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The Relationship Between Parent and Child Health Behaviors in Youth with Autism Spectrum Disorder

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THE RELATIONSHIP BETWEEN PARENT AND CHILD HEALTH BEHAVIORS IN YOUTH WITH AUTISM SPECTRUM DISORDER

by

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ABSTRACT

Previous studies found that children with ASD tend to participate in lower amounts of physical activity (PA), accumulate greater hours of screen time (ST), and have poorer sleep quality (SQ), compared to typically developing (TD) youth. Unfortunately, these poor health behaviors put youth with ASD at a high risk for developing obesity, as well as other obesity-related conditions (e.g. Type 2 diabetes). In order to reduce this risk, it is critical to understand the factors that affect activity levels and sleep in youth with ASD. Several studies have demonstrated that parents may have a large influence on social behaviors in youth with ASD, however, no studies have focused on the association between parent and child health behaviors in youth with ASD. Therefore, the purpose of the current study was to examine the association between parent and child PA, sedentary behavior (SB), ST, and SQ in youth with ASD. Data was collected from 15 child (ages of 6-17) and parent pairs, recruited from a private school in Central Orlando. Daily minutes of PA, SB, and SQ were measured using an Actigraph accelerometer, that both children and parents wore on their wrist over a 7-day period. Parents and children also completed surveys that inquired about both their PA and ST levels during weekdays and weekend. Pearson correlations found significant positive associations between objective parent and child PA and both self-reported weekend PA and ST. This is the first study to examine associations between parent and child health behaviors in youth with ASD, finding positive correlations between PA and ST during the weekend. These findings suggest that there is a relationship between parent and child activity levels in youth with ASD. It is critical for future work to examine the causal factors of this relationship between parent and child activity levels in

youth ASD populations. Such results may support the inclusion of parents to develop more effective interventions to target health behaviors in youth with ASD.

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INTRODUCTION

The prevalence of Autism Spectrum Disorder (ASD) diagnoses has been increasing in the past several years, with 1 in 54 children in the United States receiving a ASD diagnosis (CDC, 2020). ASD, is a neurodevelopmental disorder that typically is diagnosed in early childhood, is characterized by delayed language and communication abilities, impaired social skills, and participation in repetitive and rigid behaviors (Bremer et. al., 2016). Other common symptoms of ASD may include emotional and behavioral problems, such as inattention, disruptive behavior, or high anxiety levels (Hickey et. al., 2020; Maskey et. al., 2013). Unfortunately, such characteristics may affect the quality of life of these children, and can negatively impact health behaviors, such as physical activity (PA) and sleep quality (SQ), which are critical to healthy growth and development (Chia-Hua Chu et. al., 2020). Additionally, the negative impact on health behaviors may increase the risk of developing both physical and psychological health conditions that could extend into adulthood. For example, children with ASD are twice as likely to become obese compared to typically developing (TD) youth, which may be partially due to factors such as low PA and high levels of sedentary behavior (SB) (Must et. al., 2017). Given that there are health disparities between youth with ASD and TD youth, it is critical to further examine factors that can affect health behaviors in youth with ASD.

Studies comparing physical activity (PA), sleep quality (SQ), and screen time (ST) in children with ASD with TD youth have found that children with ASD tend to participate in lower

amounts of PA, accumulate greater hours of ST, and have poorer SQ (Garcia et al., 2019; Healy et al., 2019). For example, a recent study by (Gehricke et. al., 2020) reported that 18% of adolescents with ASD did not participate in any PA compared to only 4% of TD adolescents. A study by (Chonchaiaya et. al., 2011) reported that children with ASD were more likely to exceed the recommended guidelines of ≤ 2 hours of daily screen time than TD children. Overall, studies have consistently shown that a large percentage of youth with ASD display irregular sleep patterns (Cortesi et al., 2010; Healy et al., 2019). A study by (Moore et. al., 2017) reported that 80% of youth with ASD reported sleep disturbances compared to only 25% of TD youth. As mentioned eariler, such poor health behaviors may negatively affect other factors, such as mental health or social development. For example, a low quality of sleep in children with ASD may also result in less social interaction with other children (Devnani et. al., 2015). From the literature, it is clear that youth with ASD have a poorer health profile compared to TD youth, and therefore, it is critical that further research is conducted to identify factors affecting these health behaviors in youth with ASD (Healy et. al., 2018).

