THE EFFECTS OF A MOTHER-DAUGHTER PHYSICAL ACTIVITY INTERVENTION ON CHILD SCREEN TIME AND SEDENTARY BEHAVIOR

by

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Recent data show that more than half (54%) of children aged 2-5 years do not meet American Academy of Pediatrics screen time guidelines, specifically young girls. Further, increased screen time has been associated with increased child sedentary behavior and negative health outcomes such as obesity. Parental self-efficacy to limit screen time is negatively associated with the amount of time their children spend in screen activities but the literature to support this relationship is limited. Therefore, it is important design interventions to decrease child screen time. **Purpose:** The overall goal of this study was to examine the effectiveness of a mother-daughter screen time intervention. The specific aims were: a) examine changes in child screen time and sedentary behavior, b) examine changes in maternal knowledge of screen time guidelines and self-efficacy to limit screen time, and c) examine relationships between screen time and sedentary behavior and maternal knowledge of screen time guidelines and self-efficacy from pre- to post-intervention. **Methods:** Thirty-three mother-daughter dyads were recruited to participate in an 11-week intervention study. Mothers completed a demographic questionnaire, Media Child Use questionnaire, Knowledge of Screen time guidelines questionnaire, and self-efficacy to limit screen time questionnaire before and after the intervention. Daughters wore an

accelerometer for 7 days to measure sedentary behavior. Twelve mother-daughter pairs received a physical activity only intervention, 12 mother-daughter pairs received physical activity plus screen time intervention, and 10 mother-daughters pairs sewed as participants. Mother-daughter intervention pairs met weekly for 1-hour in community parks and were given information related to physical activity and/or screen time, various games and new physical activity toys, and new challenges for physical activity and/or screen time in the upcoming week depending on their group assignment. Repeated measures 3 (group) x2 (time) ANOVA were used to examine changes in child's screen time and sedentary behavior and maternal knowledge of screen time guidelines and self-efficacy to limit screen time. A Pearson product moment correlation was used to examine associations between maternal self-efficacy and child screen time and sedentary behavior. **Results:** Mothers in this study had an average age of 35.53 (4.42) years and daughters were aged 3.87 (1.05) years. Mother's average BMI was 27.88 (6.75) kg/m^2, 87.5% had a college degree or higher and 78.13% reported $50,000 or higher household income. There was a statistically significant group x time interaction for frequency of screen time activities ($F(2,26)= 7.32$, $p= 0.003$, $d= -0.96$. There were non-statistically significant interactions for all other variables. Finally, there was a moderate-to-strong negative correlation ($r= -0.43$) between maternal self-efficacy to limit screen time and children's screen time at pre-intervention ($r= -0.38$, $p < 0.05$) and post-intervention ($r= -0.51$, $p < 0.004$). **Conclusions:** The physical activity plus screen time intervention successfully reduced child screen time. Along physical activity and screen time participants, maternal knowledge and self-efficacy to limit screen time increased despite non-statistically significant differences between groups. However, all changes in the physical activity plus screen time group were in the expected direction and stronger in magnitude than the physical activity only and control group. The hypotheses were partially supported due to

lack of statistically significant differences between groups for sedentary behavior, maternal knowledge, and self-efficacy to limit screen time. This intervention showed promising results for decreasing child screen time and sedentary and maternal knowledge of screen time guidelines and self-efficacy to limit screen time. Future studies should examine this intervention with larger, completely randomized samples of participants.

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Chapter 1. Introduction

Childhood obesity has more than doubled among children and quadrupled among adolescents in the last 30 years (Centers for Disease Control and Prevention, 2014). Approximately 8.9% of young children (2-5 years) are obese and the prevalence rises to 18% for children aged 6-11 years and almost 21% for adolescents between ages 12-19 years (CDC, 2014). In 2012, more than one-third of children and adolescents were overweight or obese and their parents were projected to outlive their children. Specifically looking at young girls, status of overweight or obesity doubles between ages 2-5 and 6-11 years (Ogden, Carroll, Fryar, & Flegal, 2015). Overweight and obesity are the results of "caloric imbalance"- too little calories expended and too many consumed (CDC, 2016).

There are many reasons for the increasing prevalence of overweight and obesity among children from such a young age (Rey-Lopez, Vincente-Rodriguez, Biosca, & Moreno, 2008). One contributing factor to weight gain is too much time spent in screen-based sedentary behaviors (Viner & Cole, 2005). Sedentary behavior is defined as any waking activity characterized by energy expenditure less than or equal to 1.5 METs in any sitting or reclining postures. This includes but is not limited to screen viewing, video gaming, reading, and computer use (Sedentary Behavior Research Network, 2012). Screen time includes time spent watching television or using a computer but as technology has advanced, now young children are being exposed to touch screen devices, cell phones, and video games. The American Academy of Pediatrics (AAP) has established and recently updated screen-time guidelines for children (2016). For a child under the age of 18 months, intentional screen time is discouraged completely other than video chatting. For children 18-24 months it is important for the parent to choose high

quality programming and participate in viewing it with their children if they want to introduce their child to media. Children 2-5 years are recommended to not exceed one hour per day of intentional high quality content screen time. The AAP has also established suggested boundaries called 'screen-free zones' in homes (i.e, no televisions, computers, video games, or other screens in bedrooms). The AAP further recommends that children do not have any screen exposure during dinnertime and at least an hour before bedtime. These guidelines can help create awareness with parents about violence on the TV, fast-paced programs that young children cannot yet understand, and create more time for free and creative play. Parents who interact with their young children during play are more likely to have active children versus using screen time as a way to "get things done around the house" or calm them down (American Academy of Pediatrics, 2016; Roxon, 2009).

Unfortunately, many children do not meet the AAP screen time guidelines. Stanger (1997) surveyed parents about their child's screen time and thoughts about programs their children view. TV watching was the second highest activity done within the house with an average of two hours a day next to the highest being sleep. Two out of five children between the ages of 2 and 17 years had televisions in their bedrooms and as they aged, the likelihood of having a TV in their bedroom increased to age 11 (Stanger, 1997). More recent data show that children under the age of two, 90% of them are exposed to media of all types (Zimmerman & Christakis, 2007). Current data are showing children aged 6 to 11 years consume three to four hours a day in entertainment media (AAP, 2016) and more than half (54%) of American, Australian, and Canadian children aged 2-5 years exceed the previous AAP recommendation of two hours of screen time per day (Zimmerman & Christakis, 2007). For many children, exposure to screens begins at a very early age. In one sample, 40% of three-month old children were being

exposed to media despite the recommendation (Zimmerman & Christakis, 2007). Researchers questioned why parents were allowing their children to watch so much television versus engaging in social and unstructured play. Parents reported beliefs that screen time was educational and good for the child's brain and that it was enjoyable and relaxing (Zimmerman & Christakis, 2007). Contrary to parental beliefs, negative effects can result from too much screen time including increased sedentary behavior, obesity, negative psychosocial behaviors, and poor physical health and academic outcomes.

Researchers have identified several factors associated with child screen time behaviors including: parental knowledge of screen time guidelines, parental screen time usage, and parental self-efficacy to limit screen time. Parents reported difficulties implementing the screen time guidelines that could be associated with child screen (Gustafson & Rhodes, 2006). Mothers reported to be knowledgeable about screen time guidelines but screen time is also more prevalent in mothers with younger children under the age of 2 years (Campbell et al., 2010). Parents, mothers specifically, feel like they are capable of implementing screen time rules but experience barriers related to consistently enforcing due and adhering to screen time guidelines (Smith, Grunseit, Hardy, King, Wolfenden, & Milat, 2010). Parents reporting four or more obstacles for consistently enforcing screen time rules had children who were 83.3% more likely to exceed screen time recommendations compared those parents who only reported 0-1 obstacles (Smith et al., 2010). Very little literature exists on examination of parental knowledge of screen time guidelines. Campbell et al. (2010) identified that maternal knowledge of previous screen time guidelines is present, but knowledge of the newly set guidelines needs to be addressed in various settings with younger children.

A closer look at the parents themselves and their time spent in screen viewing behaviors shows percentages do not differ much from their children. Weekday screen time reports showed 30% of mothers watched two or more hours of screen time each day. When mothers exceeded the two-hour time span, their children were 3.4-3.7 times more likely to exceed their screen time recommendations (Jago et al., 2014). Increased screen time for parents results in increased screen time for the child as well as increased bouts of sedentary behaviors for both individuals (Wood, Jago, Sebire, Zahra, & Thompson, 2015). The more parents engage in screen time themselves, the more likely their child is to engage in the same behavior and exceed recommendations. Thus, it is important to teach parents to model healthy screen time behaviors.

Researchers suggest lack of self-efficacy for limiting child screen time as a possible factors associated with increased child screen time. Self-efficacy is defined as a situation-specific confidence in an individual's ability to perform a behavior. High levels of self-efficacy can have an impact on personal well-being and capabilities to approach difficult challenges (Bandura, 1998). Self-efficacy to limit child screen time, a parent's situation-specific confidence in his/her ability to control their child's screen viewing behaviors, is an important variable to consider in efforts to reduce children's screen time. When parents lack self-efficacy, they lack perceived ability to reinforce recommendations, not only for their children but also for themselves. Seventy-one percent of parents with low self-efficacy for limiting screen time reported having children who exceeded screen time recommendations (Smith et al., 2010). Reasons for lowered self-efficacy included the cost of alternative activities, lack of interest from the child in other activities, and high levels of parental stress (Barnes, Plotnikoff, Collins, & Morgan, 2015). Efforts to increase parental self-efficacy to limit screen time are needed to examine the impact of child screen time and sedentary behaviors.

Limited studies have examined the relationship between self-efficacy to limit screen time and child screen time and/or physical activity among mothers. Campbell et al. (2010) studied maternal self-efficacy to promote physical activity over screen time and maternal self-efficacy to limit screen viewing. Through self-administered questionnaires, self-efficacy to replace screen viewing was inversely associated with children's screen time among children aged 1-5 years. Maternal self-efficacy to limit screen viewing was also inversely associated with children's total screen viewing; the higher the reported self-efficacy for limiting screen viewing, the lower the time spent in screen viewing for both ages 1 and 5 (Campbell et al., 2010). Barnes et al. (2015) found that mothers who believed physical activity was more important for their 7-9 year old daughters than screen time were more likely to have physically active daughters. Further, daughters who were aware of their mothers' beliefs about physical activity were more likely to seek opportunities to be active and involved in moderate-vigorous physical activity (Barnes, 2015). Parents are not always presented with easy means for decreasing sedentary behavior and screen time. With younger children especially, the time spent in unorganized activity was inversely correlated to barriers and self-efficacy (Smith et al., 2010). Children who had higher levels of unstructured playtime had parents who reported fewer obstacles for limiting screen time and higher levels of self-efficacy for implementing physically active lifestyles and reduced screen time (Smith et al., 2010). It is possible that when reinforcing unstructured play, parents could exhibit higher levels of self-efficacy and reduced screen time. With fewer obstacles for limiting screen time and increased levels of self-efficacy, mothers could better restrict screen viewing time and seek opportunities for encouraging their children to be active.

Some qualitative studies have targeted physical activity and/or sedentary behavior and screen time to better understand health behaviors and health outcomes among children. Hamilton

and Hatzis (2015) reported that physical activity and screen time are linked and children could easily obtain recommendations for activity, but still achieve more than an hour of screen time (Hamilton & Hatzis, 2015). In another study, levels of high screen time were also highly correlated to physical activity levels and as age increased, the odds of being insufficiently active and more sedentary increased by 22% each year (Smith et al., 2010). Strategies for understanding risks of sedentary behavior and techniques for creating more recreational activities need to be addressed.

Christian, Zubrick, Knuiman, Nathan, Fister, Villanueva, et al. (2017) delivered a cross-sectional sub-study to families with children between ages 5 and 15 on neighborhood convenience. The study was done by interviewing families over the phone for weekly reported minutes of screen time, socioeconomic demographics, and objectively reported neighborhood destinations. Neighborhood destinations in the community were reported and recorded and based on convenience goods, services, and public open spaces. Results showed that on average, children engaged in over 800 minutes of screen time weekly (on average 114/day) and when having access to 12 or more recreational activity facilities, children engaged in 83 less minutes of screen time per day. Particularly, girls with access to recreational facilities undertook less than 109 minutes of screen time per day compared to girls with only 0-3 destinations. Among girls, community destinations were inversely associated with screen time and sedentary behaviors. There was a significance found between girls and destinations in a dose response manner when looking at neighborhood activity space. This study concluded that with more neighborhoods and surrounding areas supporting active living, the less time, girls specifically, spend in sedentary screen-based activities and potentially increased their time spent in outdoor active activities (Christian et al., 2017). If more studies focus on neighborhood and community environments,

there is potential for screen time to reduce and physical activity to increase particularly in younger girls.

