

BEST PRACTICES FOR STRENGTHENING PHYSICAL ACTIVITY POLICIES AT
CHILDCARE

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Michelle Glee Strang

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By

Michelle Glee Strang

The Supervisory Committee certifies that this *disquisition* complies with
North Dakota State University's regulations and meets the accepted standards
for the degree of

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SUPERVISORY COMMITTEE:

Abby Gold, Ph.D.

Chair

Wonwoo Byun, Ph.D.

Mary Larson, Ph.D.

Kjersten Nelson, Ph.D.

Approved:

04/28/2017

Date

Yeong Rhee, Ph.D.

Department Chair

ABSTRACT

The sharp increase in childhood obesity in recent years has been dramatic and continues to negatively impact children and their families. Low levels of physical activity (PA) during the preschool years is likely a contributing factor. Considering that most children in the U.S. attend some type of childcare, this is an ideal venue for implementing policies that shape children's activity and sedentary (SED) patterns. The purpose of this dissertation was twofold. The first study compared levels of moderate-to-vigorous PA (MVPA) and SED in children attending licensed childcare centers *with* a PA-policy with those attending centers *without* a PA policy. The second study identified correlates (child-level, teacher-level, and classroom-level) of children's MVPA and SED at childcare. Preschoolers (191), lead teachers (23), and center directors (12) from 12 licensed childcare centers (6 intervention/6 comparison) participated in the study. Children wore accelerometers during childcare for 3 days in the spring (April/May) of 2016. For the first study, separate mixed-model ANCOVAs were utilized to examine group differences in MVPA and SED, with gender entered as a covariate and classroom as a random factor. Levels of MVPA (6.74 min/h vs. 5.62 min/h, $p = 0.06$) and SED (29.97 min/h vs. 31.30 min/h, $p = 0.32$) were not significantly different between intervention and comparison groups. Findings from study one suggest the implementing a PA policy may not improving children's PA behaviors, although compliance to policy guidelines was low. For study two, accelerometry data were utilized to examine potential correlates (measured by surveys completed by parents, teachers, and directors) of children's PA and SED. Correlation and mixed-model regression analyses were conducted to examine associations between 18 potential correlates across multiple domains (demographic, anthropometric, social, and environmental), accounting for gender and clustering of activity within classrooms. Results from study two indicate that gender (boys) ($p <$

.01), time spent outdoors ($p < .05$) and the amount of play equipment available ($p < .05$) were positively associated with MVPA, and gender (boys) ($p < .01$), and time spent outdoors ($p < .05$) were negatively associated with SED.

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LIST OF ABBREVIATIONS

AHA	American Heart Association
BMI	Body Mass Index
IOM	Institute of Medicine
MVPA	Moderate-to-Vigorous Physical Activity
NASPE	National Association for Sport and Physical Education
ND	North Dakota
OA	Outdoor Activity
PA	Physical Activity
SED	Sedentary
SEM	Social Ecological Model
SCT	Social Cognitive Theory
SLSA	Staff Led Structured Activity
TPA	Total Physical Activity
US	United States

INTRODUCTION

The steady increase in childhood overweight and obesity in recent years has had profound negative effects on the health and well-being of millions of children and their families. Current assessments indicate that roughly 23% of preschool-aged children are overweight and more than 18% are obese (Ogden, Carroll, Kit, & Flegal, 2014), signifying an almost five-fold increase in the past 40 years. When compared to children of normal weight, overweight or obese preschoolers are five times more likely to be heavy as adolescents (Cunningham, Kramer, & Narayan, 2014), with increased risks for developing insulin resistance, hypertension, and dyslipidemia (Barlow, 2007). Furthermore, a preschooler's weight is a robust predictor of his or her adult weight (De Kroon, Renders, Van Wouwe, Van Buuren, & Hirasing, 2010; Nadar et al., 2006). Although childhood obesity is a multi-faceted, complex disease with numerous contributing factors, research suggests that improving physical activity (PA) behaviors during the preschool years is a viable approach to prevent weight gain (Guinhouya, Samouda, Zitouni, Vilhelm, & Hubert, 2011; Reilly, 2008).

Given the poor health outcomes often associated with childhood obesity, and the fact that activity and weight patterns tend to track from childhood to adulthood, the focus has recently shifted to designing programs and interventions aimed at *preventing* obesity. Considering that over 60% of preschool-aged children in the United States (U.S.) spend as much time in childcare as they do at home (U.S. Department of Education, 2016), the childcare setting represents an ideal venue for implementing these types of programs (Goldfield, Harvey, Grattan, & Adamo, 2010). According to the National Association for Sport and Physical Education (NASPE), preschool children should accumulate at least one hour each of structured and unstructured PA each day, and should not be sedentary for more than 1 hour at any one time (NASPE, 2009).

More stringent guidelines from the American Heart Association (AHA) recommend that children participate in at least 60 min/d of moderate-to-vigorous physical activity (MVPA) (AHA, 2016). Unfortunately, few children are meeting these guidelines (Alhassan, Sirard, & Robinson, 2007; Bower, Hales, Tate, Rubin, Benjamin, & Ward, 2008; Hannon & Brown, 2008; Oliver, Schofield, & Kolt, 2007; Pate, McIver, Dowda, Brown, & Addy, 2008; Raustorp, Pagels, Boldemann, Cosco, Söderström, & Mårtensson, 2012; Reilly, 2010).

In an effort to address this issue on a larger scale, state licensing regulations for childcare centers are being assessed. Healthy People 2020 includes objectives that increase the number of states with licensing regulations aimed at improving PA and sedentary (SED) behaviors at childcare (U. S. Department of Health & Human Services, 2010). In addition, the Institute of Medicine (IOM) has set forth specific PA and SED recommendations for childcare regulatory agencies, such as providing multiple opportunities for structured and unstructured PA throughout the day, providing light, moderate, and vigorous activity for at least 15 minutes each hour, integrating PA into the daily routine, providing a variety of portable play equipment, and implement guidelines that limit sitting or standing to no more than 30 minutes at a time (IOM, 2011).

When fully implemented, these recommendations can improve children's activity patterns at childcare. An extensive body of research supports the fact that childcare centers differ significantly in the quality and quantity of PA opportunities they provide (Boldemann, Blennow, Dal, Mårtensson, Raustorp, Yuen, & Wester, 2006; Hinkley, Crawford, Salmon, Okely, & Hesketh, 2008), and differences in these factors have explained up to 45% of the variation in children's PA behaviors among centers (Finn, Johannsen, & Specker, 2002; Pate, Pfeiffer, Trost, Ziegler & Dowda, 2004; Sugiyama, Okely, Masters, & Moore, 2012). Even small changes to

existing practices may increase children's activity levels and help form the foundation for a healthy active life.

In the U.S., each state, city, or licensed childcare center may *choose* to implement more rigorous regulations, as long as they comply with the state's minimum health and safety standards (Benjamin, Craddock, Walker, Slining, & Gillman, 2008; Kaphingst & Story, 2009). Current state regulations for childcare centers in North Dakota (ND) include only five of the 15 IOM recommendations listed above (Duffy, Slining, & Benjamin-Neelon, 2014), and many of the most stringent recommendations are not included. For example, ND licensed childcare providers are not required to limit the amount of time children spend in sedentary activities, provide minimum amounts of daily PA, and provide PA-focused training for childcare staff (Duffy et al., 2014). Unfortunately, robust evidence to support the development and implementation of more rigorous policies and licensing regulations is limited, partly due to the dearth of research assessing existing policy effectiveness and compliance (Larson, Ward, Neelon, & Story, 2011).

In 2014, in an effort to improve health behaviors of young children attending licensed childcare centers, the City of Fargo implemented an ordinance that established specific requirements for children's activity, beverages, screen time, and teacher trainings. The policy guidelines were created using the *Best Practices for Preventing Childhood Obesity in Early Care and Education Programs* (National Early Care and Education Program Standards for Obesity Prevention, 2010). Presently, compliance is measured with a PA evaluation, performed as part of the annual environmental health inspection for license renewal. The current study examines the PA components of this policy to provide empirical evidence of policy efficacy and compliance in real time.

In order to create more effective regulations and policies, correlates of children's PA and SED behaviors at childcare must first be identified. The Social Ecological Model (SEM) posits that efforts to change behaviors are more likely to succeed when multiple levels of influence are addressed (see Figure 1). Instead of using the model to design or evaluate an intervention, the current research will use the SEM as a guide to investigate the individual (child-level), social (teacher-level), and environmental (classroom-level) factors within a childcare center that may affect children's PA and sedentary behaviors.

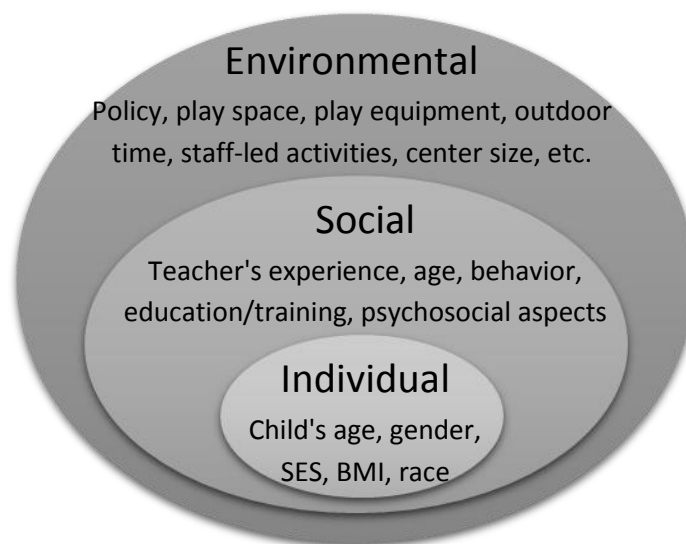


Figure 1. Correlates of children's physical activity and sedentary patterns at childcare using the Social Ecological Model.

At the center of the SEM lie individual factors that may influence behaviors, such as the child's age, race, socioeconomic status, gender, and body mass index (BMI). Although most of these factors are not modifiable, their relationships with children's activity patterns are important to understand when creating, implementing, and evaluating policy guidelines. For instance, preschool-aged boys tend to be more active and less sedentary than girls (Byun, Blair, & Pate, 2013; Gagné & Harnois, 2013; Nicaise, Kahan, & Sallis, 2011; Olesen, Kristensen, Korsholm, & Froberg, 2013; Stephens et al., 2014). With this knowledge, more effective trainings can be

developed that provide specific guidance on best practices to help girls improve their activity levels.

Due to the vast amount of time spent with children in the childcare setting, teachers and staff play a central role in shaping children's activity habits (Bell et al., 2015; Finch et al., 2012; Henderson, Grode, O'Connell, & Schwartz, 2015; Jones-Taylor, 2015). Thus, the second level of our model consists of factors that *indirectly* influence children's PA through the actions and behaviors of their teachers. Modifiable factors, like teachers' knowledge/training, self-efficacy, and social support, as well as non-modifiable factors, such as age, experience, and education level may be closely tied with children's activity patterns, but have not been thoroughly studied. For instance, children attending centers with limited space and play equipment may be more likely to participate in adequate levels of PA if their teachers are enthusiastic role models that create opportunities for children to be active throughout the day.

The outermost domain of our model encompasses the environmental aspects of a classroom/center, which may have the broadest reach and most sustainable impacts on children's activity. Environmental modifications, such as providing additional play equipment, sufficient play space, limiting sedentary-promoting devices or activities, and implementing specific PA guidelines/policies have been shown to improve activity levels at childcare (Bell, et al., 2015; Brown, Pfeiffer, Mciver, Dowda, Addy, & Pate, 2009a; Cardon, Labarque, Smits, & Bourdeaudhuij, 2009; Vanderloo, Tucker, Johnson, van Zandvoort, Burke, & Irwin, 2014).

In addition to using the SEM to investigate the complex interplay between children's PA and individual, social, and environmental factors, this study also employs facets from the Social Cognitive Theory (SCT) to gain a better understanding of the variables that influence teachers' PA-promoting actions and behaviors (see Figure 2). A key construct of the SCT is that of

reciprocal determinism, which posits that there is a dynamic interaction between an individual, their environment, and their behaviors (Bandura, 2004). Individual SCT constructs include *self-efficacy*, which refers to a person’s confidence in his/her ability to successfully perform a behavior, and *outcome expectations*, which are beliefs about the likelihood of performing a behavior and value of the outcome. Environmental SCT constructs include *observational learning*, which asserts that a behavior is more likely to occur if an individual can observe others performing the behavior, and *social support*, which refers to the response to, or support for the behavior from others (Bandura, 2004)

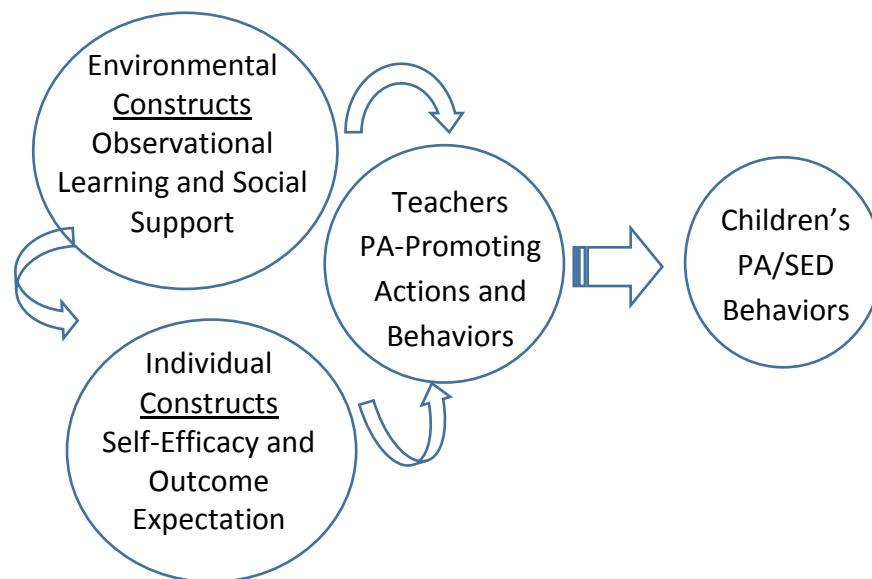


Figure 2. Relationship between select Social Cognitive Theory constructs, teachers’ physical activity-promoting behaviors, and children’s physical activity and sedentary patterns at childcare.

