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The Impact of Judo on Aggressive Behaviors in Youth with Autism Spectrum Disorder

Paola Rivera
University of Central Florida

THE IMPACT OF JUDO ON AGGRESSIVE BEHAVIORS IN YOUTH WITH AUTISM SPECTRUM DISORDER

by

PAOLA M. RIVERA
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ABSTRACT

The aim of this study was to examine the effects of an 8-week judo program on lifestyle habits and behavior in children with Autism Spectrum Disorder (ASD). **METHODS:** Participants included 25 children (ages 8-17), with a formal diagnosis of ASD. The sample participated in an 8-week judo program (45 minutes, 1x week), with measures taken at baseline and at the end of the 8-weeks. In order to assess activity levels and sleep quality, participants were instructed to wear Actigraph GT9X Accelerometers for 7 days and nights. In order to assess behavioral changes, parents were given the ABC survey to fill out at baseline and post-intervention. Non-parametric paired t-tests were conducted to compare differences in behaviors, MVPA, SB, and sleep quality (i.e. sleep efficiency, total sleep time, number of awakenings, and wake after sleep onset) pre and post judo. **RESULTS:** Results indicated there was a strong negative correlation (r= -0.632) with inappropriate behaviors and the number of classes attended. Participants also spent a significantly greater percentage of time in daily MVPA (8% vs 4%, p=0.05) following the program. There was a significant increase in total minutes of sleep duration (572.56 vs 333.8, p=0.008) following the program, and although not statistically significant, a trend existed for improved sleep efficiency (92% vs 88%, p=0.1). **CONCLUSION:** Despite no significant differences in ABC scores pre and post-judo, a strong association between class attendance and lower ABC scores were observed, along with improvements in MVPA and sleep quality. Future studies should include larger samples of youth with ASD, over a longer intervention period.

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LIST OF ACRONYMS/ABBREVIATIONS

ASD	Autism Spectrum Disorder
CARD	Center of Autism and Related Disabilities
MVPA	Moderate to Vigorous Physical Activity
PA	Physical Activity
SB	Sedentary Behavior
WASO	Wake After Sleep Onset

CHAPTER ONE: INTRODUCTION

Prevalence of Autism Spectrum Disorder (ASD) has rapidly increased in recent years and is the second most often diagnosed developmental disability in the United States, with 1 in 59 children receiving a diagnosis of ASD in 2018 compared to 1 in 2,000 in the 1980's (Center for Disease Control and Prevention (CDC) 2018; World Health Organization 2017). Primary characteristics of ASD include impaired communication, difficulties with social interactions, and repetitive behaviors (head banging and rocking). Such symptoms of ASD have been linked with poor academic outcomes and inability to form relationships with peers (National Institute of Mental Health (NIMH) 2018). While the majority of characteristics may negatively impact development, a few of the core symptoms such as a propensity towards aggressive behaviors, can be especially debilitating (Kanne & Mazurek, 2011). Research indicates that among individuals diagnosed with mild to severe ASD, at least 1/3 of this population has been shown to display aggressive tendencies, such as head banging, throwing objects, and property destruction (Kanne & Mazurek, 2011). In addition, individuals with ASD may display these aggressive behaviors towards peers, which can exacerbate feelings of social isolation. Research indicates that individuals with ASD, who display aggressive tendencies, are more likely to be incarcerated as they transition into adulthood (Tsakanikos et al., 2007). Given the increased difficulties associated with aggression in adulthood, as well as the devastating impacts on the family unit (Gupta & Singhal, 2005), it is critical to develop treatments that may attenuate the severity or frequency of aggressive behaviors (Hodgetts, Nicholas, & Zwaigenbaum, 2013).

Common forms of intervention to treat aggressive behaviors include: cognitive behavior therapy, family therapy and community interventions (Cornet, De Kogel, Nijman, Raine & Van

Der Laan, 2015; Marans & Schaefer, 1998). An alternative form of treatment which has recently been gaining attention due to its positive effects on symptoms of ASD, is physical activity (PA) participation (Bremer et al. 2016; Lang et al. 2010). Although the research in this area is limited, the majority of findings have shown positive results, with no studies demonstrating any negative effects on behaviors in this population (Ash et al., 2017). For example, a study by Oriel et al (2012) found that youth with ASD demonstrated a higher number of correct responses on a standardized test following a bout of moderate intensity physical activity. Unfortunately, these results did not extend to aggressive behaviors in this population, indicating that specific exercise modalities may be necessary to effectively reduce aggressive behaviors (Elliot et al. 1994; Prupas and Reid 2001).

While participation in PA has been increasing in popularity as a form of treatment, it is still unclear whether specific exercises may be more effective for reducing aggression in youth with ASD. Interestingly, it has been postulated that activities integrating mind/body focus may be more effective in reducing disruptive behaviors (Chan et al,2013; Jensen et al, 2004). For example, a study by Jensen et al (2004) found that a 20-week yoga class was effective in significantly reducing aggressive behaviors in youth with impulsive behaviors. Although the mechanisms by which mind/body interventions decrease behaviors are unclear, studies have shown that the success of mind/body physical activity in decreasing behaviors may be partly due to self-regulatory skills and body awareness that may help youth with sensory deficits and aggressive behaviors (Chan, Sze, Siu, Lau, & Cheung, 2013). One limitation of yoga and mindfulness activities is that the majority of the sessions are low intensity, which may prohibit substantial gains in physical health domains such as aerobic fitness or weight loss (Elliott,

Dobbin, Rose, & Soper, 1994). Therefore, it is necessary to explore other activities that may contain the mind/body integration, in addition aerobic fitness gains and weight management in this population.

Martial arts training is a physical activity that has the potential to incorporate mind-body awareness, and to reach high intensities of activity throughout sessions. Most importantly, recent studies that have measured the effects of martial arts on aggression have found that specific types of martial arts, specifically those that are based on the premise of the development of mind and body, may be effective in reducing aggression in youth (Chan, Sze, Siu, Lau, & Cheung, 2013). The martial art of judo is classified as a mind/body sport, with the capacity to improve several aspects of physical fitness. Judo draws focus away from the combat component of martial arts and is more centered on the mental development of the athlete, thus instilling concepts of self-control (Weinmann, 1997).

Although only a few studies have examined the effects of martial arts training in children with ASD, results have been promising, demonstrating improvements in social interactions and reductions in stereotypical behaviors (Movahedi et al., 2013; Bahrami et al., 2012). Similar to TD youth, martial arts that incorporate mind-body components during training were linked with increased calmness, communication and decreased behavioral issues in children with ASD (Milligan et al., 2013). Interestingly, no studies to our knowledge have investigated the effects of judo, specifically, on behaviors in youth with ASD, however, there have been two studies that have examined the effects of mind/body martial arts on aggressive behaviors and communication (Movahedi et al., 2013; Bahrami et al., 2012). These two studies examined the effects of a 14-week kata program on children with ASD, finding reductions in repetitive behaviors and improved

communication. However, as judo has been postulated to be particularly beneficial in reducing aggression and promoting self-regulation (Bahrami et al., 2012; Movahedi et al., 2013, and Twemlow & Sacco, 1998), it is critical that studies investigate the effects of judo training in youth with ASD. The proposed study intends to advance the existing literature by investigating the effects of judo training on aggressive tendencies in both children and adolescents with varying levels of ASD. Such findings may provide directions for future recommendations regarding the connection between symptoms of ASD and recommendations for physical activity and exercise in this population.

CHAPTER TWO: LITERATURE REVIEW

Research in the field of Autism Spectrum Disorder (ASD) ranges from that of intervention measures in order to reduce behaviors, modes to improve sleep, social interactions and increase physical activity levels in youth with ASD. Autism Spectrum Disorder is characterized as impairments in mainly social interactions which stem from their difficulty with communicating with others as well as restricted or repetitive patterns (World Health Organization, 2017). In regards to social impairments, according to the Diagnostic and Statistical Manual of Mental Disorders (DSM-5), people with ASD experience deficits social-emotional reciprocity, impaired abilities to use nonverbal communication for social interactions (eye contact, body language and hand gestures), as well as difficulty developing, maintaining and understanding relationships. Repetitive behaviors can consist of repetitive motor movements, speech, or use of objects (flipping objects or tapping on a desk), ritualized patterns and inflexible adherence to routines, highly restricted interests and focus, as well as hyper- or hypo activity to sensory input. Some of the repetitive behaviors however, can progress to aggressive tendencies and behaviors. In the United States, the prevalence of ASD was increased from 1 in 59 children being diagnosed compared to 1 in 2,000 in the 1980's (Center for Disease Control and Prevention (CDC) 2014; World Health Organization 2018).

In a study by Kanne and Mazurek (2011) looking at prevalence of aggression in children with ASD, they found 68% of parents reported aggression towards caregivers and 49% reported aggression towards non-caregivers. The study looks at a sample of 1,380 individuals who live in a household with one child diagnosed with ASD. Aside from cognitive function, vocabulary

skills, and adaptive skill, aggression was a main measurement used to look for prevalence of aggression. Results showed, not only were 68% of parents reporting aggression but also that 56% of the children were already engaging in some form of aggressive actions towards caregivers. In addition, correlation coefficient was examined for both occurrences, between caregivers and non-caregivers, and was found to be significant. This is indicative that the propensity for a child to express aggressive behaviors towards a non-caregiver is more likely if they already express aggression towards their caregivers. These aggressive behaviors are vast though, in a review by Matson & Adams (2014) on the characteristics of aggression in children with ASD, found that among the most common aggressive behaviors were: kicking, hitting, biting, throwing, scratching, pulling hair, grabbing others and property destruction. These aggressive behaviors can cause so much more than just impaired social functioning, but with characteristics such as property destruction and physical outbreaks, as the children get older they face a possibility of classroom removal, rejection of services, being institutionalized or even incarcerated (Tsakanikos et al., 2007). Additionally, the prevalence of aggression was found to be significantly higher in individuals with ASD compared to individuals with any other developmental disabilities or even the general population (Matson & Rivet, 2008).

