Examining the Physical Activity Levels of Youth with Intellectual and Developmental Disabilities During Physical Education and Recess

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ABSTRACT

Introduction: It is currently believed that children with intellectual and/or developmental disabilities (IDD) are less physically active than their peers. The school setting may offer a promising solution to allow children with and without IDD to engage in physical activity (PA). However, the current school-based PA levels of this population remain unclear. Therefore, the purpose of this investigation was to compare the PA levels and related context of youth with and without IDD during the total school day, physical education, and recess. Methods: A total of 13 children (n = 3 with IDD) enrolled in first- and second grade participated in the investigation. Accelerometry was used to assess the PA levels during the total school day, physical education, and recess. Additionally, PA was assessed using the System for Observing Fitness Instruction Time (SOFIT) and Observational System for Recording Physical Activity in Children-Elementary School (OSRAC-E) during physical education and recess, respectively. Results: During the school day, children with IDD spent less time engaging in sedentary activities ($p = .032$) and more time engaging in moderate intensity activities ($p = .011$). During an inclusive physical education class, children spent a majority their time in the seated position (56%) and engaged in the management lesson context (51%). Additionally, about 33% of the time with spent accumulating moderate to vigorous intensity PA. During recess, both children with and without IDD spent a majority of the period engaged in sedentary and light PA. Finally, during recess, children with IDD preferred solitary play compared their peers that preferred to be in a group or with another peer.

Conclusion: It appears that it is possible for children with IDD to accumulate PA during the school day. However, these individuals seem to participate in non-traditional PA isolated from their peers.

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CHAPTER ONE
INTRODUCTION

An intellectual and/or development disability (IDD), which impacts approximately 15% of children ages 3 to 17 years old (Boyle et al., 2011), is an umbrella term for any condition that results in physical, learning, language, and/or behavior delays occurring before the developmental process concludes (Rubin & Crocker, 1989). Those with IDD are at an increased risk for a variety of chronic physical, developmental, behavioral, and/or emotional conditions (Bishop-Fitzpatrick & Kind, 2017; McPherson et al., 1998). Additionally, those with IDD have reported feelings of isolation, marginalization, and ineptitude (Bedini, 2000; Devine, 2004; Sable & Gravink, 2005). Moreover data suggest, that when compared to peers, youth with IDD are at a greater risk of being obese and diagnosed with many obesity-related complications including asthma, high blood pressure, high blood cholesterol, type 2 diabetes, depression, fatigue, preoccupation with weight, and pressure sores (Foley & McCubbin, 2009; Rimmer & Rowland, 2008; Yamaki, Rimmer, Lowry, & Vogel, 2011). These findings are concerning as the lifetime economic burden associated with supporting those with IDD is estimated to be one million dollars (Centers for Disease & Prevention, 2004). Thus, researchers and health care professionals are tasked with developing strategies to improve the lifestyles of youth with IDD.

For youth with IDD, physical activity (PA) has been suggested as a lifestyle behavior to improve their daily lives. Specifically, for those with IDD, PA could potentially decrease the risk of developing many secondary conditions associated with

obesity, thus reducing the economic burden associated with their disability (Traci, Seekins, Szalda-Petree, & Ravesloot, 2002). Additionally, PA has been shown to improve functional independence, psychological well-being, and overall quality of life (Warburton, Nicol, & Bredin, 2006). Due to the benefits of PA, it is currently recommended that youth with and without IDD (ages 6 to 17 years), accumulate 60 minutes of moderate to vigorous PA (MVPA) on a daily basis (Physical Activity Guidelines Advisory Committee, 2018). Current evidence suggests that only 23.1% of youth are meeting current PA guidelines (Child & Adolescent Health Measurement Initiative, 2016). However, when compared to their peers, youth with IDD accumulate even lower levels of PA. For example, using data from the National Survey of Children's Health (NSCH), Hughey and colleagues (2016) found that about 11% of children with cerebral palsy, 17% of children with autism spectrum disorder, and 18% of children with Down syndrome (all ages 6 to 17 years) met current PA recommendations (Hughey et al., 2016). The PA levels of this population are concerning as these behaviors tend to matriculate into adulthood which has been shown to assist in reducing the risk of developing obesity and obesity-related conditions later in life (Foxhall, 2006).

There are a multitude of barriers that youth with IDD face which may contribute to epidemically low PA levels. A lack of opportunities for children with IDD, for example, may contribute to low PA levels (Frey, Stanish, & Temple, 2008; Rimmer & Rowland, 2008). Furthermore, for those with IDD, there are fewer programs developed and adapted to meet their needs (Kodish, Kulinna, Martin, Pangrazi, & Darst, 2006), a deficiency of adapted equipment (Darrah, Wessel, Nearingburg, & O'Connor, 1999),

and inadequate training of staff members providing recreational PA (Schreiber, Marchetti, & Crytzer, 2004), which may also contribute to low PA levels. Barr and Shields (2011) found that for children with Down syndrome, the most common barriers to PA were a.) physiological and anatomic characteristics commonly associated with Down syndrome; b.) family responsibilities; c.) reduced physical or behavioral skills; and d.) a lack of an accessible environment (Barr & Shields, 2011). Similarly, Anderson, Bedini, and Moreland (2005) found that girls with physical disabilities ages 10 to 16 years old reported a lack of formal program opportunities to participate in as a common barrier to PA participation (Anderson, Bedini, & Moreland, 2005). Thus, researchers are challenged with finding optimal time periods and opportunities for this population to engage in PA.

Approximately 10% of students attending public school are diagnosed with a disability. Due to the fact that there are less community-based opportunities for these individuals, it is recommended that these children accumulate PA within the school setting (Rivard et al., 2012). In general, students spend approximately half of their waking hours (6 to 8 hours) during the week and a significant portion of their year (9 to 10 months) attending school (United States Department of Health and Human Services, 2000).Thus, a large population of children can be reached for intervention without the risk of stigmatization or discrimination (Fox, Cooper, & McKenna, 2004; Kriemler et al., 2011). Since, most children spend a majority of their youth (~ 6 to 12 years) attending public schools, this setting provides an opportunity for children to accumulate and develop lifelong PA behaviors and skills over extended periods (Saint-Leger, Kolbe,

Lee, McCall, & Young, 2007). Moreover, due to the consistencies in the public education system at the state level, successful interventions may be translatable and generalizable from school to school (Pate & Dowda, 2019). Finally, school based PA interventions are thought to be a cost-effective intervention strategy that can influence a large cohort of individuals (Barrett et al., 2015; Gråstén, 2017).

Specifically, physical education, which is thought to provide a practical school-based opportunity to engage in PA, systematically provides PA delivered by a knowledgeable professional (Wechsler, Devereaux, Davis, & Collins, 2000). Additionally, inclusive physical education allows children with IDD to interact with their peers without disabilities in an opportunity that they would not otherwise be afforded. This is important as peer contact has been shown to benefit both youth with and without IDD (Bedini, 2000; Place & Hodge, 2001). Recess also appears to offer a promising opportunity for youth with and without IDD to engage in PA. Juxtaposed to physical education, the unstructured nature of recess allows children to spontaneously engage and experiment with different types of PA (Johns & Ha, 1999; Sarkin, McKenzie, & Sallis, 1997). For these reasons, public education offers a pragmatic opportunity to allow youth with IDD to learn, develop, and explore different PA options while also developing a longstanding commitment to PA.

Thus, it has been suggested by the Centers for Disease Control and Prevention that children accumulate at least half of their daily recommended PA (30 minutes) during the school day (Pate et al., 2006). A comprehensive understanding of PA in the school setting may equip researchers, administrators, and health care providers with

strategies to promote PA in children with IDD (Felekidou, Howard, & Lenakakis, 2018). However, with the current physical education curricula and recess practices, the majority of youth with IDD fail to meet these recommendations. For example, Pan and colleagues (2014) found that children with intellectual disabilities (ages 12-17 years old), in either inclusive or self-contained classrooms, only spend approximately 11 minutes engaging in MVPA and accumulated only 9% of PA during a recess period (Pan, Liu, Chung, & Hsu, 2014). More recently, Sit and colleagues (2017), found that during an average recess period (~30 minutes), approximately 50% of the time was spent performing sedentary activities while only about 9 minutes were spent engaging in MVPA for school-aged children with IDD (ages 6-20 years old) (Sit et al., 2017).

The low PA levels during physical education may be explained by the lesson context and teacher behavior. For example, Sit and colleagues (2008) found that differences in PA levels were related to both lesson context and teacher behavior. The more time teachers spent on instruction and delivery knowledge related to physical education, the less PA the youth engaged in. During recess, PA levels may be impacted by environmental context and teacher behavior (Sit, McKenzie, Lian, & McManus, 2008). In a study by Faison-Hodge and Porretta (2004), they also discovered that youth with intellectual disabilities were more likely to be active when teachers spent less time providing instruction. These findings suggest that lengthy instruction may reduce the amount of time that can be spent in PA during physical education and recess (Faison-Hodge & Porretta, 2004).

For youth with IDD, the lack of opportunities to engage in PA outside of the school setting remain sparse (Frey et al., 2008; Rimmer & Rowland, 2008). Thus, to increase PA levels, researchers must determine the best options to engage in PA. It appears that for children without IDD, school provides a pragmatic opportunity to engage in PA through physical education and recess (Naylor & McKay, 2009). Accordingly, the public education setting may also be favorable for youth with IDD. This is because public education provides two promising periods to participate in PA. These periods provide opportunities for structured and unstructured PA that develop skills that may matriculate into lifelong PA behaviors. Both periods, may offer youth with IDD a variety of psychological, physical, and social benefits. However, for youth with IDD, the PA accumulated during these programs remains low. The reasons why these periods are failing to make a significant contribution to daily PA remains unclear. A more comprehensive understanding of the structure of these periods may equip researchers with strategies to develop interventions to induce lifelong PA behaviors.

Definitions

Below are detailed definitions for terms that are commonly used throughout this document

1. Physical Activity (PA): any type skeletal muscle movement that results in energy expenditure (Caspersen, Powell, & Christenson, 1985).
    a. Can be accumulated in four different domains including a.) occupational PA; b.) transportation PA; c.) household PA; and d.) leisure time PA.

b. It is currently recommended that children accumulate at least 60 minutes of moderate to vigorous physical activity (MVPA) daily, with at least 60 minutes of moderate to vigorous aerobic activity three days per week. Additionally, youth should engage in both muscle and bone strengthening activities for 60 minutes at least three days per week.

2. Intellectual and/or developmental disabilities (IDD): a cluster of conditions resulting in physical, learning, language, or behavior impairments, that occur before the developmental process concludes, which is typically before the age of 22 years (Rubin & Crocker, 1989).
    a. Examples include intellectual disability, autism spectrum disorder, hearing loss, vision loss, cerebral palsy, attention deficit hyperactivity disorder, or other developmental delays.
3. Special Education: specially designed instruction at no cost to parents, that is intended to meet the unique needs of a child with a disability. This includes a.) instruction conduced in a variety of settings (classroom, home, hospitals, and instruction in other settings); and b.) instruction in physical education (U.S. Department of Special Education Programs, 2010, 20 U.S.C. 1401[29]).
4. Inclusion: providing instruction specially designed to students with disabilities within the mainstream educational setting (Meyer, Peck, & Brown, 1991).
5. Physical Education: curriculum that intends to teach student about PA while also providing skills for lifelong PA behaviors (National Association for Sports & Physical Education, 2004).

6. Recess: a break period for children that usually occurs in an outdoor environment (Pellegrini & Smith, 1993). Provides an opportunity for children to engage in unstructured free play (Ramstetter et al., 2010).
7. Social-ecological model: a comprehensive approach that focuses on intrapersonal and other factors that may influence a behavior (Mehtälä, Sääkslahti, Inkinen, & Poskiparta, 2014).
8. Accelerometers: small noninvasive devices that objectively estimate PA through accelerations of body movements (Chen & Bassett, 2005; Welk, 2002).
9. Direct Observation: an assessment technique that focuses on the classification of behaviors (e.g. free-living PA) and the categorization, quantification, and analysis of these behaviors into greater detail (McKenzie, 2002).
10. System for Observing Fitness Instruction Time (SOFIT): a momentary time sampling and interval recording system that was developed to evaluate the variables associated with the PA and related PA opportunities for students during physical education classes (McKenzie, Sallis, & Nader, 1992).
11. Observational System for Recording Physical Activity in Children-Elementary School (OSRAC-E): a system developed to observe and document the levels and types of PA and physical and social contexts of PA in elementary school students during the school day (McIver, Brown, Pfeiffer, Dowda, & Pate 2016).

Statement of Problem

Youth with IDD are accumulating epidemically low levels of PA and are at an increased risk of becoming obese, as well as developing obesity-related problems (Frey

et al., 2008; Rimmer, Rowland, & Yamaki, 2007; Yamaki, 2005). Thus, it is paramount that strategies are developed to allow these individuals the opportunity to engage in PA. Due to a variety of factors, few opportunities exist during leisure time for these individuals (Shields, Synnot, & Barr, 2012). However, the school setting specifically, during recess and physical education periods may offer a promising opportunity to accumulate PA (Pate & Dowda, 2019). Nevertheless, current evidence suggests that youth with IDD are not accumulating adequate amounts of PA during these periods (Pan et al., 2014). Additionally, the factors that are associated with PA participation during these periods remain unclear. Thus, prior to developing interventions, a more cohesive understanding of factors that predict PA participation during the school day, may be necessary.

Statement of Purpose

The purpose of this investigation was to compare the PA levels and related context of youth with and without IDD during the total school day, physical education, and recess. To evaluate the PA levels during the total school day, physical education and recess direct observation and accelerometry were employed. Direct observation was used because it is provides contextually rich information about PA while also allowing researchers to understand how this behavior is influenced by a variety of factors (McKenzie, 2002). Accelerometry, which estimates PA in terms of the acceleration of body movements, is often the preferred method for PA assessment (Chen & Bassett, 2005). Using both methods provides a wealth of information about the

PA levels of youth with and without IDD during school day while also providing a comprehensive understanding of factors that may influence this behavior.

Specific Aims

The current investigation aims to address the following.

1. To compare the PA levels of youth with IDD (i.e. students that were eligible for special education and/or its related services based on their Individualized Education Program [IEP]) to their peers during the school day.
    a. Using accelerometers to measure PA, youth with and without IDD will spend less than 30 minutes of their school day engaging in MVPA.
    b. Using SOFIT to estimate PA and its related contexts, youth with and without IDD will spend less than 50% of their physical education class accumulating MVPA.
    c. Using OSRAC-E to estimate PA, youth with and without IDD will spend less than 40% of their recess period accumulating MVPA.
2. To compare PA related contests of students with and without IDD during recess.
    a. Using OSRAC-E to evaluate the PA contexts, students with IDD will have different play behaviors during recess than their peers.

CHAPTER TWO
LITERATURE REVIEW

Intellectual and/or Developmental Disability (IDD)

The Centers for Disease Control and Prevention defines an intellectual and/or developmental disability (IDD) as a cluster of conditions resulting in physical, learning, language, and/or behavior impairments (Rubin & Crocker, 1989). The hallmark sign of IDD is an inability to perform daily tasks that persists throughout a lifetime. Those with IDD are considered to have a delay, disorder, or impairment that impact their ability to function in various domains including cognition, communication, socialization, and/or physical. To be diagnosed with IDD, the delay, disorder, or impairment must occur before the developmental process concludes, which is typically before the age of 22 years old (Odom, Horner, & Snell, 2009). Nevertheless, the level of impairment and disability varies for each individual diagnosed (Rubin & Crocker, 1989). Examples of IDD include intellectual disability (ID), autism spectrum disorder, hearing loss, vision loss, cerebral palsy, attention deficit hyperactivity disorder, or other developmental delays.

Typically, those with IDD experience deficits in one of four domains. This includes motor development, speech and language development, socio-emotional development, and/or cognitive development (Patel, Greydanus, Calles, & Pratt, 2010). Motor development includes fine and gross motor skill deficits, whereas, speech and language development include receptive and expressive deficits. Socio-emotional development includes a combination of components within the other domains including

fine-motor adaptive-, overall communication-, and cognitive abilities. Finally, cognitive development includes visual perceptual, visual motor, and problem-solving deficits (Patel et al., 2010). Furthermore, ID is defined as an IDD that occurs before the age of 18, resulting in significant delays in general mental capacity and adaptive behaviors. This includes conceptual, adaptive, and social behaviors (National Institutes of Health, 2015). For those with IDD, atypical development occurs as either a developmental delay, developmental deviation, developmental dissociation, or developmental regression. A developmental delay is defined as a significant interruption in one or more milestone or skill domain (Patel et al., 2010). Whereas developmental deviation is defined as the acquisition of a milestone or skill in an atypical manner. Conversely, developmental dissociation is defined a delay in the rate at which skills or milestones are acquired. Finally, developmental regression is defined as a loss of a previous acquired milestone or a failure to continue to progress in a typical manner (Patel et al., 2010).

Globally, it is believed that as many as 52.9 million (95% uncertainty interval 48.7 - 57.3) children under the age of 5 are diagnosed with IDD (Olusanya et al., 2018). In the United States, it is believed that 18.7% (56.7 million) individuals are diagnosed with IDD (Brault, 2012). Furthermore, research suggests, that from 2006 to 2008 approximately 15% of US children ages 3 to 17 years were diagnosed with IDD. This was a 17% increase from the previous decade (Boyle et al., 2011). Using data from the 2009-2016 National Health Interview Survey (NHIS), McGuire and colleagues (2019) found that per 1000 children approximately 3.2 children were diagnosed with cerebral

palsy (95% confidence interval: 2.7 - 3.7), 11.1 were diagnosed with ID (95% confidence interval: 10.2 – 12.1), 6.4 were diagnosed with moderate to severe hearing loss (95% confidence interval: 5.6 – 7.2), and 1.6 were diagnosed with blindness (95% confidence interval: 1.3 – 2.0). Furthermore, they found that the prevalence of IDD was higher for those born at a low birthweight, from families with lower parental education, from families with a lower socioeconomic status (< 200% of federal poverty level), and those receiving public insurance. Additionally, it was revealed that boys were more likely to be diagnosed with ID and cerebral palsy. Finally, the data revealed that prevalence of children diagnosed with ID had increased from the previous decade (McGuire, Tian, Yeargin-Allsopp, Dowling, & Christensen, 2019).

Youth with IDD face many challenges that differ from their peers. In general those with IDD are at an increased risk for a variety of chronic physical, developmental, behavioral, and/or emotional conditions that require increased services (McPherson et al., 1998). For example, approximately 40% of youth with ID present with mental health issues and they are at a three to four times greater risk for these conditions compared to their peers (Emerson, 2003; Tonge & Einfeld, 2000). A recent review by Simo-Pinatella and colleagues (2019) found that the most commonly reported behavioral issues of children with IDD were aggression and self-injury (Simó-Pinatella, Mumbardó-Adam, Alomar-Kurz, Sugai, & Simonsen, 2019). This is important as behavioral issues have been shown to reduce overall physical health (Naaldenberg, Kuijken, van Dooren, & van Schrojenstein Lantman de Valk, 2013; Nissen & Haveman, 1997), prevent access to facilities (Parmenter, Einfeld, Tonge, & Dempster, 1998; Wodehouse & McGill, 2009),

lead to stress or burnout for others (Hastings & Brown, 2002), and reduce overall quality of life (Emerson et al., 2014). Additionally, untreated behavioral and emotional issues can lead to costly preventative interventions later in life (Singh, Matson, Cooper, Dixon, & Sturmey, 2005). Those with IDD are also at risk for sleeping problems that can lead to irritability and hyperactivity which may exacerbate behavioral issues (Ballester et al., 2019; Newman, O'Regan, & Hensey, 2006; Valicenti-McDermott et al., 2019).

Furthermore, children with IDD have been shown to have difficulties initiating and maintaining relationships with their peers and struggle to adapt to changing environments (Gresham & MacMillan, 1997). Those with IDD have also displayed reduced self-esteem (Miyahara & Piek, 2006; Nambiar, Jangam, Roopesh, & Bhaskar, 2019), self-concept (Russo et al., 2008), and experience social isolation (Krahn, Hammond, & Turner, 2006). Moreover, youth with IDD have been shown to have reduced opportunities to engage in academic tasks compared to their peers (Winstead, Lane, Spriggs, & Allday, 2019). A review conducted by Maïano and colleagues (2019) found that those with ID perceive their cognitive-academic, global, and behavioral self-concept to be lower than their peers (Maïano et al., 2019). Furthermore, youth with IDD are challenged with succeeding in the classroom while also dealing with the characteristics associated with their disability(ies) which may make it more difficult to succeed within the school setting (Anaby et al., 2019). For example, a child with a physical disability may have difficulties maneuvering throughout the classroom which may prevent access to supplies. Youth with IDD are also at risk for bullying which may result in a variety of negative psychological, physical, and social outcomes (Hoover &

Kaufman, 2018). These factors may hinder the ability of these individuals to be successful in a general education setting.

Obesity and IDD.

Generally, those with IDD are underserved population and are at a greater risk for health disparities (Froehlich-Grobe & Lollar, 2011) as well as provided with reduced health promotion strategies and preventative care measures (Krahn et al., 2006). In addition, it appears that the more significant the disability, the worse the individual's health status (Krahn et al., 2006). Likewise, it appears that the prevalence of adverse health conditions increase with age (Janicki et al., 2002). As such, the quality of life of individuals with IDD is often reported to be reduced compared to their peers (Hensel, Rose, Kroese, & Banks-Smith, 2002; Watson & Keith, 2002). Youth with IDD are also at a greater risk of being classified as overweight and obese (Foley & McCubbin, 2009; Rimmer & Rowland, 2008; Rimmer, Yamaki, Davis, Wang, & Vogel, 2011; Rimmer, Yamaki, Lowry, Wang, & Vogel, 2010; Yamaki et al., 2011). Currently, the National Center on Health, Physical Activity, and Disability (NCHPAD) reports that children and youth with IDD are at 38% higher risk for being classified as obese compared to peers (The National Center on Health, Physical Activity, and Disability, n.d.). This disparity between youth with IDD and their peers may be evident as early as 3 years old (Emerson, 2009).

A variety of large cohort studies have explored the obesity rates of those with IDD. For example, Rimmer and colleagues (2007), found that children with autism spectrum disorder, Down syndrome, and spina bifida had a two to four times higher risk

of being obese and overweight compared to peers. These children were at a higher risk for developing secondary health conditions including a higher prevalence of asthma, high blood pressure, high cholesterol, diabetes, depression, fatigue, preoccupation with weight, and pressure sores (Rimmer et al., 2007). De and colleagues (2008) found that 40% of children and adolescents with IDD (ages 2 to 18 years) living in a suburban Australia were classified as obese or overweight (De, Small, & Baur, 2008). Similarly, using web-based surveys, Rimmer and colleagues (2010) found that adolescents with autism spectrum disorder and Down syndrome were two to three times more likely to be obese than their peers. They found that these individuals were at a greater risk of developing many obesity-related complications including hypertension, dyslipidemia, diabetes, depression, fatigue, liver or gallbladder related issues, low self-esteem, early maturation, and pressure sores (Rimmer et al., 2010). Yamaki and colleagues (2011), found that one in five adolescents with a mobility limitation and one in three adolescents with a nonmotility limitation were considered overweight. When compared to peers, these children exhibited a higher prevalence of chronic health conditions (Yamaki et al., 2011). Slevin and colleagues (2014) found that youth with ID had a significantly higher mean body mass index (BMI) compared to their peers without IDD (NID) (ID: 20.5 kg/m^2 vs NID:19.2kg/m^2; $p \leq .05$). Furthermore, youth with ID were at a significantly greater risk for being diagnosed with obesity compared to peers (ID: 33% vs NID: 24%; $p \leq .05$) (Slevin, Truesdale-Kennedy, McConkey, Livingstone, & Fleming, 2014).

Bandini and colleagues (2015) summarized obesity information of children with IDD at the *National Institute of Child Health and Human Development Conference,*

2010. Data were summarized from three nationally representative data sources including the National Health and Nutrition Examination Survey (NHANES), NHIS, and the National Survey of Children's Health (NSCH). Using the NHANES data from 2005-2012 covering children ages 5-12 years, those with IDD were 35% more likely to be obese compared to peers. Using the NHIS data from 2008-2013 covering youth ages 12-17 years, those with IDD were 59% more likely to be obese compared to peers. Using the NSCH data from 2011 covering youth ages 10-17 years, those with IDD had 27% greater risk for special health care needs. Moreover, those with mobility limitations were at a greater risk for obesity than those with other disabilities types. Those with IDD had higher obesity rates than those without disabilities (NSCH: 26.7% vs 15.2%; NHANES: 22.5% vs 14.4%). The obesity prevalence for those with hearing or visual impairments was less conclusive (Bandini et al., 2015). This is important as the risk of developing many obesity related complications such as diabetes, high cholesterol, hypertension, and higher C-reactive protein, appear to be greater in obese adults with disabilities than their peers (Froehlich-Grobe, Lee, & Washburn, 2013; Reichard, Stolzle, & Fox, 2011).

Recently, Kasagi and colleagues (2018) explored the obesity and thinness among children with IDD ages 5 to 18 years. They found that obesity rates increased with age for both males and females (males: 7% [age 5 to 8 years] vs 35% [age 13 to 18 years]; females: 12% [age 5 to 8 years] vs 43% [age 13 to 18 years]). Additionally, independent of sex, those with ID had the highest rate of obesity (males: 30.3%;

females: 42.9%) and those with attention deficit hyperactivity disorder were at the greatest risk for thinness (males: 12%; females: 8.3%) (Kasagi, Hayashi, & Ito, 2018).

It appears regardless of activity status, those with ID are at a greater risk of being overweight and obese. For example, Lloyd and colleagues (2012) described the BMI of Special Olympic athletes with ID, ages 8 to 17 years old, by world region, gender, and age. They found that 30% athletes, included in the investigation, were classified as overweight or obese. Furthermore, the prevalence of obesity and overweight were significantly higher in North America females athletes, with 55% being classified as obese or overweight (Lloyd, Temple, & Foley, 2012). It also appears that income may contribute to obesity status. Using the same cohort of athletes, Lloyd and colleagues (2014) explored the impact of economic status on obesity. They found that those from countries stratified into the higher economy group (18.02%: 95% Confidence Interval: 16.88 to 19.16%) had increased obesity rates compared to those stratified into the lower economy group (3.07%: 95% Confidence Interval: 2.08 to 4.06%) (Lloyd, Foley, & Temple, 2014). Finally, Li and colleagues (2015) found that Special Olympic athletes from the United States were 2.47 times more likely to be obese compared to Special Olympic athletes from China (Li, Frey, McCormick, & Johnston, 2015).

Factors Contributing to the Obesity Rates of Youth with IDD.

Youth with IDD display similar obesity-associated risk factors to their peers, (e.g. low socioeconomic status and parental factors); however, there are a plethora of additionally factors that may exacerbate the obesity risk for these individuals (Grondhuis & Aman, 2014). For example, psychotropic mediations which are commonly prescribed

to youth with IDD, typically elicit weight gain (Schwartz, Nihalani, Jindal, Virk, & Jones, 2004). It is important to note that drugs themselves do not elicit fluctuations in weight. However, it is believed that these drugs may induce a hypo- or hyperphagia effect, alter food preferences, foster thyroid dysregulation, lead to fluid retention, change hormone production, and/or impair metabolism. All of which have the potential to elicit weight gain (Correll, 2007).

An additional factor that may explain the obesity rates of this population, is the result of an inherent syndrome (Grondhuis & Aman, 2014). For example, the genetic phenotype associated with Down syndrome, typically results in an increased risk for obesity and hypotonia (Murray & Ryan-Krause, 2010). Likewise, those with Prader-Willi syndrome typically display hyperphagia (i.e. uncontrollable hunger) which often is associated with an increased incidence of obesity (Cassidy & Driscoll, 2009; Cassidy, Schwartz, Miller, & Driscoll, 2012). Other examples of inherent conditions associated with obesity, include Bardet-Bidel, Carpenter, and Cohen syndromes (Allison, Packer-Munter, Pietrobelli, Alfonso, & Faith, 1998; Grondhuis & Aman, 2014). Because of the nature of these conditions, health care professionals may not regard obesity as important as other health and psychological issues and thus many not provide adequate guidance and attention to addressing this issue (Minihan, Fitch, & Must, 2007).