Wu, Sun, He, and Jiang, (2016) conducted a systematic review on the effectiveness of various randomized control interventions targeting screen time reduction in adults and children. After meeting inclusion criteria, 14 studies concluded that interventions targeting screen time reduction had significant effects on Body Mass Index reduction and overall viewing time. They also found interventions that lasted less than seven months had larger effects on screen time reduction, specifically those that focused on health promotion (Wu et al., 2016). Downing, Hnatiuk, Hinkley, Salmon, and Hesketh, (2017) also conducted a systematic review focusing on family involvement in interventions to reduce sedentary behaviors, specifically screen time. Results from 31 studies concluded that interventions greater than 6 months duration in a community setting were most effective for screen time reduction. Specifically, those interventions that targeted physical activity were more effective than those directly targeting sedentary behavior. Three studies included community-based interventions among pre-school aged children, but only one reported positively significant findings (Downing, et al., 2017). Campbell, Lioret, McNaughton, Crawford, Salmon, Ball, et al. (2013) studied children aged 3-5 years old over 15 months to determine the effect of six, 2-hour dietician-delivered sessions to parents focusing on child diet, physical activity, and screen time. Results showed statistically significant inverse associations between physical activity and screen time with the intervention group at post-intervention (Campbell et al., 2013). These studies suggest that interventions targeting parents of young children to promote reducing screen time and/or increased physical activity in community settings may be effective.

Previous studies on screen time, sedentary behavior, and physical activity have provided some initial evidence for reducing screen time and sedentary behavior, but there are still several gaps in the existing literature. Research on screen time is often studied in home settings, therefore causing a lack of interventions taking place in community settings (Salmon, Tremblay, Marshall, & Hume, 2011). Mothers report knowledge of guidelines to screen time, yet screen time is still prevalent in young children. There are some data about maternal knowledge of screen time guidelines but not all mothers may be aware of the new guidelines (Campbell et al., 2010; Bentley, Jage, & Turner, 2015). Mothers also feel capable to implement screen time rules but experience barriers related to consistently enforcing rules and following the guidelines (Smith et al., 2010). Finally, there are few programs targeting the impact of a program designed for mothers and their young daughters. Researchers found that mothers who think physical activity is more important for their daughters were more likely to have active daughters (Barnes et al., 2015). Conversely, daughters who were aware of the importance their mothers placed on physical activity were more likely to seek opportunities to be active (Barnes et al., 2015). This provides the rationale behind the current study's focus on mothers and daughters in a physical activity community-based intervention to reduce their child's screen time and sedentary behaviors.

The purpose of the current study is to examine the effect of a community-based program to decrease screen time among preschool-aged girls. The study will also assess maternal knowledge of screen time guidelines and self-efficacy to limit screen viewing. Specifically, this study compares the effectiveness of a physical activity group (MDMT) to a physical activity plus screen time education group (MDMT+) to a control group for decreasing child screen time and sedentary behavior.

Purpose I

To compare the impact of a physical activity intervention and a physical activity plus screen time intervention with a control group on sedentary behavior and screen time among child participants.

Hypothesis I

We hypothesize that child screen time and sedentary behavior will decrease for physical activity plus screen time group and remain constant in the physical activity only and control group.

Purpose II

To compare the impact of a physical activity plus screen time intervention to a physical activity intervention and control group on maternal knowledge of screen time guidelines for children and maternal self-efficacy to limit child screen time.

Hypothesis II

We hypothesize that maternal knowledge of screen time guidelines and self-efficacy to limit screen time use will increase among mothers given extra screen time information compared to those in the control group and those in the physical activity group who do not receive extra information.

Purpose III

To examine the relationships within the intervention group participants between changes in child screen time and sedentary behavior from pre- to post-intervention with changes in maternal knowledge and self-efficacy from pre- to post-intervention and to examine relationships among sedentary behavior, screen time, maternal knowledge, and self-efficacy at pre- and post-intervention.

Hypothesis III

We hypothesize that there will be a negative relationship between changes in child screen time and sedentary behavior with changes in maternal knowledge and self-efficacy to limit screen time. Secondly, we hypothesize that there will be a negative relationship between screen time and sedentary behavior with maternal knowledge and self-efficacy at pre- and post-intervention.

Delimitations

1. Ages of child between 2-5 years old, specifically preschool aged
2. Female children
3. Mothers 18 years and older
4. Mother has to be living with child full-time
5. Mothers had option to choose most compliant child to participate if there was more than one child in the home

Limitations

1. No children above the age of 5 years
2. Women who were currently pregnant were not included due to possible accelerometer discrepancies

Operational Definitions

Physical Activity- any bodily movement via skeletal muscles which results in energy expenditure (Caspersen, Powell, & Christenson, 1985)

Screen Time- time spent using a device such as a computer, television, or games console (Oxford University Press, 2017)

Overweight- above a weight considered normal or desirable; between 85^{th}-95^{th} percentiles for children; 25-29.9 kg/m^2 BMI for adults (CDC, 2016)

Obesity- the condition of being grossly fat or overweight; above 95^{th} percentile for children; 30.0 BMI and above for adults (CDC, 2016)

Sedentary Behavior- any waking activity characterized by an energy expenditure less than or equal to 1.5 METs and a sitting or reclining position (Tremblay, et al., 2017)

Self-Efficacy- an individual's beliefs about their own capabilities to produce designated levels of performance that exercise influence over events that affect their personal lives (Bandura, 1998)

Young Children- toddler and preschool aged children between the ages of 2 and 5 years

Chapter 2. Review of the Literature

Introduction

The purpose of the current study is to examine the impact of a physical activity intervention compared to a physical activity plus screen time intervention on child sedentary behavior and screen time, both compared to a control group. The following review of literature will discuss screen time recommendations for children, current rates of screen time, negative consequences of screen time, sedentary behavior, and interventions designed to decrease screen time in zero to five year old children.

Screen Time Recommendations and Guidelines

The American Academy of Pediatrics (AAP) established guidelines for the recommended amount and type of screen time among children. Children ages 2-5 years and older are recommended not to exceed more than one hour per day of high quality content screen time (ST) (American Academy of Pediatrics, 2016). For children between the ages of 18 and 24 months, parents should choose high quality programming that they can watch together with their children if they want to introduce media. High quality content consists of educational or informational television such as PBS Kids and Sesame Street Workshop. For children younger than 18 months old, all screen time with the exception of video-chatting is discouraged as it can delay the growth of enhanced learning, interaction, and hands-on unstructured social play. Learning, interaction, and unstructured play are used to build language, cognitive, and social-emotional skill (AAP, 2016). The AAP has also encouraged the establishment of 'screen free zones' (i.e., places in the home with no televisions, computers, video games, for example, bedrooms). The AAP further recommends turning off the TV during dinnertime and one hour before bedtime. Parents are

discouraged from putting TVs in children's bedrooms where they cannot closely monitor their viewing time and are encouraged to have children spend more time engaged in outdoor play, reading books, using imagination in free play, and other activities. In addition, parents should avoid using media as a substitute and as the only way to calm their child (American Academy of Pediatrics, 2016; Roxon et al., 2009). Parents are also encouraged to avoid fast-paced programs that contain immense amounts of distracting content and violence. The AAP has endorsed these guidelines to ensure screen time is limited and other activities are given priority.

Current Screen Time Rates

Researchers have examined screen time and children since the 1980's and its correlation to detrimental effects in children aged 6-17 (Dietz & Gortmaker, 1985). In 2001, the AAP established the first screen time guidelines for children aged 2 to 5 years recommending that parents limit their child's screen exposure to less than two hours per day. For children under the age of two, 90% were exposed to screen time throughout the week (Zimmerman & Christakis, 2007). Stanger (1997) and the Anneberg Public Policy Center surveyed parents and children on media in the home, their involvement, and personal opinions about screen time. Two in five children between the ages of 2 and 17 had TV sets in their bedrooms. Furthermore, one in four preschoolers had a TV in their bedroom and the likelihood increased as they aged. After measuring nine different activities done in the house, next to sleep, screen viewing was the second highest with an average of two hours per day (Stanger, 1997). Using this information can help parents become more aware of how much similarly aged children are watching screens in the home.

Unfortunately, children currently do not adhere to the guidelines set by the AAP. Most parents are not observing current recommendations of one hour or less for children 2 to 5 years. On average, children aged 5 to 17 years collectively consume seven hours a day on entertainment media including: televisions, computers, phones, and other electronic devices like touch screen devices (AAP, 2016). More than half (54%) of American, Australian, and Canadian children aged two to five years exceed AAP's former recommendations of two hours of ST per day (Hinkley et al., 2012). Approximately 90% of children under the age of two are exposed to media; 40% of them already being exposed to media by 3 months of age despite the AAP recommendations (Zimmerman & Christakis, 2007). Children 2-5 years are consuming on average 3.6 hours per day of screen time in the home (Tandon, Zhou, Lozano, Christakis, 2011) and watching reportedly 34 more minutes of screen time per day with the presence of TV in their bedrooms (Zimmerman & Christakis, 2007). Furthermore, when broken down into weekdays and weekends 27% of children do not meet the previous AAP recommendations during weekdays and 30% do not meet it on the weekends (Okely & Trost, 2009). Overall, for children between ages 2-5 years and into adolescence, the recommendations are far from being met.

Researchers question parents as to why they allow their child to watch television versus engaging in social and unstructured free play. Parents said the "most important" reason for media was the belief that screen time is educational or good for their child's brain. The second most important reason was that it was enjoyable and relaxing for their child. Contrary to those stated parental beliefs, there are negative effects of too much screen time regardless of the content/device. As such, parents should adhere to the recent AAP suggestions.

Negative Consequences and Factors with Screen Time

Given past and current findings of television viewing rates in young children and adolescents, the statistics appear to stay relatively the same despite efforts by scholars to decrease it. Roberts examined 8-18 year old children and exposure of media in the home. Results indicated, out of the media devices examined in the study, children were averaging 3.25 hours per day of direct TV time (Roberts, 2000). As previously stated, current rates of screen time do not differ from this finding. Researchers have been trying to understand the impact of screen time and its harmful effects on children since the late 1990's, and have been able to better define guidelines due to advancements in technology. For children, it seems to have negative impacts on them physically, psychosocially, academically, personally, environmentally, and within family units. With increased screen time, there is potential for one or more of these factors to have an impact on young children.

Cognitive Development

Cognitive function is an important health indicator for children under 2 years but becomes a critical aspect once they reach 3-5 years. For children, age five and younger is a crucial time for development of cognitive function and learning abilities (Barkovich, Kjos, Jackson Jr, Norman, 1988; Yamada, Sadato, Konishi, Muramoto, Mikura, Tanaka et al. 2000). Types and intensities of visual and auditory experiences can have a large influence on a newborn's brain growth and development early in life (Christakis et. al, 2004). With this information and the joint knowledge of television and how it can portray changing images, scenery and events, there is a possibility it could shorten a child's attention span based on age and amount of exposure (Singer, 1980; Healy, 1990). Children exposed to 9 minutes of fast paced cartoons immediately had impaired executive function compared to watching educational shows or drawing (Zimmerman & Christakis, 2004). As a result of fast-paced TV shows.

Children who watch fast-paced TV shows score significantly worse on the hyperactivity subscale of the Behavioral Problem Index than children who did not, despite having equal onset attention. Zimmerman and Christakis (2004) also found negative relationship between attentional issues and amount of screen viewing in young children. To further this research, they also found a positive correlation with screen viewing hours per day at both ages one and three and attentional problems at age seven (Zimmerman & Christakis, 2004). Exposure to screen time in ages zero to five may potentially hinder development of the brain from a cognitive aspect.

Psychosocial Development

Psychosocial development is critical from ages 1 to 4 years (Guyatt, Oxman, Kunz, Atkins, Brozek, Vista et al., 2011). Psychosocial development refers to one being fully aware of their environment and surroundings and ineractions with social environments. Reduced time with parents and siblings could result in reduced opportunities for creative imagination and play (Vanderwater, 2006), attentional problems in childhood (Christakis, Zimmerman, 2004), reduced concentration with reading (Koolstra & Van der Voort, 1996), and exhibiting aggressive behavior (Manganello & Taylor, 2009). Consequently, the less time children are spending with parents or family, there is potential for increased screen time and this may have negative psychosocial effects on young children. Aggressive behaviors negatively affected children with screen viewing and served as a predictor for problem behaviors (Strasburger, Jordan, & Donnerstein, 2010). Screen viewing negatively impacted children by contributing to increased aggressive behaviors and served as a predictor for problem behaviors (Strasburger, Jordan, & Donnerstein, 2010). A study done by Rosen et al. (2014) discovered for children ages four to eight, total ill-being, attention, and physical problems were all predictors of daily technology use (Rosen et al., 2014). Finally, there have been connections between exposure of screen time

violence and teacher-reported antisocial symptoms, emotional distress, and inattention in second graders. There was also a positive association with less child-reported academic self-concept and intrinsic motivation (Fitzpatrick, Barnett, & Pagani, 2012). Although the studies previously presented focus on children older than five, there could be psychosocial problems in younger children that have not been yet discovered. Psychosocial problems reduce time spent with family and affect other psychosocial factors such as aggression and attention.

Physical

According to the National Center of Health Statistics/ Centers of Disease Control and Prevention, twice as many children and three times as many adolescents are obese now than they were thirty years ago (CDC/ National Center for Health Statistics, 2014). From 2011-2014, the CDC provided national data showing that prevalence for children being overweight or obese more than doubles from preschool age to adolescence, according to body mass index scores. The obesity rate of children aged 2-5 years is 9.4% but doubles by the time they reach ages 6-11 (17.4%) (CDC, 2014). Anderson and Whitaker (2004) conducted a cross-sectional analysis using a sample of four year olds and examined the association between childhood obesity and three household activities: regularly eating dinner as a family (< five nights per week), obtaining adequate nighttime sleep on weekdays (> ten hours per night), and limiting screen-viewing to less than two hours per day. According to the results, 18% of the children examined were obese and 14.5% of healthy and obese children were exposed to all 3 activities. This contributes to the literature by concluding that children exposed to the positive household routines were approximately 40% less likely to being obese than those not exposed to any activities (Anderson & Whitaker, 2004). Anderson also published on active play and screen time to show that of U.S. children between the ages of 4-11, 37% had low levels of active play, 65% had high screen time,

and only 26% met both guidelines for physical activity and screen time (Anderson, Economos, & Must, 2008). For the past thirty years, child obesity rates have continued to steadily increase each year and are associated with time spent in active play.