Aggressive tendencies not only effect the children, who suffer from difficulty in social setting due to these, but also the parents of the children and those surrounding them. Hodgetts, Nicholas, & Zwaigenbaum (2013) conducted a study which aimed to look at the experiences of families with a child diagnosed with ASD who additionally exhibited aggressive behaviors, where primary caregivers were interviewed. Key themes found were: isolation, exhaustion, concern for safety of people and property, out-of-pocket expenses, and limited availability of

professional support. In terms of isolation from primary caregivers, which were mostly parents, they felt an inability to go out in to their community, socialize with others, or even take vacations both with and without children. The inability to go on vacation without children then leads to another problem, being lack of alternate care for children. Caregivers reported an immense need for support and services to care for the children but there always being a lack of access. Due to the specificity of behaviors and increased in aggression in children with ASD, parents are often found being primary caregivers and can never find appropriate care. Aggression was found to be dangerous and limited access to treatment and increases hospitalization rates. Parents in turn were found to be more susceptible to exhaustion, having to always keep an eye on the child. One parent stated: “We never sleep. You’re always listening for him” regarding the constant surveillance some parents/ caregivers need to have on their children. In addition, some families reported significant physical aggression towards family members going as far to state that children can’t be in the same room together because one’s aggression towards the other. The mechanism behind their aggressive tendencies in not well understood but postulated to stem from their frustration with social interactions. Conclusively, the presence of aggression in a child with ASD is the strongest predictor of parental stress (Gupta & Singhal, 2005) and was further said to likely exacerbate or reinforce the behaviors and foster progressively worse behaviors (Hodgetts, Nicholas, & Zwaigenbaum, 2013).

Research, however, has been shown to use a variety of interventions in order to reduce the occurrence of these aggressive tendencies such as cognitive behavior therapy, family therapy and community interventions. As found by Cornet and colleagues (2015), most of these interventions began to take rise in the 1980s, when psychosocial treatments were dominant and

focused on treating the issue. Common treatments to reduce aggression, found in a review by Matson and Jang (2014), were psychotropic drugs such as: risperidone, valproate, aripiprazole, fluvoxamine, and clomipramine. Further treatments were behavior modification, replacement behavior, and contingent exercise. Now interventions look to decrease the occurrence of these disruptive behaviors.

Interventions such as physical activity predominantly, which has recently shown to elicit positive outcomes on stereotypic behaviors such as aggressive tendencies. A review of eighteen studies conducted by Lang and colleagues (2010) looked at interventions with physical activity as a means to decrease stereotypy in individuals with ASD. Interventions included activities such as running or jogging, swimming or water aerobics, roller-skating, and muscle toning. All interventions reported to either improve behaviors or increase the amount of time engaged in exercise. Improved behaviors included decrease aggression, stereotypy and a decrease in self-injurious behaviors. More specifically, a study by Allison and colleagues (1991) introduced a 20-minute jogging protocol around a track that significantly decreased the number of aggressive episodes. However, in a review conducted by Ash and colleagues (2017) physical activity interventions which promoted mindful movement found positive outcomes in regards to decreasing aggression, whereas studies that did not find any difference in aggression had participants performing primarily aerobic exercise. Studies which had a single bout of moderate-to-vigorous intensity however showed to have positive outcomes with impulsive behavior, which can also be beneficial for aggressive tendencies. This calls in to question the type of exercise performed in decreasing specific behaviors for children with ASD.

Further studies were conducted in order to compare the intensity and frequency of exercise in regards to its effects on aggression. Elliot and colleagues (1994), conducted a study with 6 participants and utilized two forms of exercise: vigorous aerobic and general motor training, as well as a non-exercise group as the control. Results showed a positive response in regards to the vigorous aerobic activity with a participant having a 60% reduction in aggressive and maladaptive behaviors, as well as two other participants with notable decreases in targeted behaviors, whereas for general motor training had little to no difference (Elliott, Dobbin, Rose, & Soper, 1994). All which suggest that vigorousness of the exercise is critical for reducing aggressive, maladaptive and stereotypic behaviors (Elliott, Dobbin, Rose, & Soper, 1994). In terms of frequency for exercise, Prupas and Reid (2001) conducted a study where participants were put through a walk/jog at moderate intensity for both a single frequency and then multiple frequency over the course of two weeks. Results were then compared to establish which frequency provided lower levels of behaviors, finding that multiple frequency had a reduction in stereotypic and repetitive behaviors. Upon further investigation, one study conducted by conducted by Chan and colleagues (2013) utilized an alternative form of physical activity, not being jogging or walking but rather "*Nei Yang Gon*" a practice very much similar to Tai Chi. *Nei Yang Gon* involves taking the participants through a set of slow movements that are meant to foster self-awareness and self-control (Chan, Sze, Siu, Lau, & Cheung, 2013). In a one month intervention, 48 children aged 6 to 17, were separated in to a *Nei Yong Gon* group and a Progressive Muscle Relaxation (PMR) to see the effects in their self-control and impulsivity. Results for this study showed that children who participated in the mind/body intervention showed better self-control, reduced frequency of rule breaking and became less impulsive.

Overall, the children were taught lessons on how to practice with a peaceful mind and to relieve anger and distress, which is postulated to be the cause for the great effect this exercise mode had on children with ASD.

Eastern civilization sports and culture is successful in executing these characteristics- combining a mind/body exercise mode in to an intervention that will be beneficial to the children. Traditional martial arts, having components of grounding the mind and connecting to your body has recently been a topic of interest in reducing aggressive tendencies in the general population and to our interest, in children with ASD. Studies conducted by Bahrami et al., 2012, Movahedi et al., 2013, and Twemlow & Sacco (1998), found that use of martial arts in reducing aggression is effective partly due to the philosophy and self-control taught during practice. In a review by Harwood et al. (2017) it was found that some martial arts interventions are conducted in as little as two weeks, though most take place at ten weeks or more. Additionally, in a review conducted by Bell, Palace, Allen, & Nelson (2016), looking at different martial arts, found the most beneficial practices to range between 30-90 minutes (Bahrami et al., 2012; Movahedi et al., 2013) where a decrease in social dysfunction was noted in children with ASD. However, it should be noted that traditional martial arts (taekwondo, kata, judo, et.) are of focus when designing a study for the reduction of stereotypic behaviors, due to their combination of mind and body techniques. Trulson (1986) found that modern martial arts, such as boxing and other "fight-heavy" sports are inferior in the reduction of behaviors and may actually be harmful. The use of traditional martial arts allows participants to focus on internal techniques, such as controlled breathing, which in turn builds on the mind/body connection (Hernandez & Anderson, 2015).

One particular martial art of interest is Judo. Having been around for more than 130 years, Judo is one of the leading martial arts disciplines in western civilization. Judo was founded in 1882 by Dr. Jigoro Kano in Japan. The word "judo" is broken down into two parts: Ju, meaning gentle, and do, meaning way or path- "the gentle way" (Matsumoto, 1996). Judo has been recognized as one of the safest martial art and combat sports for youths to take participation in (Nishime, 2007). Not only is judo one of the safest combat sports for youths, but also has shown to improve "cognitive performance, enhance motor learning, and increase the sense of well-being and life satisfaction among youth participants (Fukuda, Stout, Burris, & Fukuda, 2011). Studies implicating a greater sense of well-being and life satisfaction as well as the gentle nature of the sport make it a great candidate for further study (Nishime 2007).

There is little to no studies on the use of Judo regarding reducing aggression. In the case of Reynes and Lorant (2002), and Nosanchuk and Lamarre (1999) little to no difference in aggression was found after a judo intervention. These studies were conducted over too short of a time period, 2 weeks, with no significant changes as well as multiple limitations. Regarding the use of Judo for children with ASD, there is limited research. Observing the degree to which this physical and mental stimulation translates into management of aggressive behaviors warrants investigation (Matsumoto & Konno, 2005).

The vast majority of research has been done in the general population and have hardly looked at Judo as an intervention. There is need for further study in to both the field of interventions for children with Autism regarding reducing behaviors, but more importantly exploring the possibility of a Judo intervention in these youth, which utilizes both mind and body

components to help reduce not only aggression but other intrusive behaviors that come along with Autism Spectrum Disorder.

CHAPTER THREE: METHODOLOGY

Study Design

The proposed study was a part of a larger, ongoing study examining the effects of an 8-week judo intervention in youth with Autism Spectrum Disorder (ASD). The current study focused specifically on changes in aggression following the 8-week program. A description of the sample and measures pertaining to the larger study are presented below.

Participants

The sample included 33 children (ages 8 – 17) with a primary diagnosis of Autism Spectrum Disorder (ASD). Participants were recruited through the Center for Autism and Related Disabilities (CARD), an organization that provides resources and support for individuals with ASD and their families. Children who have severe physical limitations or display violent behaviors, as confirmed by CARD staff, were excluded from the study due to safety concerns. The University of Central Florida's Institutional Review Board approved all procedures, and parental consent/assent were collected prior to any testing measures.