Understanding if and how these factors influence teachers’ actions and behaviors is a fundamental step in developing effective interventions or policy guidelines that aim to improve children’s PA. For example, research suggests that providing active opportunities and designating time for staff-led structured activities (SLSA) may help to improve children’s activity and sedentary behaviors (Bell et al., 2015; Finch et al., 2014; Van Cauwenberghe, De Craemer, De Decker, De Bourdeaudhuij, & Cardon, 2013). However, if a teacher does not feel

confident in his/her ability to lead activities (e.g., limited training or low self-efficacy) the effectiveness of the SLSAs may be reduced, thus negatively impacting children's PA.

The negative consequences of childhood obesity are numerous and can persist throughout adulthood. Although this issue is multi-faceted and complex, research suggests that increasing preschoolers' PA and decreasing time spent in SED behaviors can help prevent weight gain. Because many children spend a considerable amount of time at childcare, it has become an ideal setting for improving activity behaviors through the implementation of new or the expansion of existing PA policies. While this type of intervention may provide effective and sustainable outcomes, robust evidence to guide the development of these regulations is limited.

Purpose of the Studies

The present study consists of two distinct studies. The purpose of the first is to examine children's activity and sedentary behaviors while at childcare in order to determine: 1) the average number of minutes per hour (min/h) children are participating in different intensities of PA and SED, 2) if time spent participating in MVPA and SED differs significantly between children attending Fargo centers (intervention sites with a PA policy) and children attending all other centers (comparison sites without a PA policy), 3) the proportion of children meeting policy guidelines, and 4) whether compliance to the modifiable policy guidelines is related to children's activity.

The purpose of the second study is: 1) to examine children's activity and sedentary behaviors at childcare to determine the average amount of time (min/h) children are participating in MVPA and SED, and 2) to evaluate the individual, social, and environmental correlates that influence preschoolers' MVPA and SED. Findings from both studies will be utilized to improve

efficacy and compliance of existing guidelines, as well as provide evidence to support expansion of the policy to non-licensed and in-home care programs.

Significance of the Studies

This research is unique in three ways. First, it evaluates and compares centers functioning within a city-mandated PA policy to centers without this policy, providing researchers with a better understanding of if and how the policy influences children's PA and SED behaviors in real time. Second, using constructs from the SCT, we assess the less-well-understood social determinants, allowing researchers to evaluate the complex relationship between teachers' knowledge, attitudes, and behaviors, and children's activity levels. Finally, findings from both studies will be used to create recommendations that may inform policy guidelines, interventions, and curricula that aim to improve children's PA and sedentary behaviors at childcare.

Organization of Dissertation

Following the introduction, a review of literature provides an overview of previous studies that have examined determinants of children's PA behaviors at childcare and how the current research helps to fill existing gaps in the literature. Two original research articles follow, the first titled "The Influence of a Physical Activity Policy on Preschoolers' Physical Activity and Sedentary Behaviors at Childcare" followed by "Individual, Social and Environmental Determinants of Children's Physical Activity and Sedentary Behaviors at Childcare". The methods are described in detail in each article. Finally, a summary of the research articles is presented, followed by the complete list of references.

REVIEW OF LITERATURE

Currently in the U.S., more than one out of every five preschoolers are overweight and 8% are classified as obese (Ogden, et al., 2014). The negative consequences of childhood obesity are serious and often persist into adulthood, as heavy children are more likely to become overweight or obese adults (De Kroon et al., 2010; Nadar et al., 2006; Cunningham et al., 2014) with higher rates of heart disease, diabetes, and other types of chronic conditions (Barlow, et al., 2007). A reduction in the amount and intensity of PA, and an increase in time spent in SED activities early in life, likely contribute to the sharp rise in childhood obesity in recent years (Story, Kaphingst, & French, 2006; Ward, Vaughn, McWilliams, & Hales, 2010). Given the important role of regular PA in preventing or limiting the scope of childhood overweight and obesity, researchers and practitioners have intensified efforts to improve preschoolers' PA patterns.

Over half of all U.S. preschool-aged children are enrolled in some type of childcare (U.S. Department of Education, 2016), making this environment an important target for obesity-prevention interventions. With this in mind, the IOM (2011) released important PA-focused policy recommendations to promote healthy environments within childcare centers, including providing at least 15 minutes of PA each hour and limiting activities where children are sitting for more than 30 minutes. In addition, NASPE (2009) recommends that preschoolers acquire a minimum of 60 minutes of structured *and* 60 minutes of unstructured activity, for a total of at least 120 minutes of total physical activity (TPA) throughout the day.

Children's Physical Activity at Childcare

A misconception exists that young children are very active and should therefore easily meet established recommendations (Adamo et al., 2010; Tucker, van Zandvoort, Burke, & Irwin, 2011). In reality, multiple studies reveal that very few children, whether in childcare or at home,

meet current guidelines (Bornstein, Beets, Byun, & McIver, 2011; Reilly, 2010; Tucker, 2008). An overwhelming body of evidence has revealed that preschool children spend a significant portion of their day engaged in sedentary activities (Alhassan et al., 2007; Bower et al., 2008; Dowda, Pate, Trost, Almeida, & Sirard, 2004; Hannon et al., 2008; Oliver et al., 2007; Pate et al., 2008; Raustorp et al., 2012; Reilly, 2010). However, findings are highly dependent upon the cut points used to quantify activities of different intensities. Cut points differentiate between sedentary (sitting/sleeping), light (slow walking), moderate (fast walking, skipping), and vigorous (jogging, running) activities (Bornstein et al., 2011). Unfortunately, making comparisons between studies that used different cut points may be misleading and difficult to interpret because no “gold standard” accelerometer cut-points exist for preschoolers (Beets, Bornstein, Dowda, & Pate, 2011).

In one study, Canadian preschoolers accumulated only 1.5 min/h of MVPA and 17.4 min/h of TPA during a single 8-hour day (Vanderloo et al., 2014). Using different accelerometers and a longer monitoring time, Pate et al. (2004) observed that children accumulated an average of 7.7 min/h of MVPA. A more recent study discovered that children spent an average of 9 min/h in MVPA, although measurements again reflected different cut point (Henderson et al., 2015). Over the course of the day, children averaged about 27 minutes of MVPA, which the authors noted was an optimistic calculation considering the data were collected on days when the weather was nice and children were able to play outdoors (Henderson et al., 2015). Given the current recommendations of 60 minutes of daily MVPA, these findings are troubling. While figures may vary from study to study, the resounding perception is that preschoolers are not getting the recommended amount of MVPA at childcare.

Children's Sedentary Behaviors at Childcare

Being sedentary and having low levels of PA are not the same. Although both can negatively influence health, they are distinct constructs and should be measured as such (Byun, Dowda, & Pate, 2011). Generally, as children spend more time participating in sedentary activities (seated play, watching television, and using electronics), time spent participating in MVPAs decrease. Thus, many studies that examine children's MVPA also assess the amount of time children are sedentary (Pate et al., 2008). Both cross-sectional and longitudinal studies have consistently found that preschoolers who are highly sedentary are at an increased risk of overweight and obesity, indicating that reducing SED activities may be just as important as increasing MVPA (Oliver et al., 2007). For this reason, in addition to the recommendations to increase PA, the IOM set specific guidelines for reducing the amount of time children spend in SED activities at childcare. Guidelines suggest that childcare providers implement activities throughout the day that limit sitting or standing to no more than 30 minutes at a time, and that providers avoid withholding PA as a means of correcting negative behavior (IOM, 2011).

The body of research concerning children's SED at childcare is small, but growing. As with studies that measure MVPA, findings provide a clear understanding that children are far too sedentary throughout the day. In a 2014 study by Vanderloo and colleagues, children spent an average of 40.6 min/h, or 68% of their time in sedentary activities during one 7.5 hour day. Pate et al. (2008) and Tandon, Saelens, & Christakis (2015) observed even higher levels, with 80% and 73% of the day spent in sedentary activities and only 3% and 14% in MVPA, respectively. Using direct observation, Brown and colleagues (2009a) found that the overwhelming majority (89%) of children's time in preschool was spent participating in SED activities.

Determinants of Children's Physical Activity at Childcare

An extensive body of research highlights the fact that preschoolers' PA and SED patterns are closely tied with the center in which they attend (Boldemann et al., 2006; Dowda et al., 2004; Finn et al., 2002; Hinkley et al., 2008; Pate et al., 2004). In some research, childcare characteristics have explained up to 45% of the variation in children's PA behaviors among centers (Finn et al., 2002; Pate et al., 2004; Sugiyama et al., 2012). Factors such as PA-specific policies, play equipment, and activity opportunities (Bell, et al., 2015, Bower et al., 2008; Hannon et al., 2008), sufficient play space and group/class size (Brown et al., 2009a; Cardon et al., 2009), child-initiated versus staff-initiated play (Bell, et al., 2015; Brown et al., 2009a), and education and training of childcare staff (Dowda et al., 2009), have been studied to determine if, and how these variables influence children's activity patterns at childcare.

Environmental Determinants

A center's environment can have a powerful influence on how much activity children acquire on a daily basis. When compared with children attending centers with low environmental scores (less supportive environment), children in centers with high environmental scores participated in 80 additional minutes of MVPA and 140 fewer minutes of SED per week (Bower et al., 2008). Much of the current research in this area examines how the built environment (play space, play equipment, and presence of electronic devices) influences behaviors, but there is a growing body of evidence to support the role of indirect environmental influences (center requirements for staff training, outdoor time, and SLSAs) in improving PA behaviors (Copeland, Khoury, & Kalkwarf, 2016; Finch et al., 2014, Henderson et al., 2015). While promising, this body of research is relatively small and inconclusive, and more studies are necessary to identify which environmental aspects have the largest impact on children's behaviors.

PA-focused policies. A common method for improving children’s PA behaviors at childcare is to implement PA-focused curricula or purchase equipment that fosters movement. However, strengthening state and local regulations and policies may have the potential to vastly improve activity patterns and reduce childhood obesity trends on a larger scale (Benjamin et al., 2008). Not surprisingly, children attending centers that promote PA and/or have policies that specifically target PA, are more active throughout the day (Bell et al., 2015; Finn et al., 2002; Story et al., 2006). Childcare policies and practices that allocate minimum amounts of time for PA, require PA-specific teacher training, and appropriate dedicated play space may have the most potential for increasing children’s PA levels (McWilliams, Ball, Benjamin, Hales, Vaughn, & Ward, 2009)

In the U.S., each state, city, or childcare center may choose to implement a more stringent policy, as long as it complies with the state’s minimum health and safety standards. Currently, Alaska, Delaware, Massachusetts, New York City, and the City of Chicago have some of the most comprehensive guidelines in the nation (Garbor, Mantinan, Rudolph, Morgan, & Longjohn, 2010). As of 2013 when ND last updated its state standards, only 5 of the 15 IOM recommendations were included. Some of the most fundamental regulation regarding requirements for the amount of TPA and MVPA, limitations on SED activities, or for PA-specific training for childcare staff, are not included (Duffy et al., 2014). Unfortunately, ND is not alone in the paucity of structure provided, as most states lack strong regulations for childcare facilities (Benjamin et al., 2008; Kaphingst et al., 2009). Evidence to support the development and implementation of more stringent policies and licensing regulations is limited, due in part to the small body of research evaluating the efficacy of current PA policies and practices (Larson, Ward, Benjamin, Story, 2011b).

Policy compliance. Implementing more stringent policies, without connecting policy guidelines to evidence-based strategies with strong compliance language, may not improve children’s PA behaviors (Larson et al., 2011b). McWilliams and colleagues (2009) reported that even though 48% of centers in their study had active play policies, language was vague and included phrases such as “children go outside daily, weather permitting”. Therefore, it is essential that once a policy is enacted, compliance is measured in real-world settings to ensure that intended benefits are sustained, and that specific center characteristics that either facilitate or hinder compliance are identified.

New York City’s Department of Health and Mental Hygiene was one of the first to implement regulations in group child care centers that require 60 minutes of TPA per day and at least 30 minutes of structured PA per day in full-day classrooms (Lessard et al., 2014). In sites serving low-income communities, researchers used a multicomponent design to first measure center compliance and then evaluate how compliance was associated with children’s MVPA (Lessard et al., 2014; Stephens et al., 2014). Using objective and subjective measures of compliance, researchers found that only 21.5% of centers were classified as compliant in both components. Thus, the duration and intensity of PA can vary widely, even within a single classroom from day-to-day, depending on whether the policy is being followed (Lessard et al., 2014).