Television exposure and obesity levels have been correlated among children as young as 29 and 53 months (Pagani et al., 2010). Every additional hour spent in screen-viewing predicted a 10% increase in video game use, 9% decrease in fitness scores, 13% decrease in weekend activity, and an 8% decrease in physical efforts for events such as physical activity testing in schools (Pagani et al., 2010). Additional time spent in screen time decreases a child's opportunity to spend in other physical activities.

Decreased physical activity and increased BMI scores have been associated with increased sedentary behaviors in youth and adolescence. Sisson et al. (2010) using the National Survey of Children's Health 2003 examined screen-based leisure time sedentary behavior and physical activity in overweight children aged 6-17 years. Approximately 44% of the sample spent two or more hours in daily screen-based leisure time sedentary behaviors, more than one-third of the sample was overweight prior to the study. The results found that boys and girls who engage in low physical activity and high leisure time sedentary behavior were two times more likely to be overweight than more active, less sedentary children (Sisson et al., 2010). If higher rates appear in children aged 6-17, younger age groups could not be adhering to recommendations as well.

When looking specifically at gender differences and physical activity, females report having higher inactivity levels than boys. Girls who take fewer than 11,000 steps a day were 2.37 times more likely to be overweight than those who met recommendations (Laurson, Eisenmann, Wlk, Wickel, Gentle, Walsh, 2008). Despite this, Boone (2007) found that females who had

greater amounts of moderate-to-vigorous physical activity and decreased amounts of screen time lowered their associations to becoming obese. This could provide information connecting physical inactivity with screen time use between genders.

However, there is literature that contradicts gender differences for screen time and obesity. Laurson et al., (2008) found correlations between screen time and BMI in boys as well as having higher odds (1.69 times more likely) for being overweight when exceeding the screen time recommendations (Laurson et al., 2008). Overall, boys and girls who did not meet either physical activity guidelines or screen time recommendations were 35-40% more likely to be overweight than those who did meet recommendations for both physical activity and screen time (Laurson et al., 2008). Thus, there is a need to do further examination into gender differences with screen time in relation to obesity.

Danner (2008) estimated that watching four hours of screen time a day would predict the average child to reach and/or exceed the 85th percentile for BMI by the 5th grade when controlling for gender, race/ethnicity, social economic status, birth weight, and age. There was a positive and statistically significant increase for BMI acceleration when compared to time interaction for screen time hours specifically for females ($F(7,262, 0.830) = p<0.001$) (Danner, 2008). The more hours young females engaged in screen time, as they age, are more likely to reach and/or exceed BMI obesity levels. For children under two years, their amount of time spent in active play, social contact, language development, and length of focus time could be impaired. Screen time has also been shown to hinder the ability to learn simple motor skills like: reaching, kicking, feeling, and ability to move freely and creatively. For children between ages of 2-5 years, there are associations of screen-viewing and its direct connection with being less active, going outdoors and creative play as well as increased risk of being overweight and developing

unhealthy habits (Roxon, 2007). A study done by Velde et al. (2007) found that among girls, high TV use and high PC use had an increased risk of being overweight and reports of low exercise in greater than 85% of their sample. The authors concluded, for girls, sedentary behavior is a more important factor with regards to being overweight than physical exercise (Velde, te, Bourdeaudhuij, Thorsdottir, Rasmussen, Hagstromer, Klepp, et al., 2007). Targeting mothers and their daughters could not only decrease sedentary levels in younger girls but mothers as well. This could potentially reduce time spent in screen time behaviors as well. Presented literature seems to depict known differences between young boys and girls, but links to parents and/or individual mother/father comparisons to their children need to be further explored.

Academic

Recent studies concerning academic performance and the connection to screen time have been mixed and inconclusive, but show the potential of harmful effects of overexposure (Pagani & Fitzpatrick, 2010). Household media environments were statistically significantly associated with student performance on standardized tests, especially the presence of TV's in the bedroom, imposing a negative association with test scores. Conversely, the study projected that the absence of TV's in the bedroom could influence higher standardized test scores (Borzekowski & Robinson, 2005). As younger children moved to adolescence, with respect to home environments, they had higher odds of poor performance in school with increased weekday screen time and movie channels and decreased parental restrictions of screen time content (Sharif & Sargent, 2006). Pagani and Fitzpatrick (2010) also concluded, in terms of academic adjustment, that higher levels of screen viewing at 29 months resulted in lower levels of elementary-level classroom engagement (7% decrease), mathematics achievement (6%

decrease), and no changes to reading achievements respectively (Pagani & Fitzpatrick, 2010). As young children become more exposed to screen time, it seems to continually have a negative effect on their learning abilities and school engagement.

Sedentary Behavior and Screen Time Association

Sedentary behavior refers to any waking activity characterized by an energy expenditure less than or equal to 1.5 metabolic equivalents and sitting or reclining postures; i.e.- sitting or lying down. This includes but not limited to: screen viewing, video game playing, reading, drawing, driving, and computer use (Sedentary Behaviour Research Network, 2012). Variables associated with children being less sedentary were: sex (specifically male), parental overweight status, physical activity preferences, physical activity intentions, perceived barriers and physical activity, healthy diets, facility access, and time spent outdoors versus indoors (Sallis, Prochaska, & Taylor, 2000). Meta-analyses have also found associations between child screen viewing and higher risks for type 2 diabetes, fatal or nonfatal cardiovascular disease, and all-cause mortality later on as adults (Grontved & Hu, 2011). Various health issues can be correlated with increasing bouts of sedentary behavior in adolescents and younger children. Younger children who spend time in sedentary behaviors are more likely to spend greater amounts of time engaging in sedentary behavior as an adolescent (Tremblay, Marshall, & Hume, 2011).

Factors Associated with Screen Time and Health Behaviors

Family associated factors

Personal, family and environmental factors are important for understanding *why* a child may have increased screen time behaviors. Researchers have gathered over time parental thoughts and beliefs about screen time recommendations and the impact it has on their child's attitudes through qualitative studies. Mothers (n=10) were mostly aware of the screen time

guidelines for children aged 2 to 5 (Hamilton & Hatzis, 2015). Less than half of mothers and fathers (45%, n=9) agreed to the concept of limiting screen time; 80% of the sample reported lack of time to commit to other activities as reasoning for excessive screen time. Mothers (60%, n=10) said they would be able to restrict screen time better if there was less confrontation from their children, but, in reality, they did not take the positive steps to limit screen time with their children. Active parents provide a stronger support system for limiting screen time and tend to be more active as a family (Hamilton & Hatzis, 2015). Parents who also interact with their young children during play are more likely to have active children (Roxon et al., 2009). Parents, mothers in particular, seem to have a general understanding of the need to control amounts of screen time viewed by children but have a difficult time implementing rules for it in the household.

Self-Efficacy to Limit Screen Time Behaviors

Children are influenced in their day-to-day activities; one established factor being parent's subjective feelings and behaviors towards specific activities. Parents create environments of support, encouragement and role modeling. However, when it comes to establishing and abiding to guidelines set for their children, barriers and self-interest can have an impact on their family (Gustafson et al., 2006). Yet, mothers are not always presented with easy ways of increasing physical activity and decreasing sedentary behavior and screen time. With younger children, the time spent in unorganized activity is negatively and significantly correlated with reported barriers by parents and level of self-efficacy (Smith et al., 2010).

Self-efficacy is defined as an individual's beliefs about their capabilities to produce desired levels of performance that influence events affecting their lives (Bandura, 1998). Levels of self-efficacy can have an impact on personal well-being and capabilities to approach difficult

challenges (Bandura, 1998). When it comes to administering and adhering to screen time guidelines, mothers specifically feel they are capable of implementing the rules, but barriers prevent them from keeping it constantly enforced (Smith et al., 2010). Parents who reported four or more barriers had children who were 83.3 perent more likely to not meet screen time recommendations compared to parents who only reported 0-1 barriers (50.5%). Additionally, children who exceeded screen time recommendations had parents who reported having lower self-efficacy (70.8%) compared to parents with higher reported self-efficacy (57.9%). These statistics were also highly correlated to physical activity levels; as age increased, odds of being insufficiently active and more sedentary increased by 22% each year. Reasons for lowered self-efficacy are reported to come from activities being too expensive, their child being uninterested, and parental stress (Smith et al., 2010). Strategies for understanding guidelines of screen time, risks of sedentary behavior, and techniques for creating more recreational activities need to be addressed not just in homes but in the community for parents from all socioeconomic statuses.

Limiting screen-time has proved to be a challenge for parents given different confounding factors like self-efficacy, importance of limitation and parental screen use in the home environment. Restriction is also a factor often not given priority in the home. Problems with limiting screen time use, regardless of home environment, can be linked to challenges with increasing self-efficacy, parental screen use and increases in sedentary behavior.

Sedentary Behavior

Children in western societies spend majority of their free-time in sedentary activities like TV viewing or video gaming; equating to 6-8 hours of their day, per day (Rideout, Foehr, & Roberts, 2010). Literature illustrates that an excessive amount of sedentary behavior is associated with negative health outcomes. If a child spends more time in sedentary behaviors, they are more

likely to exhibit higher prevalence of: obesity, increased blood pressure and cholesterol, decreased attachment to parents or peers, and poor cognitive development and academic achievement (de Rezende, Lopes, Rey-Lopez, Matsundo, & do Carmo Luiz, 2014, Salmon, Tremblay, Marshall, & Hume, 2011, Tremblay et al., 2011). Specifically when it comes to maternal influences, there have been positive correlations of mother-daughter total time spent in physical activity and sedentary behavior (Barnes et al., 2015). Barnes et al. found that mothers who believed physical activity was important for their daughters were more likely to have physically active daughters. Further, daughters who were aware of their mothers' beliefs about physical activity were more likely to seek opportunities to be active and involved in moderate-vigorous physical activity (MVPA) (Barnes, 2015). Children with high levels of screen time also have greater probability of factors associated with obesity and also psychosocial difficulties, high levels of hyperactivity and peer problems affect levels of social behavior. High psychosocial well-being was stronger in older children than younger children, but developed habits made when younger can cause problems as age increased. These factors play into children's increased sedentary behavior and only contribute to the negative issues they could be faced with in adulthood.

Knowledge of Screen Time Guidelines

A qualitative study done in the United Kingdom looked at the perceptions mothers had about their child engaging in and meeting physical activity and screen time guidelines through semi-structured interviews. Twenty-four mothers were recruited from preschools and nurseries with a child at least two years of age. Researchers found that ninety percent of mothers were unaware of physical activity or screen time guidelines; two-thirds of them believed their child already met those guidelines (Bentley, Jago, & Turner, 2015). Mothers agreed to guidelines

being appropriate for their child and made remarks about screen time being addictive, distracting from playtime and making their child unresponsive towards demands. Despite these feelings, mothers still felt the guidelines were unnecessary because their child was sufficiently active and they are irrelevant to the functioning of their family (Bentley, Jago, & Turner, 2015). Researchers concluded that in addition to guideline targets, mothers should be educated on accurate assessment of their children's physical activity and sedentary levels. Researchers also suggested mothers should be informed about the benefits of increased physical activity and decreased sedentary behavior. Lack of awareness in the home and lack of concern for their children being engaged in too many sedentary activities can give mothers the idea that TV viewing is a relaxation tool instead of an education tool.

Parental Modeling and Guidance

When studying children and sedentary behaviors related to screen time, researchers have examined parents because they have a majority of the control. Wood et al. (2015) looked at rates of parents' screen-viewing tendencies and the effect it has on their children. Compared to their spouse, mothers spent two more hours watching screens on weekends than they did weekdays (Wood et al., 2015, Jago et al., 2014) and there was a positive association with more minutes mothers spent in sedentary behavior during weekends than weekdays. Wood et al. (2015) also found a strong correlation to total family screen time and sedentary behavior. During the weekdays, 30% of mothers engage in more than two hours of screen viewing per day, during the weekend that percentage rises to 53% (Wood et al, 2015). When mothers exceed that two-hour time-span, their children were 3.4-3.7 times more likely to exceed their recommendations of screen time (Jago et al., 2014). The more time either parent spends in sedentary activities or

screen time, the higher the probability their child will also exceed recommendations for sedentary behavior and screen time.