Measures & Procedures

Overview of Original Study

Parents and participants met before the start of the intervention, where investigators explained the study, procedures and what was to be asked of the children throughout their involvement in the study. During this informational session, parents and participants were able to see the space and ask any questions before volunteering to take part in the study. Consent forms

were obtained at this time as well as baseline measurements (i.e. body composition and questionnaires) and accelerometers. Participants wore accelerometers for 7-days during the first week of practice to obtain baseline activity levels. Prior to the start of the second week, participants returned their accelerometers. Following this, the 8-week judo program continued, with participants meeting once a week for practice.

Questionnaires were distributed to participants prior to the first judo session and again at the end of the 8-week program. Research assistants were available to aid participants regarding comprehension of questionnaire items. In order to minimize bias, parents were discouraged from providing assistance to their child during the assessment measures. All questionnaires took no more than 15 – 20 minutes to complete. Additionally, parents completed a semi-structured interview regarding physical and psychosocial changes in child behaviors post-intervention.

Description of Judo Program

Participants were taught the proper procedures for caring for their judogi (judo gi). Each judo session began with a formal opening and description of the class and closed with a few minutes of mindfulness to reflect on the practice. With the progression of the sessions, participants learned how to safely fall, move with partners, balancing/unbalancing strategies and other important judo techniques. Each practice taught morals and foundations of Judo to promote self-awareness, body mindfulness and non-combative techniques. All sessions took place on a clean training mat for safety of participants. Additionally, the judo instructor was a USA Judo certified coach with prior experience teaching judo in school settings. Experienced CARD

counselors and facilitators, to assist in any behavior specific dilemma, monitored sessions. Sessions will were held once a week and each practice lasted approximately 45 minutes.

The Current Study

Demographic Information

Parents were given a series of demographic questions to be filled out on behalf of their child. The questionnaire consisted of a series of items regarding the child's family background, health information and the child's diagnosis.

Child Behavior Characteristics

A modified version of the Aberrant Behavior Checklist (ABC) (Aman, Singh, Stewart, & Field, 1985) was administered to parents to determine changes in behavior at home. The ABC consists of 58 statements categorized into subscales of "irritability", "lethargy", "inappropriate behaviors", "and hyperactivity" with a higher score indicative of greater levels of aggression. Statements for rating included: temper tantrums/outbursts, stereotyped behavior, abnormal/repetitive movements, impulsive, yells at inappropriate times, and repetitive speech. Response options ranged from zero to three; zero indicating no problem at all and a three indicating the problem is severe in degree. The ABC was administered prior to the start of the judo program, and at the end of the 8-week sessions.

Physical Activity, Sedentary Behavior. Sleep Quality and Screen Time

Parent-Reported Child Activity. Parents were given a Physical Activity and Sleep Quality Survey, which determined subjective measures of PA, screen time, and total minutes of sleep a child received in an average week. This survey was given at baseline and the end of the 8-week program.

Physical Activity and Sedentary Behavior. Physical activity (PA) and sedentary behavior (SB) were assessed using the ActiGraph GT9X Accelerometers (ActiGraph Inc, Pensacola, FL). The ActiGraph can detect normal human motion while filtering out high-frequency vibrations that would artificially increase movement data and has been validated for use in children and adolescents in laboratory and field studies (Trost Troiano). Activity counts were averaged into 1-minute epochs and validated cut-point criteria was applied to calculate minute of time spent in moderate to vigorous physical activity (MVPA) and their sedentary behavior (Evenson et al., 2008). Participants wear instructed to wear the ActiGraph for 7-days during the first week of practice to measure physical activity and sleep quality prior to the beginning of the Judo program. Accelerometers were distributed again at the end of the 8-week program to examine any changes.

Sleep Quality. The ActiGraph GT9X Accelerometer can additionally measure several components of sleep quality including total sleep duration, wake after sleep onset, number of awakenings, and sleep efficiency. Sleep efficiency was defined as the time spent sleeping divided by the total amount of time in bed. Validated algorithms (Cole et al., 1992) were applied to the data via ActiLife version 6 to determine sleep periods and sleep quality.

Actigraphy Processing. Actigraphy data was processed through the ActiLife version 6 software to calculate both physical activity and sleep quality. First, all actigraphy data was run through a wear-time validation algorithm to determine wear-time compliancy. As per guidelines set by Trost et al (2008), any periods of 60 minutes+ of 0 counts were regarded as non-wear time and excluded from the analyses. Participants were required to have at least 4 full days of data (1 weekend day, 3 weekdays) to be included in the final analysis (Hildebrand et al., 2014; Kim & Yun, 2009). Days showing a wear-time of less than 10 hours were removed from the analysis (Hildebrand et al., 2014; Matthews et al. 2008).

Analysis

Descriptive statistics were run to determine distribution patterns. Non-parametric paired samples t-tests were conducted to examine changes in behavioral variables (irritability, stereotypic, inappropriate, hyperactivity and lethargy) from baseline to post-judo. After assessing for normality, Spearman correlations were conducted to examine the association between all health and behavioral characteristics and the number of classes attended by participants. Additionally, an exploratory analysis was conducted to examine the association among behaviors and amounts of participant objective and subjective physical activity, sleep and screen time. All analyses were conducted in SPSS Statistics 23 with a significance level set at $\alpha \leq 0.05$.

CHAPTER FOUR: RESULTS

A total of 25 participants (88% male, 12.67 ± 2.99 years old) were included in the current study. Thirty-three participants were initially enrolled in the 8-week judo intervention, however, eight participants failed to complete post-program questionnaires, and therefore, were excluded from the current study. Thus, twenty-five participants had complete baseline and post-judo measures and were used for these analyses. Average attendance for participants was 7.04 ± 1.06 classes (out of 8 possible sessions), with 76% attending 7 or more classes. A description of participant characteristics is displayed in Table 1.

Changes in Behavioral Factors

Changes in all subscales and the total sum of the behavioral scales from baseline to post-judo are displayed in Table 2. There were no significant differences between lethargy (6.13 ±6.02 vs. 6.16 ± 5.17; p= 1.0), hyperactivity (11.13 ± 6.73 vs. 9.08 ± 7.11; p= .27), stereotypic (2.38 ± 2.4 vs. 2.28 ± 2.4; p= .78) inappropriate (2.29 ± 1.73 vs. 2.32 ± 1.78; p= .77), irritability (6.38 ± 5.30 vs. 5.28 ± 6.66; p= .55), and total scores on the ABC (28.29 ± 15.53 vs. 25.12 ± 14.95; p= .541) before the judo intervention and after the 8-week program.

Changes in Health Behaviors

Pre and post-judo health factors are displayed in Table 3. Significant differences were seen for days children participated in 60 minutes of PA per week (2.9 vs. 3.32, p= .01). No significant differences were seen in screen time during the weekday and number of hours of sleep.

After running the ActiGraph accelerometer data through the validation criteria, eleven participants were excluded, resulting in a new sample size of 14 for our final analysis of health behaviors. Results indicate participants spent a significantly greater percentage of time in daily MVPA (8% vs 4%, p=0.05) shown in Table 6. There was a significant increase in total sleep duration (572.56 vs 333.8, p=0.008) following the program, and a trend existed for improved sleep efficiency (92% vs 88%, p=0.1) shown in Table 7.

Correlation between Changes in Health Behaviors, Behavioral factors, and judo attendance

When comparing behaviors and classes attended, strong negative correlations were found between inappropriate behaviors and the number of classes attended (r= -.632), shown in Table 5. Further negative correlations were found between screen time on the weekend and stereotypic behaviors (r= -486), hyperactivity (r= -.439), and total score on the ABC (r= -.553). Negative correlations were also seen between screen time on the weekday and irritability (r= -.496), hyperactivity (r= -.436) and total score on the ABC (r= -.528). Additionally, a strong relationship was seen between screen time on the weekend and the number of class attended (r= .421).

CHAPTER FIVE: DISCUSSION

This study aimed to examine the effects of judo training on aggressive tendencies and lifestyle factors in both children and adolescents with ASD. Results indicated an overall positive impact on the lifestyle behaviors and health behaviors of this population. With an increase in classes attended; there was an interesting overall reduction in behaviors reported from the parents. Additional improvements were also seen in objective health behaviors, such as average MVPA minutes, percentage of MVPA, and total sleep time in a week for participants after the judo intervention. Furthermore, at the end of the judo intervention there was an overall improvement for children who met MVPA and sleep recommendations.

Interestingly, although there were no significant differences in behavior variables following the judo program, reductions in behaviors were linked with greater participant attendance at the judo sessions (Figure 1). This agrees with Bell et al. (2016) and Milligan et al. (2013) who found that as a martial art intervention progresses and children participated longer, greater improvements were seen in behavioral and social outcomes. This relationship demonstrates the importance of measuring implementation fidelity, since the effectiveness of the intervention may be dependent on dosage. As this is one of the first studies to examine the effects of a judo program on youth with ASD, optimal dosage has yet to be established. It is possible that the duration and frequency of the program did not provide sufficient exposure to the intervention in order to elicit significant changes in behaviors. The suggestion of increased frequency and duration is supported by Bell et al. (2016), who conducted a review on martial arts programs in youth with ASD, finding that significant benefits were more likely to be observed in programs that occurred twice a week for a minimum of 12 weeks. It is important, however, to

balance the increased dosage of the program with measures of feasibility. Lack of significant changes in all other subscales could be due to changes in environment as well as the duration of the intervention- as previous research has suggested to have interventions for this population at a minimum of 12 weeks (Bell, Palace, Allen, & Nelson 2016). Additional, things to consider would be the time of the intervention and the novelty of the sport. Being that the intervention took place towards the end of the summer and ended near the beginning of the school year, outside factors could have played a role here in triggering adverse behaviors in participants. As characterized by ASD, new situations or changes in routine can cause abrupt changes in behavior and elevated anxiety or agitation ("DSM-5 Diagnostic Criteria," 2013).