Several studies have investigated individual, social, and environmental factors associated with health behaviors of children with ASD (Healy & Garcia, 2018). The majority of research has focused on factors associated with participation in PA, with findings suggesting that psychosocial factors, such as friend and family support, may play a role in determining levels of PA in youth with ASD (Healy et. al., 2019; e.g. Ding et. al. 2011; Davison and Lawson, 2006). Factors in the home can also influence on health behaviors. For example, having media equipment in the bedroom of the child may affect the levels of screen time and PA they engage in (Healy et. al., 2019; Maitland et. al., 2013). For example, having a TV in the bedroom has shown to be associated with a greater amount of screen-time viewing (Jago et. al., 2012)

One area that has not been explored is the relationship between parent and child health behaviors in an ASD population. There is sufficient evidence to show that parental support for PA is associated with increased PA participation in TD youth populations (Brown et. al., 2020). Similarly, studies in TD youth have also found a link between parent and child screen time (Lauricella et. al., 2015). In fact, prior research found that high levels of sedentary behavior in parents was predictive of greater sedentary behavior in TD children, and children who watched more than 2+ hours of ST per day, typically had parents who also had high levels of ST (Jago et. al., 2010; Jago et. al., 2012). Finally, although not as much research has been conducted in this area, significant associations have been found for reported parent and child sleep disturbances in TD populations (Rönnlund et. al., 2016).

Despite the existing research that depicts the significant association between parent and child health behaviors in TD population, there are a limited number of studies that have examined the association between parent and child health behaviors in youth with ASD. Interestingly, prior research in ASD populations stresses the importance of parent support in providing optimal treatment for youth with ASD, however, those studies focus on clinical and education-based therapies rather than preventive health behaviors (Srinivasan et. al., 2014). Given the importance of parent health habits on TD youth's health habits, coupled with the increased importance of parent support to enhance treatment effectiveness in youth with ASD, it is critical that studies in youth ASD populations examine the link between parent and child health behaviors in a sample of children and adolescents with ASD.

REVIEW OF THE LITERATURE

Autism Spectrum Disorder is a neurodevelopmental disorder that can be characterized by deficits in socialization skills, behavior, and communication (Bremer et. al., 2016; American Psychiatric Association, 2013). This disorder can be diagnosed as earlier as 2-3 years of age (Angie W.S. et. al., 2015). Currently, the Centers for Disease Control (CDC) states that 1 in 54 children are diagnosed with ASD each year, which is a large increase from 1 in 150 estimated back in 2000 (CDC, 2018; CDC, 2020). Other characteristics often seen in youth with ASD include stereotypical or repetitive movements (hand flapping), and rigid or inflexible behaviors. Unfortunately, these types of symptoms may interfere with daily functioning and negatively affect the physical and mental health of this population (Bremer et. al., 2016; Bodfish et. al., 2000).

Health Behaviors in Youth with ASD

Physical Activity (PA)

Physical activity is critical for optimal health in youth, especially youth with ASD (CDC, 2014; Bremer et. al., 2016). A recent meta-analysis by (Healy et. al., 2018) reported that youth with ASD who participated in sufficient amounts of PA were more likely to have better coordination, balance, muscular and aerobic fitness, and social function compared to youth with ASD that did not participate in any PA. Research examining health behaviors in youth with

ASD has primarily focused on PA levels, with limited studies examining sedentary behavior or ST (Srinivasan et. al., 2014). Most of these studies determined that youth with ASD do not meet the recommended 60+ minutes of daily PA (Srinivasan et. al., 2014). For example, a previous study found that only 12 % of children with ASD(from a sample of 83) met the recommended levels of PA, and another study reported similar results, with only 14% of children with ASD meeting the recommended amounts of PA (Stanish et. al., 2017; Must et. al., 2017). Additionally, the majority of research has found that youth with ASD have lower amounts of PA compared to their TD counterparts (Healy & Garcia, 2018; Garcia et. al., 2019). Studies by (Mccoy et. al., 2020; Mccoy et. al., 2016) found that adolescents with ASD are 60% less likely to participate in PA compared to their TD peers. Additionally, a study done by (Stanish et. al., 2015) found that only 68% of adolescents with ASD found sports enjoyable, compared to 95% of TD adolescents. It is also important to note that these differences were found using both subjective and objective assessments of PA (Healy, Haegele & Garcia, 2018; Bandini et. al., 2013).