Environment

Cerin, Baranowski, and Barnett, (2016) studied Latino preschoolers and commonalities between inactivity and sedentary behaviors, physical activity, and environmental factors. Objectively measured physical activity and sedentary behavior was collected on the children using accelerometers (monitor sensors) over the course of a week for 8 hours/day. Results showed that children spent 53% of their monitor-wear time in sedentary activities with majority of time occurring in childcare/school settings. On the other hand, when active, 88% of children spent time engaged in moderate-to-vigorous physical activity (MVPA) in parks or playgrounds. This also predicted higher averages in accelerometer counts of moderate-to-vigorous activity than a child observed in the home (Cerin, Barnowski, & Barnett, 2016). Reilly et al. (2004) determine through total energy expenditure, at age three, median MVPA time measured at 2%. This only equates to approximately 20 minutes in MVPA, whereas children should be obtaining 60 minutes of MVPA daily yet they are not (Reilly, Jackson, Montgomery, Kelly, Slater, Grant et al., 2004). This study shows children at young ages are not meeting physical activity recommendations in and outside the home, especially at the MVPA level.

Interventions Targeting Screen Time and Sedentary Behavior

In the literature, it is clear children at various ages are engaging in too little physical activity, too much screen time, and, as a result, too much sedentary behavior. Researchers have developed interventions to examine each presented aspect in various settings. The following presented literature has a common theme: screen time and its relation to sedentary behavior and body composition.

Todd et al. (2008) wanted to measure the effect of a family-based intervention on media use and body composition specifically in boys aged 8-11 years. This 20-week long program examined screen time and body composition outcomes as well as their physical activity and dietary behaviors. The experimental group learned how to set media use goals and was given an allowance for media each week while the control group continued daily routines. Results showed daily interactions between media use and body compositions; by week ten of the intervention, step counts had increased by 543 steps per day for experimental group and decreased by 340 steps per day in the control. The experimental group also decreased meals and snacks in media settings and both groups had increased steps by the end of the intervention. This pilot study goes on to suggest that family based interventions may be a desired method to reduce media use in the home and assist with goal to change body composition (Todd, Reis-Bergan, Sidman, Flohr, Jameson-Walker, Spicer-Bartolau et al., 2008).

Maddison et al. (2014) delivered a home-based family intervention to reduce sedentary behavior and screen time in children and its effects on body composition and physical activity. Children aged 9-12 years (boys and girls) were used for the study and sedentary behavior, physical activity, diet, and enjoyment of sedentary behavior and physical activity were self-measured. For 20 weeks the intervention primary caregivers were educated on strategies to reduce screen time behavior and given monitoring devices for TVs in the home. An activity pack was given to the intervention children including: coloring pencils, rope, playing cards, tennis balls, etc. The control group was offered the same incentives upon completion of the study. Questionnaires were given to the children to record and measure their physical activity, food frequency, and physical activity enjoyment. Results showed that there was no significant difference in measures of physical activity, sedentary behavior, or sleep between control and

experimental group. Children's enjoyment of physical activity and sedentary behavior did not differ between groups and 46% of caregivers reported never using the TV monitor to budget their child's screen use. A main limitation to the study could be the age group chosen where habits have already been established with the children in the home and lack of compliance from the parents on using the monitoring device (Maddison, 2014). The author suggests for future research a younger age group, controlling for gender, for analysis and combining objectively measured items to better understand physical activity and sedentary behaviors. Doing so could have potential to affect the time children spend in one activity, deterring away from screen time.

Yilmaz, Caylan, and Karacan (2014) studied the screen time behaviors of families recruited from a children's hospital via fliers targeting children aged 2-6 years. A total of 412 families signed up for the intervention and 363 completed the entire study. There were three groups: one blind control group and two randomized intervention groups. During baseline interviews, demographic data were collected. Parents were also asked to note the average time they and their children spent during the week watching screens, videos, or being on the Internet, if their child had a TV in their bedroom, and the frequency in which the family ate dinner while watching TV. The intervention group was exposed to four different components at two week intervals over a total of eight weeks consisting of three printed materials and interactive CD's and one counseling call- all intended to decrease screen time. Several challenges were given to the parents such as reading more books with their children, no screen time during mealtime, encourage their children to think of alternative activities, putting 'no TV' signs on screens at the home, and were supported to take TV's out of their children's bedrooms. They were also given a picture book showing a screen-free home and presenting current data. Home visits were made at 2nd, 6th and 9th month follow-ups with shorter questionnaires. Results showed significant

decreases in screen time from baseline to 9-month follow-up as well as between intervention group and the control group. There were also statistically significant reductions in meals in front of the TV. A main limitation to the study was that parents were aware of the nature of the study and could have changed their self-reported responses because of social desirability or changed their behaviors just because they were enrolled in an intervention to reduce screen time (Yilmaz, Caylan, & Karacan, 2014). Future research suggested by the author is to examine child-care settings and further expand on knowledge of preschool aged children and their exposure to screen-viewing items.

Haines, McDonald, & O'Bryan, (2013) conducted a study of 121 families and their young children (aged 2-5 years) in the home assessing sleep durations, screen time on weekdays and weekends, and presence of TV in their home. Their outcome measures were to look at obesity and sedentary levels from a low-income population. The six-month intervention promoted household routines, appropriate sleep durations, limiting screen time, and provided motivational coaching for parents via email, phone, and text messages. Results indicated participants in the intervention group increased their sleep time by 0.75 hours, decreased weekly screen time by one hour on weekdays, and decreased BMI by 0.40. Longitudinal interventions should highlight parents creating home routines, screen time limitations, and how motivation can be effective in lower-income housing but should be examined among other types of households as well (Haines et al., 2013).

Gaps in the Literature

Presented interventions focused on body composition and its relation to screen time, all taking place in the home. Sedentary behavior was shown to be a direct effect of screen viewing but ultimately did not always determine increased BMI.

What we do not know is the effectiveness of community-based screen time interventions (Salmon, Tremblay, Marshall, and Hume, 2011), specifically targeting younger age groups. There also appears to be little knowledge about screen time guidelines correlated to mothers' ability to limit screen time in the home (Bentley, Jage, and Turner, 2015). It is also uncertain if mothers are aware of the new screen time guidelines set by AAP. Finally, there are few associations strictly between mothers and daughters in physical activity settings. Presented research shows an effectiveness when promoting physical activity and limiting screen time versus just focusing on increasing physical activity. Researchers are also aware that mothers know sedentary behaviors should be limited. It is unclear if mothers are aware of the connection it has to screen time and/or their confidence to replace screen time with another engaging and active activity.

Summary

A young child under the age of 5 has been shown to be in a crucial time of life for development of cognitive function and learning abilities. Much research has been done to intervene in the potential progression of a sedentary lifestyle and overexposure of screen time and devices but little has been done on the younger population. While there are guidelines and parents are becoming more aware about screen time and the harmful effects it can have on their children, they still are exceeding the recommendations. Parents are positively affected by interventions, but maintenance becomes a challenge when they are given resources and have to

try and figure out how to maintain once the resources are gone. There is also little research done on the gender differences of young children and their sedentary behaviors and associations with screen time. Additionally, most research takes place at intervention sites and home settings. The purpose and significance of this intervention is to create awareness about sedentary behavior and reduction of screen time with inexpensive choices for mothers and their daughters in the community. This research adds to the literature by focusing on the younger population, specifically girls, and taking interventions into the community with the focus on being more physically active and reducing screen time.

Purpose and Hypothesis

Although sedentary behaviors have been strongly associated with screen viewing time and children, there are still gaps in the literature. Studies have failed to target interventions in various settings, specifically community-based settings, and identify and examine mediators and moderators of change in sedentary behaviors (Salmon, Tremblay, Marshall, & Hume, 2011). As previously stated, 90% of mothers are unaware of guidelines set for children regarding screen time and physical activity (Bentley, Jago, & Turner, 2015). The purpose of this study is to examine the impact of a physical activity intervention on screen time and sedentary behavior among child participants. Our second purpose is to examine the impact of a physical activity intervention on maternal knowledge of screen time guidelines and maternal self-efficacy to limit screen time. Third, we also want to examine the relationships between changes in maternal self-efficacy to limit screen time and child's screen time and child's sedentary behavior from baseline and post-intervention and relationships among these variables at each time point. This intervention titled *Mothers and Daughters Moving Together* took place in a community-based

setting and promoted increased shared and individual time spent in physical activity and reduced time spent in sedentary behaviors with the MDMT+ group, specifically screen time behaviors. Therefore, we hypothesized that participation in the intervention would decrease overall use of screen time and sedentary behavior in child participants for both participating groups compared to the control group. Second, we hypothesized maternal knowledge of screen time guidelines and self-efficacy to limit screen time use would increase among mothers who receive extra screen time information compared to those who do not receive extra information. Finally, we hypothesized in physical activity and physical activity plus screen time information groups that child's time spent in screen time and sedentary behavior would decrease as maternal knowledge and self-efficacy to limit screen time increases.

Chapter 3. Methods

Participants

The primary goals of this study were to examine the effectiveness of a mother-daughter intervention for reducing sedentary behavior and screen time change among young children (aged 2-5 years) and changes to increasing maternal self-efficacy to limit screen time behaviors. Participants for this 13-week intervention were 33 mother-daughter pairs (*N*= 12 Mothers and Daughters Moving Together, *N*=12 Mothers and Daughters Moving Together+) with a control group (*N*= 9) who live in the city of Greenville, North Carolina. All mothers were 18 years and older with a daughter in the pre-school age range of 2-5 years. Participants recruited from East Carolina University's listserv, City of Greenville employees listserv, Pitt Community College listserv, East Carolina Health Science campus listserv, Pitt County Playdates Facebook page, local libraries, local daycares, other social media avenues. Inclusions for mothers were they must be living full-time with their daughter in the same household, 18 years and older, and able to read and understand the informed consent. Exclusions included the inability to exercise due to a medical condition, currently pregnant, father participation, and children outside of the 2-5-age range. (See Appendix E for full recruitment and enrollment process).

Procedure

Once Institutional Review Board approval was complete, recruitment for participants was initiated. The researcher sent flyers to all facilities listed above and posted flyers with contact information about the study in community spaces. Once recruitment was complete, informed consent and screening questionnaires were obtained and initial baseline data was taken for

demographic information. Mothers completed the informed consent for themselves and parental permission for their daughters.

The 33 pairs self-selected into one of two groups based on their availability to attend prescheduled intervention sessions: Mothers and Daughters Moving Together (MDMT, *n*= 24) or a control group (*n*= 10). Mothers were then randomized into two intervention groups (MDMT, *n*=12 and MDMT+, *n*=12) by the primary investigator. During pre-intervention testing, mothers and daughters came in during scheduled meeting times to complete the informed consent and do height and weight measurements. Mothers were briefed on accelerometer use and wear. Accelerometers were worn for the following seven consecutive days from wake time to bedtime by both mother and child. Accelerometers came with a log, which was filled out by the mother for herself and daughter on times accelerometer was worn, and any time the accelerometer was removed in the day. Mothers were instructed to keep the accelerometer on their right hip either under or over their clothes. On day five of seven of accelerometer wear mothers received an email with the link to baseline questionnaires to complete before their first intervention session. Participants were told their information will be completely anonymous and asked to answer the questions as honestly as possible. The total complete time for baseline questionnaires was approximately 22 minutes.

Each dyad was assigned a random number using the random number function in Excel. Random numbers were organized from high to low. The first half of participants were assigned to MDMT and the second assigned to MDMT+. Participants received an email with the name of their group leader prior to the first intervention session. Intervention mothers returned the accelerometers at the first intervention session and the control group returned it during a second visit the following week. During week 1 and 12, participants wore the accelerometers again for

same duration as baseline. The physical activity intervention duration was 11-weeks. Mothers and daughters in MDMT, MDMT+, or control groups completed all of the assessments from pre-intervention in the week immediately following the end of the intervention (post-intervention, week 12). The intervention included 11 in-person sessions that occurred weekly for one hour on Saturday mornings. The sessions were held on Saturdays because previous research suggests that parents and children have higher screen time on weekends versus a weekday (Okely & Trust, 2009; Wood et al., 2015; Jago et al., 2014). At each session, various educational topics were discussed between groups. All mothers in both intervention groups received activity manuals and activity equipment to facilitate increased physical activity.

Intervention

Throughout the study, intervention participants visited seven different park locations and daughters received five different types of active toys (i.e., bouncy ball, knobby balls, jump rope, bean bags, and a hula-hoop) over the 11 weeks to be active with. At the beginning of each session, mothers and daughters in MDMT and MDMT+ groups discussed how they used the previous week's educational topic and physical activity challenge at home and had options to further discuss once broken into each specific group. Mothers were also able to see their progress and the researcher compared their presented data to national recommendations on a personalized informational page for them and their daughters. Each new activity scheduled for the week challenged the mothers to step outside of their comfort zone and engage in different physical activities with their daughters lasting approximately 30 minutes. At the end of every session, groups discussed their previous challenge and how they achieved or did not achieve it and discuss with others how they could have done it differently. Mothers also received new physical activity challenges (MDMT) or physical activity and screen time challenges (MDMT+) to

complete with their daughter and/or family over the following week (See Appendix D for detailed weekly sessions). Such challenges included using equipment from their activity kit to create a game to play together or additional screen time challenges.

MDMT and MDMT+ Strategies

At the beginning of each session, mothers were briefed on a specific physical activity topic that was administered to the entire group. For example, mothers were given information about how to protect their time for physical activity by scheduling it weekly, making it routine, and telling people in their lives about it. Shared physical activity topics (MDMT and MDMT+) included the following: physical activity guidelines, how to use an activity plan and various ways to use it, games to play with little equipment, trying new activities, how to maximize park playtime, importance of outdoor play, benefits of family activity, using nature to be active, and activity plan revisions to implement retention of the program.