Remarkably, feedback from the intervention was overall positive from participants and parents. According to parent interviews, changes in participants behaviors and overall confidence was significantly different compared to before starting the program. Not only is Judo an incredible outlet for physical activity but this intervention additionally provided a support system among participants. Creating the small groups as Scott and colleagues (2005) suggested, allowed the participants to become more comfortable with their peers and may have helped with adherence of the principles of Judo. Furthermore, it should be noted that some social improvements, such as being more comfortable with being touched by their partner/teammate could be attributed to the specificity of the sport. In a study by Tse, Pang, & Lee (2018) participants were put through a ball tapping exercise to reduce hand flapping, results showed a significant decrease in hand flapping. This can transfer over to some of the social improvements seen in participants (i.e. speaking to their peers in class, being more comfortable with working in pairs). As judo is a sport requiring the cooperation of partners this allowed participants to

practice being around other people and get accustomed to being touched while practicing. The type of intervention implemented should mimic the type of behavior trying to be reduced Tse, Pang, & Lee (2018).

As expected, minutes of MVPA increased following the 8-week program. This was the first study, to our knowledge, that examined MVPA outside of the intervention program, although the mode of MVPA was not assessed. Therefore, it is unknown whether participants were practicing judo techniques or engaging in additional sports or activities. An unexpected finding was an increase in hours of screen time was observed following the program. Further findings varied across health behaviors and stereotypical behaviors among participants. Increases were seen with average PA min/day during the weekday, screen time on the weekends and average sleep time during the week (Table 7). These findings at first seem to be contradictory for PA and screen time. However, a possible reason for these changes in behaviors could be due to parents using screen time, such as games on a tablet or the ability to watch a television show, as a reward for a decrease in other negative behaviors. A study by (Tang, Darlington, Ma, Haines, & on behalf of the Guelph Family Health Study, 2018) found that some parents set rules and guidelines for screen time and incentivize the use of tablets, television or games. Children are given guidelines to follow, such as completing homework, chores and additionally behaving when in certain situations. It could be due to these guidelines that parents unknowingly increased the use of screen time while they observed improvements in behavior from their child, as an incentive. Furthermore, the intervention took place at the end of summer, which has been linked with greater screen time compared to other times during the year (Nelson, Neumark-Stzainer, PHannan, Sirard, & Story, 2006). Further research needs to be done to understand the true

underlying mechanism. Additional to the increase in screen time on the weekend, there was also a decrease in PA during the weekend. However, overall sedentary behavior for the week was still lower than at baseline. It is necessary to examine these relationships among PA, sedentary time, and screen time in this population.

Similar to MVPA, an increase in sleep duration was observed following the judo intervention. This finding may have substantial implications for future interventions considering most children within this population have disrupted sleep patterns and are significantly restless at night. A study conducted by Øyane & Bjorvatn (2005), using wrist worn accelerometers, found that children with ASD, spent less than 85% of time sleeping when they were in bed, denoting poor sleep efficiency. Consistent with previous research, stating that sleep disturbances are among the most common secondary diagnosis in children with ASD (Cortesi, Giannotti, Ivanenko, & Johnson, 2010). As current medicine states, sleep disturbances, primarily lack of sleep, may lead to adverse health consequences including hypertension, diabetes, cardiovascular diseases and obesity (Cappuccio, D'Elia, Strazzullo, & Miller, 2010). Therefore, the improvement in sleep duration from this intervention adds to the already existing benefits of physical activity and behavioral improvements.

Strengths

This study is one of the first studies to examine the effects of judo on this population. Strengths of this study include the use of objective measures in addition to subjective questionnaires- such as the ActiGraph GT9X for physical activity, sleep time, sedentary behaviors, and other sleep measurements. Regarding the intervention itself, we used small

groups for the children to participate with as well as facilitators from CARD and hosted practice for 45 minutes, which is most beneficial for children in this population (Bell et al., (2016). With the help of CARD, we were able to have 2-3 facilitators who were familiar with the participant's behaviors and how to aid in class management. Including the CARD facilitators, each practice session had 4 people at minimum to help with the sessions. The instructor for all sessions was an experienced Judo Sensei whom had prior experience teaching a student with ASD. His prior experience helped immensely in the comfort and communication for this intervention to be carried out successfully. Furthermore, a weekly email was sent out to parents of participants with a brief description of what practice consisted of and encouraged parents to ask their child about what they learned. It is important to note that all activities pertaining to judo were reflected on at the end of practice as a part of the mindfulness component.

Limitations

As previously stated, the small sample size was a limitation of the present study. Future studies should examine larger samples in addition to a longer intervention, in order to see larger improvements. Due to logistical complications, the study was limited 8 weeks and took place towards the end of the summer, leading up to the beginning of the new school year. The intervention originally recruited 40 participants, but lost 7 due to scheduling issues, and then excluded another 8 participants when both baseline and post intervention measures were not present. Additionally, as suggested by Bell et al., (2016), a frequency of two sessions per week may be necessary to elicit significant changes in behaviors, however, the current study was limited to a single weekly session. Future studies should compare the weekly and twice a week

judo programs to determine any additional benefits from the extra sessions, and determine feasibility of attendance.

Conclusion

In conclusion, the current study found that there were no significant differences between baseline and post the judo intervention in terms of aggressive or inappropriate behaviors. However, significant differences were found in levels of PA, MVPA and total sleep time suggesting the judo intervention helped increase health behaviors and reduced total sedentary behavior. This study also found that although no significant differences were noted in behaviors, there was a strong negative correlation between inappropriate behaviors and total number of classes attended. These findings pose a recommendation for longer interventions as they may provide better results and help decrease these inappropriate behaviors in youth with ASD.

APPENDIX A: FIGURES

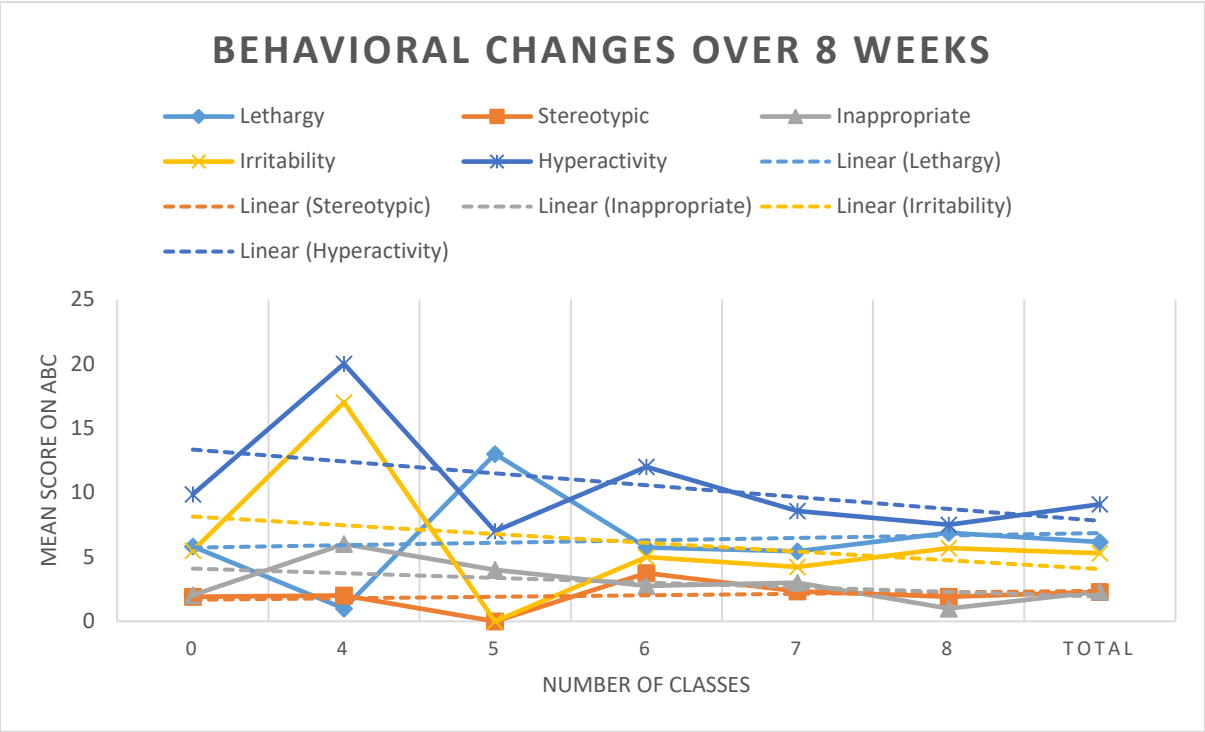

Figure 1. Correlation of behaviors with number of classes attended

APPENDIX B: TABLES

Table 1. Descriptive characteristics of participants

Variable	N (%)	Mean (SD)
Males	22 (88%)	
Age		12.67 ± 2.99
Caucasian	13 (52%)	
Height (cm)		157.35 ± 17.58
Weight (kg)		53.32 ± 20.56
BMI percentile		66.36 ± 31.06
Classes Attended		7.04 ± 1.06