Screen Time (ST)

Sedentary behavior in youth with ASD has been a growing concern as it has been linked with adverse health outcomes, including obesity, lower self-esteem, and poorer academic performance (Ekris et. al., 2016; Healy et. al.,2019). Sedentary behavior (SB) is often represented by screen time(ST) because over 50% of SB is made up of ST and there has been more adverse health effects linked with ST over any type of SB (Healy et. al., 2019). Although there has been limited research on ST amounts in youth with ASD, it was found that this population spends more time viewing television compared to their TD peers (Healy et.al., 2017). For example, a recent study by (Healy et. al., 2019) found that youth with ASD were 36% less likely to meet ST

recommendations (≤ 120 minutes per day) compared to TD youth. Similarly, another study reported that children with ASD were shown to spend an hour more in SB on weekdays compared to TD children, with differences shown to be from the excessive amounts of ST in the ASD population (Must et. al., 2014). Finally, one study reported that youth with ASD reported on average a maximum of 150 minutes of ST per day compared to TD youth who had a maximum of 120 minutes of ST per day (Healy et. al., 2017).

Sleep Quality (SQ)

Sleep quality is often viewed as the sum of several sleep indicators, most notably sleep duration and sleep efficiency, defined as the percentage of time asleep compared to the total amount of time in bed (Cortesi et. al., 2010). Overall, studies have reported that children with ASD do not meet the recommended sleep guidelines of 8-9 hours of daily sleep duration or achieve 85% or higher sleep efficiency (Healy et. al., 2019). Additionally, the majority of research on SQ in youth populations suggest that SQ is poorer in youth with ASD compared to TD youth (Mazurek & Sohl, 2016; Richdale & Schreck, 2009; Healy et. al., 2019). One study found that 50% to 80% of youth with ASD reported sleep disturbances compared to only 10% to 50% in TD youth (Clesi et. al., 2018; Richdale & Schreck, 2009). Additionally, (Healy et. al.,2019) found that youth with ASD were 50% less likely to meet the recommended sleep duration compared to TD youth. The majority of research, however, has utilized only subjective measures, typically in the form of parent-reports, rather than objective assessments of SQ (Garcia et. al., 2019; Healy et. al., 2019).

Factors associated with health behaviors in youth with ASD

Numerous studies have examined factors associated with participation in health behaviors in TD youth, and there is growing interest in examining these relationships in youth ASD

populations (Healy et. al., 2019). A common approach used to examine factors associated with health behaviors is the use of the Social Ecological Model (SEM), developed by (Bronfenbrenner,1979). The SEM approach typically examines individual-, social-, and environment-level factors that affect health behaviors. The following sections will describe the SEM approach to health behaviors in TD populations and then will apply this model to ASD populations. Although, environmental-level factors are typically described following social factors for the purpose of addressing the gap in the literature for the current study, the social levels will be described last.

Individual level factors associated with health behaviors

TD youth populations

Numerous studies have examined individual-level factors associated with PA, ST, and SQ in TD populations, with research suggesting that factors such as age, gender, self-efficacy, and enjoyment may be positively or negatively associated with health behaviors. A study regarding PA levels in TD youth found evidence suggesting that both male and younger adolescents engage in more PA than females and older adolescents (Singh et. al., 2008). Additionally, a review done by (Craggs et. al., 2011) investigated how self-efficacy and PA levels correlated in adolescents. It was found that there was a positive correlation between both. Age is also associated in increased levels of ST. For example, one study found that as children get older their amount of ST increases. There also was an association between individuals that were ethnic minorities or had a low socio-economic status (SES) and increased amounts of ST (Brodersen et. al., 2007). SQ was found to be greater in TD children who were younger or had a higher socio-economic status (SES). It was also

found that children from minority groups were more likely to have worse SQ (Vaughn et. al., 2015; Matthews et. al., 2014).

ASD youth population

There is research that suggests that factors affecting TD youth's behaviors are similar in youth with ASD, however it is much more limited. For example, it was found that as age increases the levels of PA decrease in youth with ASD. However, sex was inconsistently associated with PA levels, with a few studies finding no differences in PA between females and males diagnosed with ASD (Jones et. al., 2017). Psychological factors also appear to affect health behaviors in youth with ASD (Healy & Garcia, 2018). For example, youth with ASD reported low levels of both PA enjoyment and self-confidence regarding participation in PA (Brown et. al., 2020; Paquet, Olliac, Golse & Vaivre-Douret, 2016). Additionally, some individuals in this population may view PA as a social challenge (e.g. fear of socialization or exclusion) (Healy et. al., 2013). In contrast, youth with ASD reported that they preferred engaging in ST behaviors rather than participating in PA (Healy & Garcia, 2018). Larger ST viewing times in this population has been associated with the mindset that the Television is far less intimidating than participating in sports or other forms of PA (Healy et. al., 2018). Similar to PA, studies have reported that as children with ASD age, their SQ decreases (Healy et. al., 2019). For example, one study done by (Garcia et. al., 2019) found that of 49 participants, only 21 met sleep recommendations and they significantly younger than the rest of the samples. Psychological factors, such as perceived stress, may also have a negative effect on SQ in this population.