During the sessions, the activities of the week focused on keeping mothers and daughters engaged in playtime together and assisting with fun and new creative ways to play outside or in new environments. Some of the activities played throughout the intervention were hopscotch, freeze-tag with music, Zumba, Yoga, obstacle courses, Easter egg hunts filled with exercises, and walking through neighborhoods to different parks.

Once the session had ended, each group was given a recap on the educational information as well as the same physical activity challenge to complete with their daughters over the following week. A few activities given as challenges were trying a Zumba routine at home, coming up with new games that included toys from their activity kits, making a family activity plan, and setting up obstacle courses at home.

MDMT+ Only Strategies

Those in MDMT+ group specifically received physical activity education topics as well as screen time educational topics. For example, mothers were given information about how to use phrases like 'how about we do this activity together' instead of saying 'no' to screen time to learn how to better substitute for screen time. Such screen time topics included: screen time guidelines and benefits of reducing screen time, media time calculator, using the family media plan to establish screen use in accordance to the guidelines, how to substitute other activities for screen time, monitoring mother's and child's screen time, breaking up sedentary time for mother and child, role modeling screen time behaviors, benefits of screen-free time, screen-free zones in the home, and adjusting the family media plan. Only MDMT+ group members received additional screen time information and were given screen time challenges related to the above topics each week. Some of the challenges administered to the MDMT+ group consisted of tracking and recorded their own and their child's screen time for the week, setting timers for their child's screen time, choosing a healthy behavior to model for their children, and replacing screen time with other activities.

Control Group Strategies

The control group did not receive any additional information and education regarding physical activity and screen time. Mothers in the control group did not attend any of the Saturday sessions over the 11-weeks and were instructed to go about their normal schedules for the duration of the study. Control group participants received all intervention materials including: the intervention manual and all 5 toys (bouncy ball, knobby balls, jump rope, bean bags, and hula-hoop) after the intervention ended and post-intervention testing was completed.

Measures

The main outcome variables studied in the intervention are sedentary behavior and screen time amongst young children as well as maternal knowledge of screen time and maternal self-efficacy to limit screen time.

Demographic Health History Questionnaire

Mothers completed a demographic questionnaire to assess items that included age and race of both mother and daughter, income, and educational status of participants prior to the start of the program.

Media Use in Children

Mothers complete the Media Use in Children questionnaire for their daughter's screen use assessed media use and accessibility to media in the home (See Appendix B). Media Use in Children is a 27-item survey examining the number of items families have in their home, how much time parents spend with their children in media use, and how much time children spend in media use for recreational and educational purposes. For this intervention, we used 13-items examining: apps downloaded to phones, specifically for their daughters, how often their child engages in various screen-based activities (watching TV/DVDs, using mobile devices, etc.), and how much time the mother and daughter spent in screen time activities. The specific outcomes used in this study were a) how often children are spending time in screen-based activities (frequency) and b) an average of how much time their daughters spent in screen-based activities yesterday. Example items include, "How often does your child: watch DVD's or videotapes, watch TV, use the computer, read books on an e-reader or tablet, etc." (Common Sense Media, 2013).

Maternal Knowledge of Screen Time Guidelines

One item was used to assess knowledge about child screen time guidelines for children 2-5 years and measured pre-intervention and post-intervention. The following was answered to the best of the mother's ability: "Children between the ages of 2 and 5 should watch no more than how many hours per day?" This question helped address basic knowledge of screen time guidelines and whether or not the mother was aware of these guidelines.

Maternal Self-Efficacy to Limit Screen Time

Self-Efficacy was measured on a 3-item subscale with a 5-point Likert scale assessing the mother's ability to limit screen time (1= nothing, 5= a great deal) with questions including how much they control, give alternatives to, and reduce screen time in the home (Campbell et al., 2010) (See Appendix C). Parent self-efficacy to reduce child screen viewing behavior measures were based on and are valid through Bandura's recommendations (Bandura, 2006).

ActiGraph Accelerometers

ActiGraph GT3X+ accelerometers are reliable and accurate monitors for physical activity measures and a preliminary method of estimating energy expenditure in free-moving environments (John & Freedson, 2012). The dyads wore accelerometers for 8 hours for 7 consecutive days in line with the hip. Dyads needed at least 3 days to be considered valid for statistical analysis. Child sedentary time was considered 0-195 counts per minute (CPM) of wear time for children 2 years old (Trost, Fees, Haar, Murray, Crowe, 2011). For children 3-5 years, 0-239 CPM was considered (Butte, Wong, Lee, Adolph, Puyau, and Zakeri, 2013). Once collected, data were downloaded and processed in ActiLife 6 using the two sets of cut-points based on child's age. These measures have been validated, confirmed, and published by researchers through ActiGraph. These measures were used to compare pre-intervention to post-intervention sedentary time for children.

Statistical Analysis

The main outcomes of this intervention were examining sedentary behavior and screen time amongst younger children as well as maternal knowledge of screen time guidelines and self-efficacy to limit screen time behaviors. Mothers and daughters were paired in dyads to observe potential relationships between mothers' outcome variables and daughters' outcome variables by examining physical activity and sedentary behavior reported in minutes. Data entry included each dyad having an identification number with separate mother-daughter variables. Data was assessed using SPSS version 19.0 for means and standard deviations. Intervention on screen time and sedentary behavior was examined using a 3 (group: MDMT; MDMT+; control) x 2 (time: pre- and post-intervention) repeated measures ANOVA. Changes in maternal self-efficacy to limit screen time and knowledge of screen time guidelines were examined using a 3x2 repeated measure ANOVA. To examine the size of changes in primary outcome variables from pre- to post-intervention within groups, effect sizes were calculated using Cohen's *d* (Cohen, 1988) and further evaluated using Morris and Deshon's (2002) equation for within-subject groups. Effect sizes were interpreted as small being 0.2 or less, moderate at 0.5, and large at 0.8 or greater (Cohen, 1998; Morris & DeShon, 2002). Finally, a regression analysis was conducted to create residualized change scores for self-efficacy and maternal knowledge of guidelines to examine the associations between changes in child screen time and sedentary behavior. Then, Pearson product moment correlations were used to examine associations between maternal self-efficacy to limit screen time with child screen time and sedentary behavior. Statistical significance was set at $p > 0.05$.

Chapter 4. Results

Demographics

There were a total of 33 dyads for this intervention; 11 in the MDMT group, 12 in MDMT+, and 10 in the control group (For full report on dyads, see Appendix E). Five participants were excluded from final analysis due to lack of interest or drop out (no longer interested, unable to commit) so a total of 28 dyads were included in the final sample. Nine pairs from MDMT, 11 from MDMT+, and 8 from the control group were used for analysis. For baseline demographics, data includes 32 dyads for analysis.

Mothers in the sample were aged 35.53 ± 4.42 years, mostly Caucasian (*n=24*, 75%), married (*n=30*, 96.8%), earned a college-level degree or higher (*n=28*, 87.5%), working full-time (*n=15*, 48.4%), and reported household income of $50,000 and greater (*n*=25, 78.13%). Mothers body mass index was measured 27.89 (6.75) kg/m^2. Children in the sample were aged 3.87 ± 1.05 years and mostly Caucasian (*n= 26*, 62.5%). See ***Table 1*** below.

The top reported screen devices children used the most of at pre- and post-intervention were frequency of TV time and mobile devices used for screen time. Fifty-five percent of mothers reported having 4 or less apps on their smartphones that catered to their children (*n*= 18). Seventeen mother-daughter pairs (85%) from the intervention groups attended 6 or more of the weekly sessions, 5 MDMT mother-daughter pairs (55%) attended 6 or more sessions, and 10 mother-daughter pairs from the MDMT+ group (92%) attended 6 or more sessions.

Table 1. Participant Demographic Characteristics.

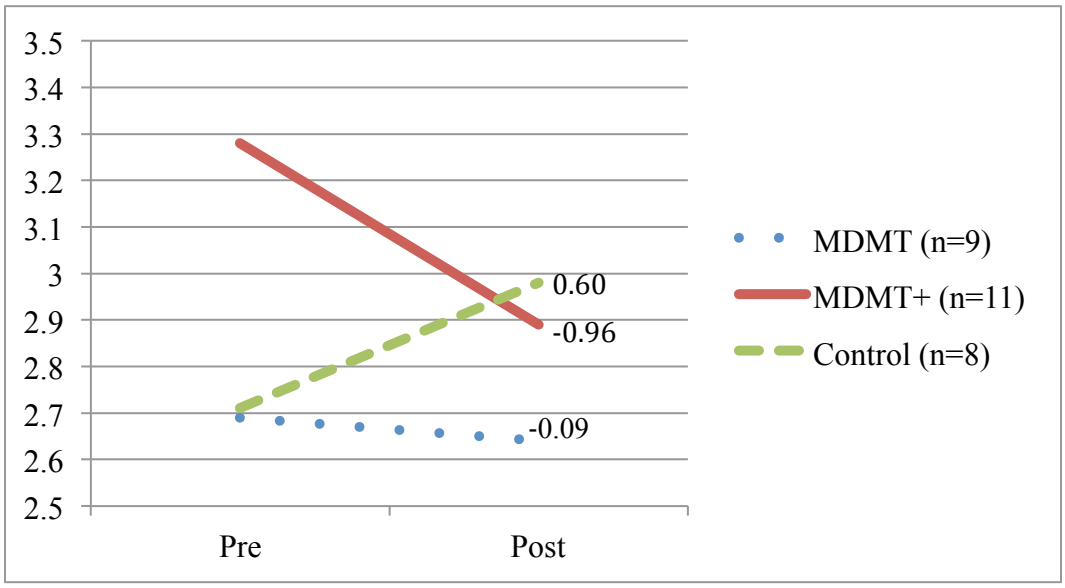
Variable	Intervention (*n*=24)	Control (*n*=9)
Mother BMI	27.13 ± 7.24	29.61 ± 5.15
Mother Age	34.86 ± 4.33	37 ± 4.24
Child Age	3.89 ± 1.09	3.80 ± 0.95
Mother Income	\$16k-\$24,999, *N*=2 (8%) \$25k-\$34,999, *N*=2 (8%) \$35k-\$49,999, *N*=1 (4%) \$50k-\$74,999, *N*=8 (33%) >\$75k, *N*=9 (37.5%)	\$16k-\$24,999, *N*=0 \$25k-\$34,999, *N*=0 \$35k-\$49,999, *N*=2 (22%) \$50k-\$74,999, *N*=2 (22%) >\$75k, *N*=6 (67%)
Mother Education	HS Graduate, *N*=1 (8%) College/Vocational, *N*=1 (8%) College Graduate, *N*=9 (37.5%) Graduate Degree or Higher, *N*=11 (46%)	HS Graduate, *N*=0 College/Vocational, *N*=2 (22%) College Graduate, *N*=6 (67%) Graduate Degree or Higher, *N*=2 (22%)

Purpose One- Change in Screen Time and Sedentary Behavior

Means and standard deviations are presented in ***Table 2*** for how often children engaged in screen time activities. Nine participants from MDMT, 11 from MDMT+, and 8 from control group were used for analysis. Results showed no statistically significant time main effect for changes in frequency of screen time ($F(1, 26)= 0.612$ $p= 0.44$). However, there was a statistically significant interaction effect for changes in frequency of screen time by group ($F(2,26)= 7.32$, $p= 0.003$), as shown in ***Figure 1***. Effect sizes were calculated to describe the size of group changes in frequency of screen time for the MDMT, MDMT+, and control groups. The MDMT+ group had a large decrease in frequency of child screen time ($d= -0.96$), whereas the

control group had a moderate increase (*d= 0.60*), and there was no change in the MDMT group (*d= -0.09*).

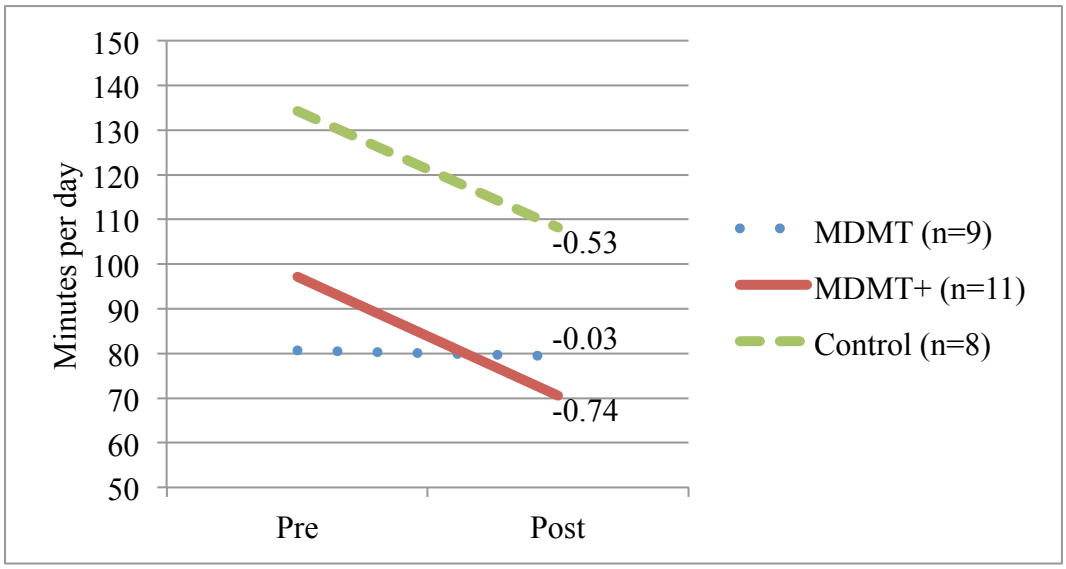
Figure 1. Changes in Child Screen Time Frequency.