Additionally, physical limitations may contribute to the high obesity prevalence of those with IDD (Grondhuis & Aman, 2014). For example, those with hypotonic cerebral palsy may be at risk for obesity due to lethargy associated with their condition (Lobstein, Baur, & Uauy, 2004). Since, it is believed that there is an association between

restriction of movement and caloric expenditure, those with the most significant restriction are at risk for excessive weight gain (Grondhuis & Aman, 2014).

Finally, dietary habits of those with IDD may also impact their obesity status. Typically, youth with IDD are involved in reward-based behavioral programs that often use calorically empty foods as a reward for accomplishments (Bandini, Curtin, Hamad, Tybor, & Must, 2005). Additionally, those with difficulties with sensory processing such as those with autism spectrum disorder, may have narrow food preferences that may lead to inadequate intake of essential nutrients which possibly induces weight gain (Seiverling, Williams, & Sturmey, 2010). Socially, parents or caregivers may be less likely to oppose their child's food requests and are more likely to use food as a coping strategy (Reinehr, Dobe, Winkel, Schaefer, & Hoffmann, 2010; Rimmer et al., 2007).

Physical Activity (PA)

The importance of physical activity (PA) and its impact on public health has rapidly emerged over the last few centuries (Physical Activity Guidelines Advisory Committee, 2018). PA is defined as any type of skeletal muscle movement that results in energy expenditure (Caspersen et al., 1985). This differs from exercise, which is a type of PA that is planned, structured, repetitive, and is designed to improve some aspect of an individual, including physical performance, fitness, and/or overall health (Caspersen et al., 1985). Typically, PA can be accumulated in four different domains including a.) occupational PA; b.) transportation PA; c.) household PA; and d.) leisure time PA. Occupational PA is defined as any type of PA that is performed during work. Transportation PA is defined as any type of PA that an individual uses to go from one

location to another (Physical Activity Guidelines Advisory Committee, 2018). Household PA is defined as any type of PA that an individual does during household chores. Finally, leisure time PA is any type of PA that an individual does during their free time (Physical Activity Guidelines Advisory, 2018). For Americans, leisure time PA is a critical time to accumulate PA, as occupations have become more sedentary, technological advances have decreased the labor needed to perform household chores, and automotive transportation has become ubiquitous (Brownson, Boehmer, & Luke, 2005). Likewise, children and adolescents accumulate most of their PA during their leisure time (Ross, Dotson, Gilbert, & Katz, 1985).

In addition to PA, physical fitness also appears to be important to induce many health-related benefits. Physical fitness is defined as a set of attributes that an individual possess that allow them to perform muscular work. Within physical fitness there is cardiorespiratory endurance, which is the ability to perform whole-body, large muscle activities at moderate to high intensities for extended periods (Physical Activity Guidelines Advisory Committee, 2018). Musculoskeletal fitness is defined as the integrated ability of skeletal muscles to perform work. Flexibility is defined as the joint or group of joints range of motion. Balance is defined as the ability to maintain stability while moving or stationary. Finally, speed is defined as the body's ability to move as quickly as possible (Physical Activity Guidelines Advisory Committee, 2018). Current evidence suggests that greater physical fitness is associated with a reduction in all-cause mortality, mortality related to cardiovascular disease, and the development of a plethora of non-communicable diseases (Ross et al., 2016).

Compared to PA, sedentary behaviors are defined as any waking behavior that is performed while sitting, recycling, or lying down and are characterized by an energy expenditure of 1.5 metabolic equivalents (METs) or fewer. Examples include any office work that is performed while sitting, watching television while sitting, and driving a car (Tremblay et al., 2017). It is currently believed that children and adults spend approximately 7.7 hours (55% of monitored time) engaging in sedentary behaviors (Matthews et al., 2008). Evidence suggests that there is an association between sedentary time and adverse health events (Owen et al., 2011; Salmon, Tremblay, Marshall, & Hume, 2011; Thorp, Owen, Neuhaus, & Dunstan, 2011). More specifically, it appears that high volumes of moderate to vigorous PA (MVPA) reduce the morality risk associated with high volumes of sitting. Conversely, the negative consequences of low volumes of MVPA is reduced but not eliminated by very low time spent sitting. Thus, it appears that individuals benefit from increasing MVPA and reducing time spent sitting (Physical Activity Guidelines Advisory Committee, 2018).

Benefits of PA.

There is an abundance of evidence that suggests that those that engage in more PA accrue more health benefits than those that do not accumulate sufficient PA. For example, accumulating a greater amount of MVPA has been shown to reduce the risk of excessive weight gain, reduce anxiety and depressive feelings, and improve sleep and quality of life (Physical Activity Guidelines Advisory Committee, 2018). Acutely, PA has also been shown to have cognition benefits. For young children (ages 3 to 5 years), those that are more physically active have been shown to have stronger bones and a

healthier weight status. For older adults, evidence suggests that engaging in PA reduces the risk for dementia, improves their ability to complete routine tasks, and reduces fall risk and the injury risk if a fall does occur (Physical Activity Guidelines Advisory Committee, 2018). PA has also been shown to reduce the risk of cancers of the bladder, breast, colon, endometrium, esophagus, kidney, stomach and lungs. For those with colorectal cancer, breast cancer, and prostate cancer, there is a positive association between reduced risk of mortality from the original type of cancer and PA engagement. Additionally, those with colorectal cancer or breast cancer are at a reduced risk for all-cause mortality from their cancer when they engage in more PA. Finally, it appears, that there are benefits for those that engage in more PA from a variety of chronic conditions, including osteoarthritis, hypertension, type 2 diabetes, dementia, multiple sclerosis, spinal cord injury, stroke, Parkinson's disease, schizophrenia, attention deficit hyperactivity disorder, and recent hip fracture (Physical Activity Guidelines Advisory Committee, 2018).

Because of these benefits, the Department of Health and Human Services recommends that individuals perform 150 to 300 minutes of moderate intensity or 75 to 150 minutes of vigorous intensity PA or a combination of both per week. In addition to aerobic activities, it is recommended that individuals perform muscle strengthening activities of large muscle groups on 2 non-consecutive days, weekly (Powell et al., 2018). Children ages 6 to 17 years should accumulate 60 minutes of MVPA daily. This includes at least 3 days of at least 60 minutes of either moderate- and/or vigorous intensity aerobic activities, at least 3 days of at least 60 minutes muscle-strengthening

activities, and at least 3 days of at least 60 minutes of bone-strengthening activities (Physical Activity Guidelines Advisory Committee, 2018).

Accelerometers.

Accelerometers are one of the most commonly used activity tracking devices for PA assessment (Welk, 2002). Accelerometers are small noninvasive devices that objectively assess PA through acceleration changes in terms of body movements (Chen & Bassett, 2005). Acceleration is defined as the change in velocity over the change in time and is most commonly expressed in terms of gravitational force (g = 9.8 meters/second^2) (Chen & Bassett, 2005; Welk, 2002). Accelerometers have the ability to measure accelerations in one to three orthogonal plans (anteroposterior, mediolateral, and/or vertical) (Chen & Bassett, 2005). These devices provide information about the rate at which a distance is covered, making it an ideal assessment of movement (Welk, 2002). Furthermore, these devices have the capability to store a considerable amount of information allowing for detailed reports of activity patterns for extended periods of time to be captured (Welk, 2002). Most accelerometers use one or multiple piezoelectric sensors. These sensors detect accelerations when the piezoelectric element of the device, becomes deformed from bending, direct tension, or compression. The deformation causes a displacement in the charge, which generates an output voltage signal that is proportional to the acceleration applied (Chen & Bassett, 2005). These devices have low- and high-pass filters that remove accelerations outside typical human movement. The low-pass filters remove low frequencies and electrical interference, whereas the high-pass filters removes high frequencies (Welk, 2002).

Since these devices measure segmental or limb accelerations, the repeated acceleration and deceleration allow the recording of constant movement during steady-state activities (Welk, 2002).

The accuracy and reliability of accelerometers depends on the way the data are collected, processed, and analyzed (Welk, 2002). During data acquisition, the Nyquist criterion is typically used to capture the full range of human motion. This concept states that all sampling frequencies must be at least twice the highest frequency of the object measured. Failure to meet the highest frequency results the distortion of rapid human movements (Oppenheim, Willsky, & Young, 1983). The general frequency for humans during normal movement is below 8 Hz and can be as high as 25 Hz, thus most sampling frequencies for these devices range between 1 to 64 Hz (Chen & Bassett, 2005; Winter, Quanbury, & Reimer, 1976). Additionally, most current devices require an initialization process prior to usage. This ensures that the device has a specific start and end time for accurate data collection (Welk, 2002). Another consideration is affixing the devices tightly against the user's body. This will prevent spurious results due extraneous movements caused by bouncing or jostling of the accelerometer (Welk, 2002).

Data produced by activity monitors can be imported into a computer and used for data processing. Information provided by accelerometers can be segmented into discrete time periods that allow activity characteristics such as frequency, intensity, or duration of an activity to be examined (Welk, 2002). The raw information produced from these monitors are known as counts; however, the physiological meaning of a count

remains unclear (Chen & Bassett, 2005). Nonetheless, the advantage of using a count is that they avoid potential errors and bias that may occur from estimating energy expenditure or time spent in an activity. Thus, detailed data processing is needed to allow for the information to be examined systematically (Welk, 2002).

Most often the raw accelerometer count data is averaged over a period of time known as an epoch (Chen & Bassett, 2005). Following each time interval a summed valued or activity count is written to memory (Trost, McIver, & Pate, 2005). Epoch length is critical to the interpretation of the data (Chen & Bassett, 2005). For example, a shorter epoch length has a higher resolution and captures multiple short bouts of activity, however the energy expenditure associated with these sampling frame has little physiological significance. Conversely, longer epoch provides normal smooth data but has difficulty differentiating mixed intensities. For instance, if a high intensity activity occurs briefly during data collection, the intensity, of the total activity, may not be accurately captured. This is because other intensities may predominate the sampling epoch period (Chen & Bassett, 2005). Currently, the consensus for an appropriate epoch length for adults is one minute (Chen & Bassett, 2005; Trost, McIver, & Pate, 2005). However, since children perform short bouts of MVPA, this sampling time frame may not accurately capture information (Trost et al., 2005). It is thus recommended that for children the epoch length, last around 10 seconds or less in duration (Rowlands, 2007).

One common accelerometer outcome is the prediction of energy expenditure. A variety of equations have been developed to covert accelerometer counts into units of

energy expenditure (Welk, 2002). Many of these estimations were developed based on the linear relationship between accelerometer counts and energy expenditure. This approach is intuitive, easily understood, and allows all types of activity to be summed providing an overall activity index. However, the validity of estimating energy expenditure during free living situations remains unclear (Welk, 2002). As such a time-based approach has also been used to determine the period spent performing PA. This is preferred to the energy expenditure approach, as it eliminates many of the errors associated with this estimation. Additionally, this approach is behaviorally based which may be beneficial for interpretation (Welk, 2002). To perform this method, the monitors were calibrated based on the relationship between accelerometer counts and various intensities. Thus, the level of counts and the intensity can be determined using accelerometer cut-points (Welk, 2002). The major advantage to using cut-points is it provides a systematic way to determine meaningful information from a large cohort of individuals. However, cut-points may be systematically bias or inadequate for some populations (Welk, 2002).

Like adult accelerometer research, accelerometers appear to be one of the most common forms of PA assessment for youth (Rowlands, 2007). This is because these devices are unobtrusive, easy to use, and appear to be unnoticed by youth. Furthermore, children are not required to recall their PA behaviors and thus cognition is not required (Rowlands, 2007). A variety of cut-points have been developed to determine the PA of youth. One of the most commonly used accelerometers in contemporary PA assessment of youth, is the Actigraph (Trost et al., 2005). To date,

there have been five validated sets of cut-points developed for assessing PA of youth using the Actigraph (Evenson, Catellier, Gill, Ondrak, & McMurray, 2008; Mattocks et al., 2007; Freedson & Janz, 2005; Puyau, Adolph, Vohra, & Butte, 2002; Treuth et al., 2004). Trost and colleagues (2011) compared accelerometer cut points for predicting activity in youth and found that only cut-points developed by Evenson and colleagues (2008) exhibited excellent classification accuracy at all intensity points (ROC-AUC =0.90) (Trost et al., 2011). Nonetheless, for children without IDD, most accelerometers cut-points have been found to be relatively valid (r = .27 to .89) and reliable (ICC = .49 to .98) (De Vries et al., 2009).

For children with IDD, accelerometry has also been used to assess PA. One of the major limitations associated with all wearable devices is the refusal of participants to comply for extended periods (Whitt-Glover, O'Neill, & Stettler, 2006). Thus, the feasibility of these devices for this population is inconclusive. However, a recent study conducted by Lobenius-Palmer, Sjoqvist, Hurtig-Wennlof, and Lundqvist (2018) found 93% of a large cohort (n = 102) of individuals with IDD wore an accelerometer for 4-7 days. This suggests good compliance for this population (Lobenius-Palmer, Sjoqvist, Hurtig-Wennlof, & Lundqvist, 2018). Like the studies investigating the PA levels of their peers, the most commonly used research grade accelerometer is the Actigraph (Leung, Siebert, & Yun, 2017). Some investigations have estimated PA using cut-puts that were validated for children without IDD (e.g. Pan et al., 2014; Sit et al., 2017; Stanish et al., 2019), whereas others have used accelerometer counts to quantify PA (e.g. Bandini et al., 2013; Foley, Bryan, & McCubbin, 2008). Nonetheless, using cut-points may not be

appropriate for this population (Hinckson & Curtis, 2013; Leung et al., 2017; McGarty, Penpraze, & Melville, 2016). This may make it difficult to make generalizations and comparisons as cut-points were developed using different populations (Leung et al., 2017). Thus most cut-point estimations are specific to the population evaluated and the activity(ies) that they were developed on (Yun & Ulrich, 2002). As such the physiological and anatomical differences between youth with IDD and their peers may impact that the validity and reliability of these devices. For example, the different gait patterns of youth with IDD and those without may not be able to accurately capture the movements patterns of this population (Whitt-Glover et al., 2006). Furthermore, differences in resting and maximal oxygen consumption between these populations may hinder the ability to accurately classify PA intensity (McGarty et al., 2016; Whitt-Glover et al., 2006). For these reasons, reporting raw accelerometer counts in additional to cut-points, has been suggested as the best practice for quantifying PA for youth with IDD (Leung et al., 2017).

Recently, McGarty and colleagues (2016) aimed to calibrate and cross-validate the first accelerometer intensity cut-points for youth with ID. A total of 50 children with ID were assigned randomly to either the calibration- (n = 36; 28 boys; mean age: 9.53 ± 1.08 years) or cross-validation (n = 14; 9 boys; mean age: 9.57 ± 1.16 years) groups. Participants performed a semi-structured activity session that included a warm-up (10 minutes; light/moderate intensity PA), instructional games (10 minutes; moderate intensity PA), obstacle games (10 minutes; vigorous intensity), and team games (15 minutes; vigorous intensity PA). Intensities were determined based on energy

expenditure from the compendium of PA for youth (Ridley, Ainsworth, & Olds, 2008). The System for Observing Fitness Instruction Time (SOFIT) was used as the criterion method to determine the sensitivity, specificity, total agreement, and Cohen's kappa scores. Receiver Operating Characteristics curve was used to determine cut-points. The optimal (AUC = .87−.94) vertical axis cut-points (counts per minute [cpm]) were ≤507 (sedentary), 1008−2300 (moderate), and ≥2301 (vigorous), which demonstrated high sensitivity (81−88%) and specificity (81−85%). The optimal (AUC = .86−.92) vector magnitude cut points (cpm) of ≤1863 (sedentary), 2610−4214 (moderate), and ≥4215 (vigorous) demonstrated comparable, albeit marginally lower, accuracy than the vertical axis cut points (sensitivity = 80−86%; specificity = 77−82%) (McGarty et al., 2016).

Nonetheless, accelerometers offer a pragmatic opportunity to objectively estimate the PA patterns of youth with IDD. These devices appear to be nonintrusive, are small, and can store a relatively large amount of data allowing PA behaviors to be assessed in a large cohort of individuals over extended periods (Chen & Bassett, 2005; Welk, 2002). Because of this, accelerometers have been used as an instrument to validate other self-reported PA assessments (Welk, 2002). Additionally, these devices have been used as the dependent variable to predict PA patterns. Finally, accelerometers have been used in intervention studies to promote PA. However, it is important to ensure that these devices are standardized and follow a systematic protocol (Welk, 2002). Thus, when assessing the PA levels of youth with IDD, using accelerometers, it is suggested that raw counts and cut-points be reported (Leung et al., 2017).

Direct Observations.

Direct observations, which are considered critical to understanding many types of human behaviors, have often been considered too cumbersome and tedious for assessing PA (Montoye, Kemper, Saris, & Washburn, 1996). Yet, this method provides contextually rich information and is considered pragmatic for understanding the factors that may influence PA behaviors (e.g. physical and social). Additionally, laptop computers and digital recording devices, allow large amounts of information to be recorded and stored, making this methodology more enticing (McKenzie, 2002). At its core, PA direct observation focuses on the classification of free-living PA and the categorization, quantification, and analysis of these behaviors into greater detail. Thus, this method not only allows for the assessment of PA, but offers the ability to identify the activity type, and when, where, and with whom it occurs (McKenzie, 2002). Direct observation eliminates the possibility for recall bias, which suggests this tool is practical for PA assessment of children and those with cognitive deficits. This is because these individuals may have difficulties recalling and articulating PA type, duration, level and intensity. Additionally, objective PA assessment devices may not appropriately capture the movement patterns of those with IDD. Nonetheless, when using direct observation to assess PA, it is currently recommended that this technique is used in conjunction with an objective tool (McKenzie, 2002).

Current direct observation practices suggest that a systematic process be employed. This means that the observation should have a specific purpose and include definitive behavioral classification categories, and a coding convention (McKenzie, 2002). Although there are differences in the recording technique, all systematic

observations should include: measuring frequency (number of times observed per observation), duration (length of observation), and latency (time between stimulus and the onset of the behavior) (McKenzie, 2002). Technological advances have led to the development of commercially available software packages that allow observation data to be collected, managed, analyzed, and presented into a computer or handheld device. These programs allow the user to input data into digitally recorded videos and/or media files. These data can be stored and used for further and more robust analysis (McKenzie, 2002). In addition, observations can be scored through the software which allow time-stamped events to be created. Contemporary software also has the ability to provide figures and statistical reports of the data (McKenzie, 2002).

Since direct observation requires rigor and attention to detail, a general assessment procedure has been recommended. This includes ensuring that all categories analyzed are mutually exclusive. To ensure the greatest precision multiple codes are suggested; however, a robust coding scheme makes both training and implementation more challenging. This may also cause fatigue, ultimately reducing observation reliability (McKenzie, 2002). The sampling method, which specifies person of interest as well as when to observe and how-to code, should also follow systematic procedures. Although, a continual observation may be precise, this may not be feasible and can be overwhelming. As such, it is suggested that observations are divided into segments. To ensure that sampling time frame is consistent, it is advised that the researcher be prompted (e.g. using a stopwatch) during observation segments (McKenzie, 2002). Researchers must also consider the time frame in which the

observation occurs. Currently there is not consensus on an appropriate time frame, but time, cost, location, season, weather, and temperature should all be considered when determining appropriate sampling procedures (McKenzie, 2002). Direct observation is susceptible to human error, and thus observer training is paramount. To ensure accuracy, of the observer, it is suggested that, a.) there is an orientation; b.) the observation tool manual is studied and categories/codes are memorized; c.) practice sessions occur; d.) video-recorded practices sessions with feedback occur; e.) practices sessions in the field with immediate feedback occur; f.) additional field practice with reliability comparison to a certified observer occur; and g.) continual monitoring occur (McKenzie, 2002).

System for Observing Fitness Instruction Time (SOFIT).

The System for Observing Fitness Instruction Time (SOFIT), which was developed by McKenzie, Sallis, and Nader (1992), is a momentary time sampling and interval recording system. This tool determines the variables associated with health-related to PA. Precisely, SOFIT evaluates PA and related PA opportunities for students during physical education periods (McKenzie et al., 1992). Additionally, this tool has been thought to be a valid and reliable methodology to evaluate the PA levels of youth with IDD during physical education (Faison-Hodge & Porretta, 2014.). Within this observation tool, there is a systematic three phase evaluation process that includes how active the students are (Phase 1), how the class time is designed for tasks and goals (Phase 2), and how the physical education teacher uses their class time (Phase 3). Phase 1 (*Student Activity*) consists of observing one preselected student at a time every

20 seconds (10 second observation interval; 10 second recording interval). In Phase 1, the observer codes the student's activity, using predetermined codes. Codes 1 to 4 are based on student's activity (lying down, sitting, standing, and walking respectively), whereas Code 5 is chosen when the focal child's energy expenditure is perceived to be higher than typical ambulation. Additionally, an MVPA category can be determined by taking the sum of the walking (fourth) and very active (fifth) categories (McKenzie et al., 1992). For Phase 2 (*Lesson Context*), following 20-second observation intervals (10 second observation; 10 second recording) the observer determines if class time is being allocated for general content (example management) or the actual subject matter (physical education). If a significant amount of time is spent on physical education, an additional decision of if the lesson focuses on knowledge (either general or physical fitness knowledge) or on motor content (PA) is made. Finally, for motor content an additional decision is made as to if the activity is fitness-related, skill practice, or game play (McKenzie et al., 1992). Phase 3 (*Teacher Behavior*) occurs at brief moments and are recorded when they transpire (partial interval recording). This phase consists of coding the teacher's class involvement in one of three categories. The first behavior, promotes fitness, is coded when the teacher prompts or reinforces physical fitness engagement, whereas the second category demonstrates fitness, is coded when the teacher prompts or reinforces physical fitness behaviors outside of the classroom. The teacher does not promote physical fitness behaviors (McKenzie et al., 1992).

The five level PA coding system was developed through a validation study conducted by McKenzie and colleagues (1991) in which the heart rates of children ages

4 to 9 years (n = 19) were evaluated during a variety of activities. The average heart rate was 99 beats per minute while lying down and was approximately 153 beats per minute during very active activities. The linear increase in heart rate as the activity categories increased supports the coding system used in the SOFIT (McKenzie et al., 1991). The categories for Phase 2 and 3 were based off of codes and definitions that are commonly used in physical education training and pedagogical research (Darst, Zakrajsek, & Mancini, 1989). The reliability and validity of the SOFIT was investigated through the evaluation of 88 third-, fourth-, and fifth-grade classes by three trained physical education professionals. Following a training session, the inter-observer reliability was 88.3%, 91.8%, and 89.8% for Phase 1, Phase 2, and Phase 3 respectively (McKenzie et al., 1992). During this validation, student's reported little burden from being observed and all teacher complied. Additionally, compared to other systematic observation, SOFIT requires a short training session. Both suggest that SOFIT is acceptable and feasible for observing students during physical education classes (McKenzie et al., 1992).

Construct validity was supported by correlations reported between the three phases. For example, time allocated for management was positively correlated with students standing time ($r = .448$; $p = .001$) and negatively correlated with walking ($r = -.411$; $p = .001$), being active ($r = -.324$; $p = .01$) and engaging in MVPA ($r = -.556$; $p = .001$). Additionally, there was a strong positive relationship between time allocated for management and the amount of time spent managing the class ($r = .887$; $p = .001$). There was a positive correlation between time allocated for fitness activities and time

spent by the students walking (r =.488; p = .001), being active (r =.360; p = .001), and engaging in MVPA (r =.685; p = .001). There was a strong positive correlation between the amount of time allocated to fitness and the amount of time the teacher promoted fitness (r = .918, p =.001). There was a positive correlation between time allocated for developing skills with time spent standing (r =.254; p = .01) and was negatively correlated with the amount of time engaging in MVPA (r =-.291; p = .001). A strong positive correlation was observed between the amount of time allocated to developing skills and the amount of time engaged in general instruction (r = .469, p =.001). Time allocated for game play was positively correlated with time spent by the standing (r =.310; p = .01) and was negatively correlated with the amount of time engaging in MVPA (r =-.241; p = .05) (McKenzie et al., 1992).

Furthermore, to determine validity, fitness (at least 40% of time spent in fitness activity) and non-fitness classes (less than 40% of time spent in fitness activities) were compared. Those in fitness classes spent more time walking (35.8% vs. 27.2%), being active (21.8% vs. 16.6%), and engaging in MVPA (51.3% vs. 37.2%) compared to those in non-fitness class which spent more time standing. Compared to the non-fitness class, the fitness class tended to be shorter (23.4 vs 25.8 minutes) and was four times more likely to allocate time for fitness activities (64.2% vs. 15.6%). The non-fitness class allocated more time for management (16.3% vs. 23.1%), skill practice (19.7% vs. 4.5%), and game time (28.4% vs. 2.9%). Neither type of class spent time in the fitness knowledge context. Finally, the teachers of the fitness class promoted fitness through prompting, modeling, or feedback (57.4% vs. 11.3%) and less time giving general

instruction (21.1% vs. 53.6%). Little time was spent demonstrating fitness, observing passively, or being off task (McKenzie et al., 1992).

The SOFIT has been validated for those with IDD by Faison-Hodge and Porretta (2004). A total of 46 (males = 25) students ages 8 to 11 years were divided into one of three groups. This included those with mild IDD (n = 8; Intelligence Quotient: 45 -70) and students without disabilities that were classified as either those with low cardiovascular fitness (n = 19; LCRF) or those with high cardiovascular fitness (n = 19; HCRF) based on Fitnessgram Progressive Aerobic Cardiovascular Endurance Run scores. PA information was collected during a 4-week lesson plan that consisted of 5 to 8 classes lasting approximately 30 minutes and during 15-minute recess sessions. For those with ID, the concurrent validity was established through the relationship between heart rate and PA. For physical education classes, the Pearson's product moment correlation between these variables ranged from r = .72 to .86 (mean r = .81; p =.01). For recess periods, the Pearson's product moment correlation between these variables ranged from r = .06 to .90 (mean r = .69; p =.01 for seven of the eight participants). This suggest that this is a validated tool for student with IDD (Faison-Hodge & Porretta, 2004).

Observational System for Recording Physical Activity in Children-Elementary School.

The Observational System for Recording PA in Children-Elementary School (OSRAC-E), which is an addition to the OSRAC test battery, presents PA information on the physical and social environment context specific to the elementary school aged students (McIver et al., 2016). The OSRAC-E developed based on the OSRAC-

Preschool Version (OSRAC-P). The OSRAC-P was developed to quantify preschool behaviors. These behaviors include a.) PA levels; b.) types of PA; c.) locations; d.) indoor and outdoor activity context; e.) initiators of activity; f.) group composition; and g.) adult and peer prompts to PA (Brown et al., 2006). Like its predecessor, the OSRAC-E maintains relevant categories including PA levels, type of PA, group compositions, initiators of activity, and prompts for activity. Additionally, the OSRAC-E does include environmental categories such as the physical settings, instructional settings, and contexts (McIver et al., 2016). A momentary time sampling strategy is used for the observation of a focal children during a 30 second period (5 seconds of observation; 25 seconds of coding). Each child was observed for 10 minutes of the recess period (20 observations in total).