Environmental factors associated with health behaviors

TD youth populations

Research suggests that environmental factors such as, home or neighborhood environment are associated with PA, ST, and SQ levels in TD youth. There was a negative association found between PA levels in TD youth and high crime rates, large number of roads, and increased traffic near an individual's home (Davison and Lawson ,2006). Another study found associations between a presence of a television in a child's room or adverse neighborhood qualities (e.g. sidewalks, vandalism ,presence of sidewalks) and increased ST amounts in TD youth(Healy, Garcia, & Hagele 2018). It was also found that less limits on television watching was associated with an increased amount of ST in children. Low socioeconomic status (SES) has also been linked with poorer SQ in TD youth (Jarrin et. al., 2014). SQ in TD children is associated with particular household environments. One study found that children with suboptimal sleep environments (e.g. too loud, too hot/cold) have a higher risk of poor SQ than, their peers that have optimal sleep environments (Wilson et. al., 2014).

ASD youth populations

Although a few studies have reported similar results regarding environmental factors and health behaviors in ASD youth populations, there is some evidence to suggest that environmental factors may play less of a role in influencing health behaviors compared to individual- or social-level factors (Healy, Haegele, & Garcia, 2018). A few notable environmental factors that impact PA participation in the population include a lack of

transportation to PA programs, faulty equipment, and a general lack of PA programs that are geared towards youth with ASD (Brown et. al., 2020; Obrusnikova and Miccinello, 2012). Interestingly, the presence of a television in the bedroom was linked with both greater amounts of ST and less time spent asleep in youth with ASD (Healy, Haegele, & Garcia, 2018).

Social-level factors associated with health behaviors

TD youth populations

There has been an abundance of research regarding the association between social-level factors and health behaviors in TD populations (Strauss et. al., 2001). Previous studies have reported that peer-related factors, including the presence of peers, peer support, and peer participation in PA may increase levels of PA in TD youth (Beets et. al., 2006; Sawka et. al., 2013; Garcia et. al., 2016). Interestingly, for TD populations, friend support may be more important for PA levels in females compared to males (Beets et. al., 2007). Friends also have an influence on ST amounts. For example, one study found that friend groups that were part of sports teams influenced less ST among each other (Garcia et. al., 2017). For SQ, it appears that parent factors are the primarily social influence in TD youth, which is discussed in subsequent sections.

ASD youth populations

Research suggests that ASD youth may face different social barriers than TD youth, however, both TD youth and youth with ASD have indicated that levels of social support are linked with participation in PA (Healy & Garcia, 2018). For example, although bullying was not related

to PA levels in TD youth, a study by (Healy & Garcia, 2018) reported that youth with ASD participated in less amounts of PA due to fear of bullying. Additionally, one study found that greater ST amounts were associated with the number of close friends and low prosocial behavior rating from their parents (Healy & Garcia, 2018). Regarding SQ, one study found that poorer social interaction and limited social skills have been linked with increases in sleep disturbances (Schreck et. al., 2004). As discussed further in this review, parent involvement may have more of an impact on health behaviors in youth with ASD compared to friend or peers.

Parental influence on health behaviors in TD youth

There has been an abundance of regarding how parents may influence health behaviors in their TD children. One study found an association between parent and child BMI, particularly for overweight females (Baker et. al, 2018). There also has been a lot of research that provides evidence for the importance of parent support and this has been shown to be a key factor in encouraging PA participation in TD youth (Brown et. al, 2020 ; Yao & Rhodes, 2015). For example, a study by (Garcia et. al.,2016) reported that both parent support and parent participation in PA was positively linked with PA levels in TD youth. Similarly, there was a positive association regarding ST levels between parents and their TD children (Garcia et. al., 2016). Although less is known regarding parental influence on SQ in TD youth, family stress has consistently been linked with poorer SQ in TD youth (El-Sheikh & Kelly, 2017). Additionally, there has been evidence that parenting style is a factor that affects sleeping outcomes for TD children. Previous studies found that parents with a more laid-back approach to bedtime was a risk factor for children to have sleep problems (Reid et. al., 2009; Hall et. al., 2007; Coto et. al., 2018; Staple et. al., 2015). Lastly, poor relationship

with parents and a lack of perceived family bedtime norms was linked with poorer SQ in TD populations (Belmon et al., 2020).