To expand this research, Nonas and colleagues (2014) evaluated specific childcare center characteristics associated with levels of compliance. Interestingly, the method of assessment made a significant difference in how much PA was documented. When staff were interviewed, 77% reported providing 30 minutes of SLSA and 86% reported providing 60 minutes of TPA (Nonas, Silver, & Khan, 2014). However, when activities were validated through direct

observation by a trained researcher, less than 30% of teachers actually provided 30 minutes of SLSA or 60 minutes of TPA (Nonas, Silver, & Khan, 2014).

Child-initiated free play versus SLSA. Inconclusive and mixed findings are common in research examining children's PA and the amount of time centers dedicate for free play and SLSA. In some studies, children attending centers that deliver more SLSAs were more active (Bell et al., 2015; Bower et al., 2008; Van Cauwenberghe et al., 2013), while in others, increased time spent in unstructured play was associated with more MVPA (Brown, Gooze-Smith, McIver, & Rathel, 2009b; Nicaise et al., 2011; Pate et al., 2004; Stephens et al., 2014). Thus, the IOM (2011) suggests providing a combination of developmentally appropriate structured and unstructured PA opportunities for children attending childcare.

A 2010 review of interventions to increase PA at childcare revealed that the most successful programs provided more SLSAs than did less successful programs, but even the programs deemed "successful" reported less SLSA than what is recommended by NASPE (Ward et al., 2010). Children were significantly more active (using pedometers to measure activity) during SLSAs or when staff joined during active play at least three times during the day (Bell et al., 2015). Additionally, on days when SLSAs were integrated into the curriculum and delivered by childcare staff, children spent less time in SED and more time in MVPA than on days without the structured activities (Van Cauwenberghe et al., 2013).

Providing time for free or unstructured play is critical to support children's cognitive, social, emotional, and motor development; however, it is important for staff to stay engaged and provide support and encouragement when needed (Bower et al., 2008). A recent study evaluating variations in indoor versus outdoor, and free play versus teacher-led opportunities suggested that child-initiated free play, both indoors or out, resulted in less SED and more MVPA when

compared with SLSAs. However, SLSAs were offered for less than 9 minutes throughout the day (Tandon et al., 2015). In another study, children had higher levels of MVPA when they initiated the activities on their own and when adults were not present or involved in the activity (Brown et al., 2009b). Although, researchers noted that even when teachers were present, they did not engage in activities or encourage children to be more active.

Outdoor activity. Considerable research has determined that the amount of outdoor activity (OA) provided is a significant determinant of the children's MVPA and SED (Henderson et al., 2015; Hinkley et al., 2008; Raustorp et al., 2012; Timmons et al., 2007). As such, the IOM (2011) suggests that childcare staff provide daily outdoor time whenever possible, and that the outdoor environment should have a variety of play equipment, shade, open grassy areas, and adequate space per child.

Tandon and colleagues (2015) observed that children were more active and less sedentary when playing outdoors compared with indoors, although children only spent 33 minutes/day, or about 8% of their time at childcare playing outdoors. Consistent with these findings, children in both the US and Sweden had higher levels of PA when playing outdoors (Raustorp et al., 2012), and Canadian preschoolers were also significantly more active and less sedentary when outdoors (Vanderloo, Tucker, Johnson, & Holmes, 2013). A caveat to consider, is that PA levels tend to decline the longer children play outdoors, suggesting that it may be most beneficial to offer shorter and more frequent opportunities for OA (Pate, Dowda, Brown, Mitchell, & Addy, 2013).

Play space. Not surprisingly, the amount of dedicated play space available, how the space is arranged, and the density of the play space (child per square meter) are common predictors of children's activity patterns at childcare (Boldemann et al., 2006; Dowda et al.,

2009; Stephens et al., 2014). When examining associations between the childcare environment and young children's PA behaviors, Gubbels, Van Kann, & Jansen, (2012) observed that children were more active when more space was available indoors. A key finding from focus groups to determine challenges and opportunities related to implementation of new a PA policy in Delaware, was that providers felt that limited outdoor space was a major challenge to regulation compliance (Garbor et al., 2010). Another study found that children's activity levels (measured outdoors with pedometers) decreased as the number of children per square meter increased, indicating the importance of considering both the amount of play space and the number of children using the play space at any given time (Cardon et al., 2009).

Play equipment. The quantity and intensity of children's PA is also influenced by the amount and type of play equipment available. Childcare providers specifically cited *lack of appropriate equipment* as a barrier to PA in childcare centers (van Zandvoort, Tucker, Irwin, & Burke, 2010). This is in line with much of the research examining variations in children's PA based on different types (fixed versus portable) of play equipment. More often, portable play equipment promotes higher-intensity activity than does fixed play equipment (Bower et al., 2008; Brown et al., 2009a; Dowda et al., 2009; Nicaise et al., 2011; Vanderloo et al., 2014).

Somewhat surprisingly, Vanderloo and colleagues (2014) found a negative association between the amount of fixed play equipment available and children's activity levels. Authors suggested that stationary apparatus may not allow movement that is easily captured by accelerometers or that kids tend to stand on (or under) fixed equipment instead of moving with (or on) portable play equipment. Simply adding activity-promoting playground equipment to existing play spaces has been shown to improve activity patterns (Hannon & Brown, 2008).

Thus, centers may not need to install costly fixed equipment if incorporating less-expensive portable play equipment provides greater results.

Sedentary environment/opportunities. The influence of sedentary environments, include the presence and usage of electronic devices (TVs, video games or computers) in the classroom or center, have been assessed as a determinant of children's activity at childcare. However, like many of the previous factors, findings are not consistent. While it would seem likely that children would engage in more SED activities when additional SED opportunities were presented, some research has observed an inverse association between PA and the amount of time children spent using electronic devices (Bower et al., 2008). Authors postulated that this unlikely relationship may have been due to funding, where centers with more money to purchase TV/video equipment might also attract more educated staff, and have additional funds to provide training and education, two variables that have been linked to higher levels of PA.

Social Determinants

Research has established that certain environmental factors, such as the amount of play space, the availability of play equipment, and the presence of and compliance to a PA-focused policy, explain variations in the amount and intensity of children's PA. However much less is known about the role of a center's social environment, such as teachers' PA-specific knowledge, attitudes, and behaviors that have a direct effect on children's PA. Interestingly, these social factors may be at least, or even more important to understand than the environmental variables mentioned above. Because preschool children have little control over their own activities at childcare, teachers' behaviors, and the active opportunities they provide, may be key determinants of children's PA. In this aspect, the teachers themselves may play a critical role as the "gatekeepers" of children's activity (Ward, 2008).

Teachers' actions and behaviors. Although it seems probable that teachers' actions directly influence children's PA behaviors at childcare (Beets et al., 2011; Bower et al., 2008; Brown et al., 2009; McWilliams et al., 2009), solid evidence to support this theory and to explain the mechanisms involved, is virtually nonexistent due to the lack of high-quality intervention studies (Ward, Bélanger, Donovan, & Carrier, 2015). Because little is known about this relationship, teachers may unknowingly decrease the amount and intensity of children's PA because they are unaware of the role that they play (Copeland, Kendeigh, Saelens, Kalkwarf, & Sherman, 2012). Teachers may also be unaware that making small changes to their daily schedule, such as prompting children during play time or introducing movement into traditionally sedentary activities, can make a significant difference in children's activity levels (Gubbels et al., 2011).

Bower (2008) observed that staff behaviors were among the strongest predictors of children's PA at childcare, however, this association only applied when teachers were involved in the activities and encouraged children to be more active (Brown et al., 2009b). In one study, children had significantly higher step counts when their teachers joined them in active play at least three times during the day (Bell et al., 2015), and in another, teachers' behaviors were positively correlated with children's MVPA and inversely correlated with SED (Bower et al., 2008). During SLSAs specifically, the behaviors of the childcare providers may play a key role in children's PA levels, depending on whether she sees herself as an active facilitator or simply a supervisor (Bower et al., 2008).

Focus groups to evaluate teachers' perceptions about the benefits and barriers to children's PA at childcare revealed that staff and teachers could be a benefit or barrier depending on their behaviors, and their level of engagement with the children would likely influence

children's PA (Copeland et al., 2012). A similar study assessing Canadian teachers found similar results, in that providers felt that their own actions were very influential on children's PA behaviors, and if they were active with the children and provided positive role modeling, the children would also be more active (Tucker et al., 2011). Furthermore, teachers' behaviors can positively or negatively impact many of the environmental determinants listed above. For instance, it has been shown that children attending centers with large play areas and abundant play equipment are more active, but if teachers restrict opportunities to use the space or if they are not actively engaged with the children, the beneficial environmental attributes of the center may be diminished. On the other hand, children attending centers with limited space and play equipment may take part in adequate levels of PA if their teachers are enthusiastic role models and create ample opportunities for children to be active throughout the day.

Although most studies exploring the link between teachers' behaviors and children's activity patterns find favorable results, a few have not (Bell et al., 2015; Gubbels et al., 2011; Tucker et al., 2015). Researchers cited lack of active prompts and/or active role modeling (Vanderloo et al., 2014), and that younger children and girls prefer to stay close to teachers, rather than playing with other children (Cardon et al., 2009; Gubbels et al., 2011) as possible explanations for the findings.

Teachers' attitudes/beliefs. Although limited research suggests that teachers' behaviors may influence the amount and intensity of children's PA at childcare, gaining a better understanding of *why* a teacher does or does not perform PA-promoting behaviors is necessary when designing and evaluating policies aimed at improving preschoolers' PA. For example, a teacher may want to lead SLSAs more often, but he/she may not feel confident in that role. Knowing this, interventions/policies could include components that focus on improving teachers'

self-efficacy, either through PA-focused teacher trainings or by delegating a role model within the center who is comfortable and proficient at leading SLSAs. Copeland et al. (2012) observed that teachers' attitudes and beliefs about their perceived roles (regarding providing PA opportunities) significantly influenced children's activity levels, even within the same center. However, Gagne (2013) reported a relatively weak relationship between teachers' intentions and perceived behavioral control, and preschoolers' PA.

Teachers' education level and PA-specific training. The IOM (2011) recommends that childcare providers receive continuing education and training that encourage PA and decrease sedentary behaviors, and research supporting this link is present in the literature (Mehtälä, Sääkslahti, Inkinen, & Poskiparta, 2014). A review of PA-focused interventions at childcare revealed that the most successful interventions utilized specialized, well-trained staff (Ward et al., 2010). Additionally, childcare providers themselves identified "additional training" as an effective and efficient means to improve children's PA behaviors (Tucker et al., 2011). However, not all studies agree. Stephens and colleagues (2014) found no evidence that providing teacher training (on how to implement quality PA opportunities in the classroom) was associated with children's MVPA.

Teachers' level of education may also influence children's activity patterns, although research in this specific area is scarce. A study of Quebec childcare teachers did not observe that children's activity was related to their teacher's education level, but most childcare providers in Quebec have college degrees, thus the sample was very homogenous for this variable (Gagné & Harnois, 2013). Conversely, Dowda et al. (2004) found that children had significantly more MVPA on the playground in preschools that employed more college-educated teachers.

Barriers. Understanding the real and perceived barriers that caregivers encounter when trying to improve children’s PA behaviors is essential when developing interventions, programs, policies and resources. Commonly-sited barriers to incorporating SLSAs in Delaware childcare centers were “lack of desire/motivation, lack of understanding of the need for structured activities, lack of knowledge about how to incorporate simple activities into the daily routine, and physical inability to be active due to being overweight or having other physical disabilities” (Garbor et al., 2010, p. 40). A study by Copeland and colleagues found different barriers. Childcare providers from inner-city Head Start and Montessori schools in Ohio cited concerns about children being injured, financial barriers, and a stronger focus on academics than on PA (Copeland, Sherman, Kendeigh, Kalkwarf, & Saelens, 2012b).

PAPER 1: INFLUENCE OF A PHYSICAL ACTIVITY POLICY ON PRESCHOOLERS’ PHYSICAL ACTIVITY AND SEDENTARY BEHAVIORS AT CHILDCARE

Introduction

The substantial increase in childhood overweight and obesity in recent years is alarming. Currently, 23% of preschoolers in the U.S. are overweight or obese (Ogden et al., 2014). The negative consequences of childhood obesity are serious and often persist into adulthood (Cunningham et al., 2014; De Kroon et al., 2010; Nadar, 2006), as obesity is associated with greater risks for heart disease, diabetes, and other types of chronic conditions (Barlow et al., 2007). Effective strategies for preventing childhood obesity are essential to protect children from the unhealthy consequences of excess weight.

The American Academy of Pediatrics (2010) suggests that increasing the amount and intensity of children’s physical activity (PA) is a viable strategy for preventing childhood obesity, and experts recommend implementing obesity-prevention strategies during early childhood when habits are first forming (Institute of Medicine [IOM], 2011). Considering that most preschool-aged children in the U.S. spend a significant portion of their day at childcare (Federal Interagency Forum on Child and Family Statistics, 2015), childcare centers and/or preschools have become a focus for implementing programs and policies to improve children’s PA behaviors (Goldfield et al., 2012; Larson et al., 2011a).