*How often children engage in various screen-based activities was measured on a 5-point Likert Scale. 0= Has never done this, 1= Less than once a week 2= Once a week, 3= Several times a week, 4= Once a day, 5= Several times a day.
*Screen-based activities included: smartphone, iPad, iPod Touch or similar device.

Mean parent-reported minutes and standard deviations for child screen time are presented in ***Table 1***. Result showed no statistically significant time (F(1, 22)= 3.14, *p=0.09*) or interaction (F(2, 22)= 0.67, *p= 0.52*) effects, as shown in ***Figure 2***. Based on effect sizes, there was a moderate-to-large decrease in minutes of screen time for MDMT+ group (*d= -0.74*), a moderate decrease for the control group (*d= -0.53*), and no change in the MDMT (*d= -0.03*) group.

Figure 2. Change in Child Screen Time Minutes.



For sedentary behavior, analyses were run on data from child participants who had at least three valid days of accelerometer data. Eight participants from MDMT, 11 from MDMT+, and 8 from control group (*n= 28)* were used for analysis. ***Table 2*** presents the mean and standard deviation values for child sedentary behavior minutes per day. ***Figure 3*** shows changes in child sedentary behavior from pre to post intervention by group. Results showed there were no time ($F(1, 24)= 1.67$, $p=0.21$) or interaction effects ($F(2, 24)= 0.33$, $p= 0.73$) for sedentary behavior. An analysis of effect sizes indicated that there was a moderate decrease in sedentary time for MDMT+ participants ($d= -0.41$), a small decrease in sedentary behavior in the control group ($d= -0.29$) and no change in the MDMT group ($d= -0.06$).

Figure 3. Changes in Child Sedentary Behavior.

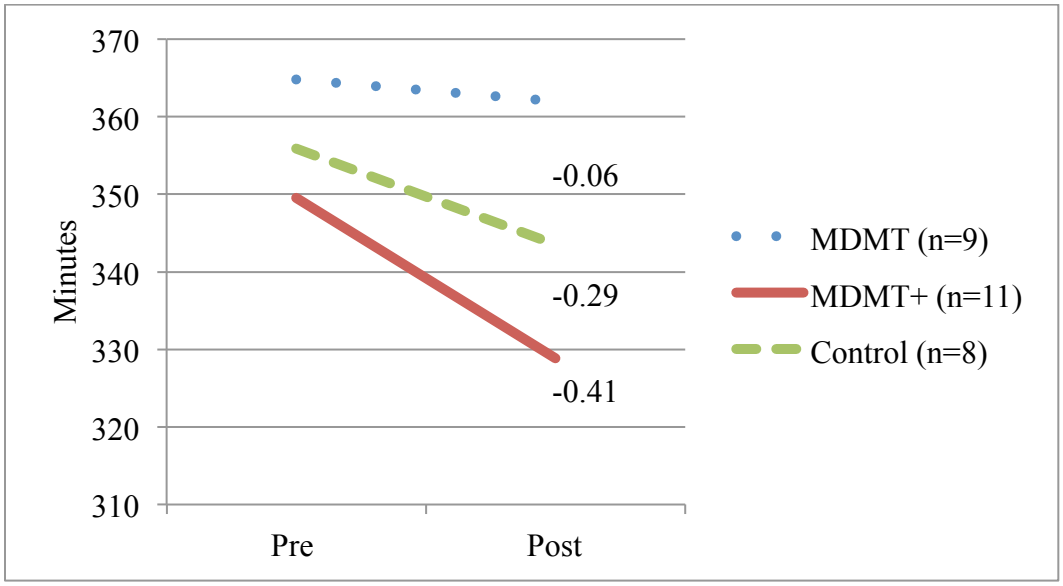


Table 2. Changes in Screen Time and Sedentary Behavior from pre- to post-intervention

	Screen Time (frequency)		Screen Time (min)		Sedentary Behavior (min)	
Group	Pre	Post	Pre	Post	Pre	Post
MDMT	2.69 ± 080	2.64 ± 0.75	80.63 ± 46.02	79.38 ± 62.13	364.84 ± 64.99	361.98 ± 67.37
MDMT+	3.28 ± 0.66	2.89 ± 0.53	97.22 ± 64.04	70.56 ± 37.12	349.57 ± 75.81	328.86 ± 63.18
Control	2.71 ± 0.71	2.98 ± 0.60	134.38 ± 74.22	108.13 ± 63.88	355.87 ± 57.20	343.53 ± 60.55

*MDMT, n=9, MDMT+, n=11, Control, n=8
*Note: all variables presented as M ± SD.

Purpose Two- Changes in Maternal Knowledge and Self-Efficacy

The American Association of Pediatrics states that children between ages of 2 and 5 should be consuming no more than 60 minutes per day of screen time on any type of device. Parents were asked for children between the ages 2 to 5 should have no more than how many hours of screen time per day. Means and standard deviations for maternal knowledge of screen time guidelines and self-efficacy to limit screen time are presented in ***Table 3***. Results showed no statistically significant time main effect ($F(1,25)= 0.21$, $p= 0.21$) as well as no statistically significant interaction effect ($F(2.25)=0.10$, $p= 0.68$) for maternal knowledge of guidelines and self-efficacy to limit screen time as shown below in ***Figure 4***. Effect sizes were calculated to describe the size of group changes in parent-reported daily-recommended amount of screen time hours for MDMT, MDMT+, and control groups. The MDMT+ had a small-to-moderate decrease in reported number of screen time hours recommended by the guidelines ($d= -0.41$) whereas the control group had a small decrease in the reported number of screen time recommended hours ($d= -0.36$), and there were no changes in the MDMT group ($d= 0.00$).

Figure 5a, ***5b***, and ***5c*** further illustrate the number of participants accurately reporting the correct screen time recommendations (60 minutes) as well as comparisons of higher or lower than the recommended amount at pre- and post-intervention. The bar graphs indicate MDMT group had more participants incorrectly report hours from pre- to post-intervention and decreased

correctly reported hours. MDMT+ had a decrease for overestimated hours from pre- to post-intervention but remained the same for correctly reported hours. Control group remained the same across all values.

Figure 4. Changes in Parent Reported Screen Time Guidelines for Ages 2-5.

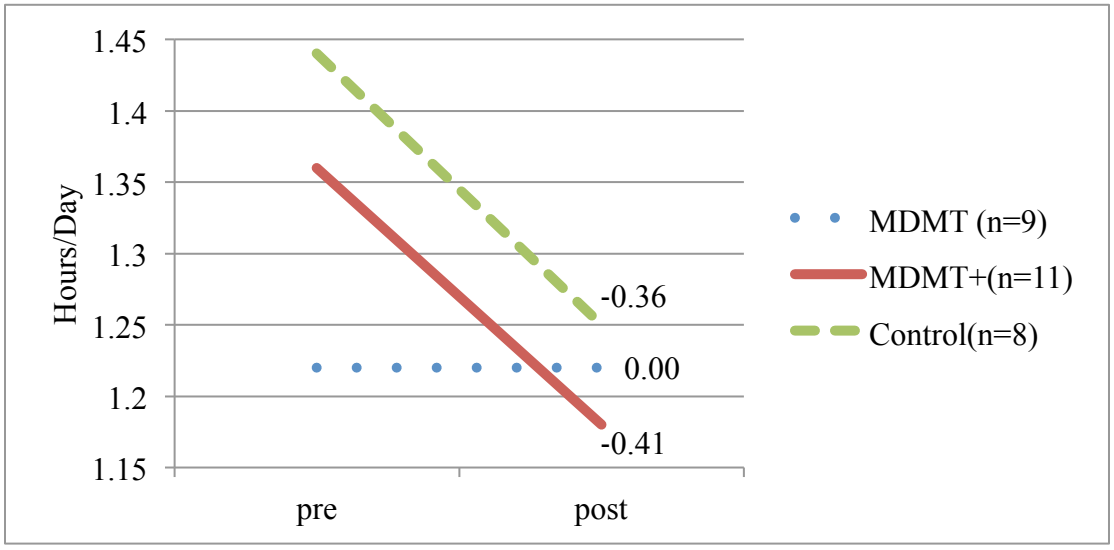


Figure 5a. MDMT Knowledge of Guidelines pre- and post-intervention.

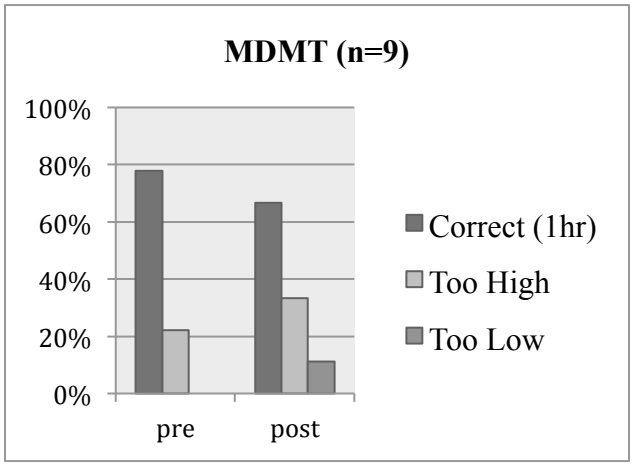


Figure 5b. MDMT+ Knowledge of Guidelines pre- and post-intervention.

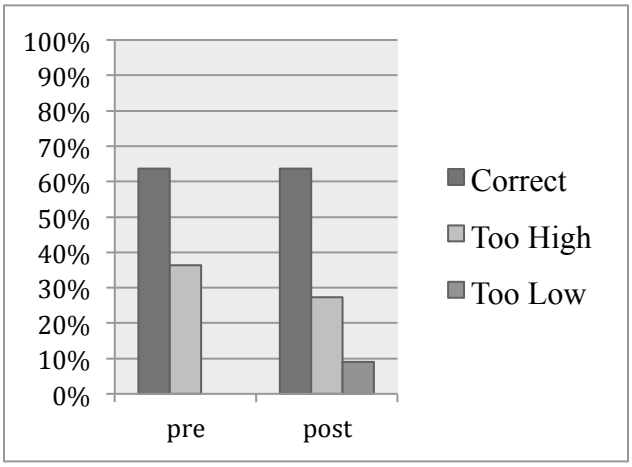


Figure 5c. Control Knowledge of Guidelines pre- and post-intervention.

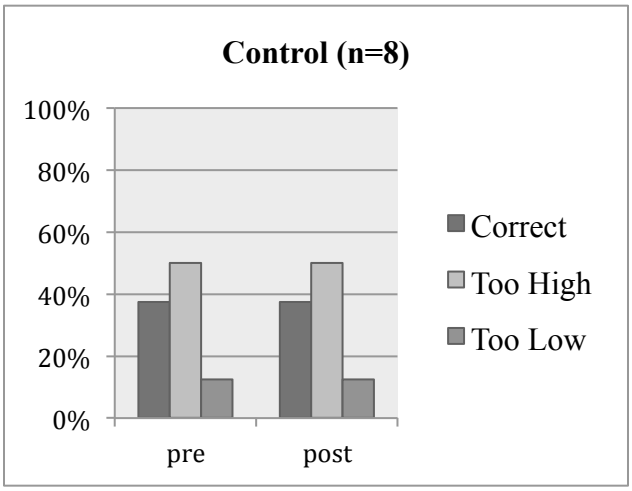
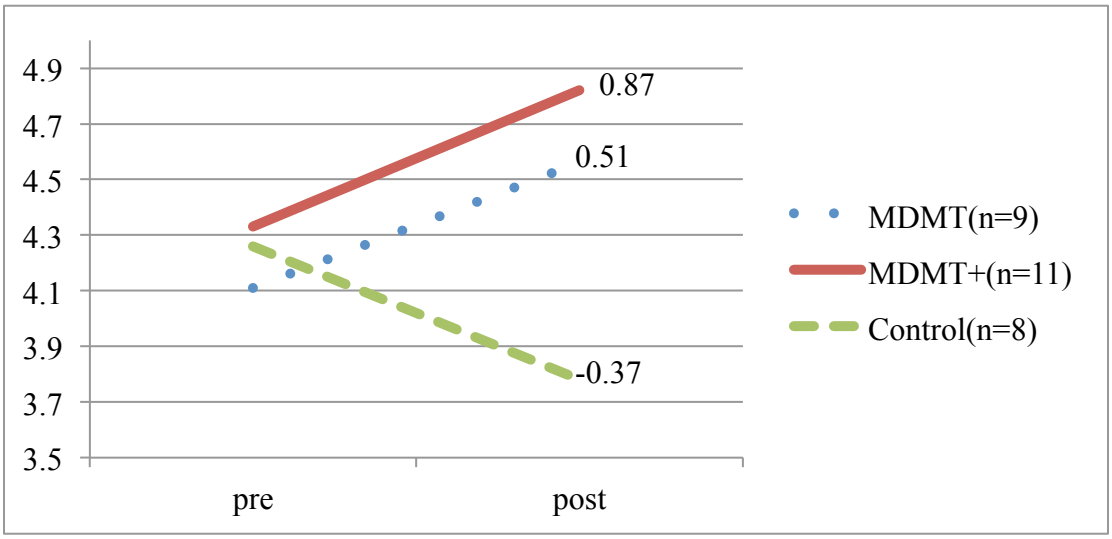


Table 4 presents the means and standard deviations for knowledge and self-efficacy by group. Results from ***Figure 6*** shows there were no statistically significant time main effect for self-efficacy ($F(1,25)= -.32$, $p= 0.40$), and no interaction effects ($F(2,25)= 2.80$, $p= 0.06$). An

analysis of effect sizes indicated a large increase in self-efficacy for MDMT+ participants (*d= 0.87*), a moderate increase for MDMT (*d= 0.51*), and a small decrease for the control group (*d= -0.37*).

