaviors.

0 1 2 3 4 5 6 7 8 9 10

Completely Disagree Moderately Agree Completely Agree

38. I can overcome most problems with a bit of advice.

0 1 2 3 4 5 6 7 8 9 10

Completely Disagree Moderately Agree Completely Agree

39. Knowing that other people have similar difficulties with their children makes it easier for me.

0 1 2 3 4 5 6 7 8 9 10

Completely Disagree Moderately Agree Completely Agree

Appendix E:
Part III-IV Child Survey

Section 1:

(1) I can be physically active on most days of the week.

1	2	3
Disagree	Neither disagree nor agree	Agree

(2) I can ask my parents or other adults to do active things with me.

1	2	3
Disagree	Neither disagree nor agree	Agree

(3) I can be physically active on most days even if it is very hot or cold outside.

1	2	3
Disagree	Neither disagree nor agree	Agree

(4) I can do active things because I know how to do them.

1	2	3
Disagree	Neither disagree nor agree	Agree

(5) I can be physically active even at home.

1	2	3
Disagree	Neither disagree nor agree	Agree

(6) I can be physically active on most days even if I could watch TV or play video games instead.

1	2	3
Disagree	Neither disagree nor agree	Agree

(7) I can ask my parents to be physically active with me on most days.

1	2	3
Disagree	Neither disagree nor agree	Agree

(8) I have the skill to be active in my free time.

1	2	3
Disagree	Neither disagree nor agree	Agree

Section 2:

During a typical week, how often:

(1) do you encourage your friends to do physical activities or play sports?

1	2	3
Never	Sometimes	Every Day

How about your family members?

1	2	3
Never	Sometimes	Every Day

(2) do your friends encourage you to do physical activities or play sports?

1	2	3
Never	Sometimes	Every Day

How about your family members?

1	2	3
Never	Sometimes	Every Day

(3) do your friends do physical activities or play sports with you?

1	2	3
Never	Sometimes	Every Day

How about your family members?

1	2	3
Never	Sometimes	Every Day

(4) do your friends tell you that you are doing a good job at physical activities or sports?

1	2	3
Never	Sometimes	Every Day

How about your family members?

1	2	3
Never	Sometimes	Every Day

(5) has someone encouraged you to do physical activities or play sports?

	2	3

1		
Never	Sometimes	Every Day

(6) Has someone done a physical activity or played sports with you?

1	2	3
Never	Sometimes	Every Day

(7) Has someone provided transportation to a place where you can do physical activities or play sports?

1	2	3
Never	Sometimes	Every Day

(8) Has someone watched you participate in physical activities or sports?

1	2	3
Never	Sometimes	Every Day

(9) Has someone told you that you are doing well in physical activities or sports?

1	2	3
Never	Sometimes	Every Day

Section 3:

(1) When I am active I feel bored.

1	2	3	4	5
Disagree a lot	Disagree a little	Neither agree nor disagree	Agree a little	Agree a lot

(2) When I am active I dislike it.

1	2	3	4	5
Disagree a lot	Disagree a little	Neither agree nor disagree	Agree a little	Agree a lot

(3) What I am active it is no fun at all.

1	2	3	4	5
Disagree a lot	Disagree a little	Neither agree nor disagree	Agree a little	Agree a lot

(4) When I am active it makes me depressed.

1	2	3	4	5
Disagree a lot	Disagree a little	Neither agree nor disagree	Agree a little	Agree a lot

(5) When I am active it frustrates me.

1	2	3	4	5
Disagree a lot	Disagree a little	Neither agree nor disagree	Agree a little	Agree a lot

(6) When I am active it is not at all interesting.

1	2	3	4	5
Disagree a lot	Disagree a little	Neither agree nor disagree	Agree a little	Agree a lot

(7) When I am active I feel as though I would rather be doing something else.

1	2	3	4	5
Disagree a lot	Disagree a little	Neither agree nor disagree	Agree a little	Agree a lot

Appendix F:
Part III-IV Program Evaluation

Please list as many benefits of outdoor physical activity you can think of for children.

_____
_____
_____
_____
_____

What are three (3) outdoor games to play with your kids as a family?

1) _____

2) _____

3) _____

Please identify as many parks as you can for your family to go and be active.

_____
_____
_____
_____
_____

Please identify as many greenways as you can for your family to go and be active on.

_____
_____
_____
_____
_____

What is the Knoxville Urban Wilderness?

_____
_____
_____

What services does the Outdoor Knoxville provide?

_____
_____
_____

Appendix G:
Part III-IV Family Activity Log

Please contact Jenny if you have questions!

Health, Physical Education and Recreation Building

1914 Andy Holt Ave.

Knoxville, TN 37996

Phone (865) 974-5091

Email: jflynn6@utk.edu

Fax: (865) 974-8981

Family Name:

_____

WEEK 1

ctive Families in the Great Outdoors

ctive Families in the Great Outdoors

Please log your family's physical activity this week. Be sure to report a detailed description of the type of activity your family performed. On Monday, mail the journal in a pre-paid envelope to Jenny. Thank you!

DATE	What did you do?	Where did you go?	Start Time	Stop Time	Who went?	How many steps?

Vita

Jennifer Irene Flynn was born on July 31, 1987 in Tawas City, MI. She was raised in Harrisville, MI with her brother, Jimmy, by their parents Mike and Nancy Flynn. She attended school and graduated from Alcona Community High School in June 2005. She then received her Bachelors of Science in Exercise Science from Saginaw Valley State University in Saginaw, MI in August 2009. Following her Bachelors, she attended the University of Tennessee in Knoxville, TN. There she obtained her Masters of Science in Exercise Physiology (2011) and her Doctor of Philosophy in Kinesiology and Sport Studies with a specialization in Exercise Physiology in 2014. Following her Ph.D., she went on to accept a position as a postdoctoral fellow at the University of South Carolina in Columbia, South Carolina.