Activity and Sedentary Behaviors at Childcare

PA guidelines from the National Association for Sport and Physical Education (NASPE) recommend that preschool-aged children participate in at least 60 minutes of structured and unstructured PA for a total of 120 minutes of total physical activity (TPA) each day, and that children should not be sedentary for more than 60 minutes at any one time (NASPE, 2009). More

specific recommendations from the American Heart Association (AHA) suggest preschoolers participate in at least 60 minutes per day (min/d) of moderate-to-vigorous PA (MVPA) (AHA, 2016). A common misconception among parents and teachers is that young children are very active, both at childcare and at home, and should easily meet these guidelines (Adamo et al., 2010; Tucker et al., 2011). In reality, a vast amount of evidence confirms that preschool-age children spend a large percentage of their time at childcare engaged in sedentary behavior (Alhassan et al., 2007; Bower et al., 2008; Hannon et al., 2008; Oliver et al., 2007; Pate et al., 2008; Raustorp et al., 2012; Reilly, 2010).

The likelihood that a preschooler attending childcare will meet current PA guidelines depends on many factors, most importantly which childcare center he or she attends. Depending on the study, up to 47% of the variance in children's PA can be explained by factors within the childcare, including indoor and outdoor play space, equipment, teacher training, and the presence or absence of PA-specific policies (Boldemann et al., 2006; Dowda et al., 2004; Finn et al., 2002; Hinkley et al., 2008; Pate et al., 2004).

Policy

A traditional approach to increase the amount and intensity of children's PA at childcare is to implement PA-focused curricula or purchase equipment that encourages children to be active. However, strengthening state and/or local policies is an approach with the potential to improve activity patterns and reduce childhood obesity trends on a much larger scale (Benjamin et al., 2008; IOM, 2011). Children are more likely to be active if they attend centers with a PA policy, particularly if the policy includes regulations that require staff and/or teacher trainings on PA and recommendations for staff-led structured activities (SLSA) and outdoor activities (OA) (Bell et al., 2015; Bower et al., 2008; Dowda et al., 2004; Finch et al., 2012; Gubbels et al.,

2011; Lyn, Maalouf, Evers, Davis, & Griffin, 2013; Ward et al., 2010). Dedicated policies that target PA in childcare centers are uncommon and vary significantly among states, municipalities, and even between childcare centers (Kaphingst & Story, 2009). Unfortunately, evidence to support the development and implementation of more rigorous policies and licensing regulations is limited, due in part to the small body of research evaluating the effectiveness of current PA policies and practices (Larson et al., 2011a).

Simply implementing new or strengthening existing PA policies may not improve children's PA behaviors if compliance is low (Copeland et al., 2011; Larson et al., 2011b; McWilliams et al., 2009). The duration and intensity of children's daily PA can vary widely depending on whether policy regulations, like providing a minimum amount of time to play outdoors, are consistently followed by staff (Lessard et al., 2014). Therefore, it is essential that policy compliance is evaluated in a real-world setting to ensure that children are reaping the benefits on a consistent basis.

Present Study

To improve the health behaviors of young children attending licensed childcare centers, Fargo, ND, implemented new regulations that established specific requirements for children's activity, beverages served, screen time limits, and teacher training. The current study examines the PA components of this policy. Thus, the aim of this research is to determine if children attending centers with a PA policy have different levels of MVPA and SED than children attending centers in neighboring communities without the policy. Because achieving the intended outcomes (increasing PA and decreasing SED) is dependent on consistent compliance to the policy requirements, a secondary aim is to measure the proportion of children meeting the PA guidelines, and evaluate whether compliance is associated with measured levels of MVPA and

SED. Few studies have compared activity patterns of children attending licensed childcare centers with, and without a PA policy. Findings from this study may be used to strengthen policies and practices that aim to improve PA behaviors at childcare and expand the small base of literature on the effects of implementing a municipal PA policy at childcare.

Method

Procedure

A cross-sectional research design was used to evaluate children's activity and sedentary behaviors at childcare. Eligible centers consisted of 65 licensed full-day childcare centers and preschools with at least 10 preschool-aged children (3-5 years) enrolled full-time in Fargo and surrounding areas including West Fargo, ND, and Moorhead, MN. Fargo centers, which were functioning within the guidelines of a PA-specific policy, served as the intervention group and the remaining sites were the comparison group.

Letters providing a general overview of the project and an invitation to participate were sent to all eligible centers (*Appendix A*). Twelve centers (6 intervention and 6 comparison) responded and were provided with detailed information and consent forms. Center directors (*Appendix B*) and teachers (*Appendix C*) completed consent forms, and all eligible children (3-5 years and attending full-time) were given a packet to take home with an information letter, parental consent form (*Appendix D*), and a child demographic survey (*Appendix E*). The study protocol was approved by the North Dakota State University Institutional Review Board (*Appendix F*).

Children with parental consent wore accelerometers during their time at childcare for three consecutive days in the spring of 2016. A three-day data-collection period was used to minimize participant burden and studies have used similar or fewer days to evaluate children's

PA (Alhassan, 2007; Bower, 2008; Copeland, 2016; Gagne, 2013; Henderson, 2015; Sugiyama, 2012). On the first day of the evaluation, a trained member of the research team measured each child's height and weight, and attached an accelerometer to the child's right hip using an elastic waist band. Accelerometers were numbered and assigned to each child for the duration of the evaluation. Childcare providers were instructed on how to properly place and remove accelerometers for the remainder of the evaluation period. Because these actions were considered part of the data collection process, teachers also completed an IRB training video and supplemental questionnaire documenting their understanding and completion of the training. Teachers documented children's time of arrival and departure from the center. After completion of the evaluation period, center directors (*Appendix G*) and lead teachers (*Appendix H*) from participating classrooms completed surveys providing information about the social (teacher-specific) and environmental (center-specific) variables that may influence children's PA, such as play space and equipment, teacher demographics, and PA-specific guidelines. Each participating center received a \$100 gift card to be used to purchase PA-promoting equipment or materials, and each participating classroom received a \$50 gift card.

Participants

Participants included 223 children (Age: 4.28 ± 0.80 years, Boys: 50%) enrolled at 12 licensed childcare centers: six intervention centers with a PA policy (N = 131) and six comparison centers without a policy (N = 84). The sample was comprised of primarily Caucasian children (90.3%) with smaller proportions of mixed-race (5.5%), Hispanic (1.9%), African-American (1.3%), and Native American children (1.0%). The racial composition of the sample was reflective of the racial composition of the surrounding community (Table 1). Adult

participants included 38 classroom teachers (26 intervention, 12 comparison) and 12 center directors (6 intervention, 6 comparison).

Assessment of Policy Compliance

Currently, policy compliance for licensed group childcare centers in Fargo is monitored through a yearly site visit completed by the local Public Health department. The assessment of the PA-specific regulations is basic and includes examining teacher-documented activity plans of scheduled OA and SLSA, and verifying teacher training schedules and completion. This study used both objective measurements for MVPA and SED (accelerometer data) and teacher self-report (time spent outdoors and participating in SLSA) to measure the following policy guidelines: 1) children should be active (MVPA) for at least 60 minutes each day, 2) children should not be inactive (SED) for more than 60 minutes at any one time, 3) teachers/staff should provide at least 30 minutes of daily SLSA, and 4) teachers/staff should provide at least 60 minutes of daily OA or active free play indoors if weather is inclement.

Measures

Physical activity assessment. The amount of time children spent outdoors and participating in SLSAs was assessed using the Activity Tracking Form (*Appendix I*). Teachers documented the start and end times for each type of activity, as well as time spent napping/resting and daily weather conditions. For each classroom, the mean number of minutes (averaged over three days) was calculated and reported as minutes per day (min/d) for each type of activity.

The amount of time children participated in MVPA and SED was measured using ActiGraph accelerometers (Actitrainer or GT3X+ models; Actigraph LLC, Pensacola, FL). Accelerometers were initialized to save data in 15-second intervals (epoch) to account for the

spontaneous activity patterns of preschool-aged children (Pate et al., 2008). The amount of time a child participates in activities of different intensities is measured through the application of established cut points, which differentiate between sedentary (sitting/sleeping), light (slow walking), moderate (fast walking, skipping), and vigorous (jogging, running) activities (Bornstein et al., 2011). Raw accelerometer data were downloaded and reduced using ActiLife software. To account for varying lengths of wear time, the total amount of time spent in MVPA and SED was summed into minutes of hourly (min/h) activity based on the total wear time for each participant, averaged over three days. Non-wear time, which was defined as 60 minutes of consecutive zeros (accounted for nap time, where applicable) was excluded from total wear time. Data from participants with at least two days, and a minimum of five hours of valid wear time per day, were used in the analysis (N = 191). Data were categorized using cut points from Evenson (2008) and classified as sedentary (<25 counts/15-sec), light (25-574 counts/15-sec), moderate (575-1002 counts/15-sec), or vigorous (≥ 1002 counts/15-sec). These cut points were utilized because they were more moderate than other calibration studies conducted with children (Pate et al., 2006; Puyau, Adolph, Vohra, & Butte, 2002; Sirard, Trost, Pfeiffer, Dowda, & Pate, 2005)

Anthropometric and demographic assessment. Children's age, gender, race, and parent education level (used as a proxy measure for socioeconomic status) was reported on the parent survey. Participants were weighed and measured twice on the first day of the assessment at each center. Height was measured to the nearest 1 mm using a stadiometer (without shoes) and weight was measured to the nearest 0.1 kg using a digital scale (without shoes or outerwear). The average of two measurements for both height and weight, along with age and gender were used to calculate BMI percentiles.

Statistical Analysis

All analyses were performed using IBM SPSS (version 24). Alpha levels for tests of significance were set at $p < .05$. Descriptive statistics (mean, SD, frequency, and percent) were calculated for all demographic variables. To examine potential differences in children's demographic and anthropometric variables between intervention and comparison groups, independent samples *t*-tests were run to compare groups on continuous measures (age, BMI%, and accelerometer wear time) and chi-square tests were used to assess gender, race, and parent education proportionality.

Separate mixed model ANCOVAs were utilized to examine group differences in MVPA and SED, controlling for child-level covariates influencing children's PA (BMI, race, gender, age, parent education level) and accounting for multilevel data with naturally occurring group (classroom). Frequency tables were used to examine compliance (compliant/not compliant) to the four policy mandates listed above. Separate mixed model ANCOVAs were used to evaluate the relationships between compliance to the two modifiable guidelines (>60 min/d OA and >30 min/d SLSA) and children's hourly MVPA and SED, controlling for nesting within classrooms.

Results

Of the original 223 children who had parental consent to participate in the analyses, data from 191 children (96 boys, 95 girls) with a mean age of 4.28 years ($SD = 0.80$) were used in the final analyses (118 intervention, 73 comparison). Thirteen participants were no longer attending the childcare centers or the participating classroom at the time of data collection. Data from 13 children were excluded for not meeting minimum wear time requirements (at least five hours per day on at least 2 days). An additional three participants were excluded due to accelerometer

malfunction and three were omitted for not meeting minimum classroom participation requirements (minimum of five children per classroom).

Overall, children wore accelerometers for an average of 7.78 hours per day and for an average of 2.85 days of the three-day evaluation period. Children attending comparison centers wore accelerometers for longer periods each day than children attending intervention centers (Table 1). Intervention centers were larger (more children/center), had more play equipment available, and employed teachers with more PA-specific training (number of trainings attended in the previous year). All other measured variables were similar between groups (Table 2).

Table 1

Descriptive Characteristics of Study Participants

Characteristics	Total (N = 191)	Intervention (n = 118)	Comparison (n = 73)
Age (years)	4.28 ± 0.80	4.19 ± 0.83	4.41 ± 0.72
Gender (%)			
Male	50.3	50.8	49.3
Female	49.7	49.2	50.7
Race (%)			
White	90.6	93.2	86.3
Other	9.4	6.8	13.7
BMI Percentage (kg/m ²)	66.85 ± 23.83	65.05 ± 24.68	69.76 ± 22.25
Parent Education (%)			
< College Degree	15.2	11.0	21.9
College Graduate	54.5	55.9	52.1
Post-Graduate	30.4	33.1	26.0
Wear Time			
Number of Days	2.85 ± 0.36	2.84 ± 0.37	2.88 ± 0.33
Hours per Day*	7.78 ± 1.02	7.59 ± 0.95	8.10 ± 1.06

Note. Values for age, BMI and wear time are presented as $M \pm SD$.

*Significant difference observed between groups ($p < .05$).

Table 2

Classroom and Teacher Characteristics

Characteristics	Total	Intervention	Comparison
Center-Specific	(N = 12)	(n = 6)	(n = 6)
Play Equipment Score **	7.70 ± 0.82	8.07 ± 0.62	7.11 ± 0.78
Play Space Score	5.00 ± 2.10	4.64 ± 1.86	5.56 ± 2.41
Center Size (children/center) **	79.00 ± 39.90	95.07 ± 41.08	54.00 ± 21.95
Class Size (children/classroom)	14.52 ± 5.58	15.86 ± 6.25	12.44 ± 3.78
Teacher-Specific	(N = 23)	(n = 14)	(n = 9)
Experience (%)			
< 10 years	52.2	42.8	66.7
> 10 years	47.8	57.2	33.3
Age (%)			
<40 years	61.0	57.2	66.6
>40 years	39.0	42.8	33.4
Teacher Training Score *	2.52 ± 0.79	2.79 ± 0.58	2.11 ± 0.93

Note. Values for play equipment score, play space score, center size, class size, and teacher training score are presented as $M \pm SD$.