To the author's knowledge the OSRAC has not been used for children with IDD. A brief description of all the categories and codes of the OSRAC-E are presented in Appendix C. All codes are mutually exclusive allowing one code per category during each observation (McIver et al., 2016). Within the *Activity Level* category, the codes include *stationary, limbs, slow-easy, moderate,* or *fast*. Within the *Types of PA* category, the codes include *sit or squat*, *lie down, stand, walk, jump or skip, climb,* or *throw.* Within the *Primary Locations* category, the codes include *inside*, *outside,* or *transition*. Within the *Types of PA* category, the codes include *sit or squat*, *lie down, stand, walk, jump or skip, climb,* or *throw*. Within the *Physical Setting* category, the codes include *cafeteria*, c*lassroom, gym, hallway, library, multipurpose, playground sports field, other inside area,* or *other outside area*. Within the *Instructional Setting* category, the codes

include *art, assembly, before school, change classes, computer core classes, homeroom, lunch, media arts, music, physical education, recess, other related arts* or *other*. Within the *Activity Context* category, the codes include *academics, ball/object, class business, computer, fixed equipment, games, gross motor, open space, rest, self-care, snacks, transition, TV/videos,* or *other*. Within the *Group Composition* category, the codes include *solitary, adult present,* or *with peers*. Within the *Activity Initiator* category, the codes include *adult* or *child*.

McIver and colleagues (2016) conducted pilot testing of the OSRAC-E to determine the reliability and validity of this tool. They used an observation of one focal child using a momentary sampling technique that consisted of 5 seconds of observation followed by 25 seconds of recording. Observations were set at 20 minutes over a week period. Each participant was observed for a total of 4 observations. To determine reliability two trained observers collected and analyzed the information. Eight elementary schools (grades kindergarten through fifth grade; n = 177 students) from central South Carolina volunteered for pilot testing. A total of 11,076 observation intervals occurred in the investigation. Except for activity initiators, for all other observation categories, the Kappa statistic was above .80. This indicated an adequate level of inter-observer agreement. Moreover, interval-by-interval agreement values were all 96% or greater which indicated a high agreement levels between observers. Thus, this tool can be employed reliably with children in common elementary schools (McIver et al., 2016).

Advantages to Using Direct Observation: An Ecological Momentary Assessment Prescriptive.

Compared to other preventable health behaviors (e.g. attending a yearly check-up), PA should occur frequently. Furthermore, these behaviors should not only occur daily but also consist throughout an individual's lifetime (Dunton, 2017). Thus, ensuring a person engages in sufficient amounts of PA is particularly difficult due to the daily fluctuations of life. Example challenges include changes in the way a person feels, the individuals they interact with, perceived barriers to PA participation, and current status of life (Dunton, 2017). Thus, the fluctuations of living make it difficult to manage, understand, and promote PA behaviors. Researchers seek to understand PA behaviors, however, this presents a challenge as these behaviors are not static, are based on the sample time frame, are influence by spatial and temporal features, and do not understand the impact of the behavioral fluctuations (Dunton, 2017). To combat this, ecological momentary assessment (EMA) has been suggested. EMA is not a single method of research, rather it involves the repeated collection of real-time data of the participant's behavior and experiences in their natural environment (Shiffman, Stone, & Hufford, 2008). EMA is promising in the field of PA research because it is believed to provide novel insights to this behavior. Furthermore, the ubiquity of mobile phones has made this approach easier because it allows for rapid data collection from a large cohort without being intrusive (Dunton, 2017).

PA and IDD.

For youth with IDD, PA has similar health benefits as have been reported for their typically developing peers (e.g. improved cardiovascular fitness) (Cooper & Quatrano,

1999; Rimmer & Rowland, 2008). However, accumulating PA may be more critical, as their disability may cause “a cycle of deconditioning” which may further restrict engagement and thus increase the risk of developing a variety of secondary complications (Cooper & Quatrano, 1999). This is significant as the estimated lifetime economic cost to support a disability is believed to be one million dollars (Centers for Disease Control and Prevention, 2004). For those with IDD, PA is believed to reduce this economic burden by decreasing the risk for developing secondary comorbid conditions (Traci et al., 2002). For example, PA has been shown to improve the weight status of youth with IDD (Maiano, Normand, Aime, & Begarie, 2014; Pett et al., 2013; Pona, Dreyer Gillette, Odar Stough, Gerling, & Sweeney, 2017). PA may also result in additional benefits aside from the prevention of excessive weight gain (Cooper & Quatrano, 1999). For example, PA has been shown to improve functional independence, psychological well-being, overall quality of life (Warburton et al., 2006), social connectedness (Murphy & Carbone, 2008), and perception of self-efficacy (Wickman, Nordlund, & Holm, 2018) of children and youth with IDD. This is important as improving a child with IDD’s well-being has also been suggested as a strategy to reduce health care cost (Mâsse, Miller, Shen, Schiariti, & Roxborough, 2012).

Although the physiological and psychological benefits of PA are well established, youth with IDD are accumulating alarmingly low amounts of PA. Until recently, many believed that secondary and comorbid conditions were a consequence of a disability and thus those with IDD inevitably have poorer health. However, it is now believed that those with IDD can improve their health status through countless PA intervention types

(Johnson, 2009; Krahn et al., 2006). However, it appears that having a disability does impact an individual's ability to engage in such activities (Polfuss, Dobson, Sawin, & Klingbeil, 2019). To alleviate the consequences of IDD, early recognition and intervention, such as PA participation are paramount (Patel et al., 2010). Additionally, it is recommended that a multidisciplinary approach that includes family, friends, and/or clinicians is conducted to engage youth with IDD to participate in PA (Cooper & Quatrano, 1999). Due to a more significant impact of developing chronic secondary conditions, researchers must focus on ways to control the obesity rates for this population. As previously stated, children and youth are expected to accumulate at least 60 minutes of MVPA daily. However, current evidence suggests that only approximately 23.1% (confidence interval = 22.2% to 24.0%) of children (ages 6 to 17 years) without IDD are meeting current PA recommendations (Child & Adolescent Health Measurement Initiative, 2016). When compared to their peers, youth with IDD are even less likely to meet current PA recommendations. For example, the NCHPAD has reported that the PA levels of children and youth with IDD are 4.5 times less than their peers (The National Center for Health Physical Activity and Disability, n.d.). Additionally, the National Survey of Children's Health (NCSH) found that about 11% of children with cerebral palsy, 17% of children with autism spectrum disorder, and 18% of children with Down syndrome (all ages 6 to 17 years) are meeting current recommendations (Hughey et al., 2016).

General PA Levels of Youth with IDD.

One of the first investigations that explored the PA of youth with IDD was conducted by Suzuki, Saitoh, Tasaki, Shimomura, Makishima, and Hosoya (1991). The purpose of the investigation was to survey youth with IDD (ages 3 to 22 years) from Tokyo regarding their nutritional and PA status. A total of 690 individuals (418 males) with IDD including those with hearing impairments (n = 261; 165 males), visual impairments (n = 120; 66 males), ID (n = 217; 136 males), and physical disabilities (n = 92; 51 males) volunteered to participate in the investigation. PA, measured as steps per day, was assessed using a pedometer (AM-5; Yamasatokei Company; Tokyo, Japan). Overall, males performed significantly more steps per day compared to females (males: 15,800 ± 9,000 steps per day vs females: 12,700 ± 7,500; $p < .05$). Those with hearing impairments had significantly ($p < .05$) higher steps per day compared to all other groups. Additionally, there were significant sex differences in steps per days in those with hearing impairments (males: 18,700 ± 7,700 steps per day vs females: 16,100 ± 6,700; $p < .05$). Those with visual impairments had significantly higher steps per day compared to those with physical disabilities ($p < .05$). Additionally, there were significant sex differences in steps per days in those that with visual impairments (males: 13,500 ± 7,400 steps per day vs females: 11,900 ± 6,500; $p < .05$). Those with ID had significantly higher steps per day compared to those with physical disabilities ($p < .05$). Additionally, there were significant sex differences in steps per days in those with ID (males: 16,000 ± 10,200 steps per day vs females: 12,300 ± 7,400; $p < .05$). Finally, there were no significant sex differences in steps per day for those with physical

disabilities (males: 9,200 ± 6,900 steps per day vs females: 6,900 ± 6,500) (Suzuki et al., 1991).

Using a survey, Longmuir and Bar-Or (1994) explored baseline data of the PA patterns of a large sample of children and adolescents with physical disabilities, sensory impairments, or chronic illnesses. Individuals were included if they were a.) 6 to 20 years; b.) had a disability; and c.) had the cognitive ability to complete a survey. A total of 987 youths from Ontario, Canada (physical disability: n = 342; chronically ill: n = 374; sensory impairment: n = 241) completed the Canada Fitness Survey. Participants were classified as either active, moderately active, or sedentary based on the sum of their habitual activity in a variety of settings (maximal score = 150). Approximately 39% of participants were classified as active (≥25.0 activity points based on questionnaire), 32% were classified as moderately active (16.0 to 25.0 activity points based on questionnaire), and 29% were classified as sedentary (<16.0 activity points based on questionnaire). Additionally, 52% and 41% felt limited by their ability to be active and limited by peer participation respectively. It also appeared that PA levels remained constant until 10 to 15 years in which PA levels displayed a significant gradual declined ($p < .01$). This was evident by a 16% to 30% increase in the number of individuals that were classified as sedentary after the age of 18 years (Longmuir & Bar-Or, 1994). Using a waist worn Actigraph GT11M accelerometers (ActiGraph, Pensacola, FL) to assess PA, Phillips and Holland (2011) found that individuals with ID (n = 152; ages 12 to 70 years), spent approximately 10 hours of their waking day engaging in sedentary behaviors. Approximately 2 hours of their waking day was spent engaging in light

intensity PA, and 33.7 minutes and 2.1 minutes of their waking day was spent engaging in moderate and vigorous intensity PA respectively. For those individuals that were included in the study, age was associated with a decrease in total PA ($F(1, 146) = 8.9$; $p < .001$) and MVPA ($F(1, 146) = 7.5$; $p < .001$) (Phillips & Holland, 2011).

Using MTI 7164 accelerometers (MTI Health Services, Fort Walton Beach, FL), Pan and Frey (2006) examined the PA patterns of youth with autism spectrum disorder ages 10 to 19 years. Individual where divided into 3 age groups: elementary (n = 9), middle (n = 9), and high (n = 12) school. Additionally, the Child/Adolescent Activity Log (CAAL) was used to evaluate daily PA patterns. Overall, 47% of individuals in the study accumulated 60 minutes of MVPA daily. According to grade level, 78% of elementary school, 67% of middle, and <1% of high school individuals met MVPA recommendations. Finally, the CAAL showed that children in elementary school engaged in 30 minutes of PA during non-school hours compared to 43 and 17 minutes for middle and high school students respectively (Pan & Frey, 2006). Lin, Lin, Lin, Chang, Wu, and Wu (2010) examined the self-reported PA patterns of 351 adolescents with ID (ages 16 to 18 years) in Taiwan. They found that about 30% of individuals with ID displayed regular PA patterns. Only 8% of the participants included in the investigation met the Taiwanese PA recommendations (30 minutes of PA 3 days per week) (Lin et al., 2010). Likewise, Bingham, Boddy Ridgers, and Stratton (2015) found that only 20% children with autism spectrum disorder, behavioral or emotional challenges, and other disability types met PA recommendations (Bingham, Boddy, Ridgers, & Stratton, 2015). Using the Actigraph GT1M (Actigraph, Pensacola, FL),

Downs, Fairclough, Knowles, and Boddy (2016) found that individuals with ID (ages 5 to 15 years) spent an average of 49.4 minutes engaged in MVPA and only 23.7% of these individuals met the current 60 minute per day guidelines. Additionally, about 6.9 hours per day were spent participating in sedentary behaviors (Downs, Fairclough, Knowles, & Boddy, 2016).

Foley and McCubbin (2009) explored the sedentary behaviors (watching TV or computer usage) of children with and without ID (ages: 7 to 12 years). Additionally, they wanted to determine if PA, assessed by the Actiwatch AW 16 accelerometer (Mini Mitter, Inc., Bend, OR), was related with these behaviors. A total of 50 individuals (9 with ID; 6 males) had their sedentary behaviors recorded by their parents using an after-school activity log. Individuals with ID spent more time watching television (ID: 57 ± 44 minutes per day vs No ID: 49 ± 22 minutes per day), and less time using the computer compared to their peers (ID: 34 ± 51 minutes per day vs No ID: 34 ± 51 minutes per day), however these differences were not statistically significant. Additionally, children with ID that participated in more screen time were more physically active than those that did ($r = .56$; $p = .04$) which was different from their peers that displayed a non-significant inverse relationship ($r = -.11$; $p = .64$) (Foley & McCubbin, 2009).

Recently, Lobenius-Palmer, Sjoquivist, Wennlof, and Lundqvist (2018) compared the PA levels, time spent performing sedentary behaviors and percentage of those meeting the current PA recommendations of 102 youths (ages 8 to 16 years) following 7 days using the waist-worn Actigraph GT1M accelerometer (Actigraph, Pensacola, FL). Participants were recruited from the Childe and Youth Habilitation Centre Region of

Orebro County, Sweden. Of the 102 individuals that participated in the investigation 16 were diagnosed with a physical or visual impairment (PVI; n = 5 cerebral palsy), 42 were diagnosed with ID (ID; 4 with Down syndrome), 24 were diagnosed with autism spectrum disorder without ID, and 19 were diagnosed with a hearing impairment (HI). When compared to their peers, each of the disability groups participated in lower levels of PA, spent less time engaged in light intensity PA, and spent more time engaging in sedentary behaviors. However, there were no statistically significant differences in these variables based on disability type. Except for those with ID, all disability groups spent significantly less time engaging in MVPA compared to peers. However, there were not statistically significant difference between any of the groups. Additionally, there was a significant influence of age on MVPA for those in the PVI group (B = -8.37, standard error of B [SE] = 1.84; $p < .001$), ID group (B = -10.12, SE = 1.69; $p < .001$), autism spectrum disorder group (B = -9.39, SE = 3.18; $p < .001$) and HI group (B = -12.25, SE = -.067; $p < .001$). Age had a significant influence on time spent engaging in sedentary behaviors with older individuals engaging in more sedentary behaviors than younger individuals for both the ID group (B = 10.32, SE = 3.54: $p < .01$) and the HI group (B = 13.22, SE = 22.97; $p < .01$). Approximately 31% of individuals with PVI, 52% with ID, 40% with autism spectrum Disorder, and 84% with HI met the World Health Organization's PA recommendations (60 minutes of PA daily). Finally, it appeared that for those with autism spectrum disorder and ID there was reduction in the number of individuals that meet PA recommendations with an increase in age. They concluded

that the PA for all disability groups was suboptimal and interventions to increase PA levels are necessary (Lobenius-Palmer et al., 2018).

Studies Comparing the PA levels of Youth with and Without IDD.

The differences of the PA levels of those with various disabilities and their peers remains inconclusive. Some investigations have found statistically significant differences between groups whereas other have not. Nonetheless, most studies have reported that when compared to peers those with IDD have lower PA levels. For example, a study conducted by Steele and colleagues (1996) found that Canadian children with physical disabilities ages 11 to 16 years, were almost five times more likely to be physically inactive and engaged in more than four hours of television viewing compared to peers (Steele et al., 1996).Likewise, using the PA Questionnaire for Adolescents, Maher, Williams, Olds, and Lane (2007) found a 36% variation in overall PA levels in individuals with cerebral palsy (n = 112) compared to their peers (n = 566). Additionally, they found an inverse association between overall PA and age ($F = 4.19$; $p = .03$), suggesting that PA decreases with age (Maher, Williams, Olds, & Lane, 2007).

Foley, Bryan, and McCubbin (2008) compared the PA levels of elementary school students (ages 7 to 12 years) with and without ID using the Actiwatch AW 16 accelerometer (Mini-Mitter, Bend, OR). Students were included if they a.) were diagnosed with mild ID; b.) participated in 100% of general physical education class; c.) absence of an orthopedic impairment; and d.) ID without Down syndrome. A total of 42 individuals (9 with ID) participated in the study. PA was analyzed at four different time periods including recess (15 to 20 minutes), inclusive physical education (30 minutes),

after school during weekdays (2:35 pm to 7:30 pm) and during weekends (9:00 am to 7:30 pm). In addition, classroom logs were completed by teachers to determine if the student was absent during data collection. Those with ID engaged in significantly less PA during recess (ID: 187.32 ± 47.73 counts per 15 seconds vs Non-ID: 287.34 ± 85.78 counts per 15 seconds; $p < 0.001$), physical education (ID: 188.06 ± 131.10 counts per 15 seconds vs Non-ID: 438.73 ± 103.91 counts per 15 seconds; $p < 0.001$), after school (ID: 135.28 ± 43.99 counts per 15 seconds vs Non-ID: 205.67 ± 51.08 counts per 15 seconds; $p < 0.001$), and during the weekend (ID: 135.29 ± 34.68 counts per 15 seconds vs Non-ID: 180.49 ± 45.44 counts per 15 seconds; $p < 0.001$) (Foley et al., 2008). Conversely, Rintala and colleagues (2011) compared the MVPA of a large cohort ($n = 6179$) of Canadian and Finnish children ages 13.5 to 15.5 years old using the Moderate-to-Vigorous Intensity Physical Activity Screening Measure. They found no significant differences in MVPA levels when comparing both countries as well as to peers without IDD. However, none of the individuals included in the investigation accumulated 60 minutes of MVPA daily (Rintala et al., 2011).

Bandini and colleagues (2013) compared the PA levels of children with autism spectrum disorder and their peers (ages 3 to 11 years) using both the Actical accelerometer (Phillips Respironicsl, Bend, OR) and a parental PA questionnaire. Using counts per minute, there were no significant differences in time spent in light, moderate, vigorous and total MVPA. For those without IDD, 43% engaged in 60 minutes of MVPA daily compared to 23% of those with autism spectrum disorder ($p < 0.06$). Finally, parents of those with autism spectrum disorder reported that their children participated

in fewer activities (autism spectrum disorder: 6.9 activities per year vs controls: 9.6 activities per year; $p < .0001$) and spent less time participating in these activities annually (autism spectrum disorder: 158 hours vs controls: 225; $p < .0001$) (Bandini et al., 2013). Using the Actigraph GT1M (Actigraph, Pensacola, FL), Einarsson and colleagues (2014) found that children with ID (6 to 16 years) were 40% less physically active and spent 9% more time performing sedentary activities than their peers. Additionally, none of the children with ID, included in their study, met current PA recommendations compared to 40% of their peers that were meeting such recommendations (Einarsson et al., 2015). A meta-analysis performed by Jung, Leung, Schram, and Yun, identified 11 articles that compared the PA levels of youth with IDD to those without IDD (age 4 to 20 years). The authors found that children without IDD engage in higher levels of MVPA ($g = .66$; $SE = .18$, $p < .05$). However, there were no differences in light intensity PA for both groups. Additionally, children with IDD engaged in less PA than children without IDD at younger ages and age did appear to have an overall impact on PA (<12 yr, $g = 0.83$, $SE = 0.24$, 95% CI [0.37, 1.29], $p < .05$, and >13 yr, $g = 0.37$, $SE = 0.10$, 95% CI [0.18, 0.57], $p < .05$; Q value = 3.20, df = 1, $p < .05$) (Jung, Leung, Schram, & Yun, 2018).

Recently, Stanish, Curtin, Must, Phillips, Maslin, and Bandini (2019) compared the MVPA, type of PA, and frequency of PA in youth with and without ID (ages: 13 to 21 years). A total of 98 individuals (38 with ID) had their weekly PA levels assessed using the Actical accelerometer (Actigraph, Pensacola, FL) affixed to their hip for a full week. MVPA was determined using cut-points, developed by Puyau, Adoph, Vohra, Zakeri

and Butte (2004) (Puyau et al., 2002). PA type and frequency was determined through structured interviews. Those with ID spent significantly less time engaging in MVPA compared to those without IDD (ID: 33.5 minutes per day vs No ID: 46.5 minutes per day; $p > .05$). On weekdays, those with ID spent significantly less time engaged in MVPA compared those without IDD (ID: 36.9 minutes per day vs No ID: 50.8 minutes per day; $p > .05$). There were no significant differences between the MVPA levels that were accumulated on weekends; however, those with ID did engage in less PA compared to their peers (mean difference = 11.0 minutes per day; 95% Confidence Interval = -3.1 to 25.1). Additionally, significantly fewer individuals with ID meet current PA levels when compared to peers (ID: 6% vs No ID: 29%; $p > .001$). Females with ID participated in more PA compared to their female peers (ID: 47.1 times per month vs no ID: 28.2 times per month; $p = .008$) and more activities (ID: 7.8 activities vs No ID: 5.2 activities; $p = .001$); however, there were no statistically significant difference in PA frequency between males (Stanish et al., 2019).

PA Preferences of Youth with IDD.

It appears that the types of PA that youth with IDD participate in differs from their peers. For example, during play, children with autism spectrum disorder have been shown to prefer activities such as isolated play, parallel play (playing near a peer without interactions), and orientation (watching but not interacting) (Wolfberg, 2009). Furthermore, those with autism spectrum disorder tend have difficulties with overall play and pretend play development (Pellegrini, 2015). Using the Children's Assessment of Participation and Enjoyment, Law and colleagues (2006) found that children with

physical disabilities (n = 427) preferred recreational, social, and self-improving activities as opposed to active physical and skill-based activities. Additionally, they preferred informal to formal activities (informal activity score = 3.42 ± 0.73 vs formal activity score = 1.10 ± 0.62). Finally, it appeared that total participation in activities decreased with age (6 to 8 years: 2.80 ± 0.54 vs ≥ 12 years: 2.57 ± 0.66; $p < .01$) (Law et al., 2006). Moreover, it appears that for youth with physical disabilities, those with increased motor skills are more likely to participate in leisure activities (Bult, Verschuren, Jongmans, Lindeman, & Ketelaar, 2011). Woodmansee, Hahne, Imms, and Shields (2016) found that when compared to their peers, children with IDD (ages 6 to 17 years) are less likely to participate in athletics, team sports, snow sports, playing games, and non-team sports. Additionally, children with multiple disabilities were less like to participate in athletics, cycling, individual physical activities, non-team sports, playing games, and teams sports, and more likely to participate in dancing, horse riding, and playing on equipment. Finally, children with IDD reported higher enjoyment in participating in swimming activities and a lower enjoyment in participating in individual activities (Woodmansee, Hahne, Imms, & Shields, 2016). Stanish and colleagues (2019) found that the 10 most common activities for individuals with ID (in order) were basketball, swimming, walking/hiking, active video gaming, dancing, bowling, running/jogging, bicycling, weightlifting, and baseball softball. Which were different compared to their peer that ranked running/jogging, active video gaming, walking/hiking, swimming, basketball, bicycling, dancing, football, weightlifting, and baseball/softball as their most common activities (Stanish et al., 2019).

Barriers to PA.

For individuals with IDD of all ages, a variety of PA barriers have been citied in literature (Rimmer & Rowland, 2008; Shields et al., 2012). It is believed that many of these barriers will hinder and/or possibly exclude these individuals from participating in PA (Block, Taliaferro, & Moran, 2013). One example of a PA barriers that has been cited in literature, is an inability to understand the benefits of PA (Jobling & Cuskelly, 2006; Mulligan, Hale, Whitehead, & Baxter, 2012).This includes a lack of knowledge pertaining to exercise equipment operation (Prellwitz & Skär, 2007) and available options to engage in PA (Hawkins & Look, 2006). For example, Jobling and Cuskelly (2006) found that only 53% of youth with Down syndrome (ages to 18 years; n = 38) could identify the benefits of PA. They also found that only 11% of these participants could correctly identify pictures of healthy and unhealthy activities. None of the participants could correctly identify the recommended dosage of PA necessary to maintain a healthy lifestyle (Jobling & Cuskelly, 2006).

Additionally, it is believed that there are environmental constraints which includes accessibility limitations, transportation issues, and building design flaws that may hinder the ability of a youth with IDD to engage in PA (Mulligan et al., 2012; Rimmer, Riley, Wang, Rauworth, & Jurkowski, 2004). For example, Prellwitz and Skar (2007) examined how children with different abilities use playgrounds to engage in creative play and social interactions. A total of 20 individuals (9 girls; mean age 9.4 ± 1.67 years), with different abilities (n = 5 with mobility restrictions; n = 5 with severe visual impairments; n = 5 with developmental disabilities; n = 5 without disabilities) were interviewed for the investigation. In this investigation, some of the environmental barriers cited were a.) a

lack of appropriate facilities; b.) inconvenient locations; c.) equipment was not suitable to meet their needs; d.) playground equipment was difficult to understand; and e.) fear of mocking from their peers. Conversely, the participants without disabilities did not cite any equipment related barriers and spent much of their time at playgrounds (Prellwitz & Skär, 2007). More recently, Rimmer, Padalabalanarayanan, Malone, and Mehta (2017) using the Accessibility Instrument Measuring Fitness and Recreation Environment (AIMFREE) tool, examined the accessibility and usability of 227 fitness facilities located in 10 states. A score of above 70 was considered to be a good first step for compliance of the fitness facility. A majority of facilities failed to meet the 70-point threshold that was established by the AIMFREE with the exception of programs, parking and water fountains sections of the scale. This suggests that most fitness facilities are not accessible or usable for individuals with IDD despite compliance with the *Americans with Disabilities Act* (Rimmer, Padalabalanarayanan, Malone, & Mehta, 2017).

Another barrier to PA participation that is often cited for youth with IDD is a lack of appropriate programs for youth offered to youth (Kodish et al., 2006; Martin, 2004). Aside from the a limited number of programs that are offered throughout the year, there are significantly less opportunities for youth with IDD to participate in sports and recreation at the same rate as their peers (Kasser & Lytle, 2005). Spencer-Cavaliere and Watkinson (2010) explored the perspective of inclusive PA participation of children with physical disabilities. A total of 11 children (2 girls; mean age = 10.5 years) with disabilities, including cerebral palsy, fine and gross motor delays, developmental coordination disorder, muscular dystrophy, nemaline myopathy, brachial plexus injury,

and severe asthma were interviewed using semi structured techniques. The three themes discovered in this investigation, were a) gaining entry to play; b) feeling like a legitimate participant, and c) having friends. These factors were cited as those that helped or hindered the ability of the participants to engage in free play (Spencer-Cavaliere & Watkinson, 2010). Also, Anderson and colleagues (2005) explored the recreational habits of girls with physical disabilities ages 10 to 16 years old. A total of 14 girls participated in semi structured face to face interviews. One common barrier reported in the investigation was a lack of formal program opportunities for these individuals to participate in (Anderson et al., 2005).

A final barrier to PA for youth with IDD, that has often been cited in literature, is staff attitudes with working with those with disabilities (Schreiber et al., 2004). For example, Wilkinson (1987) reported that play environment supervisors cited a.) fear of isolating the child; b.) increased risk of harming the child; c.) concerns that working with those with disabilities; d.) an increase emphasis on competitive sports; and e) fear of accidents during inclusion as possible PA barriers (Wilkinson, 1983). Jones (2003) used parental focus groups to explore the barriers to recreation participation for children (ages 5 to 35 years old) with IDD. A common barrier to recreation participation reported by the parents was the negative attitude of recreation works and community members towards those with disabilities (Jones, 2003). In a review conducted by Moran and Block (2010) fear of legal action as well as inadequate adaptation knowledge were cited as the most common barrier to participation in youth sports. Additionally, youth sport

coaches reported a lack of knowledge and training as a major barrier to sports participation for this population (Moran & Block, 2010).

A recent systematic review conducted by McGarty and Melville (2018) explored parental perceptions of facilitators and barriers to PA participation for youth with ID. Eligible studies were those that were either qualitative or quantitative and explored facilitators or barriers from the perspective of parents with children with ID. Studies were excluded if <50% of the parents sampled investigated children that were 18 years or younger with ID. A total of 10 studies were included in the review and they ranged from strong to weak in terms of study quality. From this review, five third-order themes were developed as facilitators or barriers to PA. One of the third order themes reported in this investigation, was a lack of information for parents, a lack of expert coaches/physical education teachers, parental time constraints, cost, transportation requirements, and parental concerns. Child factors which included limited skills of the child and anatomical characteristics of their disability as PA barriers was also cited as a third-order theme. In addition, children's experiences of PA which included their negative view and experiences of the activity of barriers was cited as a third-order theme. Social motivation which included limited number of friends as a barrier was also cited as a third-order theme. Finally, inclusive programs and facilities which included lack of inclusive programs as a barrier was cited as the a third-order theme (McGarty & Melville, 2018).