Table 2. Behavioral changes in participants

	Baseline	**Post-Judo**	**p-value**
Lethargy	6.16 ± 6.0	6.16 ± 5.2	1
Stereotypic	2.38 ± 2.4	2.28 ± 2.4	.784
Inappropriate	2.29 ± 1.7	2.32 ± 1.8	.770
Irritability	6.38 ± 5.3	5.28 ± 6.6	.548
Hyperactivity	11.13 ± 6.7	9.08 ± 7.1	.273
Total	28.29 ± 15.5	25.12 ± 14.95	.541

Table 3. Health behaviors (minutes) in participants

	Baseline	**Post-Judo**	**p-value**
PA_week	2.9 ± 2.0	3.32 ± 2.03	.012*
PA_weekday	31.4 ± 38.4	32.1 ± 21.7	.933
PA_weekend	34.8 ± 43.0	33.9 ± 28.3	.941
Screentime_weekday	127.7 ± 74.4	127.7 ± 57.77	.874
Screentime_weekend	170.0 ± 105.6	195.4 ± 103.1	.108
Sleep_week	54.5 ± 15.6	61.761 ± 23.9	.163

* indicates significant difference between baseline ($p = \leq 0.05$)

Table 4. Behavioral changes between pre and post-judo intervention

	PRE	**POST**
Lethargy	6.13 ± 6.02	6.16 ± 5.12
Stereotypic	2.38 ± 2.37	2.28 ± 2.39
Inappropriate	2.29 ± 1.73	2.32 ± 1.78
Irritability	6.38 ± 5.30	5.28 ± 6.66
Hyperactivity	11.13 ± 6.73	9.08 ± 7.11
Total	28.29 ± 15.53	25.12 ± 14.85

Table 5. Correlation between health behaviors, behavioral factors and judo attendance

	Average PA	Screen time weekday	Screen time weekend	Sleep week	Lethargy	Stereotypic	Inappropriate	Irritability	Hyperactivity	ABC total	N classes
Average PA	---	.270	.216	.408	.018	-.281	-.279	-.079	-.062	.176	.344
Screen time weekday	.270	---	.635**	.275	-.168	-.306	-.254	-.496*	-.436*	.528**	.171
Screen time weekend	.216	.635**	---	.403	-.352	-.486*	-.245	-.403	-.439*	.553**	.421*
Sleep week	.408	.275	.403	---	-.024	-.299	-.282	.081	-.181	.060	.218
Lethargy	.018	-.168	-.352	.024	---	.214	-.314	.046	-.027	.354	.059
Stereotypic	-.281	-.306	-.486*	.299	.214	---	.126	.353	.259	.474*	-.196
Inappropriate	-.279	-.254	-.245	.282	-.314	.126	---	.144	.368	.246	.632**
Irritability	-.079	-.496*	-.403	.081	.046	.353	.144	---	.656**	.805**	-.137
Hyperactivity	-.062	-.436*	-.439*	.181	-.027	.259	.368	.656**	---	.821**	-.304
ABC total	-.176	-.528**	-.553**	.060	.354	.474*	.246	.805**	.821**	---	-.312
N classes	.344	.171	.421*	.218	.059	-.196	-.632**	-.137	-.304	-.312	---

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Table 6. Physical activity data from Accelerometer (n= 14)

Factors	**Baseline**	**Post judo**	**p-value**
MVPA (min/day)	48.58 (40.64)	74.46 (43.43)	.1**
SB (min/day)	519.89 (119.41)	470.32 (141.72)	.24
MVPA %	4%	8%	.05*
SB %	50%	43%	.12

* indicates significant difference between baseline ($p = \leq 0.05$)
** indicates a trend towards significance

Table 7. Sleep behavior data from Accelerometers (n= 14)

Factors	**Baseline**	**Post Judo**	**p-value**
Sleep efficiency	88% (6.06)	92% (6.15)	.1**
Total sleep time (min)	333.8 (101.96)	572.56 (161.43)	.008*
Number of awakenings	15.81 (7.03)	12.59 (9.91)	.32
WASO	39.85 (15.28)	29.47 (22.54)	.18
Nighttime activity counts	17165 (6942)	14115 (10223)	.29

* indicates significant difference between baseline
** indicates a trend towards significance

APPENDIX C: IRB APPROVAL

University of Central Florida Institutional Review Board
Office of Research & Commercialization
12201 Research Parkway, Suite 501
Orlando, Florida 32826-3246
Telephone: 407-823-2901 or 407-882-2276
www.research.ucf.edu/compliance/irb.html

Approval of Human Research

From: **UCF Institutional Review Board #1**
FWA00000351, IRB00001138

To: **Jeanette Garcia** and Co-PIs: **David Fukuda, Jeffrey Ray Stout, Jennifer E Tucker, Justine M Renziehausen, Kayla Baker, Paola Rivera**

Date: **June 07, 2018**

Dear Researcher:

On 06/07/2018 the IRB approved the following modifications to human participant research until 03/15/2019 inclusive:

Type of Review:	IRB Addendum and Modification Request Form Expedited Review
Modification Type:	Additional Instruments Added, Change to Personnel, Updated Population, Revisions to the Protocol and Consent
Project Title:	The Effects of a Modified Judo Program on Physical and Psychological Health in Children: A Mixed-Methods Approach
Investigator:	Jeanette Garcia
IRB Number:	SBE-17-12999
Funding Agency:	Research and Commercialization
Grant Title:	Mixed Methods Evaluation of a Modified-Judo Training Program for Children with Autism Spectrum Disorder
Research ID:	N/A

The scientific merit of the research was considered during the IRB review. The Continuing Review Application must be submitted 30days prior to the expiration date for studies that were previously expedited, and 60 days prior to the expiration date for research that was previously reviewed at a convened meeting. Do not make changes to the study (i.e., protocol, methodology, consent form, personnel, site, etc.) before obtaining IRB approval. A Modification Form **cannot** be used to extend the approval period of a study. All forms may be completed and submitted online at https://iris.research.ucf.edu .

If continuing review approval is not granted before the expiration date of 03/15/2019, approval of this research expires on that date. When you have completed your research, please submit a Study Closure request in iRIS so that IRB records will be accurate.

Use of the approved, stamped consent document(s) is required. The new form supersedes all previous versions, which are now invalid for further use. Only approved investigators (or other approved key study personnel) may solicit consent for research participation. Participants or their representatives must receive a copy of the consent form(s).

All data, including signed consent forms if applicable, must be retained and secured per protocol for a minimum of five years (six if HIPAA applies) past the completion of this research. Any links to the identification of participants

should be maintained and secured per protocol. Additional requirements may be imposed by your funding agency, your department, or other entities. Access to data is limited to authorized individuals listed as key study personnel.

In the conduct of this research, you are responsible to follow the requirements of the Investigator Manual.

This letter is signed by:

Signature applied by Gillian Morien on 06/07/2018 04:23:37 PM EDT

Designated Reviewer

APPENDIX D: IRB FORM

Institute of Exercise Physiology and Wellness

University of Central Florida

4000 Central Florida Blvd

Orlando, Florida 32816-1250

The Effects of a Modified Judo Program on Physical and Psychological Health in Children: A Mixed-Methods Approach

Jeanette M. Garcia, Ph.D.

David H. Fukuda, Ph.D.

Institute of Exercise Physiology and Wellness

College of Education

University of Central Florida

Protocol Synopsis

1) Protocol Title

The Effects of a Modified Judo Program on Physical and Psychological Health in Children: A Mixed-Methods Approach

2) Principal Investigator(s)

Jeanette M. Garcia, Ph.D.

David H. Fukuda, Ph.D.

Co-Investigator(s)

Jeffrey R. Stout, Ph.D.

Jennifer Tucker, DPT

Paola Rivera

Justine Renziehausen

Kayla M. Baker, M.S.

3) Objectives

Examine the effect of a modified judo program on physical and psychosocial factors in typically developing children and children with varying exceptionalities using a mixed-methods approach.

4) Background

Inactivity and poor nutrition in youth is a public health concern in the U.S. These behaviors contribute to childhood obesity which typically continues into adulthood. For children diagnosed with a disability or exceptionality, such as Autism Spectrum Disorder (ASD), Attention-Deficit Hyperactivity Disorder (ADHD), or Down Syndrome, the prevalence of obesity, inactivity, and poor nutrition is even worse. Therefore, it is critical to improve these behaviors in both typically developing children and children with varying exceptionalities (VEs). Standard treatment of VEs primarily addresses cognition, language, and social development while attempting to suppress behaviors such as repetitive movements and rigidity (Joosten et al., 2009; Koening et al., 2010). While these treatments are shown to be effective for improvement in these areas, they do not

address other health risks that children with VEs are susceptible to developing such as obesity and Type 2 diabetes (Srinivasan et al., 2014). Over the past several years, the concept of physical activity as an alternative form of treatment in children with varying exceptionalities has been gaining more support, especially with evidence showing that physical activity may also improve social, emotional, and behavioral characteristics typical of varying exceptionalities such as ADHD and ASD (Movahedi et al., 2013; Bass et al., 2009). Furthermore, studies have shown that physical activity may help with improving balance, flexibility, and coordination in children with VEs, such as ASD and Down Syndrome, which is crucial given the deficiencies in motor control characteristic of this disorder (Pitetti et al., 2007).