Significant differences observed between groups, * $p < .05$ and ** $p < .01$.

Comparison of Children's Activity and Sedentary Behaviors

Children in this sample accrued 6.00 min/h of MVPA (SD = 2.41) and 30.26 min/h of SED (SD = 5.17). Compared to children at the comparison sites, children attending intervention centers participated in more hourly MVPA and less SED, but the differences were not significant. Significant gender differences were seen with both outcome variables. Boys participated in 1.59 more minutes of MVPA, and 2.76 fewer minutes of SED each hour than did girls. Children of parents with a college degree participated in significantly less MVPA than children of parents without a college degree (Table 3).

Table 3

Comparison of Children's Sedentary and Moderate-to-Vigorous Physical Activity

	MVPA (min/h)		SED (min/h)	
	M ± SE	p	M ± SE	p
Group				
Intervention	6.74 ± 0.42	.058	29.97 ± 0.96	.324
Comparison	5.62 ± 0.48		31.30 ± 1.11	
Gender				
Boys	6.98 ± 0.38	<.001	29.26 ± 0.88	<.001
Girls	5.39 ± 0.37		32.02 ± 0.84	
Parent Education				
< College	6.84 ± 0.49	.031 ⁺	29.58 ± 1.10	.176
College Grad	5.77 ± 0.38		31.36 ± 0.86	
Post Grad	5.94 ± 0.40		30.98 ± 0.91	
Age				
3	6.00 ± 0.50	.834	31.59 ± 1.13	.336
4	6.26 ± 0.39		30.10 ± 0.89	
5	6.29 ± 0.40		30.23 ± 0.91	
Race				
White	6.12 ± 0.30	.799	29.94 ± 0.70	.197
Other	6.25 ± 0.52		31.34 ± 1.18	

Note. Values are adjusted means from mixed-model ANCOVAs controlling for child's age, gender, BMI, parent education, and race.

⁺ Means differ except for college graduate vs. post graduate.

Comparison of Policy Compliance between Groups

To better understand group variations in children's MVPA and SED, a second research question examined to what extent the policy guidelines were being met in each group. Table 4 displays the percentage of children in each group that met each policy guideline. All children met the minimum recommendation for SED (<60 min at any one time), while relatively few (25% intervention, 16% comparison) met the requirements for MVPA (>60 min/d). Although children in both groups participated in similar amounts of SLSA each day, only 45% of children in the intervention centers and 57% in the comparison centers met the requirement of at least 30 minutes each day. Similar group trends were seen with OA. While children played outdoors for

about the same amount of time in both groups, only 72% of children in the intervention centers met the minimum 60 minutes per day requirement, compared to almost 77% of the children in the comparison centers.

Table 4

Proportion of Children Meeting Policy Guidelines

Policy Guidelines	Percent of Children Meeting Policy Guidelines	
	Intervention %	Comparison %
Sedentary Activity (< 60 min/hour)	100	100
Moderate-to-Vigorous Activity (> 60 min/day)	25.4	16.4
Staff-led Structured Activity (> 30 min/day)	44.9	57.5
Outdoor Activity (> 60 min/day)	72.0	76.7

Note. Sedentary and Moderate-to-Vigorous Activity were measured via accelerometer. Staff-led Physical Activity and Outdoor Activity were teacher documented.

Relationship between Children’s Activity and Policy Compliance

The second research question further inquired whether children who met the minimum requirements for OA and SLSA had different amounts of MVPA and SED than children who did not meet the requirements (Table 5). In the comparison group, no significant differences were observed in hourly MVPA or SED between children who met and did not meet minimum requirements for SLSA and OA. Children in the intervention group who played outdoors for at least 60 minutes each day accrued an additional 1.2 min/h of MVPA ($p < .01$) and were sedentary for 2.8 fewer min/h ($p < .01$) than children who played outdoors for less than 60 min/d.

Table 5

Mixed-Model ANCOVA of Policy Compliance and Time Spent in Sedentary and Moderate-to-Vigorous Physical Activity

Group	Outcome Variable	Policy Guidelines			
		Outdoor Activity (>60 min/d)		Staff-Led Structured Activity (>30 min/d)	
		$\beta \pm SE$	p-value	Met	p-value
Comp	MVPA	.38 \pm 0.65	.56	.87 \pm 0.54	.11
	SED	-1.13 \pm 1.37	.41	-1.15 \pm 1.14	.32
Inter	MVPA	-1.18 \pm 0.44	<.01	.41 \pm 0.41	.32
	SED	2.81 \pm 1.00	<.01	-.85 \pm 0.93	.36

Note. Reference values = Compliant.

Discussion

The purpose of this study was to determine whether children attending intervention centers (with a municipal PA policy) and children attending comparison centers (without a municipal PA policy) had different activity and sedentary patterns while at childcare. Because achieving the intended policy outcomes (increasing PA and decreasing SED) was dependent on the policy guidelines being met, a secondary goal was to measure the proportion of children meeting the guidelines, and evaluate whether compliance is associated with measured levels of MVPA and SED. Although only intervention centers were functioning within the policy guidelines, assessing compliance at all centers provided additional feedback with which to explain study findings.

Time Spent in MVPA and SED

The AHA (2016) recommends that preschoolers accumulate at least 60 min/d of MVPA. Children in this sample participated in approximately 30 min/h of SED (4 hours/d) and 6 min/h of MVPA (46 min/d), which is significantly less than the AHA's recommendations. In other

words, although children were active for about half of the day, over three-quarters of this time was spent participating in light activities. Unfortunately, because there are no universally agreed upon accelerometer cut-points for preschoolers, making comparisons between studies that used different cut points can be difficult and misleading (Beets et al., 2011). Similar research using Evenson's cut points found that children averaged 9 min/h of MVPA in a single day evaluation period (Henderson et al., 2015), however, researchers noted that teacher behaviors and practices may have been altered because they were being observed, thus causing children's activity levels to increase. Studies using more stringent guidelines for what constitutes MVPA (Sirard et al., 2005) found that children spent significantly less time participating in MVPA than children in the current study (Alhassan et al., 2007; Cardon et al., 2009; Gagné & Harnois, 2013; Hannon & Brown, 2008; Raustorp et al., 2012).

Consistent with other studies, boys in our sample were more active and less sedentary than girls (Boldemann et al., 2006; Henderson et al., 2015; Hinkley et al., 2008; Pate et al., 2008; Pate et al., 2004; Tucker, 2008). Parent education level (used as a proxy measure for SES) was negatively associated with MVPA in the current study. While a relationship between parent income and children's PA is rare in the literature, Henderson et al. (2015) observed the opposite, where children attending centers located in higher income neighborhoods (using census block groups as a proxy for parent income) had more MVPA. Authors suggested that these findings may have reflected differences in neighborhood safety and quality, which may affect the likelihood and duration of OA (Henderson et al., 2015). Because the current study accounted for grouping of PA behaviors within classrooms by using a mixed-model approach, our findings reflect differing amounts of MVPA observed within the classroom relative to SES, and not

differences that may be due to the location of the center or center-level variables that may vary based on center resources (i.e., equipment, space, higher paid teachers).

Group Comparisons of MVPA and SED

After controlling for child-level covariates and accounting for clustering of PA within classrooms, no significant differences were observed between groups. At first glance, these findings seemed surprising considering our hypothesis that children in the intervention centers would be more active and less sedentary due to the policy mandates that were in place. But it is important to note that while comparison centers were not functioning under a PA-specific policy, they all had some form of written policy that included requirements for indoor and outdoor PA, limits on SED opportunities, and PA-specific professional development/education for staff and teachers. As similar policies are implemented in the future, research should focus on examining changes in activity and sedentary behaviors pre- and post-policy implementation, which would provide a clearer view of how children's PA behaviors are modified due to the policy.

Group Comparisons of the Proportion of Children Meeting Guidelines

Because level of compliance to policy guidelines may influence the likelihood of attaining the intended outcomes (more PA and less SED), we further examined the proportion of children meeting each guideline. Over the course of a day, just over 25% of children in the intervention centers accrued 60 minutes or more MVPA, compared with 16% of children in the comparison group. Interestingly, a higher proportion of children at comparison centers met the requirement for SLSA and OA (57% and 77%) than at intervention sites (45% and 72%), even though intervention classrooms were required to plan and document at least 30 minutes of SLSA and 60 minutes of OA each day.

Relationship between Compliance and Children's Activity

The overarching goal of this research is to provide evidence to strengthen policies and practices that aim to improve PA behaviors at childcare. To do this, we must first evaluate whether meeting the existing guidelines improve the likelihood that the intended outcomes will be achieved. Because the amount of SLSA and OA provided by teachers are modifiable factors that can be adjusted and monitored, compliance to these guidelines was further examined to determine how, and to what extent, compliance influenced children's activity.

Compliance with SLSA guideline. Children's activity levels at childcare depend upon the active and sedentary opportunities provided by teachers and staff. Thus, integrating SLSAs into the preschool day seems like a logical approach to increase activity levels. Although NASPE (2009) recommends that preschoolers participate in at least 60 minutes of structured PA each day, studies examining the relationship between SLSA and children's PA have mixed results. In the current study, children in both groups spent approximately 27 min/d participating in SLSA, just under the 30-min/d recommendation, but significantly less than the 60 minutes recommended by NASPE.

Compliance to the SLSA guideline is twofold. Teachers must lead some type of activity for a minimum of 30 minutes each day, *and* the activities must be moderate-to-vigorous intensity. While this sounds straightforward, fidelity to the second piece may be problematic because intensity is difficult to measure in real time. There were no differences in hourly MVPA or SED between classrooms that met the guideline (>30 min/d SLSA) and those who did not (<30 min/d SLSA) in either group. This is surprising, especially in the intervention centers where the policy stipulates that all SLSAs should be moderate-to-vigorous in intensity. Differing ideas about what types of activities constitute SLSA may partly explain why all children had similar

amounts of MVPA and SED, regardless of the time spent participating in SLSAs. And because the current study did not evaluate PA intensity specifically during SLSAs, it is not possible to ascertain whether it was the amount of time dedicated to SLSAs or the activities themselves that were inadequate.

Similar compliance issues were observed in an evaluation of policy regulations in licensed childcare centers in New York City. A majority of center staff (77%) reported meeting the 30 min/d requirement for SLSA; however, when observed over a 2-day period, only 30% of classrooms actually met this guideline (Lessard et al., 2014). Like the current study, compliance with the SLSA mandate was not associated with children's MVPA. Likewise, an experimental study examining teacher fidelity to a 6-month PA intervention in preschools found that children in comparison schools were offered more daily playtime than children in intervention schools due to low adherence to the study protocol by the intervention teachers (Alhassan & Whitt-Glover, 2014).

Looking beyond issues of compliance, Van Cauwenberghe et al. (2013) compared children's activity levels on days when SLSAs were provided and on days when they were not, and found that children were more active and less sedentary on days that included SLSA sessions led by the classroom teacher, even with no specific direction on what type of activities to provide. In contrast, an evaluation of the impact of a randomized control trial to increase children's activity through increasing SLSAs found that children's step counts per minute did not increase in the intervention group, even though they participated in more SLSAs (Finch et al., 2014). Authors cited potential differences between groups that were not assessed (teacher training, behaviors, and environmental characteristics) as possible confounders. Generally, SLSAs delivered by trained experts (PE teachers or members of the research team) or well-

trained staff are more effective at increasing children's PA than when delivered by classroom teachers (Alhassan & Whitt-Glover, 2014; Reilly, 2008).

In the current study, intervention teachers were required to participate in a minimum of 2 hours of PA-specific training each year. The first training (completed within three months of hire) was conducted face-to-face and covered policy requirements/implementation and included ideas for different types of MVPAs. The follow-up training (completed online during the second year after hire) provided a more intensive overview of how to best incorporate appropriate SLSAs into the daily schedule. Because teachers were not asked specifically which trainings had been completed in the year before the evaluation, there is no way to determine whether they had experienced only the first-year training or both the first- and second-year trainings at the time of the evaluation. Furthermore, two hours of training throughout an entire year may not be enough to improve teachers' knowledge, self-efficacy and willingness to provide SLSAs at the level necessary to meet policy guidelines. Although training was not a requirement for teachers in the comparison centers, many indicated receiving some form of PA-specific trainings in the year prior to the evaluation. Without knowing the exact content of the trainings, it is difficult to assess whether teacher trainings influenced the amount or intensity of the SLSAs provided to the children in the comparison group.

The relatively low percentage of classrooms meeting the SLSA guideline underscores the importance of assessing compliance in real time, versus a yearly compliance check that simply requires teachers to document a daily plan for scheduled SLSAs. Future research is needed to evaluate (through direct observation) teacher's adherence to the SLSA training and guidelines, while directly measuring children's activity intensity during the bouts of SLSA.

Compliance with OA guideline. Compliance to the OA guideline required that teachers provide at least 60 minutes of OA each day, weather permitting. On average, children in both groups played outdoors for approximately 2 hours each day, although a higher percentage of classrooms in the comparison group (77%) met the minimum policy guideline compared to the intervention group (72%).