Special Education

For most students, learning occurs within the general curriculum taught by teachers with limited to no adaptations. However, for some students, general education

program and services are not considered adequate. To meet their individualized needs, these students may be placed into a more appropriate setting, and/or receive other programs and services. This is referred to as *special education* (Friend, 2014). Current law defines special education as specially designed instruction at no cost to parents, that is intended to meet the unique needs of a child with a disability. This includes a) instruction in a variety of settings (classroom, home, hospitals and instruction, and in other settings); and b) instruction during physical education class (U.S. Department of Special Education Programs, 2010, 20 U.S.C. 1401[29]). Thus, for these students, special education provides an opportunity to receive education specifically designed to help maximize their learning experience (Friend, 2014). This includes any instruction in general or special education classrooms, community-based life and work skills training, and specialized assistance in areas such as physical education and vocational preparation (Friend, 2014).

A component of special education is related services, which are anything that a child receives to enable them to have and benefit from public education (Friend, 2014). Included in related services are general recreation and therapeutic recreation (U.S. Department of Special Education Programs, 2010, 20 U.S.C. 1401[26]). It is important to note that related services are directly associated with the student's educational instruction and are necessary for instructional access. Thus a student is only eligible for related services if it is deemed necessary to meet their Individualized Education Program (IEP) goals (Friend, 2014). Additionally, all students that qualify for special education are entitled to supplementary aids and services. This means that students

receive as needed supports, access, and instructional adjustment that allow them the opportunity to succeed similar to their peers (Friend, 2014). It is important to note that all special education related services, provided by public schools are free to parents. Finally, students that qualify for special education related services are entitled to accommodations (changes to how the student learns key curriculum) and/or modifications (what the student learns) (Friend, 2014). Ultimately, like their peers, the goal of education for those with IDD, is to prepare them for an independent and fruitful adult life (Friend, 2014).

Laws Related to Special Education.

The first federal law to clarify the rights of students with IDD was the *Elementary and Secondary Education Act of 1965* (P.L. 89-750), which provided funding to states to improve the current practices and programs for these students (Yell, 2012). The efforts to improve special education was furthered, in 1974 when congress passed the *All Handicapped Children Act*. This law further increased the funding for public education as well as required states to create full educational opportunities for student with IDD (Friend, 2014). Changes to *All Handicapped Children Act* occurred in 1975 (P.L. 94-142) which is considered the foundation for subsequent special education practices. Much of these changes addressed the current issues that were being challenged by parents and advocates of those with IDD (Yell, Katiyannis, & Hazelkorn, 2007). However, many changes have been made to this law over the years (Yell, 2012). One such example is the inclusion of services for infants and young children. The law was renamed in 1990 to *Individuals with Disabilities Education Act* (IDEA). This

reauthorization also clarified the supports need for student for transitional periods (Friend, 2014). Significant additions were made in 1997 including disciplinary procedures, expansion of parent participation, clarified roles for general education teachers for instructing students with IDD, and consideration of assistive technology as part of an education plan (Friend, 2014). Continuing to refine and revise IDEA, the most recent reauthorization (2004), focused on ensuring that this law is consistent with other federal education laws as well as provided additional strategies for parents (Friend, 2014).

The laws that were developed for special education were not only revolutionary, but also have a variety of positive effects (Osgood, 2008). Specifically, these laws have afforded educational opportunities for those that they previously not afforded, provides an objective method for qualifying student's assessment, grant parental rights, and provides clear and outlined procedures for discussing disagreements (Friend, 2014). Since first passing IDEA, additional court cases have occurred which have help to shape special education. For example, *Board of Education of the Hendrick Hudson Central School District v. Rowley* (1982) ruled that free appropriate public education is met if the IEP is reasonably developed to allow a child to receive education benefits (Katsiyannis, Yell, & Bradley, 2001). Furthermore, this ruling stated that services must provide appropriate education and there is no optimal services mandated by the law (M. Friend, 2014). *Irving Independent School District v. Tatro* (1984) ruled that health-related services that are needed for students can performed by non-physician are considered a related service. *Cedar Rapids Community School District v. Garrett F*.

(1999) ruled that health services that are necessary for a child with a disability by the IEP team are required to be provided as long as a specialized individual can perform these services (Katsiyannis et al., 2001).

Core Principles of IDEA.

Based on the information included in IDEA, there are a variety of core principles that guide the delivery of special education, related services, and supplementary aids. These principles are designed to ensure that all children's educational rights are met (Friend, 2014). For example, *zero reject*, allows all students with IDD the right to public education regardless of type and/or nature of their disability. To ensure this, a set of procedures that alerts the public about the services available for those with IDD known as *child find*, has been put in place for all states (Friend, 2014). This principle is based on the ruling of the *Pennsylvania Association for the Retarded Children v. The Commonwealth of Pennsylvania* which ruled that children with ID should have the opportunity to receive traditional academic instruction as well as instruction tailored to meet their needs and *Mills v. Board of Education* which ruled that standardized procedures must be followed to determine the placement of children with IDD in special education. Additional benefits of this policy are the prevention of exclusion of those with communicable diseases and policies for handling those with disabilities that commit serious offenses (Friend, 2014).

An additional principle that impacts students with disabilities, is *free appropriate public education* which entitles all students to public education. Specifically, this principle states that parents and family members cannot be asked to provide financial

compensation for special education services (Friend, 2014). This includes the absence of compensation for special education, related services, and transportation for students that an IEP team determines necessary for the child to succeed. *Free and appropriate public education* states that the student's education plan must include specially designed instruction, related services, and supplementary aids and services, based on their IEP goals (Etscheidt & Curran, 2010).

The IEP is a document, that all students within special education receive, which captures all the decisions made through special education assessment, eligibility, and instructional planning procedures (Friend, 2014). This document serves as the blueprint for services that a student is to receive (e.g. recreational therapy), and clarifies the type and amount of these services (Kurth & Mastergeorge, 2010). The members of the IEP team may include parents, special education teacher, general education teacher, a school district representative, an individual who can interpret the results of any evaluation, representatives from outside agencies providing transition services, the student, and others with knowledge of the student (Friend, 2014). All members can be excused from IEP meetings if the parent and school district agree that this member is not necessary (Etscheidt, 2007). There are a variety of documents that must be included in the IEP forms. One such example is present level of performance which included accurate and current information about a wide range of the student's abilities (academic, social, behavioral, communication, physical, vocational, etc.).

Additionally, annual goals, which are objectively measured major accomplishments that are expected of the student in the preceding 12 months should

be included in this document (Friend, 2014). For those with significant needs, short-term goals (minor steps that lead to accomplishment of larger goals) or benchmarks (major milestones) are included in IEP documents (Gibb & Dyches, 2000). Likewise, special education and related services (e.g. therapeutic recreation) are included in this document. Also, supplementary aids and services that support participation and the extent in which the student should participate in general education should be considered and included in the IEP (Friend, 2014). The IEP team must also indicate all accommodations needed for state and district testing and include a statement of why the testing is or is not appropriate for the student. The dates in which the IEP becomes effective and for how long as well as specifying measurable transitional postsecondary goals must be included (Friend, 2014). The age in which the student's rights have been transferred from their parent to them and the student's progress in meeting goals and objectives are to be measured and included in the IEP document. Finally, any special situation related to the student (e.g. provisions for using Braille for a student that is visually impaired) must also be included in this document (Friend, 2014).

An additional principle of IDEA is the *least restrictive environment*. This principle is related to how the student receives *free appropriate public education* and states that students must be placed in an environment in which they are most likely to succeed academically (Friend, 2014). The default protocol is that students be included in general education; however, if a student needs to be in a smaller classroom, the educator must justify why this is best for the student. *Nondiscriminatory evaluation* ensures the unbiased assessment of any part of the special education decision-making process that

IDEA outlines for parents and students (Friend, 2014). This law, based on the rulings of *Mills v. Board of Education* and *Larry P. vs Riles,* ensures that tests: a.) are administered in the native language of the child; b.) are age and characteristically appropriate; c.) use more than one disability assessment; d.) results are administered and interpreted by a knowledgeable professional; and e.) all areas of the suspected disability are assessed (Yell & Drasgow, 2007).

IDEA also requires that information regarding the student's disability is *confidential* and only shared with those working directly with the student. Parents do, however, have the right to request to view and obtain copies of all their child's information as well as contend and/or determine its accuracy (Friend, 2014). A final principle of IDEA that may impact students with IDD are procedural *safeguards*. This principle states any decision that concerns a student with a disability can only be accomplished with parental input as well as be in compliance with IDEA (Friend, 2014). Thus, parents must provide written consent before any disability assessments can occur. Likewise, parents must be invited to all meetings concerning their child and give permission before their child can receive special education. Furthermore, any disputes between parents and administers must follow a series of steps to ensure that safeguards are in place (Friend, 2014). Thus, these six principles help to ensure that the student receives the education they deserve.

Additional Provisions.

There are a variety of additional provisions within IDEA. As previously stated, transitional services, which are services that prepare a student for leaving schools, must

be addressed by a student's IEP team starting at the age of 16 years (Friend, 2014). Since special education teachers are instrumental to the education of students that qualify for special education, they must obtain two types of credentials. Not surprisingly, one of these credentials is a certificate to teach special education. Unless the teacher works with students with significant ID, those that work in secondary schools, must also be documented as being highly qualified in teaching all core subjects areas (Friend, 2014). Those that work in general education settings do not need this documentation as the general education teacher has fulfilled this requirement. Those working in elementary special education are already considered qualified to teacher core subjects, therefore, this additional documentation is not necessary (Friend, 2014). Generally, school districts have 60 days, from when the parent agrees that their child should be evaluated for special education to decide their qualification for these services. For most, reassessment occurs every three years; however, this may be modified.

Another provision of IDEA is that school districts must follow steps to ensure that there is not an overidentification of specific race and ethnicity groups within special education (Friend, 2014). According to IDEA, a student is required to have their academic progress measured by either standardized assessments or an alternate assessment process. For both, students are entitled to appropriate accommodations based on their IEP. Discipline for inappropriate behaviors of a student are also included as part of the student's IEP, if needed (Friend, 2014). For situations where the student is suspended or placed in an interim placement a behavior plan must be developed. Typically, interim placements can last up to 45 days and are contingent on determining

the next steps (Friend, 2014). Once these steps are agreed upon students are entitled to return to their special education services. Paraprofessionals or related personnel must be trained and appropriately supervised to work in the school setting (Friend, 2014).

Additional Laws.

Two additional laws have also been passed to ensure that children and adults with disabilities have their civil rights met. One of these laws, *Section 504 of the Rehabilitation Act of 1973* (Section 504), which was enacted by congress created the first civil rights legislation. This Act was passed with the intention to protect the rights of those with disabilities (Friend, 2014).This law states that no qualified person, based on their disability, should not be excluded form participation in, denied from the benefits of, or any other form of discrimination from programs or institutions that receive or benefit from federal financial assistance (Section 504, 29 U.S.C. 794[a]). According to Section 504, a disability is defined as any impairment that significantly limits one or more major life activity (walking, seeing, hearing, and learning). Section 504, protects discrimination against those with disabilities from federally funded programs, which includes public education (Guthrie & Council of Administrators of Special, 2006). Contrasting, IDEA, Section 504 does not have allocated federal finances to support services, thus, any service or support provided to the student through this law is paid for by the local school district (Friend, 2014).

Additionally, the *Americans with Disabilities Act of 1990* (ADA), which is considered the most comprehensive legislation to protect the rights of those with

disability regardless of age may also benefit those within the public-school system (Office for Civil Rights, 2009). ADA applies to both public and private sectors which includes libraries, state and local governments, hotels, theaters, transportation systems, and stores (Rozalski, Katsiyannis, Ryan, Collins, & Stewart, 2010). Specifically, ADA ensures that all buildings, buses, trains, etc. are accommodating to those with disabilities. Additionally, those with disabilities cannot be discriminated in the workplace because of their impairments (Friend, 2014). It is, therefore, important that educators be aware of ADA as there may be additional supports and services that can be obtained outside the school setting. IDEA, Section 504, and ADA ensure that the rights of those with disabilities are protected in all situations throughout their lifetime (Friend, 2014).

Prevalence of Children that Qualify for Special Education.

IDEA defines 13 specific categories for disabilities and only those classified with one of these defined disabilities are eligible for the services related to special education. These disabilities include specific learning disabilities, speech or language impairments, ID, emotional disturbance, multiple disabilities, hearing impairments, orthopedic (or physical) impairments, other health impairments, visual impairments, autism, Deaf/blindness, traumatic brain injury, and developmental delays (Friend, 2014). A definition for each of the categories is included in Appendix A. According to the U.S. Department of Education, in 2015-2016, 6.7 million (13%) of all students ages 3-21 years, enrolled in public schools, receive special education services. Furthermore, 34% of these students qualified for special education under a specific learning disability, 20% qualified due to speech or language impairments, 14% qualified due to other health

impairments, 9% qualified due to autism, 6% qualified due to developmental delay, 6% qualified due to ID, 5% multiple qualified due to multiple disabilities, 1% qualified due to hearing impairments, and 1% qualified due to orthopedic impairments (U.S. Department of Education, 2017-2018).

Additionally, the U.S. Department of Education found that 17% of children that qualified for special education services identified as American Indian/Alaska Native, followed by 16% of those that qualified identified as Black, 14% of those that qualified identify as White, 13% of those that qualified identified as two or more races, 12% of those that qualified identified as Hispanic. Likewise, 12% of those that qualified identified as Pacific, and 7% of those that qualified identified as Asian (U.S. Department of Education, 2017-2018). Except for Asians, the largest percentage of students that received services for special education were those with specific learning disabilities. Also, a higher percentage of males (17%) qualified for special education services under IDEA than females (9%) (U.S. Department of Education, 2017-2018). The percentage of students that spent most of their day (≥80%) inside a general education classroom was 63%. The percentage of students that spent 40-79% of their day inside a general education classroom was 19%. The percentage of students that spent less than 40% of their day inside a general education classroom was 14% (U.S. Department of Education, 2017-2018).

What is Physical Education?

Physical education, which has been part of educational curriculum for over 100 years, has a variety of goals including providing students with knowledge, skills,

abilities, and confidence to be physically active (Sallis et al., 2012). It is often considered to be one of the most common school-based methods to promote PA worldwide (Hills, Dengel, & Lubans, 2015). This may be because physical education is ubiquitous and may have benefits the extend beyond the classroom (Lonsdale et al., 2013). The National Association for Sport and Physical Education, which provides the recommended standards for most physical education curriculum in the United States, recommends that elementary and secondary schools should provide 150 minutes and 225 minutes of physical education each week, respectively (United States Department of Health and Human Services, 2008). Although there is no formal definition or standard for physical education, Sallis and McKenzie (1991) suggested that all physical education is considered adequate if a.) students are prepared for lifetime of PA; and b.) each class period provides an opportunity to accumulate PA (Sallis & McKenzie, 1991). Thus general physical education curriculum should provide students an opportunity to be more active during and outside of the classroom while also developing a lifelong commitment to PA (Barr-Anderson et al., 2008).

Addressing the former of the goals of a quality physical education program, recommended by Sallis and McKenzie (1991), has been difficult (Sallis et al., 2012). However, a recent article by Ladwig and colleagues (2018) found that negative attitudes toward physical education were associated with increased sedentary behaviors during adulthood (Ladwig, Vazou, & Ekkekakis, 2018). This suggests that those that have a negative physical education experience are more likely to not participate in lifelong PA. However, the National Association for Sport and Physical Education has established

standards for physical education including that those participating in physical education learn skills to perform a variety of activities, become physically fit, and engage in PA throughout life (National Association for Sports & Physical Educaiton, 1995). This suggests that creating a lifelong PA participation is a major goal of the physical education curriculum (Sallis et al., 2012). Understanding the latter goal of physical education, has provided more conclusive results as it is currently believed that contemporary physical education curriculum provides a valuable contribution to a child's daily PA levels (Tudor-Locke, Lee, Morgan, Beighle, & Pangrazi, 2006).

There are a variety of benefits that can occur from physical education classes. This includes building and maintaining healthy bones and muscles, reducing the risk of obesity, and reducing the risk of depression and anxiety (Centers for Disease Control and Prevention, 2010). Additionally, PA may improve a student academically (Block, 2016). For example, Coe and colleagues (2006) found that improved academic performance occurred when students accumulated more vigorous intensity PA outside of the school setting (Coe, Pivarnik, Womack, Reeves, & Malina, 2006). Additionally, quality physical education has been shown to lead to the development of motor and leisure skills, and improved perception of self-worth (Graham, 2019). Because of the benefits of physical education classes, it has been recommended by the Centers for Disease Control and Prevention, that 50% of class is spent engaging in MVPA (Pate et al., 2006). Due to the benefits of physical education, Every Student Succeeds Act does consider physical education as a core component of a well-rounded student (Every Student Succeeds Act, 2015).

Due to the diversity of state requirements, current physical education curricula are broad and not well understood (Lounsbery, McKenzie, Trost, & Smith, 2011). Thus, the prevalence and structure of physical education within the public school system varies from state to state (Block, 2016). A survey conducted by the National Association for Sport and Physical Education and the American Heart Association (2012) evaluated the status of American physical education. They found that most states (74.5%) mandate physical education for grades K to 12. However, most of these states do not mandate a specific amount of time, and many provide substitutions for physical education (National Association for Physical Activity and Exercise & The American Heart Assoication, 2012). Additionally, it was found that approximately, 84.3% of elementary schools, 80.4% of middle schools, and 86.3% of high schools' nationwide, mandate physical education. At the elementary level 31.4% of states specify a minimum number of minutes of PA that must be accumulated per day and or week. Finally, currently only 3 states (New Jersey, Louisiana, and Florida) require students to accumulate the nationally recommended amount of PA per week (150 minutes) (National Association for Physical Education and Exercise, 2012).

Current School-Based PA Recommendations.

It appears that similar to many other PA related programs, physical education and the PA levels associated with it are insufficient (Pühse & Gerber, 2005; World Health Organziation and Department of Noncommunicable Disease & Health, 2003). For example, Coe and colleagues (2006) found that a 55 minutes physical education class only resulted in 19 minutes of MVPA (Coe et al., 2006). There are a variety of

reason that may explain why physical education classes are not providing sufficient PA. For example, a study conducted by Morgan and Hansen (2008) determined that the five most common barriers to quality physical education were a.) lack of time and or crowded curriculum; b.) inadequate departmental assistance and professional development; c.) lack of money; d.) insufficient facilities and equipment; and e.) large class size (Morgan & Hansen, 2008). Similarly, Barroso and colleagues (2005) found that the greatest teacher reported barriers to quality physical education were related to a large class size and low priority compared to other academic subjects (Barroso, McCullum-Gomez, Hoelscher, Kelder, & Murray, 2005). Qualitatively, it is reported that adults believed their worst physical education memories were related to embarrassment (34%), lack of enjoyment (18%), bullying (17%), social–physique anxiety (14%), class-related injury (16%), and to being punished by the PE teacher (2%) (Ladwig et al., 2018).

Strides have been made to increase PA levels during physical education (McKenzie & Lounsbery, 2009). For example, Congress passed a law that mandated federally funded schools to establish a wellness policy by 2006 (P.L. 108-265). Thus, federally funded schools were required to focus on determining ways to increase school-based PA levels and to use physical education to provide a prudent solution to further increase these behaviors (McKenzie & Lounsbery, 2009). There are also many programs that have been developed to help to increase PA during physical education classes. One such example, is the *School Health Index*, which provides tools to help identify strength and weaknesses of school based PA and physical education and

provide strategies to improve both (American Academy of Pediatrics Council on School Health, 2016). Additionally, the American Heart Association (AHA) has released scientific reports known as *Promoting PA in Children and Youth*, that are designed to provide quality physical education (American Heart Assoication, 2010). One suggestion of AHA is to provide evidence-based quality physical education which ensures at least 50% of the class period is spent engaging in MVPA and should include motor and behavioral skills related to participating in lifelong PA. AHA also believes that quality physical education should be taught by certified and highly qualified physical education teachers. School districts should be held accountable for by state programs to ensure that they are meeting the national standards for physical education. Finally, colleges should prepare students to teach high quality and evidenced based physical education (American Heart Assoication, 2010).

What is Recess?

Recess is defined by Pellegrini and Smith (1993) as a break period for children that usually occurs in an outdoor environment (Pellegrini & Smith, 1993). Compared to physical education class, recess is thought to be an important opportunity for children to engage in unstructured free play (Ramstetter, Murray, & Garner, 2010). This is important as most children spend most of their waking periods within the school setting. However, much of the school day is spent within the classroom. This is concerning as school-age children have less opportunities to work together within the classroom setting (Epstein, 1989) and teachers often separate children from their friends for fear off-task behaviors and distractions (Zajac & Hartup, 1997). Thus, limited opportunities

exist for play and social interactions with peers for school-age children during the school day. Recess is therefore, believed to be one of the only opportunities within the school day for play and social development (Baines & Blatchford, 2011). Currently, it is estimated that 90% of all school districts have recess. Of the schools that provide recess, 96% of recess occurs at least 2 times per week. Finally, 75% of these schools have a recess period lasting 15 to 20 minutes (Pellegrini, 2006). Furthermore, recess is the only time in the school day that children can freely interact and play with others without the constraints of teachers (McNamara, Lodewyk, & Franklin, 2018).

The historical roots and rationale for recess and play in United States remains unclear. However, since many early 20th century buildings uniformly lacked playgrounds, it is speculated that recess was not part of the school day at this time (Pellegrini, 2006). It was not until American psychologist, G. Stanley Hall, advocated for play as an essential component to childhood development that administrators, teachers, and parents began to value play and thus recess (Cairns, 1983). It is believed that programs such as the Child Study and the Kindergarten and the Playground Movement were advocated to help children socialize and eventually developed into recess (Pellegrini, 2006).

Because of the benefits associated with PA, many organizations including, Centers for Disease Control and Prevention, National Association for Sports and Physical Education, and National Association of Early Childhood Specialists in State Departments of Education, recommend that children engage in unstructured recess during the school day (Educational Resources Information, 2000). Currently, recess

opportunities continue to decline for children of all ages and grade levels (Waite-Stupiansky & Findlay). Still, many individuals discredit recess and believe this time would be more productively spent in the classroom. Nevertheless, evidence suggest that play during recess can actually improve learning and therefore the benefits of recess outweigh its costs (Pellegrini, 2006).

School-PA Trends.

Aside from physical education and recess there are a variety of other opportunities for children to accumulate in PA throughout the school day. This includes active breaks, school sports, active after school-programs, and active transportation to school (Pate et al., 2006). However, these opportunities have shown to be limited. For example, active transport to school has decreased for students that live more than a mile from school (Johnson, 1998). Allowing mandatory physical education, developing a standardized physical education curricula, providing modified recess, having classroom activity breaks, modifying school playgrounds, and increasing active transportation programs can greatly increase the PA levels of children (Bassett et al., 2013). However many studies have shown that children are not achieving adequate PA opportunities during school (Fairclough et al., 2016; McKenzie & Lounsbery, 2009).

Currently, almost all of schools in Tennessee are meeting PA requirements through the use of recess (97%), walking (73%) and ball activities (73%) (Tennessee Department of Education, 2018). The most common methods to increase PA within the school were walking tracks (76 school districts), parental PA interventions (48 school districts), and teacher training for active PA breaks (40 school districts) (Tennessee

Department of Education, 2017-2018). For Tennessee, the most common reported barriers associated with PA in elementary schools were concerns that PA will decrease academic time (55%), lack of time for implementing programs (36%), and lack of consequences for noncompliance to the standards (33%) (Tennessee Department of Education, 2017-2018). For middle school, the most common barriers associated with PA were concerns that PA will decrease academic time (54%), lack of time for implementing programs (51%), and lack of consequences for noncompliance to the standards (35%) (Tennessee Department of Education, 2017-2018). For high school, the most common barriers associated with PA were concerns that PA will decrease academic time (66%), lack of time for implementing programs (65%), and lack of consequences for noncompliance to the standards (45%) (Tennessee Department of Education, 2017-2018).

Approximately, 86% of Tennessee school systems reported following the PA state standards established by the Office of Coordinated School Health during the 2017-2018 school year. Additionally, 42% of Tennessee public schools reported to exceed the minimal requirement for school-based PA (Tennessee Department of Education, 2018). Approximately, 94% of elementary schools, 82% of middle schools, 66% of high schools reported following the PA state standards established by the Office of Coordinated School Health during the 2017-2018 school year (Tennessee Department of Education, 2017-2018).

In general, public education provides a promising prospect for children to accumulate PA as it provides both structured and unstructured PA opportunities (Baker

et al., 2017; McKenzie, Crespo, Baquero, & Elder, 2010; McKenzie, Marshall, Sallis, & Conway, 2000; Naylor & McKay, 2009; Slater, Nicholson, Chriqui, Turner, & Chaloupka, 2012). However, according to the 2018 United States Report Card for Children and Youth, the indicator for public school PA was a D-. This grade is defined as succeeding with only 20% to 26% of children and youth (Katzmarzyk et al., 2018). It appears that the school offers a logical solution for students with IDD to accumulate PA (Mâsse et al., 2012). This is promising because a supportive inclusive, and structured environment, like physical education is suggested for children with IDD to accumulate PA (Pan et al., 2014). Aside from physical education classes, recess has also been shown to provide an opportunity for youth with IDD to accumulate PA (Lorenzi, Horvat, & Pellegrini, 2000; Sandt & Frey, 2005). Furthermore, recess has been shown to be a time in which children with autism spectrum disorder can develop social skills which suggests additionally benefits are possible (Harper, Symon, & Frea, 2008). Thus, it is important to provide enjoyable physical education and recess to students with IDD as this has been shown to positively impact their ability to engage in PA (Jin, Yun, & Agiovlasitis, 2018).

It is recommended that all children accumulate at least 30 minutes of the entire school day accumulating MVPA (U.S. Department of Health and Human Services, 2016). Additionally, it is recommended that students spend at least 50% of their physical education class participating in MVPA (Pate et al., 2006; U.S. Department of Health and Human Services, 2016). Finally, during recess, it is recommended that children spend between 40% to 50% of the period in engaged in MVPA (Ridgers, Salmon, Parrish, Stanley, & Okely, 2012; Stratton & Mullan, 2005). However, it appears that students

with IDD are not accumulating enough PA during both the total school day and these periods. This may be because physical educators put an increase emphasis on competition which may limit the opportunity for youths with IDD to engage in PA during this period. Also, a decreased emphasis on inclusion during physical education, which has also been cited in literature, may also hinder the ability for this population to engage in PA (Rimmer & Rowland, 2008). Aside from physical education classes, school-based PA opportunities may be hindered by a.) inappropriate facilities; b.) inability to adapt programs for students with disabilities; and c.) lack of attention by administration for addressing these barriers (Dunn & Leitschuh, 2014; Murphy & Carbone, 2008). Finally, special education teachers may not have the training to teach PA and recreation behaviors which may also hinder the ability for those with IDD to participate in school-based PA (Block, 2016).

To explore the facilitators and barriers to physical education of students with autism spectrum disorder, Healy, Msetfi, and Gallagher (2013) conducted structured interviews. A total of 12 students (ages 9 to 13 years old) from southwest Ireland volunteered to participate in the investigation. When discussing barriers to physical education of individuals with autism spectrum disorder, three themes emerged. The themes included a.) individual challenges; b.) peer interactions; and c.) exclusion. For individual challenges, subthemes that emerged where lack of physical ability and fitness (n = 10), sensory issues (n = 3), and fear of injury (n = 4). For peer interactions, camaraderie (n = 4), and initiation of friendships (n = 2) were cited as positive subthemes of physical education. Conversely, negative peer interactions (n = 5) and

negative social comparisons (n = 4) emerged as negative subthemes related to the peer interactions theme. A total of 7 individuals reported exclusion from physical education as a theme related to their experiences. Specially, 2 participants reported that they were asked to leave an activity. Additionally, students reported lack ability (n = 5) and their own request to be excluded as subthemes for exclusion (Healy, Msetfi, & Gallagher, 2013).