One such area of physical activity and sport that may particularly benefit children with VEs is martial arts training (Baharmi et al., 2016; Rajan et al., 2015). Although few studies have examined martial arts training in children with ASD and other behavioral disorders, the results have been positive, with participants showing improvement in communication skills, reduced stereotypical behaviors, improvement in academic achievement, and improved self-efficacy (Rajan et al, 2015). Although little to no research has been conducted in children with VEs, the martial art of judo, in particular, has been associated with significant improvements in both physical and psychosocial health in children and adolescents. Standardized judo curricula generally focus on proficiency in the areas of movement patterns, age-appropriate technique, and personal development (United States Judo Federation). Specifically, youth engaged in judo training have demonstrated improvements in aerobic capacity, muscular strength and endurance, balance, flexibility, and body composition (Fukuda et al., 2011). Furthermore, youth judo athletes report greater well-being and life satisfaction scores as compared to normative data (Matsumoto & Konno, 2005). The impact of judo training on at-risk (Fleisher et al., 1995) and clinical populations has also been explored with positive results reported in personal and social adjustment (David & Byrd, 1975); anxiety, coping, and self-esteem (Gleser & Brown, 1986); and companionship, respect to others, confidence, and self-assertiveness (Gleser & Lison, 1986). Thus, the interactive nature of judo, which often requires the ability to work with a partner, and its unique emphasis on physical education, intellectual training, and social interaction (Kano, 2005) provide a unique platform for children with VEs.

5) Setting of the Human Research

Primary locations will be physical education classrooms at the United Cerebral Palsy (UCP) charter school Downtown (Beta) and Bailes site. UCP charter schools are fully inclusive, and serve children from birth to 5th grade. An additional judo class will be held over the summer at the UCF gymnasium at the Education Complex which will be open to both children from UCP Beta or Bailes sites and children whose families are registered with the Center for Autism and Related Disorders (CARD) will be eligible to participate

6) Resources Available to Conduct Human Research

The research staff will recruit the required number of participants from UCP Beta and UCP Bailes sites directly from the schools through communication with teachers and parents, including 20 3rd-5th grade students from UCP Beta and 20 3rd-5th grade students from UCP Bailes. From each UCP site, approximately 10 typically-developing students and 10 students with varying exceptionalities will be recruited. A total of 40 participants will be recruited for the summer judo program who will be either from the two UCP sites or through CARD. A time period of 7 10 weeks (as of 5/29/18) is expected to be required to conduct and complete the research. A research staff group of 8 members will be utilized, including 1 professor, 2 assistant professors, 1 physical therapist and 3 doctoral graduate students, all with acceptable amounts of research experience and knowledge of the study sites, culture, and society. All staff members will be assigned research-related duties. Group meetings will allow for each research staff member to be up-to-date with the latest protocol and products for the proposed study. All equipment and instruments used during data collection are available in the UCF Institute of Exercise Physiology and Wellness (IEPW), and have the capacity to be transported easily for data collection at approved off-site locations (UCP Beta and UCP Bailes sites).

7) Study Design

a. Recruitment Methods

The graduate student researchers (listed Co-PIs) will recruit elementary school students from the UCP Beta and Bailes sites. The physical education teacher will identify eligible students in 3rd through 5th grade, and an envelope containing a letter introducing the study, and the consent form, will be given to parents of eligible students. This will occur at the end of the school day when parents arrive to pick up their child. Parents will be able to return the consent form to the school's main office where the graduate student researchers will collect them. Participants will consist of approximately 20 3rd-5th grade students from Beta and 20 from Bailes campus sites (approximately 10 typically developing students and 10 students with varying exceptionalities at each school site) currently attending UCP Beta or Bailes, and 40 participants with varying exceptionalities (Autism Spectrum Disorder is the primary diagnosed condition in this organization). For recruitment of CARD participants, the listed investigators will present their study at a parent meeting prior to the start of the study to go over the procedures and distribute the consent forms. Both student assent and signed parental consents will be required for all students prior to data collection.

b. Participant Compensation

Children will receive a $10 gift card and an award for participation and completion of the program. To receive full compensation, children must complete both baseline and post-program testing, including feedback groups, and participate in at least 7 of the judo sessions. Partial compensation of a $5 gift card will be provided to children who complete baseline testing and

participate in the post-program testing, but attend less than 7 of the judo sessions. For their participation in the end of study interviews, parents will be provided with $10 gift cards.

c. Inclusion Criteria and Exclusion Criteria

Student Inclusion criteria:

- Currently enrolled in grades 3rd – 5th at the UCP Beta or Bailes school site or registered with CARD.
- Free of any physical or behavioral limitations that would prohibit participation in the study protocol, as determined by either the UCP Physical Education at the UCP Beta or Bailes site or CARD counselors and staff at the UCF summer site.

Student Exclusion criteria:

- Any behavioral or physical limitation, determined by either the PE teacher and school administration (UCP school sites) or CARD counselors and staff (UCF summer site), that would prevent completion of the intervention or study assessments
- Varying exceptionality that would prevent them from properly completing the intervention or one of the assessments performed in the study.

Parent Inclusion criteria:

- Parent of a student participating in the study.

d. Study Endpoints

The study will end for children participants when they have completed the judo program, finished the final post study assessment measures, and have provided feedback on their experience. For parent participants, the study will end after the post-intervention interviews.

Cortisol tests will be completed in the first, 8th, 16th, and follow-up session.

6

• The cortisol tests are non-invasive and do not involve side-effects. • The cortisol samples will be labeled with unique identifiers and stored in a freezer in a locked room in ED172 on UCFs main campus. • The Primary Investigator will transport the cortisol samples to UCFs Lake Nona campus for analysis. o Following appropriate analysis, the samples will be destroyed and data will be maintained in password protected computer files.

Participants will be asked to complete a non-invasive cortisol test in which participants spit into a sterile testing tube. o Specimens will be collected by investigators and kept in a secure/locked area. Specimens will be labeled with unique identifiers instead of partipant names. b

e. Study Timelines

The proposed study will take place over a period of 7 weeks 10 weeks (as of 5/29/18). The first week will consist of baseline measures, followed by a 5-week 8-week modified judo program that will take place twice a week for approximately 30 minutes. The final week in the study will consist of follow-up measures, child feedback groups, and parent interviews. Both fitness (power, balance, coordination, physical activity – as of 5/29/18 lower body power, balance, reaction time, heart rate variability) and psychosocial measurements (enjoyment, perceived competence, aggression, benefits of physical activity) will be collected at baseline and after the cessation of the judo program. Children will be asked to participate in a short feedback group at the end of the study to discuss their experience and provide information for improvement. Parents of the participating children will be asked to provide interviews at the end of the study to inform investigators of any effects they may have noticed as a result of the intervention. All of the child study measures will either take place during the school day (during the semester), or in the afternoon during the week (during the summer) while the parent interviews will be scheduled in the before school or at the end of the school day, or in the afternoon following the summer judo session (as of 5/29/18), at the end of the school day. All components of the proposed study will take place on the UCP campus sites or the gymnasium at the Education Complex..

f. Procedures involved in the Human Research

Baseline and Post Intervention Assessments:

The physical assessments (power, balance, coordination, and physical activitylower body power, balance, reaction time, heart rate variability), and psychosocial factors (enjoyment, perceived competence, aggression, benefits of physical activity) will be assessed approximately one week prior to the start of the intervention, and approximately one week following cessation of the intervention. The feedback groups (children) and parent interviews will also occur approximately one week after the end of the intervention. It is requested that both participants and their parents be present at the baseline and post intervention assessments – As of 5/29/18, due to the addition of parent-reported questionnaires and the number of items children are asked to complete, study investigators decided to ask parents to accompany participants to complete their own questionnaires and assist the participants with their questions.

Physical Assessments:

Physical Activity Patterns

As of 5/29/18 – due to the participant complaint that the placement on the waist was uncomfortable, we now would like to have the device on the wrist. We also adjusted the amount of time participants wore the device for a period of 7 days at the beginning of the program and at the end of the judo program so that we could assess average physical activity.

ActiGraph GT3X+ accelerometers will be used to examine physical activity patterns in participants. Participants will wear these devices on their wrists for a period of 7 days during baseline and again following the end of the judo program. These devices will objectively assess minutes spent in sedentary, light, moderate, and vigorous physical activity.

Heart Rate Variability – due to difficulty of this assessment with children having to stay quiet for a 10 minute period, as of 5/29/16 we are no longer using this assessment

R-R intervals will be recorded using a heart rate monitoring system throughout a 10-minute period with the participant resting in the supine position. The heart rate monitor will be placed on the participant's chest and held in place using either a chest strap or a compression shirt. Using the R-R interval data, resting heart rate, time-domain measures, frequency-domain measures, and indices of autonomic nervous system activity will be calculated using specialized software.

Body Composition

Prior to the testing sessions, participants will be asked to be sufficiently hydrated and to have abstained from food consumption for a minimum of two hours. After recording their height, participants will be asked to remove their footwear, including socks, and stand on a platform while holding two handles out to the side. They will hold this position for one minute as the multi-frequency bioelectrical impedance analysis device and/or bioelectrical impedance spectroscopy device, transmits a minute electrical current will be conducted through the body to determine body composition variables, including body fat percentage.

Balance – due to difficulty in assessing these measures (Balance, Reaction Time, and Lower Body Power), as of 5/29/18, we are no longer using these tests with this study. We will use the Bruniski Osteresky Test of Motor Proficiency (BOT-2).

Postural sway measures will be evaluated using a 3-D accelerometer/gyroscope/magnetometer (Gyko; Microgate, Bolzano, Italy) and/or a force plate. During this series of tests, the participant will stand as still as possible for 30 seconds under eyes closed and eyes opened conditions. The estimated path of the participant's center of gravity during the trials will be recorded and distance/length, velocity, and amplitude in the anteroposterior and mediolateral directions will be measured.