Parental influence on health behaviors in youth with ASD

Research regarding parental influence on youth with ASD has been much more limited despite the importance of parental support for other types of activities in this population (Brown et. al., 2020; Kowalchuk & Crompton, 2009). For example, there has been a strong influence found in parent support for therapy and education that may help with social outcomes in adolescents with ASD (Smith et al., 2017). Additionally, in one study, it was found that parents may use television as a means of distraction for their child and claimed that it took less supervision than participation in sports (Nally et. al., 2000).

There has been speculation that parent support for health behaviors may play a larger role in ASD populations compared to TD youth, due to the additional support needed from parents in other aspects of daily activities. There have been a few studies that have reported a positive link between parental support for PA and increased PA participation in youth with ASD (Healy & Garcia, 2018), however in this population, no studies have examined links between actual parent health behavior and their child's health behaviors. As parent modeling of behavior has been identified as an evidence-based practice for modifying behaviors in youth with ASD, it is imperative that further research focuses on the associations between parent and child health behaviors in this population.

Summary of literature

Overall, youth with ASD consistently demonstrate poorer health behaviors compared to TD youth, which emphasizes the need to identify the significant factors associated with PA, ST, or SQ. There are individual, environmental, and social factors that can either increase or decrease PA, ST, or SQ. Research on factors that affect health behaviors in youth with ASD have been much more limited than, it has been in TD youth. Parental influences on PA in TD youth and ASD youth are important, but there is a gap in the literature for youth with ASD. To date, there has been no research that has addressed the association between parent and child PA, ST, or SQ in youth with ASD. Therefore, the purpose of this study is to determine if there is a correlation between parental influence and these health behaviors in youth with ASD. It is hypothesized that there will be a significant association between parent and child PA, ST, and SQ.

METHODS

Study design and Setting

This cross-sectional study was conducted at a private school located in Central Florida that enrolls youth with Autism Spectrum Disorder (ASD). All youth enrolled at this private school have received a formal diagnosis of Level 1 (high functioning) ASD by a physician.

Description of Sample

There were approximately 15 child/ parent pairs in the current study. To be included in the study, the child had to meet the following criteria: 1) between the ages of 6-17, 2) currently enrolled at the school site; 3) free of any violent behaviors that might cause harm to other participants, 4) free of any severe mental disorder that may limit their ability to participate in the study, 5) free of any serve physically disability that may prevent them from participating in the study, and 6) able to wear a wrist accelerometer over a 7-day period.

Recruitment

Investigators gave a PowerPoint presentation on the current study to parents of eligible children on a parents' night, which is held monthly. Following the presentation, parents were encouraged to ask questions regarding the study procedures. Interested parents were then given a consent form to read over and sign. Once parent consent was given, the investigators presented the study to the child, and obtained child consent. While at the private school site and once all the consent forms were completed, accelerometers were given to each parent/child. After, the 7-day period the participants returned to the private school site and the devices were collected. All procedures were approved by the University of Central Florida Institutional Review Board.

MEASURES

Demographic Survey

Parents in the study were asked to complete a 6-item demographic questionnaire. The items on the questionnaire inquired about their child's age, gender, race/ethnicity, age of diagnosis, current medications, and presence of any additional health conditions.

Parent and Child PA

Objectively measured PA. Both children and parents were asked to wear an Actigraph GT9X Link accelerometers (ActiGraph LLC, 2020). These accelerometers can detect normal human motion, while filtering out any high frequency vibrations that may artificially increase the movement detected (Troiano, 2008). Both children and parents were asked to wear the device on their non-dominant wrist over a seven-day period, only removing for water-based activities (e.g. swimming). These devices have been validated in both child (Evenson, 2008) and adult populations (Troiano, 2008). Accelerometer data is collected in 1-minute epochs and collapsed into counts per minute (CPM). In child participants, using the validated algorithm (Evenson ,2008), the CPM cutoff points are as follows: sedentary behavior (≤100 CPM); light intensity PA (1010-2996 CPM); and MVPA (> 2296 CPM). Similarly, in adults using the validated algorithm (Troiano, 2008), the CPM cutoff points are as follows: sedentary behavior (<100 CPM); light intensity PA(101-2019; 2020-5998 CPM); MVPA (> 5999 CPM). Children who accumulate an average of 60+ minutes of MVPA, and parents who accumulate 30 minutes of MVPA per will be classified as "meeting MVPA recommendations" (CDC,2018).