An interesting finding was that children in the intervention group (but not in the comparison group) who played outdoors for at least 60 min/d accrued significantly more MVPA and less SED each hour than children who played outdoors for less than 60 min/d. This difference can be attributed, at least in part, to the larger range of values for OA in the intervention group ($M = 114$ min/d, $SD = 55$) versus the comparison group ($M = 108$ min/d, $SD = 40$). So, while a higher percentage of children in the comparison sites played outdoors for more than 60 minutes, these children spent significantly less time outdoors overall than children in the intervention centers. It would make sense that the longer (overall) time that a child spends outdoors, the more PA and less SED they will accrue, and that attaining the arbitrary 60 min/d recommendation may not be as important as the total amount of time spent outdoors.

The amount of dedicated outdoor play space and equipment available at each site may have also influenced the current findings. While all centers had similar amounts of space to play indoors and out, the intervention centers had significantly more play equipment available. It may be that the total amount of space is not as important, if there is sufficient space to actively move and play, and enough play equipment to encourage movement. Play equipment has been shown to increase participation in PA, especially when it is portable (Bower et al., 2008; Brown et al., 2009b). While positive relationships between time spent outdoors and preschoolers' PA behaviors are fairly consistent throughout the literature (Copeland et al., 2016; Henderson et al.,

2015; Tandon et al., 2015; Vanderloo et al., 2013), a randomized control trial found no differences in children's daily MVPA between children who played outdoors for the usual time and those who were outside for two additional 30 minute periods (Alhassan et al., 2007).

However, this was a small study conducted in only one center over a 2-day period.

Increasing the amount of OA provided for children at childcare is a modifiable, low cost strategy to increase PA, although the weather may be a barrier, especially in colder climates. Future research should aim to evaluate the relationship between OA and PA in groups with similar play equipment and space.

Strength and Limitations

Data collection was completed over an 8-week period in May and June with average temperatures in the 70s, which is very mild for this time of year in ND. Hence, the findings are likely an optimistic representation of preschoolers' habitual PA behaviors throughout the year. Because this evaluation was conducted after the PA policy was implemented, it was not feasible to obtain pre-intervention data with which to compare PA levels within the intervention centers only, making a directional hypothesis unviable. Also, compliance was documented through teacher self-report, which may have been subject to social desirability, inaccurate recall, and/or lack of understanding of the policy/regulations (ex: what can be counted for SLSA). The use of a 2- to 3-day evaluation period is less than the recommendation to provide reliable estimates of PA through accelerometry, although many studies have used similar or fewer days to evaluate children's activity (Alhassan, 2007; Bower, 2008; Copeland, 2016; Gagne, 2013; Henderson, 2015; Sugiyama, 2012). Finally, although groups were similar in terms of the child-level demographics, there were significant variations in classroom and center-level variables, such as available play equipment and the number of participating children and classrooms in each group.

Despite the limitations mentioned above, this study has many unique strengths. Few studies have compared activity and sedentary patterns of children attending licensed childcare centers with and without a PA-focused policy. At the time of the evaluation, Fargo, ND was one of the only cities in the country to have specific PA regulations for licensed childcare centers, which allowed researchers to evaluate and compare PA patterns in centers with and without a policy, in the same geographical area with similar demographics. Additionally, few studies have examined the relationships between policy compliance and children's PA behaviors in a real-world setting. Lastly, our sample size was adequate, we used accelerometers to objectively measure children's MVPA and SED, and our statistical analyses accounted for clustering of children's activity within classrooms.

Conclusions and Implications

Findings from this study provide valuable and practical insight for childcare centers and other jurisdictions considering similar policies. The current study found that children were sedentary for about half of their time at childcare and participated in light activity for over three quarters of the remaining time. The average amount of MVPA accrued was not sufficient to meet policy guidelines or recommendations by NASPE and the AHA. Because the amount of OA was positively associated with children's activity patterns, children should be provided ample opportunities for outdoor play with sufficient play equipment available. Another solution to increase children's MVPA is to improve the effectiveness of SLSAs, possibly through regular teacher trainings with expanded content. In addition, teachers should be made aware of gender differences and trained to provide additional prompts and supports that specifically target girls' activity and sedentary behaviors. One of the commonly-cited barriers to providing teacher trainings and implementing regular compliance evaluations is the lack of funding. A possible

low-cost solution to improve compliance through training may be to provide a series of online trainings that are required for all teachers/staff throughout the year. Another option may be to train an individual at each site to regularly monitor compliance and offer assistance when mandates are not being met.

This research also highlights the importance of developing policies that include strategic evaluation procedures that measure compliance in real time to ensure that the intended benefits of the policy are being experienced. Because compliance can vary significantly from day-to-day, the method of assessing compliance may be even more important than the actual guidelines set forth in the policy. Determining the factors that either support or hinder consistent compliance may also be of high importance.

Many factors, other than the policy itself or the level of compliance, may have influenced children's activity patterns and may partly explain the similar outcomes in both groups. Future research should examine children's behaviors pre- and post-policy implementation, and evaluate bouts of OA and SLSA through direct observation to get a better understanding of the true influence these factors have on overall activity. In addition, future research should examine the relationship between weather/temperature, OA and children's PA during the winter months, as mild weather was likely related to high levels of activity in the current study. Finally, longitudinal research is necessary to establish causal relationships between specific policy guidelines, level of compliance, and children's activity and sedentary behaviors.

**PAPER 2: INDIVIDUAL, SOCIAL AND ENVIRONMENTAL CORRELATES OF
CHILDREN'S PHYSICAL ACTIVITY AND SEDENTARY PATTERNS AT
CHILDCARE**

Introduction

Benefits of regular physical activity (PA) include improved physical and emotional health, weight control, and decreased risk of cardiovascular disease, type 2 diabetes, and some types of cancer (Centers for Disease Control and Prevention, 2015). Engaging in regular physical activity during early childhood is especially important to establish healthy activity behaviors that often track into adolescence and adulthood (Ward et al., 2010). Furthermore, preschoolers' behaviors are more malleable than adolescents' or adults', thus promoting healthy PA patterns at this age is considerably easier than when they are older (Goldfield et al., 2012).

The National Association for Sport and Physical Education (NASPE) recommends that preschoolers accumulate at least one hour of both structured and unstructured PA each day, and should not be sedentary for more than 60 minutes at any one time (NASPE, 2009). More specific guidelines from the American Heart Association (AHA) recommend that children should participate in at least 60 min/d of moderate-to-vigorous physical activity (MVPA) (AHA, 2016). Among teachers and parents, a misconception exists that young children are very active throughout the day (Adamo et al., 2010; Tucker et al., 2011). However, multiple studies have observed that very few children, whether in childcare or at home, meet these guidelines (Bornstein et al., 2011; Reilly, 2010; Tucker, 2008). An overwhelming body of evidence highlights that preschool-aged children spend a significant portion of their day sedentary (Alhassan et al., 2007; Bower et al., 2008; Dowda et al., 2004; Hannon & Brown, 2008; Oliver, 2007; Pate et al., 2008; Raustorp et al., 2012; Reilly, 2010). Since preschoolers attending full-day

childcare have little time for additional activities at home, it is imperative that they accumulate sufficient amounts of MVPA to meet these activity guidelines during childcare.

Physical Activity versus Sedentary Behaviors

Being sedentary (SED) and participating in low levels of PA are not the same. Although both can negatively influence health, they are distinct constructs and should be measured independently (Byun et al., 2011). Generally, as children spend more time participating in sedentary activities, time spent participating in MVPAs decreases. However, because correlates of MVPA have been more thoroughly studied, less is known about the factors that influence children's SED behaviors (Tonge, Jones, & Okely, 2016). Nevertheless, both cross-sectional and longitudinal studies have consistently found that preschoolers who are highly sedentary are at an increased risk of overweight and obesity, indicating that reducing sedentary time may be just as important as increasing MVPA (Oliver et al., 2007).

Children's Physical Activity and Sedentary Behaviors at Childcare

With approximately 5 million U.S. children attending some type of structured childcare or preschool programs (Jones-Taylor, 2015), this is an ideal location for enacting policies and practices aimed at shaping preschoolers' activity patterns. Studies measuring children's PA and SED behaviors consistently observe sizeable between-center variations, reflecting the fact that childcare centers differ significantly in the quality and quantity of PA and SED opportunities they provide (Boldemann et al., 2006; Dowda et al., 2004; Finn et al., 2002; Hinkley et al., 2008; Pate et al., 2004). Where a preschooler attends childcare may be a stronger predictor of his/her activity patterns than demographic factors, like race, age, or gender (Pate et al., 2008). Although the childcare environment is a suitable and relatively untapped setting for research exploring the

determinants of children's PA and SED, few studies have done so (Cardon et al., 2009; Dowda et al., 2004; Pate et al., 2004).

One way to forecast children's activity levels is by examining factors in their surrounding environments. The Social Ecological Model (SEM) posits that human behavior is influenced by factors at multiple levels, including individual, social, and environmental. The model can also be used to identify factors that promote or hinder PA at each level. Hence, children's PA variability between childcare centers may be due to differences in center characteristics, like play space, equipment, center size, and PA-specific policies, and/or may reflect variations in the social environment, such as teachers' behaviors, and the PA-specific knowledge and beliefs that guide their behaviors (see Figure 1).

Individual (Child-Level) Correlates

Although most of the individual-level correlates that have been studied (age, gender, BMI and race) are not modifiable, their effects on children's activity patterns are important to understand when creating programs and interventions to improve these patterns. For example, boys tend to be more active and less sedentary than girls at this age (Boldemann et al., 2006; Henderson et al., 2015; Hinkley et al., 2008; Pate et al., 2008; Tucker, 2008). Therefore, developing specific guidance on best practices to help girls improve their activity levels may be an effective strategy to close the activity gap. Other child-level correlates that have been linked to preschoolers' activity patterns are age and BMI, although findings are inconsistent (Brown et al., 2009a; Gubbels et al., 2011; Hannon et al., 2008; Nicaise et al., 2011; Pate et al., 2008).

Social (Teacher-Level) Correlates

Despite the pivotal role that teachers play in shaping children's PA behaviors, little is known about the impact of the mid-level (social) factors. For example, best-practice guidelines

for PA at childcare suggest that staff should encourage children to be active and join children during playtime (McWilliams et al., 2009), however few findings support this guideline (Brown et al., 2009a; Hinkley et al., 2008). While little is known about the relationship between teachers' behaviors (prompting, engaging in PA with children, etc.) and children's PA patterns, even less is understood about how teachers' underlying attitudes/beliefs contribute to their own PA-specific behaviors. Within a single center with similar policies and environmental correlates, children in separate classrooms may participate in varying levels of PA depending on the education, attitudes/beliefs, and level of engagement of their teacher (Copeland et al., 2012).

Given the significant role that teachers play, more research is needed to provide evidence-based best practices that guide future policy (Tonge et al., 2016). This study will expand the existing body of evidence by assessing teachers' PA-specific knowledge, attitudes, and behaviors using facets from the Social Cognitive Theory (SCT). A key construct of the SCT is that of reciprocal determinism, which posits that there is a dynamic interaction between individuals, their environment, and their behaviors (Bandura, 2004). Individual SCT constructs include *self-efficacy*, which refers to a person's confidence in his/her ability to successfully perform a behavior, and *outcome expectations*, which are beliefs about the likelihood of performing a behavior and value of the outcomes. Environmental SCT constructs include *observational learning*, which asserts that a behavior is more likely to occur if an individual can observe others performing the behavior, and *social support*, which refers to the response to, or support for the behavior from others (Bandura, 2004). Assessing teachers' attitudes and beliefs about performing specific PA-promoting behaviors will provide important information about ways to improve children's PA through the actions and behaviors of their teachers.

Environmental (Center/Classroom-Level) Correlates

Findings illustrate that a center's organizational and environmental factors, including the amount of play space available, equipment, time provided for outdoor play and staff-led activities, and PA-specific policies, can strongly influence the duration and intensity of children's activity (Bell et al., 2015; Finn et al., 2002; Henderson et al., 2015; McWilliams et al., 2009; Story et al., 2006; Van Cauwenberghe et al., 2013). While much of the existing research highlights children's activity patterns that are influenced by environmental factors, this line of inquiry is still in its infancy and has produced inconsistent results.

Goals of the Study

Despite increased interest and efforts to improve children's activity and sedentary behaviors at childcare in recent years, research in this area is limited and findings are conflicting (Mehtälä et al., 2014). Because activity and sedentary patterns are influenced by a complex array of factors from multiple levels, the current research utilized the theoretical framework of the SEM to guide the categorization of potential correlates into three domains (individual, social, and environmental). While a modest body of evidence exists on the individual and environmental correlates of children's activity patterns at childcare, relatively little is known about the role of social correlates, such as teacher's knowledge, training, and PA-promoting behaviors. Furthermore, no research has specifically examined the relationship between teachers' attitudes and beliefs about performing PA-promoting behaviors, and children's MVPA and SED. A preliminary step in developing new and strengthening existing policies that aim to improve children's PA at childcare is to identify determinants of these behaviors. Therefore, the purpose of this study was twofold: 1) to measure the MVPA and SED of a sample of preschoolers during

childcare, and 2) to identify correlates (child-level, teacher-level and classroom-level) of preschoolers' MVPA and SED behaviors.