Reaction Time

The reaction time test will be conducted using a validated optical timing system (. During the reaction time test, the participant will be instructed to lift his/her hand (and/or foot) from a stable surface when prompted by an acoustic (and/or visual) stimulus. The test will be repeated several times and the time between the initial stimulus and removal of the hand (and/or foot) will be recorded.

Lower Body Power

The countermovement jump test will be conducted using a validated optical timing system. During the countermovement jump test, the participant will begin standing, hands on waist, then will encounter a series of audible signals which will alert him/her to bend his/her knees and maximally jump in the vertical plane. Each jumping procedure will be repeated several times separated by sufficient rest periods of 1-3 minutes. Flight time will be recorded and used to calculate jump height and power output.

Bruininski Osteresky Test of Motor Proficency The BOT-2 Screener will be used to assess motor skill performance in adolescents 4-21 years old. It encompasses four composite areas, including fine motor control (FMC), manual coordination (MC), body coordination (BC), and strength and agility (SA). Subjects will perform activities to test running speed and agility (subtests 1), balance/walking forward heel-to-toe on walking line (subtest 2), bilateral coordination/tapping-foot and finger on same side synchronized (subtest 3), strength/standing broad jump (subtest 4), response speed (subtest 5), visual motor control/cutting out a circle w/ preferred hand (subtest 6), upper limb speed (subtest 7) and dexterity/pacing pennies in two boxes with both hands (subtest 8). The Physical Therapist (Dr. Tucker) on the study team has extensive experience in administering this test to youth with both physical and social/behavioral/emotional disabilities.

<u>Psychosocial Measures</u>

As of 5/29/18, we added 3 questionnaires to assess behavior symptoms and aggression in participants. Due to the length

Children's enjoyment of PA will be measured using a 14 item version of the PA Enjoyment Scale which will examine how exercise makes them feel. Their perceived physical activity self-competence will be measured using a 5-item subscale from Harter's Self-Perception Profile for Children. Aggression will be measured using the 57-item Aberrant Behavior Checklist for parents to complete and two questionnaires, the 41-item Adolescent Anger Scale and the 29-item Bus Perry Aggression Questionnaire for participants to complete. Finally, participants' perceived benefits of activity will be assessed using an 8-item scale adapted from the original Exercise Motivations Inventory. Staff will be present to assist with the comprehension and completion of questionnaires. Due to the number of items the participants will be asked to complete, parents will be permitted to assist with answering the questions, or in the event of mental fatigue, the

participants will be allowed to complete the questionnaires at home. Since the children and parents will be permitted to bring the questionnaires home to complete, the format of the questionnaires will be paper and pencil, rather than electronic tablets.

As of 6/27/18, we have added in a salivary cortisol procedure where participants will provide 4 samples of cortisol during the 4th week of judo testing and during the last week of judo testing (total of 8 samples).

Salivary cortisol

Salivary cortisol will be assessed using Salivettes (Salimetrics), which are tubes that contain cotton swabs. Samples will be taken on 1 judo day and 1 non-judo day during weeks 4 (midpoint) and 8 (final week). On the non-judo day, parents will be asked to assist in collecting a cortisol sample within 30 minutes of awakening and at 2pm in the afternoon (the same time as the judo class). Parents will be provided a list of instructions that research assistants will explain to them during the consent process. For the judo day, samples will be collected right before the start of judo class (1:50) and immediately following the end of the judo class (2:50). Research assistants, listed on the protocol, will assist with the collection of samples on the judo days. The procedure consists of research assistants/parents removing the cap on the tube and placing the swab under the child's tongue by topping the tube so that the swab falls into the mouth. The child will be asked to roll the swab around in his/her mouth for about 2 minutes and then will spit the swab back into the tube, which will then be sealed with the cap by either the research assistant or the parent. If this is a non-judo day, the parent will be instructed to write the date on the label (which will already have the participant ID), and place in the refrigerator. Parents will be asked to bring the sample with them the next time they arrive at judo. If the sample is collected on a judo day, once the research assistant secures the samples, he/she will place it in the refrigerator in our laboratory that day. The sample should be kept in the refrigerator until it is time to leave for the next session. This procedure will be repeated the final week of judo. For familiarization purposes, the child will be permitted to practice with a cotton swab to ensure he/she is comfortable with the procedure. The samples will be analyzed using an ELISA kit in the human performance laboratory.

Cortisol Sampling Timeline

Sample #	Week	Day	Time	Collected by
1	4	Non-Judo day	Upon awakening	Parent
2	4		~2pm	Parent
3	4	Judo day	Upon arrival at UCF	Research assistant
4	4		After practice	Research assistant
5	8	Non-Judo day	Upon awakening	Parent
6	8		~2pm	Parent
7	8	Judo day	Upon arrival at UCF	Research assistant
8	8		After practice	Research assistant

Feedback Groups

All children who participated in the study will be asked to participate in an informal feedback group at the end of the program. Focus groups will consist of a semi-structured format that will focus on 3 areas: 1) participants' overall experience in the program; 2) any perceived changes in physical or psychosocial behavior; 3) Improvements/suggestions for a future study. The feedback group will last approximately 20 - 25 minutes and will be audio recorded for later transcription.

Modified Judo Program:

The study participants will begin their introduction to judo by learning the formal procedures for the opening/closing of training sessions (bowing procedures), how to put on and care for their judogi (uniform), and a variety of basic body weight exercises. As the participants progress through the program, they will learn to fall safely, move effectively with a partner,

balancing/unbalancing strategies, and several judo techniques. One of the final goals of the program will be formal demonstration of consecutive scripted judo techniques while working with a partner. All training sessions will take place on a clean training surface designed for the safety of participants. The judo instructor conducting the modified judo program is a USA Judo certified coach (which requires a background check) with previous experience teaching judo in a school-based setting. In addition to the judo instructor, all training activities will be monitored by experienced counselors and engage in specific activities will be dependent upon the level of comfort expressed by the participant.

Parent questionnaires:

Parents will be asked to complete a short questionnaire asking about their child's demographic and health behaviors. The questionnaire will be less than a page long and take less than 5 minutes to complete. Parents will also be asked to complete the Abberant Behavior Checklist (ABC), which is a 58-item checklist inquiring about their child's behaviors. This questionnaire takes approximately 15 – 20 minutes to complete.

Parent interviews:

Parents will be asked to participate in a semi-structured informal interview following the cessation of the judo program. These interviews will consist of several questions regarding their perception of the program and any changes (either positive or negative) that they may have witnessed as a result of their child's participation in the judo program. Interviews will last approximately 10 – 15 minutes and will be audio-recorded for transcription purposes.

Statistical Analysis

Quantitative analysis: Repeated measures ANOVA will be conducted to examine the pre and post changes between TD children and children with VEs. All data will be analyzed using SAS version 9.4.

Qualitative analysis: Using content analysis, transcripts from both child feedback groups and parent interviews will be read line by line and marked with independent codes that described the content response (Patton 2002). Two researchers will code the transcriptions independently, meet to refine code definitions, and address any inconsistencies that may exist. Cohen's Kappa statistic will be calculated to assess inter-rater reliability. The data and coding structure will be entered into NVivo qualitative analysis software, version 11.0. After the coding will be applied in NVivo, the software will be used to identify patterns of code, which will then be summarized into tables.

g. Data and Specimen Management

The results of this study will be submitted for publication in peer-reviewed scientific journals. No individual results will be published or shared with any person or party. All information attained from the focus groups, questionnaires, or performance tests will be held in strict confidence. Individual results will remain confidential and only be related to the participant upon request. All psychosocial and activity questionnaires, as well as data collection sheets will be kept in a locked cabinet during and following the study. All information will be destroyed five years from the end of the study and not used for other research purposes. Participant folders will be marked with an I.D. number to protect against a breach of confidentiality. Participant names and I.D. numbers will be stored apart from the subject folders. Cortisol samples will be disposed of following the cortisol analysis, and will not contain any identifiable information. The samples will ONLY be used to assess salivary cortisol.

h. Provisions to Monitor the Data for the Safety of Participants

To help ensure the safety of participants, both the testing and judo sessions will be supervised by a Certified Strength and Conditioning Specialist (Kayla Baker) who is certified in first aid and CPR and a Physical Therapist (Jennifer Tucker). Additionally, the PE teacher (school sites) and a minimum of two trained counselors (both school and UCF sites) will be present at all sessions.

i. Investigator withdrawal of participant

Participants may be withdrawn from the study at any time by the PIs because:

- The Principal investigators feel it is necessary for the health or safety of the participant.
- The participant has not followed study instructions.

Participant request for withdrawal from study

A participant may withdraw from the study at any time for any reason, regardless of the status of the study.

8) Risk to Participants

There is minimal risk involved with participation in this study. Participants may experience some mental fatigue while completing the questionnaires, however, participants will be closely monitored by attending graduate students and will be permitted to complete the remaining questions at home and return during the first judo session. During the judo classes, graduate students trained in exercise science and special education will be monitoring the participants closely. If immediate assistance is needed it will be provided, but participants must seek their own physician for medical treatment.

9) Potential Direct Benefits to Participants

There are no direct benefits to participants. The testing procedures do not provide any direct medical benefit to the participant, and will not be used to provide a medical diagnosis or prognosis. Potential benefits of the intervention study include improvements in physical and psychosocial health as a result of participation in the judo program.