More recently, Bertills, Granlund, Dahlstrom, and Augustine (2018) explored the relationship between physical education teaching and student self-efficacy to determined how this association impacts physical education aptitude and functional skills. A total of 23 physical education teachers from 26 different class teaching 439 students ages 13 years volunteered to participate in the investigation. The General Self-Efficacy Scale and the Self-Efficacy in Physical Education and Health tool were used to evaluate self-efficacy. The Aptitude to Participate in Physical Education was used to determined aptitude to participate in physical education. The Abilities Index was used to determine the students physical and socio-cognitive skills. A scale was developed to allow the teachers the opportunity to subjectively rate their teaching styles. They found a significant correlation between teachers rating of the classroom climate with general school self-efficacy (Spearman's rho = .132; $p < .01$), aptitude to participate in physical education (Spearman's rho = .176; $p < .01$), and self-efficacy in physical education (Spearman's rho = .110; $p = .05$). Teaching skills were correlated with aptitude to participate in physical education (Spearman's rho = .136; $p < .01$) and movement self-efficacy (Spearman's rho = .118 $p < .01$). For teaching those with IDD there was a

negative correlation between teaching skills and general self-efficacy, aptitude to participate in physical education, and physical education self-efficacy. This suggests that for students with IDD teaching physical education based on a criterion-reference may not be appropriate. Finally, there was a moderate to strong correlation between social cognitive skills and general school self-efficacy (Spearman's rho = .587; $p < .01$), aptitude to participate in physical education (Spearman's rho = .407; $p < .01$), and physical education self-efficacy (Spearman's rho = .467; $p < .01$) (Bertills, Granlund, Dahlström, & Augustine, 2018).

PA during Physical Education and Recess

Assessing PA during these periods have produced equivocal results, making it difficult to generalize. This may be due to different PA activity assessment tools being used, as well as the heterogeneity of the participants (Sandt & Frey, 2005). However, it does appear that students with IDD are not meeting school-based PA recommendations (at least 50% of physical education and 40-50% or recess engaged in MVPA). For example, Faison-Hodge and Porretta (2004) used the SOFIT to explore the PA levels during physical education and recess periods for third, fourth, and fifth grade students with and without ID. A total of 46 (males = 25) students ages 8 to 11 years were divided into one of three groups. This included those with mild ID (n = 8; Intelligence Quotient: 45 -70) and students without IDD that were classified as either those with low cardiovascular fitness (n = 19; LCRF) or those with high cardiovascular fitness (n = 19; HCRF) based on Fitnessgram Progressive Aerobic Cardiovascular Endurance Run scores. PA information was collected during a 4-week physical education lesson plan

that consisted of 5 to 8 classes lasting approximately 30 minutes and during 15-minute recess sessions. All groups participated in significantly more MVPA during recess compared to physical education ($F [1,70] = 296.52$, $p < .001$). They found that those with HCRF engaged in the highest amount of MVPA during both recess and PE (recess = 72% ± 18.8; physical education = 28% ± 15.1) compared to both the LCRF (recess = 65% ± 12.6; physical education = 21% ± 12.3) and ID groups (recess = 65% ± 25.5; physical education = 23% ± 16.4). The similar PA levels of all groups, albeit low, suggest that students with mild ID can participate in general physical education classes (Faison-Hodge & Porretta, 2004). Likewise, using the SOFIT, Hsu and Pan (2006) found that youth with ID spent 30.96% (12.07 ± 5.21 minutes) of physical education classes engaged in MVPA (Hsu & Pan, 2006).

Using both subjective (Behavior of Eating and Activity for Children's Health: Evaluation System) and objective (MTI 7164 accelerometer; MTI Health Services, Fort Walton Beach, FL) PA activity measures, Sandt and Frey (2005) found no significant differences in PA levels between those with and without autism spectrum disorder ages 5 to 12 years old. However, when compared to their peers, individuals with autism spectrum disorder did engage in lower MVPA in all four domains. This included all day PA (autism spectrum disorder: 127.5 ± 72.3 minutes vs 162.1 ± 45.6 minutes), during physical education class (autism spectrum disorder: 12.8 ± 6.8 minutes vs 16.7 ± 4.8 minutes), during recess (autism spectrum disorder: 15.5 ± 8.8 minutes vs 22.6 ± 7.8 minutes), and after school (autism spectrum disorder: 51.9 ± 35.7 minutes vs 66.2 ± 22.8 minutes) (Sandt & Frey, 2005). Conversely, Pitetti, Beets, and Combs evaluated

the MVPA behaviors using the Polar S410 heart rate monitor (Polar Electro, Kempele, Finland) of 15 students (9 girls; mean age: 8.8 ± 2.2 years) with ID during school. MVPA was collected during adapted physical education (55 minutes), classroom activities (55 minutes), and during recess (25 minutes). Students spent 43.0, 20.9, and 19.6 minutes in MVPA in adapted physical education, classroom activities, and during recess respectively. Overall, students spent 83.5 minutes per day engaging in MVPA. This suggests that the school environment provides students with IDD sufficient time to accumulate recommended levels of MVPA (Pitetti, Beets, & Combs, 2009).

Hestens and Carroll (2000) examined the play interactions and beliefs of both children with and without IDD in an inclusive setting. A total of 29 preschool aged children (8 with IDD) volunteered to participate in the study. The disabilities were classified as developmental delay or visual impairment. Play behaviors were observed during free play time, indoor and outdoor. Levels of play were classified as either cooperative, social conversation, parallel play, rough activity, solitary play, on-looking, transition, or other. Behaviors were observed following a 3- to 4-minute scan, focusing on a central child. Forty-three observations were collected on each child. They found that during school free time, both children with and without UDD engaged in gross motor activities and spent the least amount of time playing in sensory activities. Typically developing children spent more time (~50%) in cooperative play, whereas children with disabilities spent more time in solitary play and onlooking behaviors. However, children with disabilities spent time in cooperative play (~30%), this suggest that inclusion during play is possible (Hestenes & Carroll, 2000).

Sit, McManus, McKenzie, and Lian (2007) examined the PA of children with IDD (physical disability, mild ID, hearing impairment, visual impairment) during physical education and recess using the SOFIT on 2 school days over a 2-week period. A total of 172 children (physical disability: n = 42; ID: n = 79; hearing impairment: n = 18; visual impairment: n = 34) enrolled in five different special education schools in Hong Kong grades 4 to 6 volunteered to participate in the investigation. Physical education lessons lasted between 35 and 40 minutes 2 days per week. Sessions ranged from 100 to 225 minutes per week. During physical education students spent an average of 41.9% (7.9 minutes) engaged in MVPA. Approximately, 32% of the lesson was allocated for fitness activities, followed by 27.5% of the time spent on skill practice and 24.5% of the time on management. Additionally, teachers spent 40% of their time focusing on general instruction and 27% of the time on managing their students or the environment. There were no significant differences between disabilities regarding the MVPA; however, there were significant effects in lesson context and teacher behavior. Those with visual and hearing impairments, spent a greater percentage of engaging in PA knowledge lessons when compared to those with physical disabilities (physical disability: 15.9 ± 2.5 vs hearing impairment: 0.0 ± 0.0 and visual impairment: 1.4 ± 0.4; $p < .001$). Compared to those with visual impairments, those with physical disabilities spent a greater percentage of time engaging in game play activities (physical disability: 23.5 ± 4.3 vs visual impairment: 0.0 ± 0.0; $p < .001$). Teachers that taught at schools for students with visual and hearing impairments, spent a greater percentage of time promoting fitness then teachers at school for students with ID (ID: 18.4 ± 3.3 vs hearing impairment: 0.2 ±

0.1 and visual impairment: 1.9 ± 0.6; $p < .05$). Teachers at schools for students with visual impairments, spent a greater percentage of time demonstrating fitness then teachers at school for students with ID (ID: 15.8 ± 2.8 vs visual impairment: 3.4 ± 0.7; $p < .05$). Compared to teachers that taught at schools for students with ID and hearing impairments, teachers at school for students with visual impairments spent a greater percentage of time providing general instruction (visual: 69.4 ± 15.8 vs hearing impairment: 38.5 ± 6.2 and ID: 29.8 ± 5.4; $p < .001$). Finally, those with physical disabilities spent significantly more time sitting compared to the ID groups (physical disability: 50.0 ± 8.8 vs ID: 15.0 ± 2.5; $p < .05$) (Sit, McManus, McKenzie, & Lian, 2007).

In this investigation, during recess, students spent approximately 47% and 58% (8.9 minutes) of their time engaging in walking and MVPA respectively. Compared to all other groups, those with physical disabilities spent a greater percentage of time engaging in sitting behaviors (physical disability: 53.5 ± 9.1 vs ID: 24.4. ± 3.9; $p < .05$; visual impairment: 0.0 ± 0.0 and hearing impairment: 0.0 ± 0.0; $p < .001$). Compared to those with physical disabilities and ID, those with visual impairments spent more time engaged in walking behaviors (visual impairments: 77.1 ± 9.3 vs physical disability: 27.0 ± 4.8 and ID: 44.1 ± 7.7; $p < .001$). Those with physical disabilities and visual impairment, spent more time engaged in vigorous behaviors than those with hearing impairments (hearing impairments: 23.6 ± 3.8 vs physical disability: 1.6 ± 0.3 and visual impairments: 0.0 ± 0.0; $p < .05$). Those with physical disabilities, spent more time engaged in MVPA than those with hearing and visual impairments (physical disability: 28.6 ± 5.1 vs hearing impairments: 71.5 ± 11.5 and visual impairments: 77.1 ± 9.3; $p <$

.05). Overall students accumulated 61.2 (14.6%) minutes of school recommended 420 minutes of MVPA. Those with hearing impairments reached 16.5% of school recommended minutes of MVPA followed by those with ID (15.2%), those with visual impairments (15.0%), and those with physical disabilities (8.9%) (Sit et al., 2007).

Moreover, Sit, McKenzie, Lian, and McManus (2008) explored the PA levels during recess and physical education periods using the SOFIT for students with mild ID attending either a high sports focus (HSF) or low sports focus (LSF) schools. A total of 80 children (26 girls) from Hong Kong in grades fourth- (n = 25), Fifth- (n = 20) and sixth grade (n = 35) volunteered to participant in the investigation. Both schools had two 35-minute physical education class per week. However, the LSF group had two 15-minute recess periods whereas the HSF had three 15-minute recess periods per week. A total of 24 physical education lessons were observed. Overall students spent only 9.1 minutes of the physical education lesson engaging in MVPA and 50.4% of their time sitting and standing. Most of the lesson consisted of primary skill practice (36.6%), followed by management (29.8%), promoting fitness (18.4%), and demonstrating fitness (15.8%). Students in the LSF, spent a greater percentage of time sitting than those in the HSF school (HSF: 23.2 ± 3.7 vs LSF 3.3 ± 0.7; $p < .05$) and a lower percentage of time standing (HSF: 24.4 ± 3.9 vs LSF 50.8 ± 10.9; $p < .001$). Compared to students in the LSF schools, those in the HSF school spent a greater percentage of time learning about physical education knowledge (HSF: 12.2 ± 1.9 vs LSF 3.8 ± 0.8; $p < .05$). Teachers in the HSF spent a lower percentage of time managing the classroom (HSF: 25.8 ± 4.1 vs LSF 39.8 ± 8.7; $p < .05$). During recess, 57% (4.6 minutes) of the period

was spent engaging in MVPA. Additionally, the HSF group accrued an additional 1.1 minutes of MVPA, but these differences were not statically significant. Finally, the weekly minutes of PA accrued (calculated as number of physical education minutes per week x physical education MVPA% + number of recess minutes per week x recess MVPA%) was higher in the HSF school (HSF: 145.7 vs 134.1 minutes) (Sit et al., 2008).

Pan (2008) used the ActiGraph GT1M uniaxial accelerometer (Actigraph, Pensacola, FL) to compare the percent of time that students with and without autism spectrum disorder spent in MVPA during recess. A total of 24 children with autism spectrum disorder (female = 1) and 23 children without autism disorder (female = 1) ages 7 to 12 years old (mean age = 8.1 ± 1.4 years) from 14 different schools had their PA assessed over a 5-day period. Those with ID and severe behavioral problems that required formal interventions were excluded from the investigation. Twelve individuals with mild or high functioning autism and three with Asperger's syndrome were included in the investigation. Each participant attended one recess period in the morning, during lunch, or in the afternoon. The average recess periods lasted 33 minutes, 48 minutes, and 38 minutes for the morning, lunch, and afternoon recess periods respectively. Accelerometers were worn on the right hip of each participant. Children with autism spectrum disorder engaged in an average of 7.5 less minutes of MVPA during recess compared to those without disabilities (autism = 27.6 minutes vs without disabilities = 35.0 minutes). There were significant differences in the percentage of time spent in MVPA between groups (autism = 27.7% vs without disabilities = 36.2%; $p < .010$). Additionally, early primary school children with autism spectrum disorder were less

active than older school-age children with autism spectrum disorder (older individuals = 24.1 ± 7.8% vs younger individuals = 31.0 ± 10.3%) (Pan, 2008).

Pan, Liu, Chung, and Hsu (2014) used the Actigraph GT1M accelerometer (Actigraph, Pensacola, FL) to compare the PA levels of individuals with and without ID during physical education and recess. A total of 80 Taiwanese students (ID in inclusive classroom: n = 20; ID in self-contained classroom: n = 40; and No ID: n = 40) ages 12 to 17 years volunteered to participate in the study. Both general and adapted physical education classes last approximately 45 minutes whereas recess periods lasted 55 minutes. Recess included three 10-minute morning periods and two afternoon periods (10 and 15 minutes respectively). Accelerometers were worn on the hip for five consecutive days. Trost cut-points were used to determine the intensity of PA (Trost et al., 1998). Students with ID in the inclusive classrooms spent 25.8 ± 16.2% (11.3 ± 16.2 minutes) of the physical education and 17.9 ± 15.5% (8.4 ± 8.7 minutes) of recess engaged in MVPA. Students with ID in the self-contained classrooms spent 25.3 ± 16.8% (10.9 ± 7.4 minutes) of the physical education and 9.0 ± 4.3% (3.2 ± 1.8 minutes) of recess engaged in MVPA. Finally, students without ID spent 32.7 ± 17.5% (14.4 ± 7.8 minutes) of the physical education and 21.4 ± 17.6% (10.8 ± 9.7 minutes) of recess engaged in MVPA. During physical education class there were no significant differences in MVPA, however those in self-contained classrooms spent significantly lower amount of time engage/d in MVPA during recess compared to their typically developing peers (-12.8%; $p < .05$). They concluded that an inclusive, structured, and supportive environment promotes PA for adolescents with ID (Pan et al., 2014).

Boddy, Downs, Knowles, and Fairclough (2015) explored the habitual PA and recess play behaviors of 70 school age children (ages 5-15 years old; 15 boys) with ID, using the Actigraph GT1M accelerometers (Actigraph, Pensacola, FL) and systematic observation techniques (System for Observing Children's Activity and Relationships during Play ([SOCARP]). Four special education classes from different schools were investigated in this cross-sectional study. Students were classified as either autism spectrum disorder or non-autism spectrum disorder, based on their primary disability. The SOCARP is a 10 second sampling method that using intervals between observation and recording. Only 23% of individuals achieved ≥ 60 minutes of PA per day. The participants spend most of their time walking or standing and no time lying down. None of the participants engaged in large group play and spent significant time in either small group or solitary play. The participants engaged in playing games within a small group, being sedentary, and playing sport related activities. Correlational analysis suggests that children playing in small groups spent significant time either standing or being sedentary (Boddy, Downs, Knowles, & Fairclough, 2015).

Bingham, Boddy, Ridgers, and Stratton (2015) examined the PA levels and play behaviors during recess of youth with IDD. A total of 29 children (27 boys) ages 8 to 16 years old attending three special education schools in North West England, volunteered to participate in the study. PA was objectively measured using the Actigraph GT1M uniaxial accelerometer (Actigraph, Pensacola, FL) for 7 consecutive days. The SOCARP was used to examine levels, social group size, activity types, and social interactions of the children during recess. Twenty-two recess periods were observed, 10

of which were observed in real time, while the remaining 12 were recorded and observed later. A large percentage of recess time was spent engaging in sedentary activities (53% ± 26.5), followed by MVPA (47% ± 26.2), walking (35% ± 20.6) or standing (34% ± 19.2). A majority of recess time was spent either alone (42.8% ± 36.6) or in a small group (40.8% ± 31.7) (Bingham et al., 2015).

Sit and colleagues (2017) used the Actigraph GT3X accelerometer (Actigraph, Pensacola, FL) to assess the PA levels and sedentary behaviors during school of children with various disabilities. A total of 259 children (visual impairment: n = 21; hearing impairment: n = 12; physical disability: n = 27; mild ID: n = 91; moderate ID: n = 59; severe ID: n = 35; and social development problems: n = 13) ages 6 to 23 years old (mean age: 13.04 ± 4.45 years) wore an accelerometer on their hips, during three days within a one-month period. The Evenson cut-points were used to determine MVPA and sedentary behaviors of the participants (Evenson et al., 2008). Overall, students spent 17 minutes (4.2%) of their day engaging in MVPA, 106 minutes (25.8) of their day engaged in light PA, and 298 minutes (70.0%) of their day engaged in sedentary behaviors. More specifically, the students spent 7.2 (13.2%) minutes during physical education class, 3.0 minutes (9.4%) during recess, and 2.9 minutes (4.5) during lunchtime engaged in MVPA (Sit et al., 2017).

Recently, Sit, Huang, Yu, and McKenzie (2019) examined the seasonal variation of PA levels and sedentary time measured by Actigraph GT3X accelerometer (Actigraph, Pensacola, FL) for students with IDD during physical education, recess, and lunchtime. A total of 13 different special schools located in Hong Kong, designed to

accommodate children with visual impairments (n = 1 school), hearing impairments (n = 1 school), ID (n = 10 schools) and social development problems (n = 1 school) participated in the school. A total of 270 students (visual impairments: n = 21; hearing impairment: n = 11; physical disabilities: n = 24; ID [mild]: n = 11; ID [moderate]: n = 58; ID [severe] n = 33; and social developmental: n = 12) were used in the final analysis of data. Data collection occurred during the winter (November 2013 to March 2014) and Summer (June to July 2014). Participants were asked to wear an accelerometer on their right hip. The cut-points developed by Evenson and colleagues (2008) were used to classify MVPA (cut-points: ≥ 2296 cmp) and sedentary time (cut-points: ≤ 100 cpm). For both seasons, approximately 70% of their day was spent participating in sedentary activities. Additionally, for both seasons, students were most active during physical education (winter MVPA: 13.0%; summer MVPA: 12.5%) compared to recess (winter MVPA: 9.4%; summer MVPA: 7.1%) and lunchtime (winter MVPA: 4.5%; summer MVPA: 3.9%). On average students a greater amount of time engaged in MVPA during the winter months compared to the summer (winter = 4.5% [18.6 minutes] vs summer = 4.0 [15.6 minutes]). Finally, students engaged in higher amounts of PA during the winter than summer (b = 0.39; 95% confidence interval = 0.11 to 0.67) (Sit, Huang, Yu, & McKenzie, 2019).

Social-Ecological Model

Current evidence suggests, that most successful programs for promoting health are based on understanding the behavior and the situation in which they occur (Glanz, Rimer, & Viswanath, 2008). Thus, when developing strategies to increase PA, one must

consider a variety of variables and layers. The social-ecological model is an approach that focuses not only on the intrapersonal behaviors, but also factors that may influence these behaviors (Mehtälä et al., 2014). The social-ecological model is considered to be a framework or theoretical guideline that helps to understand the interrelations among diverse personal and environmental factors in human health and illness (Stokols, 1996). This comprehensive approach has several factors that are interrelated and influence an individual's engagement in PA. Thus, this model focuses on the interrelationships between the person and their social, physical, and policy environments (Stokols, 1996). More specifically, within the model there are *person factors* such as sex, self-efficacy, and age, *interpersonal factors* which include peers, family, and teachers, the *organizational factors* which include the home, neighborhood, the school, and related policies, the *community factors* which includes examples such as the standards, partnerships with organizations, and norms, and *public policy* which include all national and local regulations and laws (Bronfenbrenner, 1974; McLeroy, Tones, Steckler, Goodman, & Burdine, 1992).

Due to the complexities of human behaviors, creating and sustaining lifelong PA presents a challenge. For all children, understanding and implementing interventions to increase PA may be more difficult than it is for adults (Pate & Dowda, 2019). This is due to the wide range of factors including personal, social, and environmental, that will influence PA behaviors (Sallis, Prochaska, & Taylor, 2000; Sterdt, Liersch, & Walter, 2014). For the individual child, increasing PA behaviors can occur through clinically based PA assessments and counseling. For the interpersonal factors modifying parental

behaviors and the home environment may increase PA behaviors (Pate & Dowda, 2019). From an organizational perspective, possible intervention strategies include physical education modifications, developing active school programs, and modifications of policies. From a community perspective, PA interventions may include enhanced out of school programs, youth sport program adaptations, increasing active transportation opportunity, and improving the built environment. Finally, from a public policy perspective developing mass media campaigns to promote PA and changes to federal and state policies may help to improve these behaviors (Pate & Dowda, 2019).

Empirical evidence suggests that PA participation may be impacted by interpersonal, organizational, and policy factors (Pate & Dowda, 2019; Ward, Vaughn, McWilliams, & Hales, 2010). It is believed that an individual's environment can provide a potent source that enables or hinders PA behaviors (Stokols, 1996). For example, a person's environment can be considered safe or dangerous which may influence PA behaviors (Stokols, 1992). In terms of promoting PA as a health behavior, this model has been suggested as an ideal approach as promoting lifelong PA is too complex to be understood from only one level. Rather a comprehensive approach that includes the psychology, organizational, cultural, and community level may be more fitting (McLeroy et al., 1992; O'Donnell, 1994). To fully utilize this model one must identify potential targets and leverage for change to promote PA (Ward et al., 2010). One such example to promote PA is though public education. It is believed that this model is useful for understanding the factors and barriers that influence PA behaviors.

Since the social-ecological approach has provided promising results, researchers should determine situations, variables, and/or factors that induce PA engagement (Sallis, Bauman, & Pratt, 1998). Thus, it is important to determine environments that may increase PA opportunity and behaviors. The school setting provides a pragmatic opportunity to increase PA (Pate & Dowda, 2019). The reason that public education system is a compelling environment to induce PA, is because it is ubiquitous as many children attend school for 12 years or more. Additionally, nationwide public education follows a similar framework and thus is very generalizable (Pate & Dowda, 2019). As previously stated, physical education provides a great opportunity for children to increase activity levels; however, there are additional strategies to increase PA within the school.

For the purpose of this project, only the organizational component of this approach will be addressed using the public education system. Furthermore, the targeted behavior will be PA (Bronfenbrenner, 1974; Russell R. Pate & Dowda, 2019). Public education was chosen because it provides a promising prospect for youth to accumulate both structured and unstructured PA (Baker et al., 2017; Thomas L. McKenzie et al., 2010; Naylor & McKay, 2009; Slater et al., 2012). It is believed that public education has been integral in the provision of PA for centuries. In addition to physical education, unstructured recess appears to provide a substantial opportunity to not only be active, but to develop critical movement skills (Ridgers et al., 2012). The spontaneity associated with playing during recess, may not only improve PA levels, but other critical skills can be addressed. This is because recess has been shown to have

widespread merit including academic, cognitive, emotional, and social benefits (Ramstetter et al., 2010). Juxtaposed to physical education class, recess is thought to be an important opportunity for children to engage in unstructured free play (Ramstetter et al., 2010)

CHAPTER THREE
MATERIALS AND METHODS

Study Design

A cross-sectional design was employed to compare the physical activity (PA) levels between children with and without intellectual and/or developmental disabilities (IDD) during the school day. Prior to date collection, parents and/or guardians of eligible students, received a parent package to review. Within this handout, two informed consents (one to be returned and one for the parent/guardian's records), a parent letter, and demographic information handout was included. Parents and/or guardians were asked to review and complete these handouts to be eligible for participation. Completed handouts were returned to the child's primary homeroom teacher. Following the collection of anthropometric data, participants' total school-day PA was assessed using accelerometry. Concurrently, PA and its related contexts were assessed using direct observation during physical education and recess using SOFIT and OSRAC-E, respectively. All assessments were separated by at least 24 hours. The methods of this study were approved by the affiliated university and the governing school district's Institutional Review Boards.

Participants

Participants were first and second graders attending a primary school (K-2) in the southeastern region of the United States. There were 1005 students enrolled in this school (male: 50.6%; female: 49.4%) for the 2018-2019 academic year. A total of 6.9% of students attending this school are eligible to receive free or reduced meals during the school. The racial breakdown of students attending this school is 76.8% white, 10.5%

Asian, 9.0% Hispanic, 3.0% African American, 0.4 Hawaiian/Pacific Islander, and 0.3% Native American. Finally, 10.1% of students were diagnosed with a disability (Tennessee Department of Education, 2019).

Classrooms that included at least one child with an Individualized Education Program (IEP) enrolled in the general physical education and recess periods were eligible to participate in the investigation. This allowed for a direct comparison of the PA levels during the various periods. Additionally, due to the limitations of accelerometry, only students that were ambulatory were eligible to participate in the investigation.

Instrumentation

Accelerometer.

Accelerometers are small, lightweight instruments that measure an individual's accelerations that can then be converted and used to estimate the intensity of PA (Chen & Bassett, 2005). An Actigraph GT3X+ (Actigraph, Pensacola, FL) accelerometer was worn on the hip during the total school day. Hip-worn accelerometers were positioned above the right iliac crest of the axillary line of the participant by a trained researcher. Devices were distributed in the morning and collected at the end of each school day (approximately 6 hours), by a trained researcher that was responsible for affixing and ensuring that the device was attached to the correct wear location site.

Housed in each device are triaxial accelerometers which measures accelerations in anteroposterior, mediolateral, and vertical orthogonal planes. The devices were initialized to collect and sample raw data at 30 Hz (i.e. 30 samples per second). The ActiLife software (ActiLife, version 6.13.4) was used to store, manage, and analyze the

acceleration data. Data were converted to total vector magnitude (VM [counts per minute]). Raw accelerations in terms of VM and minutes of PA behaviors (sedentary, light, moderate, and vigorous) were estimated by the Evenson cut-points (Evenson et al., 2008). Although there are not established cut-puts for individuals with IDD, the Evenson cut-points have been used to assess PA in children with IDD (example: Einarsson, et al., 2015) as well has have been shown to be the most accurate accelerometer based PA monitor for the population of interest (Trost et al., 2011).

System for Observing Fitness Instruction Time (SOFIT).

The System for Observing Fitness Instruction Time (SOFIT), was used to evaluate the students' PA type, lesson context, and teacher behavior during a physical education class. This tool, which was developed by McKenzie, Sallis, and Nader (1992), is a momentary time sampling and interval recording system that was created to determine the factors associated with health-related PA. More specifically, SOFIT was developed to evaluate the variables associated with the PA and related PA opportunities for students during physical education classes (McKenzie et al., 1992). Additionally, SOFIT has been shown to be a valid and reliable tool to measure the PA levels of youth with IDD during physical education classes (Faison-Hodge & Porretta, 2004.). Within this observation tool, there was a systematic three phase decision making process that included how active the students are (Phase 1), how the class time was structured for tasks and goals (Phase 2), and how the instructor spent their class time (Phase 3). Except for teacher behavior (Phase 3), all observations followed a 20-second interval procedures (10 second observation interval; 10 second recording

interval). For the student activity context (Phase 1), only one child was observed per interval. Each focal child was observed for 12 intervals (4 minutes total) per round. Following this, a new focal child was observed for 12 intervals. This process continued for the duration of the physical education period. Four total students were observed during each observation period. For lesson context (Phase 2), the activity of more than 50% of the students was recorded as the subject delivered during each specific interval. For the teacher behavior (Phase 3) a partial recording technique was employed. This meant that any time the teacher promoted PA during the 10 second observation interval, the behavior was recorded. Interrater reliability was conducted for each phase to ensure consistency between coders.