Subjectively measured PA. Parents were asked to report both their own and their child's PA. They were asked the question 'during the past week, on how many days did you/your child exercise, play a sport, or participate in PA for at least 60 min that made you/your child sweat or breath hard?'. If needed, examples were available and included: 'active sports such as baseball, softball, basketball, swimming, soccer, tennis, or football; riding a bike or roller-skating; walking or jogging; jumping rope; gymnastics; and active dance such as ballet.' The responses ranged from 0 to 7 days. This measure has been used in prior research, which used the National Survey of Children's Health (NSCH) data to examine PA behaviors in youth with ASD (McCoy et. al., 2016).

Sleep quality

Objective sleep assessments. Both sleep duration and sleep efficiency were assessed by the Actigraph GT9X accelerometers for both children and parents. A validated sleep algorithm (Sadeh, Sharkey, & Carskadon, 1994) was applied to the data to calculate several components of sleep quality for the children. School aged children and adolescents that get 8-10 hours of sleep per night were classified as "meeting sleep recommendations" (Hirshkpwitz et. al., 2015). For parents, a different algorithm must be used (Cole et. al., 1992). For adults to be classified as "meeting sleep recommendations" they must have 7-9 hours (Hirshkpwitz et. al., 2015). To be classified as an "efficient sleeper" the participant must spend 85% of his/her total time in bed asleep (Javahari et. al., 2008). Sleep efficiency can be defined as the ratio of total sleep time (TST) and the time lying in bed (TIB) (Reed et. al., 2016).

Sleep Logs. Parents were asked to complete a sleep log for both themselves and their child over a seven-day monitoring period. The sleep log asked parents to fill out the following information for each day of the monitoring period: 1) Time they went to bed each night; 2) Time they fell asleep; 3) Time they got out of bed; 4) Did they wear their accelerometer during the night; and 5) was there anything unusual about the sleep period(e.g. illness that kept parent awake).

Screen-time

Screen-time Survey. Parents were asked to complete a previously validated screen-time questionnaire that asks, "in your free time on an average weekday, (Monday-Friday), how many hours do you spend doing the following activities?" (Utter et. al., 2003). These activities included watching television/DVDs/videos, using a computer, and videogames (Xbox/Play-Station/other electronic games). The parents were also asked to rate the amount of time engaged in these activities during a weekend day. The 7-response option ranged from "0 hours" to "5+ hours". The total sum of weekday and weekend hours was then divided by 7, and the hours were converted to total minutes of daily screen time, so that the value would be comparable to activity levels. Parents then completed the same survey for their child. To be classified as "meeting screen time recommendations" both parents and children were required to have a total screen time of 120 minutes or less (American Academy of Pediatrics, 2001).

STATISTICAL ANALYSIS

Frequencies and descriptive statistics were ran for all parent and child activity variables. Wear-time compliance was also calculated for all accelerometer data. Person correlations were used to examine the association between parent and child PA, ST, and SQ. Additionally, chi-square analyses were conducted to compare differences in meeting recommendation levels between parents and children. All analyses were conducted using SAS analysis software version 9.4 with statistical level set at $p < 0.05$.

RESULTS

Sample characteristics

A total of 14 participants were recruited to take part in this study. A majority of the participants were male (83%) and were classified as being White (67%). Ten of the 14 participants (83%) had a co-occurring diagnosis (in addition to ASD). Table 1 displays the participant characteristics.

Table 1: Participant characteristics (n=14)

Variable	N (%)	Mean (SD)
Male	10 (83%)	
White	8 (67%)	
Age		13.17 (2.03)
Age of diagnosis		3.58 (2.32)
Overweight	4 (33%)	
Additional diagnosis	10 (83%)	
Currently on medication	8 (67 %)	

Comparisons between parents and children by activities variables

Parents reported participating in fewer days of PA compared to their children (3.88 days vs. 5.58 days, $p < -0.0001$). Additionally, parents also reported participating in fewer minutes of weekend PA compared to their children (34.17 minutes vs. 59.17 minutes, $p=0.005$). There were no significant differences in subjectively measured weekday PA or objective measures of PA between parents and children. Table 2 displays activity variables for both parents and children.