Figure 6. Changes in Maternal Self-Efficacy to Limit Child Screen Time.



Parental Self-Efficacy to Limit Screen Time (Jago et al., 2015) was used to examine how much parents can do for limiting screen time. Self-efficacy was measured on a 5-point Likert Scale. 1= Nothing, 2= A little, 3= A moderate amount, 4= A lot, 5= A great deal.

Table 4. Changes in Maternal Knowledge of Guidelines and Self-Efficacy.

	Knowledge of Screen Time (hrs/day)		**Self-Efficacy**	
Group	Pre	Post	Pre	Post
MDMT	1.22 ± 0.44	1.22 ± 0.83	4.11 ± 0.90	4.56 ± 0.62
MDMT+	1.36 ± 0.50	1.18 ± 0.60	4.33 ± 0.70	4.82 ± 0.27
Control	1.44 ± 0.62	1.25 ± 0.71	4.26 ± 0.95	3.78 ± 1.30

*MDMT, n=9; MDMT+, n=11; Control, n=8

Purpose Three- Relationship between Self-Efficacy, Screen Time, and Sedentary Behavior

Table 4 summarizes correlations found among all variables for both intervention groups. There were no statistically significant relationships between changes in maternal self-efficacy

with changes in child sedentary behavior and screen time from pre- to post-intervention. Tables' 5a and 5b show correlations among these variables at pre- and post-intervention. Self-efficacy to limit screen time was moderately and negatively correlated with time children spent in screen time at pre-intervention (*r= -0.38, p<0.05*) and post-intervention (*r= -0.52, p<0.004*). All other variables were not significant, but in the expected direction.

Table 4. Relationships Between Changes in Self-Efficacy and Sedentary Behavior in MDMT and MDMT+.

	S-E change	**SB change**	**ST change (min)**	**ST change (frequency)**
S-E change	1			
SB change	0.12	1		
ST change (min)	0.09	-0.05	1	
ST change (frequency)	-0.03	-0.14	**0.43***	1

*Correlation is significant at the 0.05 level (2-tailed).
S-E= Self-Efficacy; SB= Sedentary Behavior; ST= Screen Time

Table 5a. Relationships Between Self-Efficacy and Sedentary Behavior in MDMT and MDMT+ at Pre-Intervention.

	S-E	**SB**	**ST (min)**	**ST (frequency)**
S-E	1			
SB	-0.30	1		
ST (min)	**-0.38***	-0.36	1	
ST (frequency)	-0.36	0.27	0.38	1

*Correlation is significant at the 0.05 level (2-tailed).
S-E= Self-Efficacy; SB= Sedentary Behavior; ST= Screen Time

Table 5b. Relationships Between Self-Efficacy and Sedentary Behavior in MDMT and MDMT+ at Post-Intervention.

	S-E	**SB**	**ST (min)**	**ST (frequency)**
S-E	1			
SB	0.23	1		
ST (min)	**-0.52***	-0.28	1	
ST (frequency)	-0.18	0.06	0.41	1

*Correlation is significant at the 0.05 level (2-tailed).
S-E= Self-Efficacy; SB= Sedentary Behavior; ST= Screen Time

Chapter 5. Discussion

Recent data show that more than half (54%) of children aged 2-5 years do not meet AAP guidelines and recommendations for screen time (Zimmerman & Christakis, 2007), specifically young girls (Danner, 2008). Further, increased screen time has been associated with increased child sedentary behavior (Rideout, Foehr, & Roberts, 2010) and lowered self-efficacy in parents to limit their children's screen time activities (Gustafson et al., 2006; Barnes et al., 2015). Increasing parental self-efficacy has been found to positively affect amount of time their children spend in screen activities (Smith et al., 2010; Babic et al., 2016), but the literature to support changing self-efficacy for reducing screen time is limited. Therefore, this study was designed to contribute to and elaborate on gaps in the literature by testing an intervention for decreasing screen time among young children. The specific purposes of this study were to examine a) changes in child screen time and sedentary behavior from pre- to post-intervention, b) changes in maternal knowledge and self-efficacy, and c) relationships between maternal self-efficacy to limit child screen time and sedentary behavior.

Findings of this study show that MDMT+ produced a statistically significant moderate-to-large decrease change by group in frequency, a non-statistically significant moderate-to-large decrease in duration of screen time activities and non-statistically significant small-to-moderate decrease in sedentary behavior from pre- to post-intervention. The MDMT+ group also had a non-statistically significant small-to-moderate increase in maternal knowledge of screen time guidelines. While there were no statistically significant changes in child screen time and sedentary behavior, maternal knowledge of guidelines, and maternal knowledge of self-efficacy, effect sizes indicated there were large changes in the MDMT+ group, moderate changes in the

control group, and no change in the MDMT group. Finally, there was a statistically significant moderate-to-strong negative correlation between maternal self-efficacy to limit screen time and children's screen time duration at pre- and post-intervention; indicating the higher maternal self-efficacy is, the less time children spent watching screens at pre- and post-intervention.

When examining the impact of the MDMT intervention on screen time and sedentary behavior amongst groups, the hypothesis from purpose one was partially supported. For purpose one, MDMT+ group had moderate to large decreases in the frequency of screen time and minutes spent in screen time. There were moderate increases in the control group and no statistically different in the MDMT group. MDMT+ also saw small decreases in sedentary behavior. Although changes in sedentary behavior for MDMT+ were not statistically significant from the MDMT or control group, there was a small decrease from pre- to post-intervention and shows potential for using this intervention to decrease sedentary behavior. Findings show the need to specifically focus on reducing sedentary behaviors given no changes were found in MDMT, who solely focused on increasing physical activity.

Parental involvement in the intervention could have facilitated changes in frequency and minutes of screen time and sedentary behavior among young children in the MDMT+ group. One success of this program is the support of the hypothesis on reduction of screen time and sedentary behavior from pre- to post-intervention, which also is in accordance to findings of Wood et al. (2015). Wood et al. found positive associations to parental involvement in screen time and sedentary behaviors and children spending time in those activities. Adherence to this particular intervention helps fill a gap in the literature. Salmon, Tremblay, Marshall, and Hume (2011) concluded from a community-based study that there is a need for future research in community environments. The current study also confirms similar findings of Sallis, Prochaska,

& Taylor (2000) that children are less sedentary when focusing on physical activity intentions, perceived barriers and physical activity, facility access, and time spent outdoors. Finally, Yilmaz et al. (2014) was able to reduce pre-school aged children's screen time through an intervention by implementing rules, education, and resources for parents in the home. This study was successful at incorporating parental involvement with reducing child screen time but the authors failed to look at various types of medias in the home (Yilmaz et al., 2014). Studying younger populations and including parental involvement seems to be an effective approach for decreasing screen time and sedentary behavior. Further, a community-based intervention provided benefits and confirmed that delivering interventions in the community may be a way to increase access and availability of alternative resources for sedentary behaviors.

However, it is unclear why the control group decreased screen time and sedentary behavior. One possibility could be due to external activities the children were involved in. Some participants self-selected into the control group because of their child's prior commitments to a spring sport/activity. This could have had an impact on the amount of screen time their child engaged in without administering any additional educational information or intervention. Additionally, due to the non-randomization process of assigning participants to the control group, mothers were aware of the goal of the intervention and may have already wanted to decrease screen time and/or sedentary behaviors. This could have had a large enough impact to potentially altar the mothers' thought process on screen time activities from pre- to post-intervention.

For purpose two, MDMT+ group had a moderate increase in correctly reported screen time hours recommended by the guidelines from pre- to post-intervention. When examining the impact of the intervention on maternal knowledge of screen time guidelines alongside maternal

self-efficacy between groups, the hypothesis was partially supported. This can conclude that MDMT+ mothers potentially had a better understanding of the parameters of screen time for their children. Results for MDMT+ also could conclude that mothers potentially adhered to additional screen time information, exhibiting a better understating from pre- to post-intervention of screen time guidelines for children aged 2-5. Campbell et al. (2010) previously stated that mothers with younger children, under the age of two, are knowledgeable about current screen time guidelines (Campbell et al., 2010). Since Campbell et al.'s study, screen time guidelines have been updated. This current study confirmed that most mothers are aware of the revised screen time guidelines set for their children.

For purpose two, MDMT+ also had a moderate-to-large increase in maternal self-efficacy from pre- to post-intervention. Similar results from Campbell et al. also revealed negative relationships between maternal self-efficacy to limit screen time and child screen time exposure. This was further supported by the findings of the current study with increased self-efficacy in MDMT+ that could be connected with decreased screen time from purpose one. Additional screen time education may have impacted overall self-efficacy in MDMT+ and is supported by Hamilton & Hatizis (2015). Hamilton & Hatzis found that mothers have a general understanding of screen time guidelines, but were reporting difficulties implementing rules for it (Hamilton & Hatzis, 2015). Through the current study, from pre- to post-intervention, mothers in the MDMT+ group reported stronger confidence in their ability to restrict screen time activities and limit overall time spent in those activities. These factors could have ultimately improved mother's abilities to implement screen time rules.

Purpose two was partially supported due to a moderate increase in self-efficacy with the MDMT group. Although mothers in MDMT group did not receive additional screen time

information, their self-efficacy could have been manipulated by other factors. Initially, mothers showed in figures 6 a ceiling effect with their responses at pre-intervention for self-efficacy to limit screen time. Concluding that although mothers did not have significant changes throughout the intervention for self-efficacy, there was not much room for improvement for MDMT group at post-intervention. Mothers in MDMT could have also used physical activity recommendations given to them each week to provide ideas for replacement activities to limit screen time. Changes in MDMT+ were larger than MDMT but due to the study having a physical activity base, the MDMT group might have focused on changing physical activity and it could have possibly affected their child's screen time at post-intervention. This could possibly and unknowingly increase their self-efficacy to limit screen time through increased knowledge of physical activities.

The current study concluded that majority of mothers in the MDMT+ group were aware of revised screen time guidelines for their young children despite being given additional screen time education. Further, mothers in the MDMT+ group felt more confident in their abilities to limit screen time for their young children. MDMT group mothers increased self-efficacy to limit screen time that could stem from conscious awareness of the physical activity portion of the intervention. Increased physical activity knowledge could have unknowingly transferred over into their abilities to better limit screen time.

For purpose three, there were moderate negative correlations between mother's self-efficacy to limit screen time and children's screen time minutes at pre- and post-intervention. When examining the relationships between child screen time and sedentary behavior and changes in maternal knowledge and self-efficacy the hypothesis was partially supported. Children are more likely to continue to exceed screen time guidelines if parents report lowered

self-efficacy than parents with higher reported self-efficacy (Smith et al., 2010). Additionally, Campbell et al. (2010) found the higher the reported parental self-efficacy for limiting screen time, the lower the reported minutes spent in screen time (Campbell et al., 2010). Jago et al. (2014) matched the findings of Campbell et al. with an intervention conducted with parents and preschool-aged children and screen time reduction. With implementation of physical activity education, games and challenges, the authors were able to see an increase in self-efficacy to limit screen time with increased physical activity as well as reduced time in sedentary behavior (Jago et al., 2014) With support from the previous studies, it can be concluded that the higher mother's self-efficacy to limit screen time, the less screen time children watch. Therefore, it is promising that MDMT+ mothers increased self-efficacy as this might result in decreasing screen time among their daughters and a strategy that should be targeted in future interventions to decrease screen time among young children.

The hypothesis for purpose three was partially supported because sedentary behavior and self-efficacy were not related. There were no correlations among changes in sedentary behavior, changes in self-efficacy, and changes in the frequency and minutes of screen time from pre- to post-intervention. The nature of the current study was not solely focused on changing sedentary behavior, but examining it as a factor of reduced screen time. Thus, sedentary behavior should be further examined considering not all sedentary behavior may be spent in screen time. Perhaps if the primary focus was decreasing child sedentary behavior and factors comprising sedentary behavior, there could have been stronger relationships between the change variables. Smith et al. (2010) found with younger children especially, unorganized activity was inversely related to lowered barriers and increased self-efficacy for parents, reduced child sedentary behavior, and reduced child screen time (Smith et al., 2010). Therefore, if a stronger emphasis is placed on

sedentary behavior, not just screen time, in future interventions, there is potential for it to affect self-efficacy and screen time as well.

There were several strengths of this particular intervention. First, the study focuses on incorporation of screen time into a physical activity intervention. Second, the study examined measurement of different screen time devices and application of the revised screen time guidelines with these screen devices. Third, the study primarily focused on younger preschool aged girls who are an important group to study to promote healthy behaviors early in life. Finally, the study took place in a community setting, which previous studies encouraged to strengthen the literature.