Phase 1 (*Student Activity*) consisted of observing one preselected student at a time every 20 seconds (10 second observation interval; 10 second recording interval) through the duration of the class. Within Phase 1, the observer quantifies the student's activity, at that specific moment, using predetermined codes. Code's 1 to 4 were based on student's activity (lying down, sitting, standing, and walking respectively), whereas Code 5 was chosen when the student's energy expenditure was perceived to be higher than what is necessary for typical ambulation. Additionally, an MVPA category was computed by determining the sum of the fourth (walking) and fifth (very active) activity categories. The focal student's activity at the end of the observation interval was coded and recorded (McKenzie et al., 1992).

For Phase 2 (*Lesson Context*), following 20 second observation intervals (10 second observation; 10 second recording) the observer determined if class time was

being allocated for either *management-, knowledge-*, or *general physical education motor content*. *Management* was coded when the lesson was not intended to be included in the general physical education content. This includes periods in which more than 50% of the students were engaged in a transition to a new activity, classroom management, and/or any breaktime. *Knowledge* was coded when the lesson was intended to allow the student to acquire either general (i.e. information not related to PA and/or physical fitness; e.g. game strategies) or physical fitness knowledge (i.e. information related to PA and/or physical fitness). Finally, *physical education motor content* was coded for activities that focused on motor skill engagement. This was further divided into four codes. *Fitness* was coded when more than 50% of students participated in activities that engaged the child's cardiovascular endurance, strength, and/or flexibility (e.g. warm-up). *Skill practice* was coded when more than 50% of students participated in activities designed to develop a primary skill (e.g. volleyball passing drills). *Game play* was coded when more than 50% of students participated in activities devoted to a game (e.g. tag games). *Free play* was coded when more than 50% of students participated in activities without the direction of the physical education teacher (McKenzie et al., 1992).

Since Phase 3 (*Teacher Behavior*) occurred at brief moments, a partial interval recording process was used. Thus, the teacher behaviors were recorded if they transpired at any point within the 10 second observational period. During this phase, the teacher's class involvement was coded into one of three categories. The first behavior, *promotes in-class MVPA*, was coded when the teacher prompted or reinforced physical

fitness and/or PA engagement within the class period, whereas the second category *promotes out-of-class MVPA*, was coded when the teacher prompted or reinforced physical fitness and/or PA behaviors outside of the classroom. *No promotion* was coded when the teacher did not promote physical fitness behaviors within the 10 second observation period (McKenzie et al., 1992). For student activity, interrater reliability was considered almost perfect [ICC = 0.822; 95% confidence interval = 0.742 to 0.877). For class structure, interrater reliability was considered substantial [ICC = 0.771; 95% confidence interval = 0.669 to 0.842). For teacher behavior there was 93.0% agreement between variables.

Observational System for Recording Physical Activity in Children-Elementary School.

The Observational System for Recording Activity in Children-Elementary School (OSRAC-E), was used to assess PA and its related contexts during recess. The OSRAC-E, which is an extension of the OSRAC test battery, was designed to provide PA information on the physical and social environment context specific to the elementary school (McIver et al., 2016). The OSRAC-E is based off the OSRAC-Preschool Version (OSRAC-P). The OSRAC-P was developed to observe preschool behaviors included a.) PA levels; b.) types of PA; c.) locations; d.) indoor and outdoor activity context; e.) initiators of activity; f.) group composition; and g.) adult and peer prompts to PA (Brown et al., 2006). The OSRAC-E maintains consistency with the OSRAC-P by keeping categories such as PA levels, type of PA, group compositions, initiators of activity, and prompts for activity. However, it does include environmental specific categories including physical settings, instructional settings, and contexts

(McIver et al., 2016). Momentary time sampling was used for the observation of a focal children during a 30 second period (5 seconds of observation; 25 seconds of coding). Each child was observed for 10 minutes of the recess period (20 observations in total).

To the author's knowledge, the OSRAC has not been used for children with IDD. A brief description of all the categories and codes of the OSRAC-E are presented in Appendix B. All codes were mutually exclusive allowing one code per category during each observation (McIver et al., 2016). Within the *Activity Level* category, the codes include *stationary, limbs, slow-easy, moderate,* or *fast*. Within the *Types of PA* category, the codes include *sit or squat*, *lie down, stand, walk, jump or skip, climb,* or *throw.* Within the *Primary Locations* category, the codes include *inside*, *outside,* or *transition*. Within the *Types of PA* category, the codes include *sit or squat*, *lie down, stand, walk, jump or skip, climb,* or *throw*. Within the *Physical Setting* category, the codes include *cafeteria*, c*lassroom, gym, hallway, library, multipurpose, playground sports field, other inside area,* or *other outside area*. Within the *Instructional Setting* category, the codes include *art, assembly, before school, change classes, computer core classes, homeroom, lunch, media arts, music, physical education, recess, other related arts* or *other*. Within the *Activity Context* category, the codes include *academics, ball/object, class business, computer, fixed equipment, games, gross motor, open space, rest, self-care, snacks, transition, TV/videos,* or *other*. Within the *Group Composition* category, the codes include *solitary, adult present,* or *with peers*. Within the *Activity Initiator* category, the codes include *adult* or *child*. For PA type, interrater reliability was considered almost perfect [ICC = 0.838; 95% confidence interval = 0.691 to 0.915). For

activity type, interrater reliability was considered almost perfect [ICC = 0.908; 95% confidence interval = 0.825 to 0.952). For activity code, interrater reliability was considered almost perfect [ICC = 0.831; 95% confidence interval = 0.678 to 0.911). For group composition, the interrater reliability was considered perfect (1.0).

Statistical Analysis

Data were analyzed using SPSS version 25 for Windows (IBM Corporation, Chicago, IL). All values are expressed as mean ± standard deviation (SD). Significance was set at $p<0.05$ *a priori*. Means and standard deviations were calculated for age and anthropometric data (height, weight, body mass index (BMI). Accelerometer data were filtered for the various periods during the school day (total day, recess, and physical education) and reported as minutes and percentage of time in sedentary, light, moderate, and vigorous activity. The percentage of time spent in each code was calculated for the SOFIT and OSRAC-E. For participants with multiple days of recess assessments, an average was determined for each variable (accelerometer data and OSRAC-E codes). This was done to account for any day to day variation. Data were not normally distributed; therefore, nonparametric analyses were conducted. A Friedman Test was used to compare the differences in PA behaviors (sedentary, light, moderate, and vigorous) during the total school day, recess period, and a physical education class. Independent samples t-tests were used to compare the differences in PA behaviors between groups (with IDD vs without IDD) during the total school day and recess only. For physical education only one individual with IDD was observed, thus no comparisons were made.

CHAPTER FOUR
RESULTS

Due to COVID-19, the school of interest closed during the data collection process. As such, the results are based on pilot data collected prior to school closure. A total of 13 individuals, attending a single elementary school, volunteered to participant in the current investigation. Descriptive characteristics of the participants are presented in Table 1. With the exception of one participant, all participants identified as white, non-Hispanic (parent reported). The remaining participant identified as Asian, non-Hispanic. Of the 13 participants, three were diagnosed with IDD. Diagnoses included Down syndrome (n=1; male, second grade), autism spectrum disorder (n=1; male, first grade), and attention deficit hyperactivity disorder/unidentified learning disability (n=1; female, second grad). Both the individual with Down syndrome and the individual with autism spectrum disorder spent a majority of their school day in a comprehensive developmental classroom. The remaining participant spent a majority of the school day in a general education classroom. The participants that were in first grade (n = 9) wore their accelerometers from 7:30 am to 1:30 pm; whereas, the participants in second grade (n = 4) wore their accelerometers from 8:00 am to 2:00 pm. All participants wore the devices for at least 360 minutes on each observation day.

Accelerometry

All students wore the accelerometers for at least 360 minutes (6 hours) during the school day. The majority of the participants wore an accelerometer for either two (n = 6) or three (n = 6) school days. Due to unscheduled school closure, the remaining

participant only wore an accelerometer for one school day. The time spent in each intensity category during the total school day, physical education, and recess is presented in Table 2. An average of 57.9 ± 8.4% of the school day was spent engaged in sedentary behaviors, 33.7 ± 6.1% of the school day was spent in light intensity activity, and 8.4 ± 4.0% of the school day was spent in MVPA.

A comparison of the time spent engaging in each of the activity intensity, during the total school day between individuals with and without IDD is presented in Figure 1. There were no differences in terms of light and vigorous intensity activity between individuals with and without IDD. When compared to those without IDD, those with IDD spent less time engaged in sedentary activities (Without IDD: 213.9 ± 23.9 vs With IDD: 175.5 ± 23.1; p = .032) and spent more time engaged in moderate intensity activities (Without IDD: 15.4 ± 4.7 vs With IDD: 26.2 ± 7.7; p = .011).

Sedentary Behavior.

Participants spent a significantly greater percentage of time engaged in sedentary behavior during the school day compared to the percentage of time spent being sedentary in recess ($p < 0.002$), and during the physical education period ($p < 0.012$). When compared to the recess, participants spent a greater percentage of physical education period time engaging in sedentary behaviors ($p < 0.036$).

Light Intensity Behavior.

There were no significant differences in percentage of time spent engaging in light intensity activity between the total school day, recess, and physical education class.

Moderate Intensity Behavior.

Participants spent a greater percentage of the total school day engaging in moderate intensity activity compared to the recess ($p < 0.002$). When compared to the physical education periods, participants spent a greater percentage of recess time engaging in moderate intensity activity ($p < 0.017$). There were no significant differences in the percentage of time spent engaged in moderate intensity activity during the total day and the recess period.

Vigorous Intensity Behavior.

When compared to the total school day, participants spent a greater percentage time engaging in vigorous intensity activity during physical education ($p < 0.002$) and recess ($p<0.002$). There were no significant differences in the percentage of time spent engaged in vigorous intensity activity during the physical education and the recess periods.

Physical Education Class

Eight first graders (IDD: n=1) were observed during a single physical education class. The observation of the class period started at 8:02 am and lasted until 8:44 am (42 minutes in duration). Overall, students spent a majority of the physical education class engaged in sedentary or light activity (~ 24%) and only accumulated about 10.0 minutes of moderate to vigorous PA (MVPA). Accelerometer data during the physical education class are presented in Table 2. The student behavior during the physical education class is presented in Figure 2. The lesson context during the physical education class is presented in Figure 3. Finally, the teacher spent very little time promoting in-class PA (~7%; 93% not promoting PA).

Recess

Accelerometer Data.

Ten participants (IDD: n=3) were assessed during two recess periods. The remaining participants (n = 3) were assessed during one recess period. The recess period was approximately 20 minutes in duration. Accelerometer data were analyzed to calculate physical activity intensity levels during recess (Table 2). For the whole group, most of the period was spent engaged in light intensity followed by sedentary behavior, vigorous and moderate intensity activity. For individuals without IDD, most of the period was spent engaged in light intensity (~41%) followed by vigorous intensity (~24%), moderate intensity (~18%) and sedentary behavior (~17%) activity. For individuals with IDD, most of the period was spent engaged in light intensity (~39%) followed by sedentary intensity (~37%), moderate intensity (~13%) and vigorous intensity (~11%) activity.

Direct Observation Data (OSRAC-E).

Due to variations in weather patterns during data collection, participants participated in recess both indoors (26% of observations) and outdoors (74% of observations). All of the outdoor recess observations took place on the playground. While indoors, the majority of the observations (80%) occurred in the classroom with the remaining (20%) occurring in the gymnasium. Table 3 depicts the PA and related contexts during the recess periods of those with and without IDD. For the total sample and those without IDD, a majority of the time was spent in *stationary - easy movements of the limbs*, followed by *translocation at a slow easy pace*, *translocation at a fast pace*, *stationary or motionless with no major limb movements*, and *translocation at a moderate pace*. For the individuals with IDD, a majority of the time was *spent in stationary easy*

movements of the limbs, followed by *translocation at a slow easy pace*, *stationary or motionless with no major limb*, *translocation at a fast pace*, and *translocation at a moderate pace*. The most common activity type for each group was *standing*, followed by *sit/squat*. The most common activity context for each group was on playing *fixed equipment* followed by *transition* in different spaces. For individuals without IDD, a majority of the time was spent with either a peer (~45%) or within a group of children (~33%). For individuals with IDD, a majority of the time was spent engaged in solitary play (~76%).

Table 1.

Descriptive Characteristics (n =13; Mean ± S.D.)

	Total Group	Without IDD	With IDD
Age (yr)	7.2 ± 0.4	7.2 ± 0.4	7.3 ± 0.6
Height (cm)	122.2 ± 5.7	123.0 ± 6.2	119.5 ± 3.4
Weight (kg)	53.6 ± 7.3	53.0 ± 7.9	56.3 ± 5.3
BMI Percentile	63.7 ± 27.5	57.1 ± 28.1	86.5 ± 2.1
Grade			
First	69%	80%	33%
Second	31%	20%	67%
Sex			
Male	69%	70%	67%
Female	31%	30%	33%

Table 2.
Activity Intensity During the School Day, Physical Education and Recess

Time (mins)	Total Group	Without IDD	With IDD
Total School Day (360 minutes)			
	(n = 13)	(n = 10)	(n = 3)
Sedentary	204.9 ± 32.9	213.9 ± 23.9	175.5 ± 23.1*
Light	119.1 ± 22.5	114.2 ± 23.1	132.5 ± 26.3
Moderate	18.2 ± 8.0	15.4 ± 4.7	26.2 ± 7.7*
Vigorous	11.2 ± 5.8	10.5 ± 3.5	12.1 ± 6.1
Physical Education Class (44 mins)			
	(n = 8)	(n = 7)	(n = 1)
Sedentary	19.7 ± 4.1	20.1 ± 4.5	17.2
Light	14.3 ± 5.3	13.0 ± 4.2	23.2
Moderate	4.1 ± 1.7	4.5 ± 1.2	1.2
Vigorous	3.9 ± 2.2	4.4 ±1.8	0.5
Recess (10 minutes)			
	(n = 13)	(n = 10)	(n = 3)
Sedentary	2.2 ± 2.1	1.7 ± 1.9	3.8 ± 2.4
Light	4.2 ± 1.6	4.1 ± 0.9	4.6 ± 3.2
Moderate	1.7 ± 1.5	1.8 ± 1.0	1.5 ± 0.8
Vigorous	2.1 ± 1.5	2.4 ± 1.5	1.1 ± 0.0

All values are presented in mean ± standard deviation; * $p<0.05$

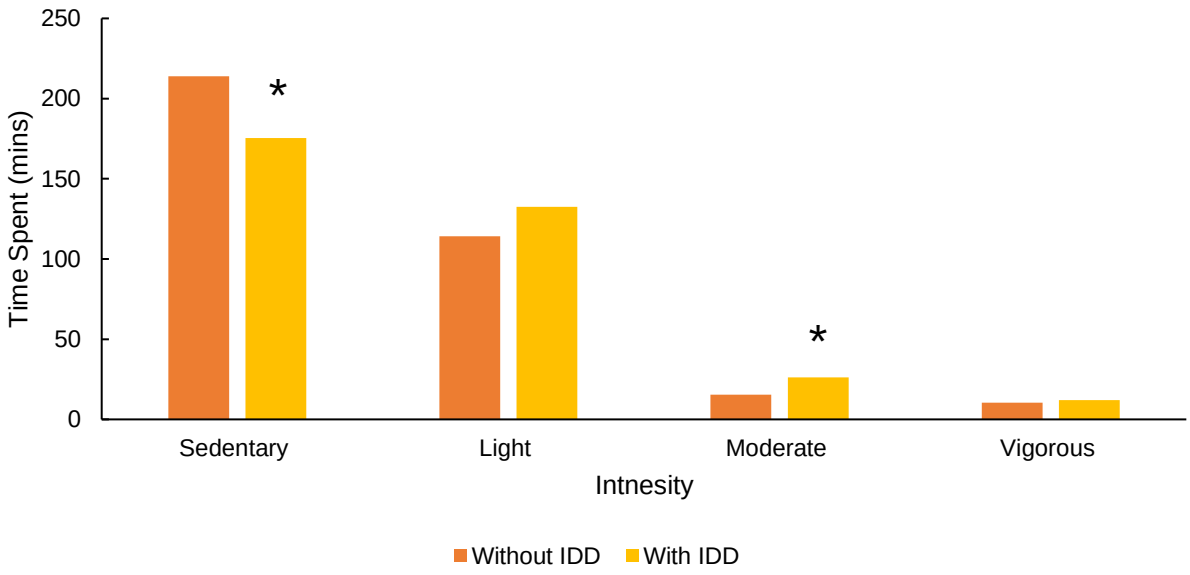

Figure 1. *A comparison of the total time spent in each intensity activity category during the school day, * p*<0.05

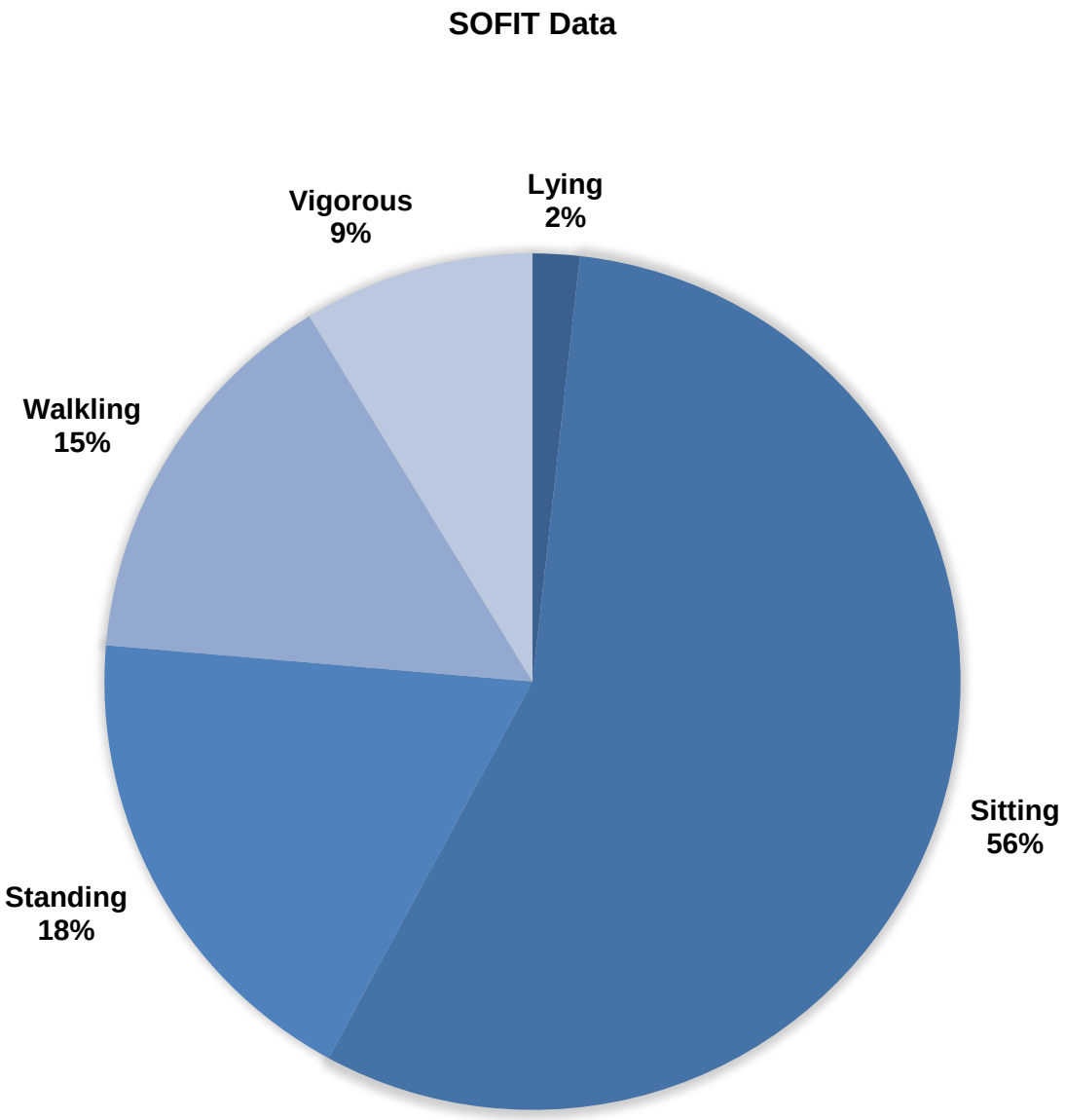

Figure 2. *The total group percentage of time in each intensity context*

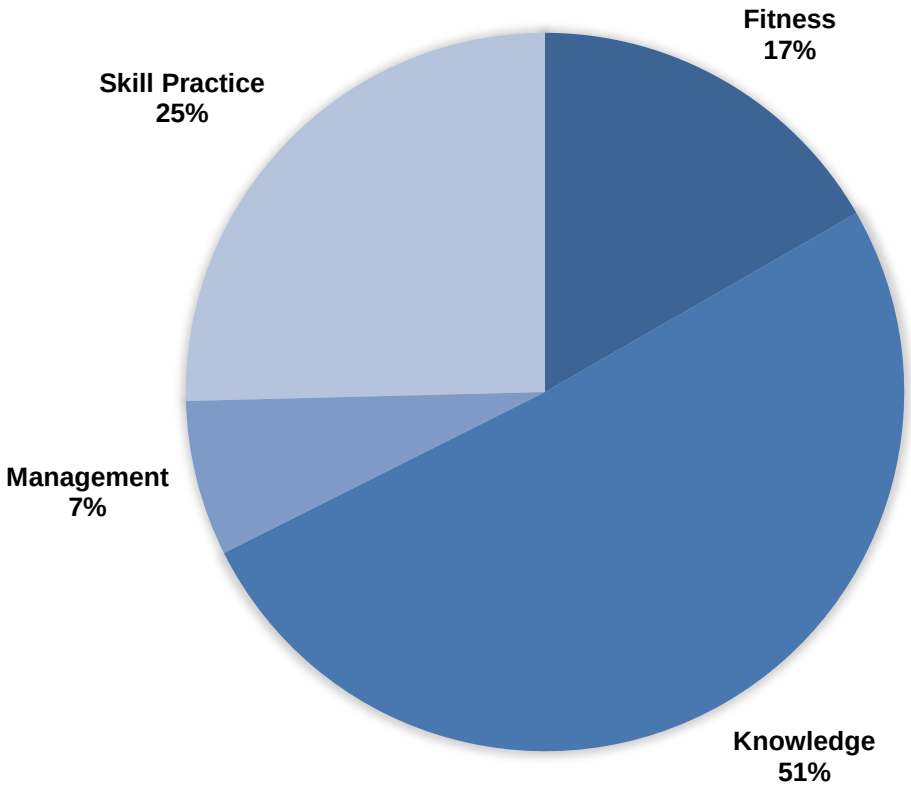

Figure 3. *The total group percentage of time in each lesson context*

OSRAC-E Data

Table 3.

Comparison of the Physical Activity and related contexts of the OSRAC-E for individuals with and without IDD.

Category	Total Group (n = 13)	Without IDD (n = 10)	With IDD (n = 3)
Physical Activity Intensity			
1	10.5%	10.2%	11.5%
2	40.4%	35.2%	52.6%
3	28.0%	29.9%	22.2%
4	5.7%	7.0%	2.2%
5	14.1%	16.0%	8.9%
Activity Type			
Climb	5.5%	4.4%	8.4%
Crawl	1.3%	1.7%	0.0%
Jump/Skip	0.4%	0.6%	0.0%
Lie Down	1.1%	1.2%	0.7%
Ride	3.8%	0.0%	13.3%
Run	10.3%	11.3%	7.4%
Sit/Squat	21.7%	22.1%	20.0%
Stand	25.9%	25.6%	25.9%
Swing	10.3%	12.2%	5.2%
Throw	1.5%	1.2%	2.2%
Walk	16.6%	18.0%	12.6%
Other	0.4%	0.0%	1.5%
Activity Context			
Academics	5.7%	0.0%	20.0%
Computer	8.2%	11.0%	0.7%
Fixed	33.9%	38.4%	21.5%
Game	2.5%	2.6%	2.2%
Open Space	11.2%	10.8%	11.9%
Rest	0.2%	0.0%	0.7%
Self-Care	0.2%	0.0%	0.7%
Snacks	2.1%	0.0%	7.4%
Sociodramatic	9.9%	13.7%	0.0%
Teacher Arranged	0.8%	1.2%	0.0%
Time Out	0.2%	0.3%	0.0%
Transition	18.3%	19.8%	14.1%
Wheels	3.8%	0.0%	13.3%
Other	1.7%	0.6%	4.4%
Group Composition			
Solitary	36.2%	20.1%	76.3%
1-1 Adult	0.8%	0.3%	2.2%
1-1 Peer	35.6%	45.1%	10.4%
Group Adult	0.2%	0.0%	0.7%
Group Child	26.1%	33.1%	7.4%

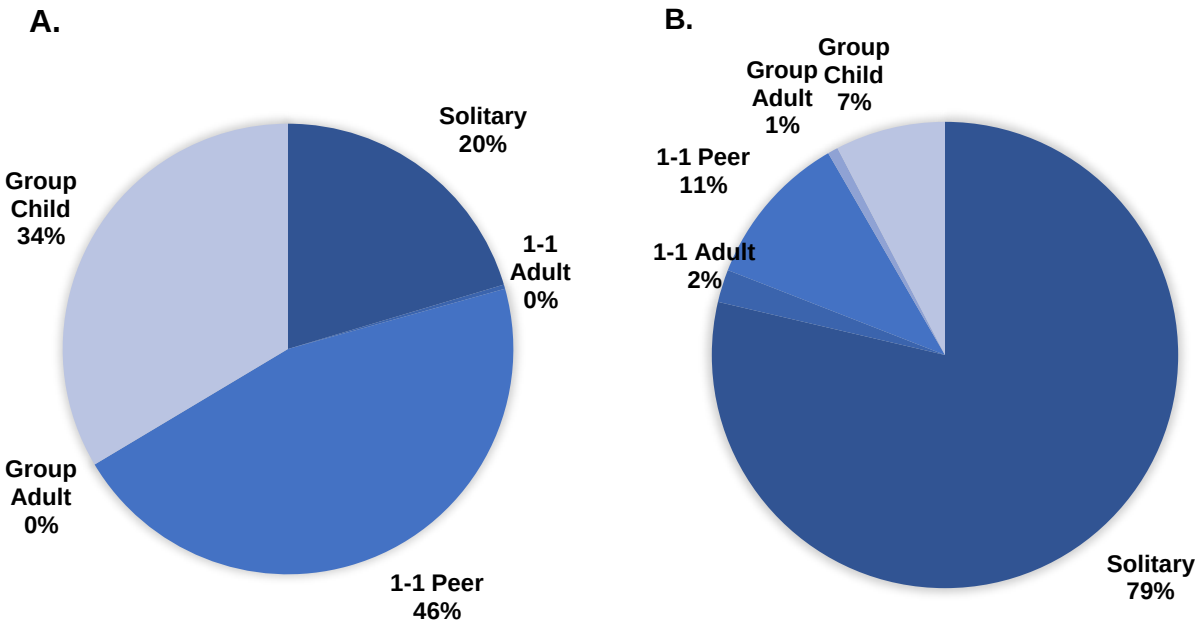

Figure 4. *Comparison of percentage of time spent in each group composition code; A:* Children without IDD; B: Children with IDD

CHAPTER FIVE

DISCUSSION

The purpose of this investigation was to compare the PA levels and related PA context of youth with and without IDD during the total school day, physical education class, and recess. During the school day, it appears that youth with IDD accumulate more PA than youth without IDD. However, youth with IDD accumulate PA during non-traditional periods (e.g. during recreational therapy and occupational therapy) of the day aside from recess and physical education. Furthermore, it appears that neither group is spending 40% to 50% of their recess and physical education periods engaged in MVPA. This is important as quantitatively, it is recommended that students spend 50% of their physical education period (Pate et al., 2006; U.S. Department of Health and Human Services, 2016) and between 40% to 50% of the recess period (Ridgers et al., 2012; Stratton & Mullan, 2005) engaged in MVPA. Finally, the activity behaviors and context differ between youth with and without IDD during the school day. For example, youth with IDD spend a large portion of the recess period engaged in solitary activities (~79%) compared to their peers without IDD who tend to engage more in group activities (~80%).