Methods

Study Design

A cross-sectional research design was used to evaluate children's activity and sedentary behaviors at childcare. Eligible centers consisted of 65 licensed full-day childcare centers and preschools with a minimum of 10 preschool-aged children (3-5 years) enrolled full-time in Fargo and surrounding areas, including West Fargo, ND, and Moorhead, MN. Letters providing an overview of the research and an invitation to participate were sent to eligible centers (*Appendix A*). Twelve centers responded and were provided with additional information and consent forms. Center directors (*Appendix B*) and teachers in participating classrooms (*Appendix C*) completed consent forms, and all eligible children (3 to 5 years and enrolled full time) were given a packet to take home with an information letter, parental consent form (*Appendix D*), and a child demographic survey (*Appendix E*). Study protocol was approved by the North Dakota State University Institutional Review Board (*Appendix F*).

Children with parental consent wore accelerometers at childcare for three consecutive days in the spring of 2016. A three-day collection period was used to minimize participant burden. On the first day of the evaluation period, a trained member of the research team measured each child's height and weight, and attached an accelerometer to the child's right hip using an elastic waist band. Accelerometers were numbered and assigned to each child for the duration of the evaluation. Teachers were instructed on how to properly place and remove accelerometers for the remainder of the evaluation period. Because these actions were considered part of the data collection process, teachers also completed an IRB training video and

supplemental questionnaire documenting their understanding and completion of the training. Teachers documented children's time of arrival and departure from the center. Each participating center received a \$100 gift card to be used to purchase PA-promoting equipment or materials, and each participating classroom received a \$50 gift card.

Participants

Participants included 223 children (50% male), ages three-to-five, enrolled at 12 licensed childcare centers. The sample was comprised of primarily Caucasian children (90.3%), with smaller proportions of mixed-race (5.5%), Hispanic (1.9%), African-American (1.3%), and Native American (1.0%) children. The racial composition of the sample was reflective of the racial composition of the surrounding community. Adult participants included 23 lead teachers and 12 center directors, whose survey data was used to analyzed classroom- and teacher-specific correlates. Most teachers were Caucasian (95%) and female (95%) with at least a college degree (86.4%).

Measures

Outcome variables. The amount of time children spent participating in MVPA and SED was monitored using ActiGraph accelerometers (Actitrainer or GT3X+ models, ActiGraph, Pensacola, FL). Accelerometers were initialized to save data in 15-second interval (epoch) to account for the spontaneous activity patterns of preschool-aged children (Pate et al., 2008). The amount of time a child participates in activities of different intensities is measured through the application of cut points, which differentiate between sedentary (sitting), light (slow walking), moderate (fast walking, skipping), and vigorous (jogging, running) activities (Bornstein et al., 2011).

Raw accelerometer data were downloaded and reduced using ActiLife software. To account for varying lengths of wear time, the total amount of time spent in MVPA and SED was summed into minutes of hourly (min/h) activity based on the total wear time for each participant, averaged over three days. Non-wear time, which was defined as 60 minutes of consecutive zeros (accounted for nap time, where applicable) was excluded from total wear time. Data from participants with at least two days, and a minimum of five hours of valid wear time per day, were used in the analysis (N = 191). Data were categorized using cut points from Evenson (2008) and classified as sedentary (<25 counts/15-sec), light (25-574 counts/15-sec), moderate (575-1002 counts/15-sec), or vigorous (\geq 1002 counts/15-sec). These cut points were utilized because they were more moderate than other calibration studies conducted with children (Pate et al., 2006; Puyau et al., 2002; Sirard et al., 2005).

Individual (child-level) predictors. Five biological or demographic predictors were included in the analyses, four of which were derived from the parent survey [age, gender, race, and their own level of education (used as a proxy measure for socioeconomic status)]. Due to limited numbers of minority children and lower education levels, race was recoded into a binary variable (Caucasian and non-Caucasian) and parent education was reduced from six to three categories (< college, college graduate, post-graduate).

Children were weighed and measured twice on the first day of the assessment. Height was measured to the nearest 1 mm using a portable stadiometer (without shoes) and weight was measured the nearest 0.1 kg using a digital scale (without shoes and outerwear). The average of two measurements for both weight and height, along with the child's age and gender, were used to calculate BMI-for-age percentiles based on the Centers for Disease Control and Prevention.

From these data, children were categorized into two groups: normal weight (BMI < 85th percentile) and overweight/obese (BMI ≥ 85th percentile).

Social (teacher-level) predictors. Eight social variables were identified from surveys (*Appendix H*) completed by lead classroom teachers (N = 22) after the evaluation period was completed. The survey was developed specifically for this project, but was informed by the Environmental and Policy Assessment Observation (Ward et al., 2008), the Good for Kids. Good for Life. Physical Activity Staff Survey (Finch et al., 2012), and the Go NAP SACC Self-Assessment Instrument (Ward et al., 2014). Survey items were based on an extensive review of the literature and surveys were pre-tested in 3 licensed centers not participating in the study. Content validity was established through peer review and (non-participating) teachers' comments upon completing the survey.

Questions concerning teachers' age, previous teaching experience in a childcare setting, and open-ended responses of perceived barriers to performing specific PA-promoting behaviors were included. Due to limited responses in some categories, teachers' age and experience were dichotomized using a median split into younger (≤ 40 years) and older (> 40 years) and less experienced (≤ 10 years) and more experienced (> 10 years). In addition, the survey was divided into three sections measuring teacher's PA-specific knowledge, attitude/beliefs, and behaviors. Based on survey data, six scales (using multiple questions) were created and scores were calculated for each teacher, with a higher score indicating a more supportive social environment.

The knowledge scale (2 questions) assessed the PA-specific trainings or professional-development activities that teachers had completed in the previous year. The behavioral scale ($\alpha = .78$) assessed frequency of each of the following PA-promoting behaviors: 1) integrating physical movement into traditionally sedentary activities (5 point scale ranging from 0 = *I don't*

do this to 4 = *several times a day*), 2) participating with children during active free play (5 point scale ranging from 0 = *I don't do this* to 4 = *several times a day*), 3) leading structured, adult-guided physical activities (5 point scale ranging from 0 = *I don't do this* to 4 = *several times a day*), 4) providing verbal prompts and/or encouragement to increase children's PA (5 point scale ranging from 0 = *I don't do this* to 4 = *several times a day*), and 5) utilizing indoor space to provide opportunities for PA during inclement weather (5 point scale ranging from 0 = *never* to 4 = *always*).

Four psychosocial scales (each with 5 questions using a 4-point scales ranging from -2 = *strongly disagree* to 2 = *strongly agree*), assessed teachers' attitudes and beliefs about performing PA-promoting behaviors: 1) *Self-efficacy* ($\alpha = .91$) - confidence in performing the behaviors, 2) *Outcome expectation* ($\alpha = .92$) - perceived outcomes of performing the behaviors, 3) *Observational learning* ($\alpha = .86$) - belief about whether peers were performing similar behaviors, and 4) *Social support* ($\alpha = .92$) - belief about whether they feel support to perform the behaviors.

Environmental (classroom-level) predictors. Five environmental variables were identified from surveys (*Appendix G*) completed jointly by the researcher and center directors ($N = 12$). The survey was developed specifically for this project, but was informed by the Environmental and Policy Assessment Observation (Ward et al., 2008) and the Good for Kids. Good for Life. Physical Activity Staff Survey (Finch et al., 2012). The researcher read all questions aloud and entered responses directly onto the survey. Survey questions were based on an extensive literature review and surveys were pre-tested in 3 licensed centers not participating in the study. Based on survey data, play equipment scores (0 - 12) were calculated for each classroom, representing the number of categories (jumping, ride-on, twirling, etc.) of fixed and

portable equipment available indoors and out. Policy scores (0-5) were calculated based on the number of *written* guidelines concerning the center's operations or expectations for teachers, staff and children (i.e. limits on the amount of screen time, amount of time provided for outdoor play, or requirements for PA-specific teacher trainings). The amount of dedicated indoor and outdoor play space was measured and documented as square feet of space for each. Due to the small sample size and clustering of data, the size of the indoor and outdoor play areas was dichotomized using a medial split into smaller (1,500/5,000 ft² or less) and larger (more than 1,500/5,000 ft²). Finally, the amount of time children spent playing outdoors and participating in staff-led structured activities (SLSA) was documented by head teachers throughout the evaluation period on the Activity Tracking Form (*Appendix I*). The mean number of minutes (averaged over three days) was calculated and reported as minutes per day (min/d) for each variable.

Data Analysis

All analyses were performed using SPSS (version 24). Descriptive statistics (mean, SD and percent) were calculated for the sample and simple *t*-tests and 1-way ANOVAs were used to explore differences in MVPA and SED (min/h) between gender, age, race, parent education, and BMI category. Because four centers had only one participating classroom and a primary goal of the study was to evaluate aspects of individual teachers, we utilized the classroom as the unit of measurement. To determine potential correlates for each outcome variable, Pearson correlation coefficients were calculated and all variables with P values of less than .10 were included as predictors. All predictor variables were tested separately to evaluate their association with time spent in MVPA and SED. Variables significant at the $p < .05$ were included in the multivariable models (full models), including classroom as a random factor to account for the clustering effects

of children's PA behaviors within each classroom. Child-level predictors were explored first, followed by contextual (level 2) predictors. Outdoor activity and equipment score were evaluated separately due to collinearity.

Results

Of the original 223 children who had parental consent to participate, data from 173 children (87 boys, 86 girls) with a mean age of 4.23 years ($SD = 0.77$) were used in the final analyses. Thirteen participants were no longer attending the childcare centers/participating classrooms at the time of data collection. Data from 13 children were excluded for not meeting minimum wear time requirements (at least five hours per day on at least 2 days). An additional 16 were omitted due to accelerometer malfunction, as well as three for not meeting minimum classroom participation requirements (minimum of five children per classroom). Overall, children wore accelerometers for an average of 7.71 ($SD = 1.02$) hours per day and for an average of 2.86 days of the three-day evaluation period. Teachers were predominantly Caucasian and female with a college degree. Table 6 displays the descriptive characteristics for children and teachers who participated in this study.

Table 6

Descriptive Characteristics of Study Participants

Characteristics	Children (N = 173)	Teachers (N = 22)
Child Age (years)	4.23 ± 0.77	
Teacher Age (%)		
18-29 years		18.2
30-39 years		45.5
40-49 years		22.7
50-59 years		9.1
60-69 years		4.5
Gender (% Female)	50.0	95.5
Race (%)		
White	90.2	95.5
Other	9.8	4.5
Child BMI Category (%)		
Normal Weight	73.4	
Overweight/Obese	26.6	
Child (Parent) Education (%)		
< College Degree	16.8	
College Graduate	53.8	
Post-Graduate	29.5	
Teacher Education (%)		
College Graduate		86.4
< College Graduate		13.6
Accelerometer Wear Time		
Number of Days	2.86 ± 0.36	
Hours per Day	7.71 ± 1.02	

Note. Values for child's age and accelerometer wear time are presented as $M \pm SD$.

Children averaged 6.23 (SD = 2.16) min/h of MVPA and 29.81 (SD = 4.89) min/h of SED. The amount of time children engaged in MVPA and SED differed by gender, where boys were more active (6.91 vs 5.55 min/h; $p < .01$) and less sedentary (28.36 vs 31.29 min/h; $p < .01$) than girls. No other differences were observed between child characteristics.

Potential Correlates of Children's MVPA and SED

The SEM guided the grouping of potential correlates of children's MVPA and SED into three domains: 1) child-level demographic and biological variables, 2) teacher-level social

variables, and 3) classroom/center-level environmental variables. The names, definitions, and variable types are described in Table 7.

Table 7

Potential Correlates of Children's Sedentary and Moderate-to-Vigorous Physical Activity at Childcare

Variable	Definition	Variable Type	Mean (SD) or %
Demographic/Biological Correlates			
Child age	Current age of child	Continuous: (years)	4.26 (0.76)
Child gender	Gender of child	Binary: (% boys)	50.0
Parent education	Parent education level (proxy for SES)	Nominal: [% of parents w/ ≤ college degree, college degree, and graduate degree]	15.3 54.0 30.7
Child race	Child's race/ethnicity (white/other)	Binary: (% white)	91
Child BMI group	Normal weight vs. overweight/obese	Binary: (% normal weight)	73.5
Social Correlates			
Teacher age	Current age of teacher	Dichotomous: (% of teachers ≤ 40 years)	57.8
Teacher experience	Teacher's experience teaching in a childcare setting	Dichotomous: % of teachers w/ ≤ 10 years	53.2
Teacher training score	Teacher's PA-specific trainings in previous year	Continuous: (0-6)	2.52 (0.79)
Teacher behavior score	Documented frequency of performing (5) PA-promoting behaviors	Continuous: (0-20)	15.57 (3.74)
Teacher observational learning score	Belief about whether peers are performing similar PA-promoting behaviors	Continuous: (-12 to 12)	7.43 (4.04)
Teacher outcome expectancy score	Belief about the perceived outcomes of performing PA-promoting behaviors	Continuous: (-12 to 12)	9.30 (3.34)

Table 7. *Potential Correlates of Children’s Sedentary and Moderate-to-Vigorous Physical Activity at Childcare (continued)*

Variable	Definition	Variable Type	Mean (SD) or %
Teacher self-efficacy score	Belief about their own confidence in performing PA-promoting behaviors	Continuous: (-10 to 10)	8.70 (1.92)
Teacher social support score	Belief about whether they feel support to perform the PA-promoting behaviors	Continuous: (-12 to 12)	6.83 (4.31)
Environmental Correlates			
Policy score	Number of written guidelines concerning children’s PA and SED behaviors	Continuous: (0-5)	3.51 (.63)
Play equipment score	Number of categories of fixed and portable play equipment inside and out	Continuous: (0-12)	7.71 (0.81)
Indoor play space	Amount of dedicated play space indoors (0-5700 ft ²)	Dichotomous: (% of classrooms w/ < 1,500 ft ²)	64.2
Outdoor play space	Amount of dedicated play space outdoors (675 – 100,000 ft ²)	Dichotomous: (% of classrooms w/ < 5,000 ft ²)	42.2
Outdoor activity (OA)	Average amount of time spent outdoors	Continuous: (23-215 min/d)	109.19 (51.4)
Staff-led structured activity (SLSA)	Average amount of time spent in SLSA	Continuous: (0-50 min/d)	26.44 (14.6)

Relationships between Potential Correlates and Children’s MVPA and SED

The results of the correlation analyses are presented in Table 8. Child’s gender ($p < .01$), the amount of outdoor activity (OA) ($p < .01$) and the equipment score ($p < .05$) were significantly associated with both MVPA and SED.