Table 2: Activity variables

Activity variables	Parents	Children	p-value
PA days (days/week)-*self-report*	3.88 (1.15)	5.58 (1.29)	0.001
Wkday PA (min/day)-*self-report*	57.08 (95.81)	47.08 (21.48)	0.71
Wkend PA (min/day)-*self-report*	34.17 (20.32)	59.17 (30.59)	0.005
LPA (min/day)	371.96 (171. 21)	337.58 (165.14)	0.94
MVPA(min/day)	23.22 (47.98)	24.45 (37.97)	0.8
Wear time (days)	5.31 (1.49)	5.46 (1.56)	0.69

*PA: physical activity; LPA: light physical activity; MVPA: moderate-to-vigorous physical activity

Comparisons between parents and children by sedentary variables

There were no significant differences in any of the ST or SB variables between parents and children. Table 3 displays sedentary variables for both parents and children.

Table 3: Sedentary variables

Sedentary behavior	Parents	Children	p-value
Wkday ST (min/day)	106.67 (69.62)	81.25 (48.06)	0.33
Wkend ST (min/day)	122.08 (80.21)	175.42 (131.63)	0.09
SB (min/day)	455.93 (186.96)	365.14 (172.78)	0.18

*ST: screen time; SB: sedentary behavior

Comparisons between parents and children by sleep variables

The average sleep duration for children was significantly higher than the average sleep duration for parents (8.79 hours vs. 6,62 hours, p=0.004). There were no differences in objective sleep variables observed. It should be noted that the sleep variable data reflects 12 participants and not 14 because of non-compliance accelerometer wear. Table 4 displays sleep variables for both parents and children.

Table 4: Sleep variables

Sleep variables	Parents	Children	p-value
Hours duration	6.62 (1.11)	8.79 (1.16)	0.004
Minutes asleep	355.13 (56.62)	401 (52.15)	0.07
Efficiency	86.74 (4.77)	78.79 (7.02)	0.09

*****Sleep Efficiency- % of time asleep compared to the total amount of time in bed

Correlations between parents and children PA levels

There were significant correlations between objectively measured MVPA (r= 0.71, p=0.007) and LPA (r=0.77, p=0.002). Additionally, there was a significant correlation between self-reported weekend minutes of PA between parents and children (r=0.58, p=0.04). Table 5 displays the correlations of PA levels between parents and children.

Table 5: Correlations in PA

Variables	r-value	p-value
Parent PA days & child PA days	0.35	0.23
Parent PA wkday & child PA wkday	0.4	0.19
Parent PA wkend & child PA wkend	0.58	0.04
Parent LPA & child LPA	0.77	0.002
Parent MVPA & child MVPA	0.71	0.007

*PA: Physical Activity; LPA: light physical activity; MVPA: moderate-to-vigorous physical activity

Correlations between parents and children SB & ST

There was a significant correlation between weekend screen time for participants and their parents (r=0.64, p=0.03). There were no other significant correlations that existed between the participation in SB and weekday ST. Table 6 displays the correlations between parent and children SB and ST.

Table 6: Correlations in SB & ST

Variables	r-value	p-value
Parent ST wkday & child ST wkday	0.03	0.92
Parent ST wkend & child ST wkend	0.64	0.03
Parent SB & child SB	0.19	0.53

*ST: Screen time; SB: Sedentary Behavior

Correlations between parents and children SQ

There were no significant correlations between parent-reported sleep duration, objectively measured minutes of sleep per night, and sleep efficiency for the parents and their children with ASD. Table 7 displays the correlations between parent and children SQ.

Table 7: Correlations in sleep

Variables	r-value	p-value
Parent hours duration & child hours duration	0.15	0.65
Parent minutes asleep & child minutes asleep	0.39	0.38
Parent efficiency & child efficiency	0.36	0.43

DISCUSSION

The purpose of this paper was to determine whether there is a relationship between health behaviors of parents and children with ASD. It was hypothesized that there would be a significant association between physical activity, screen-time, and sleep quality in children with ASD and their parents. The results of this study partially supported our hypothesis in that PA and ST levels were found to have a moderate to strong association between children with ASD and their parents. No associations, however, were found for either subjective sleep duration or objective sleep quality. This is the first study, to our knowledge, that examines the parental influence on health behaviors in youth with ASD. While there was a single prior study that demonstrated the importance of parent support for PA in youth with ASD, no studies have examined the association between parent and child PA, SB, and SQ in this population.