Total School Day Physical Activity

The Institute of Medicine recommends that all children spend 30 minutes of their school day engaged in MVPA (Institute of Medicine, 2013). In the current investigation, the participants accumulated approximately 29 minutes of MVPA throughout the school day. Although, the participants in this study accumulated a sufficient amount of MVPA

during the school day, current knowledge of school day MVPA and its context remains unclear. However, contrary to the results of this investigation, it does appear that children are not engaging in enough MVPA during the school day. For example, Yli-Piipari and colleagues (2016) using the ActiGraph 3GT3X+ accelerometers worn on the hip, found that first- through third-grade students, from the same geographic region as the current investigation, accumulated approximately 20 minutes of MVPA during school. Additionally, they found that the participants spent approximately 65% of their day engaged in sedentary behavior (Yli-Piipari et al., 2016).

Compared to the results found by Yli-Piipari et al., the current study reported higher levels of MVPA and lower levels of sedentary behaviors during the school day. The differences in MVPA levels may be explained by the current grade level of the participants in the study. In this study, only first- and second-grade individuals had their PA assessed whereas Yli-Piipari et al. investigated the PA levels of individuals from first- through third grade. Longitudinal data has shown that the amount of PA, during the total day of youth, significantly decrease from first- to third-grade years (Ball, Cleland, Timperio, Salmon, & Crawford, 2009; Basterfield et al., 2011). Additionally, information from the Gateshead Millennium Cohort Study revealed that the decline in PA consistently begins around 7 years of age (Farooq et al., 2018). Around this time, children develop competency in the fundamental motor skills (e.g. running, jumping, throwing, and catching) necessary for most gross motor activities. Subsequently, children (ages 7 to 14 years) begin to develop specialized movement skills (e.g. triple jump) necessary for more advanced movement patterns (Goodway, Ozmun, &

Gallahue, 2019). A failure to develop these basic and specialized motors skills may prevent the child from developing the confidence and motor competence for PA participation (Lloyd, Saunders, Bremer, & Tremblay, 2014; Stodden et al., 2008).

Moreover, young children (typically under the age of 7) perceive their mastery of a motor skill to be high: however, their actual motor competence is typically low. As the child moves into middle childhood, their perceived motor competence is more accurate (Harter, 1999). Thus, lower skilled individuals are more likely to perceive specialized motor activities to be more challenging. Thus, these children are less likely to participate in PA compared to their peers with more developed fundamental motor skills (Stodden et al., 2008). During middle childhood, children become more aware of their motor skill competency and are apprehensive to perform in front of others with higher competency (Weiss & Amorose, 2005), Furthermore, those with poor motor skills, report PA to be less enjoyable than their peers (Halliburton & Weiss, 2002).

Thus, a failure to develop specialized motor skills and increased accuracy in the perception of motor skill competence as a child ages may explain the differences between the investigations. This is especially true for children with IDD, as it has been documented that these individuals have poorer motor skills compared to peers (Alesi, Battaglia, Pepi, Bianco, & Palma, 2018; Abd & El, 2016). However, since motor skill development and perceived motor competence were not assessed in the current investigation, it is difficult to ascertain their impact. Future investigations should consider the impact of motor skills and perceived competence on PA during the school day. Nevertheless, these skills may be developed through both physical education and

recess. Specifically, physical education provides an opportunity for students to engage in PA delivered by a qualified professional which may allow students to develop motor skills (Lee, 2004). Whereas, recess allows the student the opportunity to engage in PA while practicing and developing related skills spontaneously (Ramstetter et al., 2010). Physical education and recess sessions provide opportunities for children during the school day to engage in PA and practice and develop motor skills.

It is important that elementary school children have the opportunity to engage in PA during the school day. Notably, increasing school-based MVPA can positively impact their daily MVPA (Long et al., 2013). The school setting is a promising solution to increase the PA levels of children, as more than 55 million children are believed to be enrolled in either public or private school (Snyder & Dillow, 2012). Additionally, students typically spend 6 to 7 hours per weekday, over approximately 9 to 10 months per year within the school setting (Snyder & Dillow, 2015). Also, most children spend their childhood and adolescence in a school setting, thus these fundamental motor skills and PA behaviors can be developed and honed through long-term interventions (Saint-Leger, Kolbe, Lee, McCall, & Young, 2007). Research supports school-based PA interventions as part of a multi-component model for increasing total day PA levels, because they are typically cost effective and may be far-reaching (Barrett et al., 2015; Gråstén, 2017). Finally, children can develop both a lifelong commitment to PA, as well as have an immediate opportunity to engage in daily PA levels, through a variety of sources including in PE classes, recess, activity breaks during the school day, active

transportation to and from school, sports clubs, intramural and interscholastic programs, and afterschool programs (Lavizzo-Mourey et al., 2012).

Additionally, compared to peers without IDD, youth with IDD spent a greater majority of the school day in moderate intensity PA and less of the school day engaged in sedentary activity. These results differ than what has been previously reported in current literature (e. g., Sandt & Frey, 2005; Pan, 2008). The conflicting results from the current investigation may be explained by differences between the general- and special education classrooms. Participants that spent a majority of the school day in the special education class were enrolled in occupational therapy, participated in weekly recreational therapy, and were afforded extra time in the gymnasium during inclement weather recess. These differences provided opportunities for students with IDD to participate in MVPA throughout the day and may be unique to the elementary school in this investigation.

Although, MVPA has been reported to be lower in youth with IDD, Pitetti and colleagues (2009) reported that students with intellectual disabilities (ID) spent a sufficient amount of the school day (~83 minutes) accumulating MVPA. The results from Pitetti et al. were not compared to youth without ID; however, these results suggest that youth with IDD can accumulate a significant amount of PA during the school day. The present study differs from Pitetti et al. in terms of the method of PA assessment (heart rate monitoring vs accelerometer). This method may have impacted the results of the investigation because children with IDD (especially those with Down syndrome), have atypical heart rate responses. Specifically, heart rate is typically higher at rest

compared to their peers without IDD (Baynard, Pitetti, Guerra, & Fernhall, 2004). Thus, it is possible that using heart rate to quantify the PA in this population can result in a misclassification of energy expenditure. This misclassification could have resulted in typically sedentary behaviors being classified as active. However, the school day may be promising for increasing PA levels as it provides a structured environment (e.g. having playgrounds and basketball courts and related equipment) to accumulate PA. A structured environment has been shown to foster PA participation in youth with IDD, specifically for those with autism spectrum disorder (MacDonald, Esposito, & Ulrich, 2011; Pan & Frey 2006). Nonetheless, since students with IDD do not accumulate sufficient PA during their leisure time (Hughey et al., 2016), the school-day may be the most pragmatic opportunity to accumulate PA. Thus, for youth with IDD it be prudent to further increase the school-based PA levels beyond the 30-minute recommendations, to allow them the opportunity to accumulate the recommended levels of PA. However, an optimal amount of school-based PA, for youth with IDD, remains unclear.Examples of successful strategies to increase school-based PA include a.) providing professional development for physical educators (Dudley, Okely, Pearson, & Cotton, 2011); b.) providing more PA opportunities throughout the school-day (Pate et al., 2019); and c.) providing PA before and after the school day (Sallis et al., 2003).

Physical Education Physical Activity

The benefits of physical education have been well established, as such it is suggested that at least half of the class is spent engaging in MVPA (Pate et al., 2006; U.S. Department of Health and Human Services, 2016). However, the current

investigation revealed that students were well below this recommendation. Using SOFIT, approximately 10 minutes (24%) of the physical education class was spent accumulating MVPA. These results are similar to what has been reported in literature (McKenzie & Smith, 2017). For example, using SOFIT, Coe and colleagues (2006) found that six-graders spent approximately 19 minutes (35%) of physical education engaged in MVPA. Similarly, Hsu and Pan (2006) found that youth with ID spent about 12 minutes (31%) of physical education classes engaged in MVPA (Hsu & Pan, 2006). Furthermore, a review by McKenzie and Smith (2017) reported that 25% of articles found that students spent 50% of physical education engaged in MVPA.

Furthermore, the delivery of the curriculum and the teacher's behavior may impact the child's ability to accumulate PA during this period. For example, Sit and colleagues (2008) found that the student engaged in less PA when the physical education teacher spent more time on instruction (Sit et al., 2008). Likewise, Faison-Hodge and Porretta (2004), found that when teachers spent less time providing instruction, youth with ID were more likely to be active. Ultimately, these results suggest that the current physical education curriculum as well as the delivery of the curriculum and the behavior of the teacher, may all impact the ability to accumulate MVPA.

Compared to SOFIT PA levels, accelerometer data revealed that the students spent about 8 minutes (19%) engaged in MVPA. This is consistent to what has been reported in previous literature. Fisher and colleagues (2011) found, using the Actigraph GT1M accelerometer that primary school aged children (mean age 6.2 ± 0.3 y) spent about 12% of physical education engaged in MVPA (Fisher et al. 2011). Additionally, Sit

and colleagues (2017) found using the Actigraph GT3X+, that students with IDD spent 7.2 minutes (13.2%) during physical education class engaged in MVPA (Sit et al., 2017). Although accelerometry is often used in as used to assess the PA levels of youth it is not without its limitations (Cain, Sallis, Conway, Van Dyck, & Calhoon, 2013). For instance, the wear location of the devices (hip, wrist, or ankle) is often cited as a challenge to accurate assessment methodology. This is because compared to wrist-worn accelerometers, hip-worn accelerometers may not be able to accurately capture arm movements (Johansson, Larisch, Marcus, & Hagströmer, 2016; Fairclough et al., 2016). Although, these devices capture ambulation, when a child is performing activities that engage the upper body (e.g. push-ups) these devices may not be as accurate. Thus, the lower results using accelerometer data from the present study, may be explained by an inability to capture arm/upper body and nonambulatory movements performed during the physical education class.

Interestingly, Pan and colleagues (2014) reported that students with ID, who participate in general physical education, accumulate more MVPA compared to those in self-contained physical education classrooms (Pan et al., 2014). Since the MVPA levels of students with IDD are similar in the inclusive (i.e. classrooms with and without children with IDD) and self-contained environments (i.e. classrooms with only children with IDD), the additional benefits of general physical education suggest that students with IDD may benefit from the inclusive setting. Specially, peer interactions are paramount for the development of social, emotional, and cognitive skills for all children (Ginsburg, 2007). Specifically, inclusive physical education, allows the student with IDD:

a.) an opportunity to learn social skills in a natural environment; b.) an environment that is more motivating to communicate with others; c.) an opportunity to learn appropriate social skills; d.) provides age-appropriate models of behavior; e.) a potential for new friendships; and f.) is less isolation. For the student without IDD, inclusive physical education allows them to learn to appreciate others with differing abilities, gain perspective, and learn how to interact with people with disabilities (Block, 2016).

Only one student with IDD had PA assessed during physical education class. This student spent an average of about 7 less minutes engaged in MVPA during physical education compared to their peers (IDD: 1.7 minutes vs No IDD: 9 minutes). To the authors' knowledge, few investigations have compared the PA levels of youth with and without IDD during physical education class. Sandt and Frey (2005) found that children with autism spectrum disorder spent an average of 4 minutes less engaged in MVPA compared to peers (autism spectrum disorder: 12.8 ± 6.8 minutes vs no autism spectrum disorder: 16.7 ± 4.8 minutes). Likewise, Pan and colleagues (2014) found that students with ID spent an average of 3 minutes less engaged in MVPA compared to their peers (ID: 10.89 ± 7.35 minutes vs No IDD:14.35 ± 7.82 minutes). However, neither study reported statistically significant differences between groups. The current investigation did not achieve statistical power to compare the groups; however, these data suggest that youth with IDD may not spend 50% of the physical education periods engaging in MVPA.

The differences in MVPA during physical education of youth with and without IDD may be explained by numerous factors. For example, the National Center for Health

Physical Activity and Disability (NCHPAD) and the Lakeshore Foundation conducted a survey of 742 physical education teachers to determine the effectiveness of inclusive physical education. They found that physical education teachers cited a lack of support for professional development for working with students with IDD, limited knowledge and/or available resources, and limited contribution to the student's IEP as barriers to providing PA to students with IDD during physical education class (NCHPAD and Lakeshore Foundation, 2018). Furthermore, an increased emphasis on competition and a decreased emphasis on inclusion may limit the opportunity for youth with IDD to engage in PA (Rimmer & Rowland, 2008). Future research should develop strategies to increase the MVPA levels during physical education periods while also making this class more inclusive.

In the present study, the majority of the physical education class was spent with students sitting and in the "knowledge" lesson context. Due to the diversity of physical education curricula, the lesson context and student behavior during physical education class remains unclear. For example, Chow and colleagues (2008) found that primary school-aged students from Hong Kong, China spent a majority of time in standing (~38%) and walking (~36%) behaviors. Furthermore, the majority of the class was spent in skill practice (~32%), followed by fitness activity (~20%), and knowledge (~17%). (Chow, McKenzie, & Louie, 2008). Conversely, Sit and colleagues (2007) found that students with various disabilities spent approximately, 32% in fitness activities, followed by 27.5% skill practice, and 24.5% of the time on management (Sit et al., 2007). The differences may be due to differences in curricula between studies. The state of

Tennessee provides physical education standards that are age-specific. One of the standards that was employed by a physical education teacher during this study was underhand throwing which was the activity that was performed on the day of observation. The standard states, that first grade student “throws underhand while facing target and using foot opposition” (Tennessee Physical Education Standards Grades K-12, MS.9.1a). However, the ability to throw an object does not appear to develop fully until the age of 10 years (Butterfield, Angell, & Mason, 2012). Thus, in the current investigation, the large portion of time spent in the knowledge lesson context and sitting behaviors may have been necessary to teach this skill.

Recess Physical Activity

It is recommended that children spend between 40% and 50% of the recess period engaged in MVPA (Ridgers et al., 2012; Stratton & Mullan, 2005). Using direct observation, this investigation found that neither group met these PA recommendations during recess (IDD: 11% vs No IDD: 23%). Consistent with current literature, studies using the OSRAC-E to evaluate MVPA have found that during recess children spend about 16% of the period engaged in MVPA (McIver, et al., 2016). However, using SOFIT, Sit and colleagues (2008) found 57% (4.6 minutes) of recess was spent engaging in MVPA. The differences may be explained by the observation tool used to assess PA. These observation tools have different definitions for PA intensities which may in part explain the discrepancy. Additionally, the individuals in the study conducted by Sit et al. participated in a shorter recess period. Thus, the relative contribution of MVPA may be different. Additionally, it appears that children’s PA levels decrease

linearly throughout a recess period (Pate, Dowda, Brown, Mitchel, & Addy, 2013). Thus, suggesting that a longer recess session may result in a lower percentage of MVPA. Nonetheless, due to the paucity of research, using the OSRAC-E, its reliability and feasibility when assessing the PA levels and its related context for those with IDD, remain unclear. More research may be necessary to ascertain the best method of direct observation for elementary school youth during recess.

Additionally, accelerometer data revealed that students with and without IDD spent about 30% and 40% of recess engaged in MVPA, respectively. Thus, accelerometer data reveled that students without IDD may be meeting the recess MVPA recommendations. Although, accelerometry is considered a reliable method of PA assessment, the information provided by these devices provide only an estimate of PA behaviors. Thus, this method is considered to be a secondary measure of PA levels in youth. Conversely, the robust nature of direct observation assessment suggests that this tool is a criterion method for youth PA assessment (Sirard & Pate, 2001). Therefore, using both direct observation and accelerometer data provides rich information of the PA during recess.

For both those with and without IDD, the most common activity types were standing, sit/squat, and walking. Although there are limited data, it appears that the most common activity types for elementary youth are sit/squat, standing, and waking (McIver, et al., 2016). To the authors' knowledge there are no published data on the activity context for youth during a recess period in elementary school children. However, using the OSRAC-Preschool edition, Nicaise and colleagues (2011) found

that the most common play behavior during recess for 4 and 5 years old was open space, followed by fixed equipment, and wheels (Nicaise, Kahan, & Sallis, 2011). For youth with IDD the most common activity types were fixed, transition, and wheels. For youth without IDD, the most common activity type was fixed, transition, and sociodramatic play.

These differences in PA behaviors may be due to the differences between the age groups. As, previously stated, compared to pre-school aged children, elementary school aged children have more developed fine and gross motor abilities. Due to the improved motor abilities, children are more often challenging their limits through trial and error (Jambor, 1998). These exploratory play behaviors are important as it allows the child to explore and develop these more specialized movement patterns (Frost, Worthman, and Reifel, 2012). Cognitively, elementary aged children are improving, and thus planning and strategy play are more likely to occur. This is because elementary school aged children have the ability to focus on a task, are more logical, and more organized than younger individuals (Frost et al., 2012). Thus, games with rules such as tag hopscotch, and social play become more prevalent (Manning, 1998).

Conversely, due to the heterogeneity, it is difficult to categorize the play behaviors of children with IDD. Specifically, play behaviors are influenced by the children's disability and level of impairment, the opportunities for play, the accessibility of the environment, and presence of activity initiators (Frost et al., 2012). However, it does appear that the behaviors of children with IDD differ from their peers (Frost et al., 2012). For example, children with Down syndrome and autism spectrum disorder tend

to prefer repetitive fixated object play behaviors over other types (Bergen 1991; Hughes, 1998). Also, children with autism spectrum disorder have difficulties with imagination and thus, pretend play is often impaired (Jarrold & Conn, 2011). Furthermore, children with IDD are at risk for impaired social play and are more likely to participate in solitary or on looking social play behaviors (Hestenes & Carroll, 2000; Frost et al. 2012). However, future investigations must continue to explore the play behaviors of children with IDD during the school age years.

During recess, the participants in the investigation appeared to have different group play compositions. Children without IDD spent about 80% of their recess period engaged in either group play or with one peer; whereas, individuals with IDD spent approximately 79% of recess engaged in solitary play. Research suggests that children with IDD spend less time in a social play context (Hestenes & Carroll, 2000). Currently, there are a variety of potential factors that may explain the solitary play behaviors of youth with IDD. McNamara and colleagues (2018) found that children with IDD report feeling victimized and isolated during recess. Furthermore, they were reported to have a more negative affect during recess compared to their peers (McNamara, Lakman, Spadafora, Lodewyk, & Walker, 2018). Other barriers include inappropriate facilities, an inability to adapt programs for students with IDD, and a lack of attention by administration for addressing these barriers (Dunn & Leitschuh, 2014; Murphy & Carbone, 2008). Strategies should address ways to make the recess period more inclusive. Strategies that may help with inclusive recess include, adapting the fixed equipment and the environment to make it more accommodating (Block, 2016).

Additional strategies include: a.) innovative design such as using common recognizable objects; b.) providing lose toys/equipment that prompts specific play behaviors; c.) ensuring the environment is accessible for all ability levels; and d.) creating an environment that meets the child's needs (e.g. sensory stimulation areas (Fernelius & Christensen, 2017). The school of interest in this study, did not appear to appear to meet these recommendations. For example, the jungle gym within this school, was not accessible for students with physical disabilities. Thus, these students did not have the ability to play on this equipment. However, a more in-depth analysis is necessary to better understand the accessibility of the whole school environment.

In this study, children spent a lower percentage of time engaged in MVPA during physical education compared to recess (physical education: ~18% vs recess: ~38%). Both periods provide an opportunity for students to increase their daily PA levels. Physical education provides a structured environment for students to participate and develop PA and its related skills delivered by a qualified professional (Sallis et al., 2012). However, during this period, students rarely have the opportunity to determine the activity type. However, due to the spontaneity of recess, children have the opportunity to accumulate PA in an unstructured manner. Although recess is unstructured, the built environment of playgrounds uniquely provides students the opportunity to engage in intrinsically motivating and self-determined activities. Thus, providing built elements (i.e., basketball courts, playgrounds) and portable objects (i.e., basketballs, hula hoops, etc.) allows youth to freely choose their own activity, which may lead to more enjoyment and thus sustained activity. As previously stated, providing

an unstructured free-play environment that provides a variety of activity options, has been shown to be beneficial to increasing the PA of youth with IDD (MacDonald et al., 2011; Pan & Frey, 2008). Although both periods are important to increasing the PA levels, it appears that providing autonomy (i.e. recess) provides a greater opportunity to engage in PA. Future, researcher should determine strategies to allow students the opportunity to freely engage in MVPA during the school (e.g. providing equipment).

Limitations.

This investigation is not without limitations. For example, the small sample size, specifically those in the IDD group makes it difficult to generalize the study findings. Having only one school participate in the investigation also impacts the generalizability of the results. Additionally, observations occurred during one season of the school year. Literature has shown that school-based PA differs from season to season (Beighle, Erwin, Morgan, & Alderman, 2012). The lack of seasonal variability may not be indicative of the PA level of the entire school year. Additionally, accelerometer cut-points have not been established in youth with IDD. Therefore, the PA data may not be accurately representing this population (Hinckson & Curtis, 2013). However, the use of direct observation, which is considered a criterion method of PA assessment provided contextually rich information. Also, the OSRAC-E has not been validated for those with IDD: however, this scale was used as it was developed specifically for elementary aged children. Finally, school cancelation due to a global pandemic limited the ability for data collection.

Conclusion.

Although public education appears to be a pragmatic solution to increase the PA levels of youth with and without IDD, it appears that these groups of individuals accumulate PA differently during the school day. Specifically, it seems that youth with IDD, do not engage in a significant amount of PA during the traditional periods of recess and physical education. Conversely, youth without IDD accumulate most of their school-based PA during these periods. Additionally, due to the reported lack of available leisure time opportunities outside of school, youth with IDD may need to increase PA beyond current school-based recommendations. Furthermore, those with IDD appear to engage in more solitary play. This is of concern as there are limited inclusion opportunities for youth with IDD. Thus, it is imperative that future research develop strategies to create more inclusive recess and physical education periods. Particularly, interventions should focus on creating an environment that is supportive of the child's IEP goals as well provides sufficient adaptations to participate in PA.

CHAPTER SIX

FEASIBILITY OF RECRUITING AND COLLECTING DATA ON YOUTH WITH IDD IN THE SCHOOLS

Recruitment Barriers

One of the greatest challenges to human subject research is the recruitment of participants (McDonald et al., 2006). A study by Kadeem and colleagues (2016) found that researchers reported complexity of protocols (38%), lack of awareness about the project (37%) and sociocultural issues related to the project (37%) as the most common barriers to recruitment of participants. Other recruitment related issues included fear of side effects (33%), negative publicity (22%), and distance to the study site (17%) (Kadam, Borde, Madas, Salvi, & Limaye, 2016). Recruitment issues present a variety of barriers including a.) an increased risk of a Type II error due to a small sample size; b.) an extension of research project which could be costly; and c.) increase the time in which the information can be disseminated to the public (Watson & Torgerson, 2006). Thus, prior to a research project, researchers should be cognizant of recruitment of participants.

Likewise, individuals with IDD present unique challenges that make recruitment difficult. For example, Nicholson, Colyer and Cooper (2013) found that researchers cited anxiety about the investigation or fear as common barriers to recruitment. Additionally, it was reported that the complexity of the project was difficult to understand and may present as a barrier to those with IDD. Finally, it was reported that the busy schedule of the participants as well as apathy towards the investigation were major barriers to research (Nicholson, Colyer, & Cooper, 2013). Additionally, when conducting research

with individuals with IDD, often times a surrogate or “gatekeeper” is needed (e.g. special education teacher). These individuals are useful as they often have access to individuals with IDD as well as an ability to contact these individuals. Often times, gatekeepers are willing to help in the recruitment process; however, this responsibility is often neglected due to other obligations (Becker, Roberts, Morrison, & Silver, 2004).

Barriers Experienced

During this current investigation, the researchers experienced many common barriers that have often been presented in the literature. One of the biggest challenges in this investigation was getting approval from the administration to conduct research at their school. Since the administration has many other obligations, it was often difficult to contact these individuals. However, the research team had success when meeting with administration in a face to face manner. However, it is suggested that a meeting is set up with the administrator beforehand. Although this may seem tedious, it is often necessary due to the many obligations that the administration may have. Additionally, many of the schools included in this investigation had pre-established relationships with at least one member on the research team. It is imperative that researchers establish a rapport with potential schools of interest. These relationships may require time, but it is important. One way to establish these relationships is to have the researchers volunteer at as many school related events as possible. This will also be helpful to establishing relationships with parents of potential research participants.

Another barrier related to recruitment is the logistical difficulties of the “parent packet” that was sent home. For this project, parents and/or guardians received a

parent letter, two informed consent forms, and a health history form. The parents were required to return one information consent and the health history form. Anecdotally, it was reported that the “parent packet” was overwhelming and may have presented a burden to the parents. This is especially true as the parents most likely have multiple items sent home daily. This could have resulted in the parents not being willing to complete the necessary forms. As it is necessary to attach the informed consent and these forms were written to be easily understood by most, additional strategies may be necessary. For example, having a parent meeting beforehand may be necessary to not only establish rapport, but also to explain the protocol in person. This in-person meeting may be feasible during “back to school night” or another night in which parents may be obligated to be on the school’s campus. Additionally, the parent letter, which was very brief and non-descriptive, could possibly benefit from providing a summary of the protocols of the investigation. This may help parents better understand the project in simplistic terms.

In general, the teachers were very receptive of the project. The research group had a lot of success with maintaining contact with at least one of the teachers in each of the schools. Often contact was made with special education teachers. These teachers were helpful in determining which classrooms were eligible for the research project. However, it may have been helpful to establish a relationship with each of the potential classrooms before the data collection process began. Many teachers were unclear of the project and this made it difficult to start data collection. The investigators suggest that the research team meet with all the potential educators to discuss the study

protocols. This is imperative as this would have allowed us to establish a plan prior to the first day of data collection. Additionally, the physical education teachers, should also be reminded of the project prior to data collection. Finally, it is important that teachers not involved in the project are aware of the project too. This could simply be done by an introduction prior to an observation session. Nevertheless, many of the educators were very receptive and had little issue with the project.

The participants in the investigation were relatively receptive of the project. It appeared that the accelerometers provided little to no burden to participants. This was evident as no issues were reported by the participants after each data collection period. The direct observation periods appeared to be very successful. The participants did not appear to be distracted by the researchers. This was especially true during the physical education class. The children were engaged in the lesson and did not appear to be distracted by three researchers collecting observational data. Recess was also very successful, and it did not appear that the children were distracted by the researchers. In general, it is suggested that the data that is collected is organized and the researcher uploads the information daily. This saves time in the future and is very helpful for understanding the data and holds the researcher accountable.

Only a few individuals that participated in the investigation were diagnosed with IDD, thus it is difficult to provide information on challenges related to this current investigation. However, previous investigations have provided valuable information for PA related research of those with disabilities. Establishing a rapport with “gatekeepers” is very helpful in recruitment of participants. This is typically done through volunteering

and participating in various events. This includes attending outdoor adventure camps for children with disabilities, “fun-runs,” and walks for a cause. This has been very helpful to this research team establishing rapport which has been very helpful for allowing parents to feel comfortable with various projects. Additionally, social media and word of mouth have been very successful in recruiting participants for various projects. There are a variety of disability related groups on social media platforms. Typically, these organizations are very responsive and helpful in disseminating information on their social media pages.

In terms of PA assessment, the researchers have had very good success with compliance with children with IDD. One strategy that has been very successful is personalizing the activity monitor band. The individuals appeared to be very receptive of this and enjoyed have a band that was personal to them. Using daily schedules that include wearing the device have also been reported to the research team as a successful way to induce compliance. Additionally, modeling has been very successful in inducing compliance. For example, having the researcher wear the activity monitor while the participant wears the monitor was a very successful technique. Many individuals were very interested in the technology of the activity monitors and this fascination also helped with compliance of these devices. Consistent with their peers, the participants with IDD did not appear to be distracted by researchers during the direct observations. However, the play behaviors of the individuals with IDD did appear to be different compared to their peers. Thus, this presented a challenge in the coding of this information. It is therefore suggested that the researcher observes all focal students

prior to the actual observation. This will allow the researchers the opportunity to better understand play patterns.