Limitations

Indeed, there were strengths within this study, but there are also limitations that need to be acknowledged. The groups in the intervention may have been affected by several factors. First, the initial sample may not have been large enough to see statistically significant changes across groups over the course of the 12-week intervention. Had there of been a larger sample size for the overall study, there may have been larger and/or significant changes either between or within groups. Secondly, specifically the control group being non-randomized weakened the study design. Mothers who contacted researchers were interested in the basis of the study before choosing a group placement. Mothers could have potentially joined the study and consciously aimed to decrease screen time or sedentary behaviors even without receiving screen time or physical activity information. Further, mother/child pairs who could not enroll in the intervention may have been participating in other activities that resulted in lower screen time and sedentary behavior. Finally, mothers in the intervention group may have shared information about screen

time that could have affected results of this study. Some of the mothers were involved in the same local groups and similar child care centers where discussion of the intervention could have occurred. However, there were few changes in the MDMT group so any shared educational information that may have occurred did not seem to result in positive outcomes for MDMT group.

Given the young age of our sample, it could have been difficult for some families to get their daughters to wear the accelerometer for the full week. Although, this may not directly affect changes in behavior, it could have affected capabilities to measure all sedentary behavior over the course of the week. Additionally, there is also the possibility of misinterpretation of questionnaires. Some of the questionnaires contained questions focused on specific time frames, potentially affecting mothers' answers.

Future Directions and Practical Applications

Several points should be noted for future investigation on this particular area of research that is lacking literature. Future studies should focus on complete randomization between groups and aim for larger sample sizes. This can be achieved by including more than one sibling, including both sexes (female and male) and potentially including fathers. Additional research needs to be conducted to determine if different measurement approaches (personal daily logs or monitoring devices for the home) with screen time minutes and screen time frequency will affect screen time outcome variables. Researchers should also take into consideration minimizing shared educational information between groups. Keeping groups and meeting times separate could potentially solve this challenge. Although it is uncertain if shared educational information between groups did occur in this study, it recommended for further investigation. Finally, further research would need to address lack of change in relationships in additional variables by creating

more longitudinal screen time studies for children aged 2-5 years. Adding a follow-up in future interventions could determine adherence to the tools learned in the intervention as well as results on time effects of self-efficacy amongst the different groups in the intervention.

Conclusion

The focus of this intervention was to examine changes over time in children's screen time and sedentary behavior, maternal knowledge of screen time guidelines and self-efficacy, and examine relationships between self-efficacy and screen time and sedentary behaviors. Findings, although non-significant, suggest this intervention was able to reduced screen time and sedentary behaviors in children and increased maternal knowledge and self-efficacy in the MDMT+ group. Indeed, with additional education of screen time and increasing overall maternal self-efficacy to limit screen time, children's reported screen time and sedentary behavior could potentially decrease. Concentrating on different screen time measurements and/or questionnaires, more educational topics on screen time and sedentary behavior, and longer intervention phases for a more meaningful impact on a particular sample over time could decrease child reported screen time and sedentary behaviors.

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Appendix A

Institutional Review Board Approval Letter

EAST CAROLINA UNIVERSITY
University & Medical Center Institutional Review Board Office
4N-70 Brody Medical Sciences Building· Mail Stop 682
600 Moye Boulevard · Greenville, NC 27834
Office **252-744-2914** · Fax **252-744-2284** · www.ecu.edu/irb

Notification of Initial Approval: Expedited

From: Biomedical IRB
To: Deirdre Dlugonski
CC:

Date: 1/30/2017
Re: UMCIRB 16-002375
Mothers and Daughters Moving Together

I am pleased to inform you that your Expedited Application was approved. Approval of the study and any consent form(s) is for the period of 1/30/2017 to 1/29/2018. The research study is eligible for review under expedited category #4,7. The Chairperson (or designee) deemed this study no more than minimal risk.

Changes to this approved research may not be initiated without UMCIRB review except when necessary to eliminate an apparent immediate hazard to the participant. All unanticipated problems involving risks to participants and others must be promptly reported to the UMCIRB. The investigator must submit a continuing review/ closure application to the UMCIRB prior to the date of study expiration. The Investigator must adhere to all reporting requirements for this study.

Approved consent documents with the IRB approval date stamped on the document should be used to consent participants (consent documents with the IRB approval date stamp are found under the Documents tab in the study workspace).

The approval includes the following items:

Name	Description
Accelerometer Log_Child_V1.doc	Additional Items
Accelerometer Log_Parent_V1.doc	Additional Items
Demographic Health History.doc	Surveys and Questionnaires
Email Recruitment_Previous participants.docx	Recruitment Documents/ Scripts
Enjoyment_Kendzierski.doc	Surveys and Questionnaires
Family Assessment Device.doc	Surveys and Questionnaires
Family physical activity.doc	Surveys and Questionnaires
Flyer 1.pptx	Recruitment Documents/ Scripts
Flyer 2.doc	Recruitment Documents/ Scripts
ICD_Parent_MDMT.doc	Consent Forms
Knowledge_Adult PA.doc	Surveys and Questionnaires
Knowledge_Child PA.doc	Surveys and Questionnaires
Marshall_Sitting Time Quest(STQ).doc	Surveys and Questionnaires
media use in children.doc	Surveys and Questionnaires
Parental Self-Efficacy for Limiting Screen Time.docx	Surveys and Questionnaires
Parental Support of Activity_Trost.doc	Surveys and Questionnaires
Parenting Styles_King.doc	Surveys and Questionnaires
Participant Manual_MDMT.docx	Additional Items
Participant Manual_MDMT_Screentime.docx	Additional Items
Protocol_MDMT.doc	Study Protocol or Grant Application
Screening Script_MDMT.docx	Recruitment Documents/ Scripts

The Chairperson (or designee) does not have a potential for conflict of interest on this study.

Appendix B

Media Use in Children Questionnaire

1. Is there a TV set in your household, or not?

   ____ 1. Yes

   ____ 2. No

2. Which of the following, if any, do you have in your household?

   ____ 1. Cable or satellite TV

   ____ 2. A digital video recorder like TiVo or through your cable company

   _____3. A DVD player

   ____ 4. A laptop or desktop computer

   ____ 5. High speed internet access (cable, wireless, or DSL)

   ____ 6. A video game player like an X-box, Playstation or Wii

   ____ 7. A handheld video game player like a Gameboy, PSP, or Nintendo DS

   ____ 8. An iPod Touch or other type of video iPod

   _____9. An iPad or similar tablet device, such as a Galaxy Tab, or other Android tablet, Microsoft surface, or Kindle Fire

   ____ 10. A Kindle, Nook or other e-reader

   ____ 11. A way to connect your TV to the internet so you can download or stream TV shows or movies onto your TV set

3. What type of cell phone, if any, do you have?

   ____ 1. A "smartphone" (in other words, you can send email, watch videos, or access the internet on it)

____ 2. A regular cell phone (just for talking or texting)

____3. I don't have a cell phone

4. One thing people talk about when it comes to cell phones and iPods is "apps." How confident are you that you know what an "app" is?

____ 1. I know what an app is

____ 2. I have an idea what an app is, but I'm not totally sure

____3. I don't know what an app is [skip to question 7]

5. Approximately how many apps, if any, have you downloaded onto your:

	None	<5	5-9	10-19	20-29	30+	Refused
Smartphone							
iPod Touch							
Tablet							

Tablet = iPAD, Kindle Fire, Galxay Tab, or other Android tablet)

6. Approximately how many of the apps that you've downloaded were for your child to use on your:

	Most of them	About half of them	Less than half of them	Only a few	None
Smartphone					
iPod Touch					
Tablet					

Tablet = iPAD, Kindle Fire, Galxay Tab, or other Android tablet)

7. In general, do the media in your home—TVs, computers, video games, and mobile devices—cause your family to spend more time together with other family members, less time together with other family members, or don't they make much difference one way or the other?

____ 1. Media cause us to spend more time with other family members

____ 2. Media cause us to spend less time with other family members

____ 3. Media don't make much difference in how much time we spend with other family members

8. We're interested in whether your child has ever used a cell phone, iPod Touch, iPad or similar mobile device to do any of the following activities. Please mark any of the activities the child has ever done:

	On a phone	On an iPod Touch	On a tablet
Watch TV shows or movies			
Watch videos			
Play games			
Use apps			
Read books			

9. We're interested in how often your child does various activities, or if your child has never done these activities. How often does your child:

	Several times a day	Once a day	Several times a week	Once a week	Less than once a week	Has never done this
Read or be read to						
Watch DVDs or videotapes						
Watch TV						
Use the Computer						
Read books on a e-reader or tablet						
Play video games on a console player						
Play games on a handheld player						
Use a mobile device to play games, use apps, watch videos						

Mobile device=smartphone, iPad, iPod Touch or similar device

10. Thinking just about YESTERDAY, about how much TIME, if any, did your child spend: Please enter the number of hours and minutes in the boxes below.

	Hours	Minutes
Read or be read to		
Watch DVDs or videotapes		
Watch TV		
Watching videos or TV shows on a handheld device like a smartphone, iPod Touch, iPad, or similar device		
Watching videos or TV shows on a computer (NOT on a DVD)		
Play video games on a console player		
Play games on a handheld player		
Using other types of apps on a smartphone, tablet, or other mobile device		
Playing games on a computer (laptop or desktop)		
Using educational software on a computer (not games)		
Doing homework on a computer		

11. We're also interested in how much time YOU PERSONALLY spent doing some activities yesterday. Thinking just about yesterday, about how much time did you spend: Please enter the number of hours and minutes in the boxes below.

	Hours	Minutes
Watching your own shows on TV		
Playing games or watching video on a cell phone, iPod, iPad, or similar device		
Using a computer (not for work)		
Playing video games		
Reading books, magazine, or newspapers for pleasure, including electronically		

12. How often, if ever, does your child use the following kinds of apps on a cell phone, iPod, iPad, or other tablet device:

	Often	Sometimes	Hardly ever	Never
Educational games, like puzzles, memory games, math or reading				
Games that are just for fun				
Creative apps for things like drawing, making music or creating videos				
Apps based on a character the child knows from TV				
Other types of apps				

13. Has your child's pediatrician ever talked to you about your child's media use?

____ 1. Yes

____ 2. No

Appendix C

Parental Self-Efficacy to Limit Screen Time Questionnaire

(1) How much can you do to control the time your child spends screen-viewing (*e.g.*, watching TV, digital video discs [DVDs], or playing video games)?

(2) How much can you do to help your children have alternatives to screen-viewing?

(3) How much could you do to reduce the time your child spends screen-viewing?

1= (Nothing) to 5= (A great deal)

Source:
Jago et al. (2015). Parental Control, Nurturance, Self-Efficacy, and Screen Viewing among 5- to 6-Year-Old Children: A Cross-Sectional Mediation Analysis to Inform Potential Behavior Change Strategies. Childhood Obesity, 11(2), 139-147.

Appendix D

12-week Activity Sessions

Week	In-Person Session Plan (MDMT & MDMT+)	Home Physical Activity (MDMT & MDMT+)	Home Screen Time Activity (MDMT+)
Week 1	Pre-Intervention testing; online questionnaires; give accelerometers	Maintain usual activity	Maintain usual activity
Week 2	Introductions Receive activity manual Child	Edu Topic: PA guidelines Find an activity that you enjoy doing together (with child)	Edu Topic: ST guidelines & Benefits of reducing ST Watch Dr. Ari Brown's: Tips for parents
Week 3	Share activity with group/game or activity	Edu Topic: Use an activity Plan Make a family activity plan	Edu Topic: Learn about/plan your child's daily time use Fill out the Media Time Calculator
Week 4	Mom & Me Zumba/dance	Edu Topic: Protect time for physical activity included in your plan	Edu Topic: establish your family's media use guidelines Complete the Family Media Plan
Week 5	Zumba	Edu Topic: Be flexible with your activity plan	Edu Topic: Substituting other activities for screen time Work with your child (and the rest of your family) to create a list of non-screen time activities
Week 6	Yoga	Edu Topic: Fun games with basic equipment Try Yoga session at home	Edu Topic: Monitor screen time Track and record your own and your child's ST
Week 7	Mom and Child Obstacle course	Edu Topic: Trying new activities Set up your own obstacle course at home	Edu Topic: Break up long periods of screen time and/or sitting Set timers to get up and move/do an activity
Week 8	free play at park/playground	Edu Topic: Maximize park/play time with your child Take your child to park and increase your own activity	Edu Topic: Model appropriate screen time behaviors – your child is watching Choose one healthy media behavior to model this week
Week 9	Outdoor games	Edu Topic: Importance of Outdoor Play Go outside and play a game	Edu Topic: Importance of Outdoor Play Replace one ST session with shared outdoor play
Week 10	Walk, bike, or stroll together	Edu Topic: Benefits of a family walk take a family walk this week	Edu Topic: Benefits of screen-free time No Screen Time for a Full Day (or week)
Week 11	Nature walk	Edu Topic: Importance of nature Sign up for Track Trails Use Track Trails brochure to take one nature walk with your child this week	Edu Topic: Screen-free environments/zones in your home Create screen-free zones or time in your home

Week 12	3k fun walk	Edu Topic: Importance of revisiting your activity plan Revisit your activity plan	Edu: Importance of revisiting your family media plan Track and record your own and your child's ST this week Revisit your family media plan

Appendix E
Participant Recruitment Process