The findings in our current study are supported by research in TD populations. For example, a study by (Bringolf-Isler et. al.,2018) found that objectively-measured parent PA was associated with objectively-measured child PA. Although, self-reported PA hasn't been as strongly linked between parents and their children, weekend PA has been found to be related between parents and children. Similar to youth with ASD, there has been research regarding the relationship between TD children's levels of physical activity and parental support (Yao et. al, 2015). However, no research has examined the association between parent and child PA in a population of youth with ASD.

In TD populations, parents ST viewing has been found to influence the amount of ST viewing in their children (Lauricella et. al., 2015; Jago et. al., 2012). The current study found a correlation between weekend, but not weekday, self-reported ST in parents and their children. This finding has been supported by prior research in TD children where parent ST was linked with child ST, but only on weekend (Fuemmler, Anderson, & Masse, 2011). This may be due to week-day commitments, such as school and work, limiting the time parents and children have together. To our knowledge, there has not been any studies investigating the parental influence on SB in youth with ASD. However, some studies focused on SB and its influence in social settings (Schenkelberg et. al., 2017).

Interestingly, the findings from the current study on sleep quality are in contrast to sleep research in TD populations. In a recent study in TD youth, a significant association between parents who reported low levels of sleep quality and poor sleep schedules in TD children. (Belmon et. al., 2020). Although, it did not examine the correlation between parent and child SQ, (Clesi et.al.,2018) reported that SQ in youth with ASD, similarly to TD populations, was positively linked with consistent bedtime routine. Although the reasons for the contrast in the association of SQ in youth with ASD compared to TD youth is unknown, it could be speculated that perhaps the poor sleep quality typically experienced by the ASD population may play a role in these findings. As (Baker et. al., 2013) found, children with ASD were three times as likely to report a sleep disturbance compared to TD youth. Additionally, one recent study found that parent daytime behaviors may have significant relationship with child

sleep (Cimon-Paquet, Tetrault, & Bernier, 2019). Therefore, future studies may need to focus on relationships between daytime parent behaviors and subsequent child sleep.

Strengths and Limitations

The current study had a number of strengths. This was the first study to examine the relationship between child and parent PA, SB, and SQ in a young ASD population. Additionally, PA, SB, and SQ were measured by both subjective and objective assessment measures. The subjective activity was also split into weekday and weekend averages to compare whether any relationships between parent and child may differ by time of the week. However, there were also some limitations that should be discussed. First, the sample size was small in the current study. Although, the results of this study demonstrate a correlation between the health behaviors of parents and youth with ASD, we cannot determine causal factors for this relationship. Additionally, it is unknown what mechanisms took place that may have led to the correlation between activity levels in children with ASD and their parents. For example, were parents modeling activity behavior or was their co-participation in physical activity or ST? The majority of participants were white males, and although males have a 4:1 greater likelihood of receiving an ASD diagnosis, these results may not be generalizable to other populations. Additionally, it should be noted that the duration of the study was short and that longitudinal designs may be warranted. Finally, parents were not as compliant as their children in wearing the accelerometer through the night, which may partially account for the lack of relationship in SQ between parents and their children. Only nine of the fourteen participants were compliant in wearing the

accelerometer through the night. Therefore, it is imperative to devise approaches that may increase wear-time compliance in both children and their parents.

Future directions

In the future, the use of a prospective cohort design may be critical to assess temporality. The addition of a qualitative aspect in future studies may allow us to determine the mechanisms by which parent and child activity are related (e.g. co-participating in activity). Lastly, once there is more information regarding causal mechanisms, more effective interventions to increase health behaviors in youth with ASD could be developed. Given prior evidence that indicated the importance of family for youth with ASD in other aspects of their life (e.g. social skill training), the use of family to promote health behaviors in this population may be critical(Hartley et. al., 2015; Smith et. al., 2017).

Conclusion

The current study demonstrates that there is a relationship between physical activity and screen time between parent and their children with ASD. Physical activity was shown to have a similar relationship between parents and youth with ASD and in TD populations. As children with ASD tend to have poorer health habits, it is important understand the mechanisms that underlie this relationship, and this is critical for future health promotion programs for this population.

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