10) Provisions to Protect the Privacy Interests of participants

Participants' privacy will be protected at all times. No participant names will be used in either the interviews or feedback groups. No information on topics of a sensitive nature will be collected. If a participant feels uncomfortable with any aspect of the Human Research situation at any time, consideration of the participant's privacy will be taken, and the participant will be removed from the situation, if he or she desires.

11) Provisions to Maintain the Confidentiality of Data

The results of this prospective examination will be de-identified and published as aggregated data as part of a scientific publication (no names or identifiable data will be used). All data obtained from participants is completely confidential and will only be reported in an aggregate format (by reporting only combined results and never reporting individual ones). All information pertaining to the prospective study (including questionnaire responses and testing results) will be linked to a participant number. No personal data will be released. All questionnaires and audio tapes will be concealed, and no one other than the primary investigator and Co-Investigators listed on the protocol will have access to them. All information obtained from performance tests will be held in strict confidence. Individual results will remain confidential between the research team involved in testing and participants. All participants are aware that demographic data will be aggregated and published to describe the study sample. All information will be destroyed 5 years from the end of the study. Participant folders and cortisol samples will be marked with an I.D. number to protect against a breach of confidentiality, and the ID number will be removed upon disposal. All questionnaires and data collection sheets will be kept in a locked cabinet during and following the study. Cortisol samples will be stored in a secure laboratory refrigerator until the samples are analyzed, where they then will be destroyed following the analysis.

12) Medical Care and Compensation for Injury

N/A.

13) Cost to Participants

There is no cost to study participants.

14) Consent Process

The potential participants will be advised of the nature of the study and the goals of the researcher in the informed consent document. Parents of eligible participants will be provided with a letter introducing the study, and a consent form. Parents will be given this information at the end of the school day by graduate research assistant, who will be available to answer questions, when they pick up their child from school. Parents can then choose to go over the study information and fill out the consent form at that time, or they can take it home to read over and return to the investigators at a later date. The consent form will contain information on all child and parent research activities, and a description of all of the questionnaires and testing assessments involved in the study.

Parents must provide signed consent before the study is discussed with the child. The study will be explained to the child by graduate student researchers. Then verbal assent from the child will be obtained prior to commencement of any of the procedures in the study protocol. The participant will be provided with the time necessary to review the physical testing procedures and expectations. There will be an investigator available to explain the study's protocol and answer any questions that each potential participant may have.

Since the cortisol samples will be collected at the midpoint of the study, parents of participants will be re-consented for this assessment measure. The research assistants will emphasize that this is optional, and opting out of this procedure will NOT affect the children's participation in the judo session.

All consent documentation will be reviewed and obtained prior to any assessments and testing sessions.

15) Process to Document Consent in Writing

All consent documentation will be available in a paper format, and sent home with potential child participants. The parent guardian may request a face to face informed consent meeting, or may request to discuss any portion of the consent form in person, before signed consent to participate is given.

16) Vulnerable Populations

The elementary school students will be minors and considered a child under the Florida Statute 63.032(7) in which "'Child' means any unmarried person under the age of 18 years who has not been emancipated by court order." As such, the consent process will require a signed consent form by one parent or legal guardian as well as verbal assent from the child prior to assessment.

17) Drugs or Devices

The Actigraph accelerometer will be used in this study. All devices are labeled with the contact information of the PI in the event a device is lost. Each participant will be assigned an accelerometer device which will be linked to the participant's ID number. These devices require special software to initialize and view physical activity data, therefore, a graduate student researcher will initialize each device for the specific participant it was assigned. Participants will wear the device for a week, and upon return, graduate student researchers will collect each device, ensuring that all participants have returned their device and downloading the data. Since the device requires special software, only the PIs and selected Co-PIs (PhD students) will have the ability to initialize, download, and view participants' data.

18) Multi-site Human Research

N/A

19) Sharing of Results with Participants

Upon request, results will be shared with the participant at the conclusion of all data collection and analyses.

APPENDIX E: DEMOGRAPHIC QUESTIONNAIRE

Family Background Information

This section contains important background questions about you and your family that will help us evaluate the effects of our judo program. Please answer all the questions. Your responses will be kept private.

What is your relationship to the child (circle one): Mother Father Grandparent Other Guardian

Marital status (circle one): Single In a Relationship Married Divorced Separated Widowed

Educational History (of parent/guardian completing survey):

❑ Did not complete High School ❑ HS Diploma/GED ❑ Some College ❑ Associate's Degree ❑ Bachelor's Degree ❑ Graduate Degree

Job Title/Occupation:	Are you currently employed? ❑ Yes ❑ No	If not, are you currently looking for work? ❑ Yes ❑ No

Do you consider yourself to be Hispanic/Latino? ❑ Yes ❑ No

In addition, please select one or more of the following to describe yourself:

❑ American Indian or Alaska Native ❑ Asian ❑ Black or African American ❑ Native Hawaiian or Pacific Islander ❑ White ❑ Prefer not to answer

Does your child qualify for free or reduced lunch? ❑ Yes ❑ No

Student Health Information

"Child" means your child who is participating in our judo study.
The information you provide will help us understand how physical activity may or may not help students' social and academic success. We will use this information to examine if the benefits of the physical activity program are different for children with different diagnoses. Please answer all the questions. Your responses will be kept private.

Child Gender: ❑ Male ❑ Female	Child Age (years):
Current Child Height: Feet Inches	Current Child Weight (pounds):
How confident are you that the height you are reporting for your child is accurate within 1 inch? ❑ Not Confident ❑ Confident	How confident are you that the weight you are reporting for your child is accurate within 5 pounds? ❑ Not Confident ❑ Confident

Child's Special Needs, Learning and Medical Diagnoses (e.g. ADHD/ADD, Bipolar Disorder, Dyslexia, Autism):

Does your child take medications that have known metabolic side effects?
❑ No
❑ Yes – he/she takes medications associated with weight gain (i.e. mood stabilizers, anti-psychotics)
❑ Yes – he/she takes medications associated with weight loss (i.e. stimulants)
❑ Unsure

APPENDIX F: ABC SURVEY

Aberrant Behavior Checklist

Relationship to participant (please circle)

1. Parent
2. Teacher
3. Support staff
4. Job coach
5. Other (please describe) _____

Where did you observe the participant?

If in school – what type of class? (Circle all that applies)

1. Regular class
2. Mainstream with "pull-outs"
3. Intellectual disability
4. ASD: Autism Spectrum Disorder
5. Emotional disability
6. Physical disability
7. Family home
8. School
9. Day program
10. Apartment
11. Group home
12. Workplace

Other:_____

Please rate the participant's behavior for the last four weeks. For each item, decide whether the behavior is a problem and indicate the appropriate number.

Response options: 0 (Not a problem at all);

1 (the behavior is a problem but slight in degree);

2 (the problem is moderately serious);

3 (the problem is severe in degree)

Items:

1. Excessively active at home, school, work, or elsewhere
2. Injures self on purpose
3. Listless, sluggish, inactive
4. Aggressive to other children or adults
5. Seeks isolation from others

6. Meaningless, reoccurring body movements
7. Boisterous
8. Screams inappropriately
9. Talks excessively
10. Temper tantrums/outbursts
11. Stereotyped behavior, abnormal, repetitive movements
12. Preoccupied; stares into space
13. Impulsive
14. Irritable and whiny
15. Restless, unable to sit still
16. Withdrawn
17. Odd, bizarre in behavior
18. Disobedient; difficult to control
19. Yells at inappropriate times
20. Fixed facial expression; lacks emotional response
21. Disturbs others
22. Repetitive speech
23. Does nothing but sit and watch others
24. Uncooperative
25. Depressed mood
26. Resists any form of physical contact
27. Moves or rolls head back and forth repetitively
28. Does not pay attention to instruction
29. Demands must be met immediately
30. Isolates himself/herself from other children or adults
31. Disrupts group activities
32. Sits or stands in one position for a long time
33. Talks to self loudly
34. Cries over minor annoyances and hurts
35. Repetitive body, or hand movements
36. Mood changes quickly
37. Unresponsive to structured activity
38. Does not stay in seat
39. Will not sit still for any length of time
40. Is difficult to reach
41. Cries and screams inappropriately
42. Prefers to be alone
43. Does not try to communicate by words
44. Easily distractible
45. Waves or shakes extremities repeatedly
46. Repeats a word or phrase over and over

47. Stamps feet or bangs objects
48. Constantly runs or jumps around the room
49. Rocks body back and forth repeatedly
50. Deliberately hurts himself/herself
51. Pays no attention when spoken to
52. Does physical violence to self
53. Inactive
54. Tends to be excessively active
55. Responds negatively to affection
56. Deliberately ignores directions
57. Has temper outbursts or tantrums
58. Shows few social reactions to others

APPENDIX G: PHYSICAL ACTIVITY AND SLEEP QUALITY SURVEY

1) During an **average week**, how many days during the week would you say your child participates in moderate to vigorous physical activity for at least 10 minutes per day?_____
2) During an **average weekday**, how many minutes would you say your child participates in moderate to vigorous physical activity? _____minutes per day
3) During an **average weekend day**, how many minutes would you say your child participates in moderate to vigorous physical activity? _____minutes per day
4) During an **average weekday** (not counting during the school day), how many minutes per day would you say your child participates in screen time (screen time: watching television, computer use, playing video games, using cell phone for social media purposes)_____minutes per day
5) During an average **weekend day**, how many minutes per day would you say your child participates in screen time?_____minutes per day
6) During an **average week**, how many hours of sleep would you say your child usually gets?_____ hours

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