Finally, it is suggested that a project of this nature starts in the beginning of the school year. One reason for this is that the weather in the Southeastern part of the United States can be very unpredictable during the wintertime. The unpredictable weather patterns during this time of year can result in school closures due to both inclement weather as well as influenza virus issues. This also prevents the students from going outside during recess and physical education. These issues are less prevalent during the fall and spring seasons. Additionally, many of the parent-related events that could be useful for explaining the protocol of the project occur during the fall. Thus, it may be important for the investigation to be approved prior to these dates. Also, this project is timing consuming and required data collection to occur at one school at a time. Thus, the earlier the in the school year that the researcher starts to collect data will allow them to collect at more schools which will increase the statistical power of the project.

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APPENDIX

Appendix A

KNOX COUNTY APPROVAL AND LETTER OF SUPPORT

KNOX COUNTY SCHOOLS

ANDREW JOHNSON BUILDING

Bob Thomas, Superintendent

October 18, 2019

Mr. Nocera, Dr. Wozencroft, and Dr. Coe

University of Tennessee, Knoxville
3413341 HPER
1914 Andy Holt
Avenue Knoxville,
TN 37996

Mr. Nocera, Dr. Wozencroft, and Dr. Moore:

You are granted permission to contact appropriate building-level administrators concerning your research study *Examining the Physical Activity Levels and Behaviors of Youth with and without Intellectual and Developmental Disabilities during Physical Education and Recess.* Final approval of any research study taking place within the Knox County School system is contingent upon acceptance by the principal(s) at the site(s) where the study will be conducted. Include a copy of this permission form when seeking approval from the principal(s).

Any study involving direct contact with students requires that the investigator(s) complete a background check with the results residing in the Knox County Schools Human Resource department.

In all research studies names of individuals, groups, or schools may not appear in the text of the study unless specific permission has been granted through this office. The principal researcher is required to furnish this office with one copy of the completed research document.

Good luck with your study. Contact me at 865-594-1735 if you need further assistance or clarification of the research policies of Knox County Schools.

Yours truly,

Dr. Laura Denton
Grant Development Manager
Research Committee

Project Number: 192017

P.O. Box 2188 • 912 South Gay Street • Knoxville, Tennessee 37901-2188 • Telephone (865) 594-1800

Farragut Primary School

509 Campbell Station Rd.
Knoxville, TN. 37934
PH: (865) 966-5848 Fax (865) 671-7187
Gina Byrd, Principal

January 22, 2020

Institutional Review Board
University of Tennessee – Knoxville

Research, Evaluation, and Assessment Department
Knox County Schools

The purpose of this letter is to grant permission for the study titled "***Examining the Physical Activity Levels of Youth with and without Intellectual and Developmental Disabilities during Physical Education, Recess, and the Entire School Day***" to be conducted at Farragut Primary School. I understand that the observations will take place during a specified time period either during recess or physical education and will not disrupt the students' school day.

I have reviewed the approval letter from Knox County School's Department of Research, Evaluation, and Assessment. If you have any questions about our participation in this study, please do not hesitate to contact me.

Sincerely,

Gina Byrd

Gina Byrd, *Principal*

Farragut Primary School

IRB NUMBER: UTK IRB-19-05494-XP
IRB APPROVAL DATE: 01/31/2020

APPENDIX B

PARENTAL CONSENT/ASSENT AND PARENT LETTER

Parent/Guardian Consent Form for Participation in a Research Study

Title: ***Examining the Physical Activity Levels of Youth with and without Intellectual and Developmental***
Disabilities during Physical Education, Recess, and the Entire School Day

Researchers: Vincenzo Nocera, M.S., University of Tennessee, Knoxville
Angela Wozencroft, Ph.D., University of Tennessee, Knoxville
Dawn P. Coe, Ph.D., University of Tennessee, Knoxville

Your permission is requested for your child to take part in a research study. This consent form explains the purpose and requirements, of the study. Please read this form carefully. You will be given a chance to ask questions. If you decide to permit your child to be in the study, you will be given a copy of this form. If you choose for your child not to take part in the study, it will not affect your child's rights to care or services. You are also free to remove your child from this study at any time without penalty.

Why is my child being asked to be in this research study?
We are asking your child to be in this research study because your child is enrolled in a Knox County School (grades K – 5).

What is this research study about?
This research will focus on determining physical activity levels of students, during recess, physical education, during the entire school day. Additionally, observation of recess and physical education classes will take place. This research study will take place while your child is at school. All youth that are enrolled in an elementary, primary, or intermediate school within Knox County school district and are between the ages of 5 and 11 years are invited to participate.

How long will my child be in the research study?
Assessments will be completed on multiple days. There will be at least 24 hours in between assessments and all assessments will be completed within 30 days of the first assessment. Your child's height and weight will also be measured (~3 min). Your child will wear a physical activity monitor for four (4) school days during the entire school day. We will place the monitor on your child at the start of the school day (~2 min) and remove the monitor at the end of the school day (~2 min). On the days that your child wears the monitor, s/he will be observed during physical education or during recess. Your child will spend approximately six (6) hours over four (4) days for all of the assessments. These assessments may not be on consecutive days. All data will be collected at your child's school.

· Day 1: Height and weight will be assessed (~3 minutes) and wearing activity monitor during total school day (~6 hours) and observation during either recess or physical education class (~1 hour) · Day 2: Wearing activity monitor during total school day (~6 hours) and observation during either recess (~20 minutes) or physical education class (~1 hour)
· Day 3: Wearing activity monitor during total school day (~6 hours) and observation during either recess (~20 minutes) or physical education class (~1 hour)
· Day 4: Wearing activity monitor during total school day (~6 hours) and observation during either recess (~20 minutes) or physical education class (~1 hour)

How many people will be in the study?
About 60 children will be participating in this study.

What will happen if I say "Yes, I want my child to be in this research study?"
Prior to your child being enrolled in the study, you will be asked to fill out the demographic sheet that accompanied this permission form. All of the information you provide on this form will be kept confidential. During the study, your child's height and weight will be measured and s/he will be asked to wear one (1) activity monitor on their right hip. This monitor will be worn during the entire school day on four (4) different days. Trained research assistants will place the monitor on your child in the morning and remove the monitor in the afternoon on each of the four (4) days that they wear the monitor. Your child
will participate in his/her regular school schedule and activity throughout the days. We will not ask your
child to do any activities. IRB NUMBER: UTK IRB-19-05494-XP

Additionally, your child's physical activity levels and related behaviors will be observed using tools designed to measure student's physical activity levels, physical activity behaviors, and the structure of the class during a physical education and recess periods.

What are the risks to my child as a participant in the study?
There is relatively little risk to the children in this study. Risks associated with the study are minimal and considered to be equivalent to the risks that the children normally face when they are active while performing physical activity. Some of the tests may lead to leg cramps, falling, and muscle sprain/strain All of these investigators are CPR certified in case of an emergency. The children will be told to let the investigators know if they feel anything abnormal (i.e., injury, joint paint, soreness, etc.). An additional risk is the belt of the activity monitor rubbing on your child's skin. If this occurs, the belt will be moved to avoid irritation or removed.

Are there benefits to my child for taking part in the study?
There are no direct benefits to your child for participating in this study. Information from this study will be gathered to determine the physical activity levels and behaviors during physical education and recess in elementary school-aged children.

What happens if my child gets hurt?
In the event that your child becomes injured as a result of participating in this study, immediate treatment will be available (First Aid and/or CPR). However, you must assume responsibility

for all medically necessary treatment. It is important that you tell the researcher, Vincenzo Nocera. M.S., if you feel that your child has been injured in this study. You can tell the researcher in person or call her at 864-9745091.

Who do I call if I have questions about the study?
Questions about the study not addressed in this form should be directed to Vincenzo Nocera, M.S.: 865974-5091 (Phone #), vnocera@vols.utk.edu (E-mail), Dr. Angela Wozencroft 865-974-1289 (Phone #), awozenc1@utk.edu (E-mail) or Dr. Dawn Coe 865-974-0294 (Phone #), dcoe@utk.edu (E-mail) and if needed, a meeting can be set up. If you have questions about your rights as a research participant, please contact the UT Knoxville, Office of Research IRB Compliance Officer at 865-974-7697.

What will it cost me to permit my child to be in the study?
There will be no cost to you for your child to be in the study.

Will my child be paid for participating?
Your child will not be paid to participate.

Who can see the information collected for this research study?
We will protect the confidentiality of your child's information by keeping the data private and data will be kept in a confidential file in a locked cabinet in a locked University of Tennessee laboratory office for 3 years following completion of the study. There will be ID numbers created and a key to the ID numbers for your child. The key will be kept separately from the ID numbers. The ID number and key with your child's information on it will be destroyed after the study is finished. Therefore, your child will not be identified in any reports.

If information from this study is published or presented at scientific meetings, your child's name and other personal information will not be used. We will make every effort to prevent anyone who is not on the research team from knowing that your child gave us information or what information came from your child. Although it is unlikely, there are times when others may need to see the information we collect about your child. These include people at the University of Tennessee, Knoxville who oversee research to make sure it is conducted properly or if a law or court requires us to share the information, we would have to follow that law or final court ruling.

What will happen to my child's information after this study is over?
We will keep your child's information to use for future research. Your child's name and other information
that can directly identify them will be kept secure and stored separately from their research data collected IRB NUMBER: UTK IRB-19-05494-XP as part of the study. We will not share your child's research data with other researchers.
What happens if I say "No, I don't want my child to be in this research study?"
Your child's participation in this study is voluntary. Your decision whether or not to permit your child to participate in this study will not affect your or your child's current or future relations with the researchers or the University of Tennessee. If you decide to allow your child to participate, you are free to withdraw your child from the study at any time without affecting

those relationships. If your child decides that s/he no longer wants to participate in the study, we will remove your child from the study.

What happens if I say "Yes" but change my mind later?
Even if you decide to allow your child to be in the study now, you can change your mind and stop at any time. If you decide to stop before the study is completed, please email Vincenzo Nocera, M.S.
(vnocera@vols.utk.edu), Dr. Angela Wozencroft (awozenc1@utk.edu), or Dr. Dawn Coe (dcoe@utk.edu).

If you agree that your child may participate, please print and sign the **Parent Permission** section below, and have your child sign the **Assent** section, on both copies of this form. Return one copy to Vincenzo Nocera and keep one copy for your records. If you do not wish for your child to participate in the research, it is not necessary to do anything, as I/we cannot use their materials without your permission and their assent required for age 7 and older.

PERMISSION OF PARENT OR GUARDIAN:
I have read or have had read to me the description of the research study. The investigator or her representative has explained the study to me and has answered all of the questions I have at this time. I have been told of the potential risks, discomforts and side effects as well as the possible benefits (if any) of the study. I freely permit my child to take part in this study.

_____	_____	
Printed Name of Child	Parent/Guardian Email Address	
_____	_____	_____
Printed Name of Parent/Guardian	Signature of Parent/Guardian	Date
_____	_____	_____
Printed name of Investigator	Signature of Investigator	Date

Child/Youth Assent
I have talked about this research with my parent(s) and I agree that Vincenzo Nocera, M.S., Dr. Angela Wozencroft, and Dr. Dawn Coe may use my information for research purposes. If I change my mind, and decide not to participate later, I only need to contact the researchers to let them know that I am no longer interested in participating in the study.

Youth Name (printed) _____

Youth Signature _____ Date _____

THE UNIVERSITY OF TENNESSEE KNOXVILLE

February 3, 2020
Dear Parent/Guardian,

The purpose of this letter is to invite you to permit your child to participate in a research study entitled: *Examining the Physical Activity Levels of Youth with and without Intellectual and Developmental Disabilities during Physical Education, Recess, and the Entire School Day.* This study will be open to all students enrolled in Knox County Schools. The specific details of the study are provided in the attached consent form. This study is being conducted by Vincenzo Nocera, M.S., a doctoral student, Dr. Angela Wozencroft, Ph.D., a Certified Therapeutic Recreation Specialist, and Dawn Coe, Ph.D., a pediatric exercise physiologist from the Department of Kinesiology, Recreation, and Sport Studies. Please contact Vincenzo Nocera (phone: 865-974-5091, email: vnocera@vols.utk.edu) with any questions concerning this study.

Thank you for your consideration.
Regards,

Vincenzo G. Nocera, M.S.

Angela J. Wozencroft, Ph.D.

Dawn P. Coe, Ph.D.

Department of Kinesiology, Recreation, and Sport Studies
College of Education, Health & Human Sciences
1914 Andy Holt Avenue, 322 HPER Building, Knoxville, TN 37996-2700
865-974-3340 865-974-8981 fax krss.utk.edu

BIG ORANGE. BIG IDEAS.
Flagship Campus of the University of Tennessee System UT

Appendix C

DATA COLLECTION MATERIALS

Data Sheet

Date: _____ **Subject ID: _____**

School: _____ **Classroom: _____**

Height (cm): _____ **Weight (kg): _____**

BMI (kg^2): _____

Data Collection Days

Day 1	Day 2	Day 3	Day 4
Date:	**Date:**	**Date:**	**Date:**
Accelerometer #:	**Accelerometer #:**	**Accelerometer #:**	**Accelerometer #:**
OSRAC/SOFIT	**OSRAC/SOFIT**	**OSRAC/SOFIT**	**OSRAC/SOFIT**
Observer:	**Observer:**	**Observer:**	**Observer:**
Reliability Check ☐	**Reliability Check** ☐	**Reliability Check** ☐	**Reliability Check** ☐

Demographic Information

Today's Date: _____

Name of parent/legal guardian completing the form:_____
_____

Participant Information
Please answer the following questions about your child.

Child's Name: _____
_____

Date of Birth (month/day/year): _____

Age: _____

Sex: ___ M ___ F

Current School: _____

Current Grade: _____

How do you identify your child (please check all that apply)?
_____Asian, Non-Hispanic
_____Asian, Hispanic
_____Black/African American, Non-Hispanic
_____Black/African American, Hispanic
_____Native Hawaiian/Pacific Islander, Non-Hispanic
_____Native Hawaiian/Pacific Islander, Hispanic
_____Native American/Alaskan, Non-Hispanic
_____Native American/Alaskan, Hispanic
_____White, Non-Hispanic
_____White, Hispanic

Is your child eligible for free or reduced fee lunch? _____Y _____N

Does your child have a physical, intellectual, or developmental disability? _
_____Y _____N

If yes, please state your child's disability or disabilities, if multiple.
_____

Observational Categories, Codes for Categories, and Definitions for Codes for the Observational System for Recording Physical Activity Elementary Version (OSRAC-E)

Physical Activity		Location		Prompt		Group		Initiator	
Code	Description	Code	Des	Code	Des	Code	Des	Code	Des
1	Stationary or motionless	**I**	Inside	**No**	None	**S**	Solitary	**A**	Adult
2	Stationary with limb or trunk movements	**O**	Outside	**A** ⇧	Adult to increase PA	**1-1A**	1-on-1 with adult	**C**	Child
3	Slow, easy movements	**T**	Transition	**A** ⇩	Adult to decrease PA	**1-1C**	1-on-1 child		
4	Moderate movements			**P** ⇧	Peer increase PA	**GrpA**	Peers + A		
5	Fast movements			**P** ⇩	Peer decrease PA	**GrpC**	Peers – no A		

I	Physical Activity Code	Type of Activity	Outdoor Play Context	Notes
1	1 2 3 4 5			
2	1 2 3 4 5			
3	1 2 3 4 5			
4	1 2 3 4 5			
5	1 2 3 4 5			
6	1 2 3 4 5			
z7	1 2 3 4 5			
8	1 2 3 4 5			
9	1 2 3 4 5			
10	1 2 3 4 5			
11	1 2 3 4 5			
12	1 2 3 4 5			
13	1 2 3 4 5			
14	1 2 3 4 5			
15	1 2 3 4 5			
16	1 2 3 4 5			
17	1 2 3 4 5			
18	1 2 3 4 5			
19	1 2 3 4 5			
20	1 2 3 4 5			
21	1 2 3 4 5			
22	1 2 3 4 5			
23	1 2 3 4 5			
24	1 2 3 4 5			
25	1 2 3 4 5			
26	1 2 3 4 5			
27	1 2 3 4 5			
28	1 2 3 4 5			
29	1 2 3 4 5			
30	1 2 3 4 5			

SOFIT RECORDING FORM

Date _____ School _____ Grade __ /Period ___ Teacher _____ Teacher Gen: M F SERIES____
Time start _____ Observer _____ Rel obs ____ No girls ____ boys ____ Location: O I
Time end _____ Lesson Length _____ No of obs. ____ Page 1 2 3 4 of __

Interval		Student Activity	Lesson Context	Interactions	NOTES
	1	1 2 3 4 5	M K F S G O	I O N	
	2	1 2 3 4 5	M K F S G O	I O N	
	3	1 2 3 4 5	M K F S G O	I O N	
o	4	1 2 3 4 5	M K F S G O	I O N	
n	5	1 2 3 4 5	M K F S G O	I O N	
e	6	1 2 3 4 5	M K F S G O	I O N	
	7	1 2 3 4 5	M K F S G O	I O N	
m/f	8	1 2 3 4 5	M K F S G O	I O N	
	9	1 2 3 4 5	M K F S G O	I O N	
	10	1 2 3 4 5	M K F S G O	I O N	
	11	1 2 3 4 5	M K F S G O	I O N	
	12	1 2 3 4 5	M K F S G O	I O N	
	13	1 2 3 4 5	M K F S G O	I O N	
	14	1 2 3 4 5	M K F S G O	I O N	
	15	1 2 3 4 5	M K F S G O	I O N	
t	16	1 2 3 4 5	M K F S G O	I O N	
w	17	1 2 3 4 5	M K F S G O	I O N	
o	18	1 2 3 4 5	M K F S G O	I O N	
	19	1 2 3 4 5	M K F S G O	I O N	
	20	1 2 3 4 5	M K F S G O	I O N	
m/f	21	1 2 3 4 5	M K F S G O	I O N	
	22	1 2 3 4 5	M K F S G O	I O N	
	23	1 2 3 4 5	M K F S G O	I O N	
	24	1 2 3 4 5	M K F S G O	I O N	
	25	1 2 3 4 5	M K F S G O	I O N	
	26	1 2 3 4 5	M K F S G O	I O N	
	27	1 2 3 4 5	M K F S G O	I O N	
t	28	1 2 3 4 5	M K F S G O	I O N	
h	29	1 2 3 4 5	M K F S G O	I O N	
r	30	1 2 3 4 5	M K F S G O	I O N	
e	31	1 2 3 4 5	M K F S G O	I O N	
e	32	1 2 3 4 5	M K F S G O	I O N	
	33	1 2 3 4 5	M K F S G O	I O N	
m/f	34	1 2 3 4 5	M K F S G O	I O N	
	35	1 2 3 4 5	M K F S G O	I O N	
	36	1 2 3 4 5	M K F S G O	I O N	
	37	1 2 3 4 5	M K F S G O	I O N	
	38	1 2 3 4 5	M K F S G O	I O N	
	39	1 2 3 4 5	M K F S G O	I O N	
f	40	1 2 3 4 5	M K F S G O	I O N	
o	41	1 2 3 4 5	M K F S G O	I O N	
u	42	1 2 3 4 5	M K F S G O	I O N	
r	43	1 2 3 4 5	M K F S G O	I O N	
	44	1 2 3 4 5	M K F S G O	I O N	
	45	1 2 3 4 5	M K F S G O	I O N	
m/f	46	1 2 3 4 5	M K F S G O	I O N	
	47	1 2 3 4 5	M K F S G O	I O N	
	48	1 2 3 4 5	M K F S G O	I O N	
SUM					

Appendix C

DEFINITIONS

Table 1.
Individuals with Disabilities Education Act Disability Categories and Descriptions

Federal Disability Term	Brief Description
Learning disability	A disorder relating to processing information that leads to difficulties in reading, writing, and computing; the most common disability, accounting for almost half of all student receiving special education
Speech or language impairments	A disorder related to accurately producing the sounds of language or meaningfully using language
*Intellectual disability**	Significant limitations in intellectual ability and adaptive behaviors; this disability occurs in a range of severity
Emotional disturbance	Significant impairment in social-emotional area to a degree that learning is negatively affected
Autism	A disorder that is characterized by extraordinary difficulty in social responsiveness; this disability occurs in many different forms and may be mild or significant
Hearing impairments	A partial or complete loss of hearing
Visual impairments	A partial or complete loss of vision
Deaf-blindness	A simultaneous significant hearing loss and significant vision loss
Orthopedic impairment	A significant physical limitation that impairs the ability to move or complete motor activities
Traumatic brain injury	A medical condition denoting a serious brain injury that occurs as a result of accident or injury; potentially affecting learning, behavior, social skills, and language
Other health impairments	A disease or health disorder so significant that it negatively affects learning: examples include cancer, sickle-cell anemia, and diabetes
Multiple disabilities	The simultaneous presence of two or more disabilities such that none can be identified as primary; the most common is a combination intellectual and physical disabilities
Developmental delays	A nonspecific disability category that states may choose to use as an alternative to specific disability labels for students up to age 9

*changed to reflect current jargon (Adapted from M. Friend, 2014).

Observational Categories, Codes for Categories, and Definitions for Codes for the Observational System for Recording Physical Activity Elementary Version (OSRAC-E) (Adapted from McIver et al, 2016)

Table 2.
OSRAC-E Activity Level Categories, Code Descriptions, and Examples

Activity Code Level	Description of Code	Examples
Stationary	Stationary or motionless with no major limb movement or major joint movement	Sleeping, standing, riding passively in a wagon
Limbs	Stationary with easy movements of limbs or trunk without translocation	Standing up, holding a moderately heavy object, hanging off of bars
Slow-Easy	Translocation at slow easy pace	Walking with translocation of both fee, slow easy cycling, swinging without assistance and without leg kicks
Moderate	Translocation at a moderate pace	Walking uphill, two repetitions of skipping or jumping, climbing on monkey bars, hanging from pbar with legs swinging
Fast	Translocation at a fast pace or very fast pace	Running, walking upstairs, three repetitions of skipping or jumping, translocation across monkey bars with hands while hanging

Table 3.
OSRAC-E Activity Type Categories and Code Descriptions

Activity Type Code	Description of Code
Climb	Climbing, hanging
Crawl	Crawling
Dance	Dancing, expressive movements
Jump/Skip	Jumping, skipping, hopping, galloping
Lie Down	Lying down
Pull/push	Pulling or pushing an object or child
R & T	Rough and tumble play, wrestling, tumbling
Ride	Cycling, skateboarding, roller skating, scooter
Rock	Rocking on a teeter totter or rocking horse
Roll	Rolling
Run	Running
Sit/Squat	Sitting, squatting, kneeling
Stand	Standing
Swim	Swimming or playing in a pool
Swing	Swinging on a swing
Throw	Throwing, kicking, catching
Walk	Walking or marching
Other	Other -record a note of the PA type for the interval on the observer form

Table 4.
OSRAC-E Location Categories and Code Descriptions

Location Codes	Brief Description
Inside	Inside the school
Outside	Outside the school
Transition	Transition between inside and outside areas

Table 5.
OSRAC-E Physical Setting Categories and Code Descriptions

Physical Setting Codes	Brief Description
Cafeteria	In the cafeteria
Classroom	In the classroom, including general classrooms, art and music rooms, and other related arts room not otherwise covered
Gym	In the gymnasium
Hallway	In the halls or walkways interior or exterior to the classroom buildings
Library	In the library
Multipurpose	In the multipurpose room (examples: auditorium, dance studio, common area)
Playground	On the playground
Sports Field	On a sports field
Other Inside	In an inside area not otherwise specified
Other Outside	In an outside area not otherwise specified

Table 6.
OSRAC-E Instruction Setting Categories and Code Descriptions

Instructional Setting Codes	Brief Description
Art	In art class
Assembly	In an assembly or other gathering of student (special program)
Before School	Before school starts
Computer	In a computer class or lab
Core class	In a core class including language arts, science, social studies, math, etc.
Dance	In dance class
Lunch	At lunch or another eating activity (snack, party, etc.)
Media Arts	In Media Center Activities
Music	In a music class
PE	In a physical education class
Recess	In a recess period
Other Related Arts	In other related arts including languages, special reading/writing programs
Other	In other instructional setting not otherwise specified

Table 7.

OSRAC-E Activity Context Categories and Code Descriptions

Activity Context Codes	Brief Description
Academics	Engaged in academic related activities including classes and related arts
Ball/Object	Engaging in activities with objects used for gross motor activities (example: balls, throwing toys, jump rope)
Class Business	Engaged in class business or non-academic activities, free time activities
Computer	Engaged in computer use for entertainment or educational activities
Fixed	Engaged in activity on fixed playground equipment (swing set, playhouse, tree house)
Game	Participating in a game with rules; tag games, basketball, soccer, board games
Gross Motor	Engaged in gross motor activities
Open Space	Being in an open outdoor space and not involved in a specific activity
Rest	Engaged in resting or nap time
Sandbox	Engaged in activities in the sandbox or other designated digging areas
Self-Care	Engaged in self-care activities (restroom, tying shoes, changing clothes etc.)
Snacks	Preparing, eating, or cleaning up food during lunch or snacks
Sociodramatic	Engaging in activities with materials and props for pretend play or make-believe roles
Teacher Arranged	Engaging in a formal gross motor activity that has been planned, arranged and is led by an adult
Time Out	Child is place in time-out for disciplinary reasons
Transition	Transition between activities
TV/Video	Watching TV or a video on a TV
Wheels	Ridding or using push toys with wheels
Other	Other context not otherwise specified

Table 8.

OSRAC-E Activity Initiator Categories and Code Descriptions

Activity Initiator Codes	Brief Description
Adult	The activity in which the focal child is involved was directed by an adult
Child	The activity in which the focal child is involved was directed by a child

Table 9.

OSRAC-E Group Composition Categories and Code Descriptions

Group Composition Codes	Brief Description
Solitary	Engaging in a solitary activity and not in proximity to peers or adults
1-1 Adult	Engaging in an activity with or in proximity to only an adult
1-1 Peer	Engaging in an activity with or in proximity to a peer
Group Adult	Engaging in activity with or in proximity to peers and an adult
Group Child	Engaging in an activity with or in proximity to peers without an adult

Table 10.

OSRAC-E Prompts for Activity Categories and Code Descriptions

Prompts for Activity Codes	Brief Description
None	Adults or peers did not explicitly prompt the focal child to increase or decrease PA or a prompt is unrelated to PA
TP-I	Adult explicitly prompted the focal child to engage in or maintain PA
TP-D	Adult explicitly prompted the focal child to stop or decrease PA
PP-1	Peer explicitly prompted the focal child to engage in or maintain PA
PP-D	Peer explicitly prompted the focal child to stop or decrease PA

VITA

Vincenzo G. Nocera was born on July 12, 1992 in Trenton, New Jersey. He was raised in Hamilton and Robbinsville, New Jersey with his two brothers, Pasquale and Calogero by their parents Patrick and Barbara (*née* Segretario) Nocera. Nocera graduated from Robbinsville High School in May of 2010. Nocera received a Bachelor of Science in Health and Exercise Science in August of 2014 from The College of New Jersey in Ewing, New Jersey. Following this, Nocera received a Master of Science in Exercise Science in August of 2017 from Bloomsburg University of Pennsylvania in Bloomsburg, Pennsylvania. Nocera enrolled in the University of Tennessee, Knoxville for his doctoral degree in 2017. While at the University of Tennessee, Nocera received a Master of Science in Recreation and Sports Management in December of 2019. Nocera received his Doctor of Philosophy in Kinesiology and Sport Studies with a specialization in Exercise Physiology in Summer of 2020. Following his Ph.D. studies, Nocera accepted a position as an Assistant Professor in the department of Sport and Exercise Physiology at Plymouth State University in Plymouth, NH.