Table 8

Bivariate Analysis for Potential Correlates and Children's Sedentary and Moderate-to-Vigorous Physical Activity

Potential Correlates	Pearson Correlations	
	MVPA/hour	SED/hour
Demographic/Biological		
Age	-.02	-.03
Parent Education	.03	.04
BMI Group	-.01	-.03
Race	-.01	.07
Gender	-.32**	.30**
Social (Teacher-Specific)		
Age	-.04	.04
Experience	.01	-.01
Training Score	.07	.08
Behavior Score	.08	-.01
Observational Learning Score	-.01	.01
Outcome Expectancy Score	-.10	.10
Self-Efficacy Score	.06	-.12
Social Support Score	.09	-.04
Environmental		
Policy Score	-.04	.11
Equipment Score	.25*	-.20*
Indoor Play Space	.03	-.07
Outdoor Play Space	.05	-.03
Outdoor Activity	.26**	-.25**
Staff-Led Structured Activity	.04	-.02

* $p \leq .05$, ** $p \leq .01$

Mixed-Model Regression Analysis for Correlates of Children's MVPA and SED

Considerable variance was observed in MVPA and SED among classrooms. The mean time spent in MVPA ranged from 1.6 to 13.0 min/h, whereas time in SED ranged from 17.0 to 40.0 min/h. Intra-class correlations (ICCs) were calculated using the results of tests of the unconditional models. ICCs indicated that 20% of the variation in children's MVPA and 29% of the variation in children's SED was attributed to contextual variables at the classroom level, indicating that PA behaviors were dependent on the center/classroom attended.

All significant variables from the bivariate correlation analysis were included in a linear mixed model analysis (Table 9). Due to collinearity between the equipment score and OA, separate models were built using gender in both. In the final models, gender (boys) ($p < .01$), OA ($p < .05$) and equipment score ($p < .05$) were positively associated with MVPA, and gender (boys) ($p < .01$), and OA ($p < .05$) were negatively associated with SED.

Table 9.

Mixed-Model Regression Analysis for Significant Correlates and Children's Sedentary and Moderate-to-Vigorous Physical Activity

Significant Correlates	MVPA (min/h)	SED (min/h)
	Estimate \pm SE	Estimate \pm SE
Final Model		
Gender (Boys)	1.40 \pm 0.29**	-2.86 \pm 0.60**
Equipment Score	0.76 \pm 0.28*	-1.42 \pm 0.74
R ²	.16	.13
Final Model		
Gender (Boys)	1.33 \pm 0.29**	-2.75 \pm 0.63**
Outdoor Activity	0.61 \pm 0.28*	-1.44 \pm 0.71*
R ²	.14	.14

* $p \leq .05$, ** $p \leq .01$

Discussion

The goal of this study was to provide support for existing individual and environmental correlates of children's PA at childcare, and to explore and identify novel relationships between teachers' PA-specific knowledge, attitudes, and behaviors and children's PA and SED at childcare. We hypothesized that preschoolers' activity and sedentary patterns are guided by multiple factors at different levels of influence, such as gender (child-level), teacher PA-specific training (teacher-level), and the amount of space available for active play (center-level), and that children in classrooms with more supportive social and environmental aspects will be more active.

Children's PA and SED

The AHA (2016) recommends that preschoolers participate in at least 60 minutes of MVPA each day. On average, children in this sample participated in approximately 6.23 (SD = 2.16) min/h of MVPA and 29.81 (SD = 4.89) min/h of SED. When extrapolated to reflect a daily amount, children were sedentary for 3.83 hours and only active at the moderate-to-vigorous level for approximately 45 minutes. In other words, although children were engaged in non-sedentary activities for about half of their time at childcare, over three-quarters of this time was spent participating in activities of light intensity. Based on cut points utilized for this study, activities in this category include slow walking and seated play (Evenson et al., 2008). Even while these observations are likely an optimistic value of MVPA and SED throughout the year (due to the nice weather and generous amounts of time spent outdoors), children's daily accrual of MVPA is still well below the AHA's recommendations. These findings are not unique. Reilly's (2010) review of accelerometer-based studies measuring children's activity levels at childcare observed that none of the 63 centers evaluated provided 60 minutes of MVPA. Unfortunately, because there are currently no universally agreed-upon accelerometer cut-points for preschoolers, making comparisons between studies that used different cut-points can be difficult and misleading (Beets et al., 2011).

Using a single-day observation period, similar research using Evenson's cut points observed that children averaged 9 min/h of MVPA. However, researchers noted that teacher behaviors and practices may have been altered because they were being observed, thus causing children's activity levels to increase (Henderson et al., 2015). Other findings illustrate that children spend significantly less time participating in MVPA than children in the current study, although these studies utilized more stringent cut points (Sirard et al., 2005) to categorize MVPA

(Alhassan et al., 2007; Cardon et al., 2009; Gagné & Harnois, 2013; Hannon & Brown, 2008; Raustorp et al., 2012).

Individual (Child-Level) Correlates

Consistent with other findings, the current research observed that boys were more active and less sedentary than girls (Byun et al., 2013; Gagné & Harnois, 2013; Henderson et al., 2015; Nicaise et al., 2011; Olesen et al., 2013; Stephens et al., 2014; Tucker, 2008). There are currently no definitive explanations for why boys are more active than girls at this age (Pate et al., 2004), but it may be partly due to sociocultural factors that presume and encourage boys to engage in more “rough-and-tumble” play. Although other studies have observed relationships between activity levels and children’s age, race, parent education level, and BMI, the current study did not (Henderson et al., 2015; Tonge et al., 2016). Despite the fact that most of these correlates are not modifiable, their effects on children’s PA behaviors is important to understand when creating or improving policy measures. For example, in the current study a child’s gender explained 12.1% and 10.2% of the variation for MVPA and SED respectively. Knowing that boys are significantly more active and less sedentary than girls can provide valuable insight when creating PA-specific teacher trainings for SLSA or other interventions aimed at encouraging activity.

Social (Teacher-Level) Correlates

Preschoolers are highly responsive to instruction and encouragement from adults, and teachers’ knowledge, experiences, and personal characteristics directly influence how teachers interact with children in their care (Mehtälä et al., 2014). Unfortunately, our hypothesis that children’s PA and SED would reflect the PA-specific attitudes, knowledge, and behaviors of their teachers was not observed. Still, our findings are not unique. Educator-focused variables have been studied much less frequently as correlates of children’s PA, and what findings are

available, are often inconclusive (Tonge et al., 2016). Olesen (2013) found no associations between staff correlates (PA enjoyment, PA-specific education, gender, age, and how often staff initiated PA outdoors) and children's daily MVPA. Authors suggested that the results may have been a consequence of low levels of interaction between children and staff during OA, a finding that has been observed in other studies (Bower et al., 2008; Brown et al., 2009b; Cardon et al., 2009; Nicaise et al., 2011)

Teachers' PA-specific knowledge/training. A review by Trost (2011) reported that centers with the highest levels of PA employed more educated teachers and were more likely to provide teachers with PA-specific training. The current study did not observe these relationships. However, since most teachers had at least a college degree (86%), and had completed similar amounts/types of PA-specific training in the year prior to the evaluation (mean training score = $2.59 \pm .75$), the non-significant outcome may have reflected high levels of homogeneity for this variable.

Teachers' attitudes/beliefs. The current study used constructs from the SCT to assess relationships between teachers' attitudes and beliefs about performing specific PA-promoting behaviors, and children's MVPA and SED. The theory posits that an individual's attitudes and beliefs, along with their environment, guides their actions and behaviors. In the childcare setting, these underlying factors not only influence teacher's behaviors, but also the behaviors of their students, as preschoolers are almost entirely dependent on their teachers to provide active opportunities (Copeland et al., 2012).

In contrast to theoretical expectations, none of the measured psychosocial correlates were related to children's activity patterns in this sample. There may be a couple of reasons for this. First, psychosocial variables were measured using self-reported measures of teachers'

attitudes/beliefs about performing PA-promoting behaviors, while children's PA was objectively measured with accelerometers. More importantly, children's PA is an indirect measure of the teachers' attitudes and beliefs. In other words, the actual behaviors of the teachers (frequency of performing PA-promoting behaviors) was not the outcome variable. In order to gain a better understanding of the relationship between teachers' psychosocial variables and children's activity, future studies could first evaluate the association between teachers' attitudes/beliefs and their own PA-promoting behaviors.

Using the Theory of Planned Behavior as a guide, Gagne (2013) evaluated the influence of psychosocial variables of childcare workers on children's PA and found that *intention* (intention to engage children in PA) and *descriptive norm* (belief that peers are engaging children in PA) were significant predictors, but together only explained 4.5% of the variance in PA. However, *descriptive norm* was negatively associated with children's activity, meaning children were more active when their teachers perceived few other teachers were engaging children in PA.

Teachers' PA-promoting behaviors. In the childcare setting, teachers' PA or SED-promoting behaviors, and children's activity patterns are closely linked. However, inconsistent findings may be reflective of the technique used to conceptualize and measure teachers' behaviors. Brown (2009b) observed that while teachers reported using prompts to improve children's activity throughout the day, direct observation revealed that teachers rarely prompted children to increase their PA. Similarly, McWilliams (2009) evaluated preschoolers at 96 childcare centers and found that in 61% of the centers, staff participation was absent or very limited. In almost half of the centers, staff used no or very few prompts, and only two centers observed staff using active play as a reward.

Using direct observation to evaluate the presence/absence of staff encouragement and participation, Henderson (2015) witnessed that children had higher levels of MVPA (indoors, but not outdoors) when staff encouraged activity. However, in this same study, researchers observed that children were *less* active when staff participated in indoor play. Researchers postulated that this unexpected finding may have been a result of teachers joining in an activity because they noticed that children were inactive. In other words, children's low levels of activity may have led to a higher level of teacher involvement (Henderson et al., 2015).

Two studies that utilized the Environmental and Policy Assessment and Observation (EPAO) instrument to evaluate teachers' behaviors found differing results (Gubbels et al., 2011; Vanderloo et al., 2014). While Vanderloo observed an inverse association between staff behaviors and children's MVPA, Gubbels did not. Ward (2015) suggests "there may be a thin line between educators being over-involved and under-involved in PA promotion" (p 1066). Whereas children who are normally inactive may benefit from teacher involvement and direction, the same level of teacher involvement may act to stifle activities of children who are habitually active on their own (Ward, 2015).

Tucker (2015) utilized the EPAO evaluation tool to compare preschoolers' SED behaviors in three different early learning environments (full-day kindergarten, center-based, and home-based) and found that staff behaviors accounted for more than half of the variation in SED among children attending *home-based* childcare. In most home-based childcare, since a single adult is often responsible for the care of all children, his/her actions will likely be solely modeled (Tucker, Vanderloo, Burke, Irwin, & Johnson, 2015). In the current study, over half of the classrooms had multiple teachers that were responsible for providing active opportunities for the

children, but the score used to measure teachers PA-promoting behaviors was calculated using responses from the head teacher only.

Environmental (Classroom-Level) Correlates

Most of the potential environmental correlates were not associated with children's PA or SED in this sample. Two that were most influential were the amount of time children spent outdoors and the number of different types of play equipment available. Because these factors are modifiable, both may be targeted in policies, interventions, and programs aimed at promoting healthy PA behaviors at childcare.

Outdoor activity. The current study observed that children who played outdoors for longer periods were significantly more active and less sedentary than those who played outdoors for less time. Positive relationships between outdoor play and improved PA behaviors are consistent throughout the literature (Copeland et al., 2016; Henderson et al., 2015; Tandon et al., 2015; Vanderloo et al., 2013). While cross sectional studies strongly suggest that increasing OA can improve children's activity behaviors, only one randomized control trial has tested this relationship (Alhassan et al., 2007). This study observed no differences in daily MVPA between children who played outdoors for the usual time (morning and afternoon) and those who were outside for an additional 30 in minutes during each play period (Alhassan et al., 2007). It should be noted that this was a small study conducted in only one center over a 2-day period.

Simply increasing the amount of time children are allowed outdoors, with no additional supports from teachers (prompts, joining/leading activities), may not be enough to substantially increase the intensity and duration of children's PA. Furthermore, since preschoolers cannot maintain MVPAs for extended periods of time, scheduling shorter, more frequent play opportunities (as opposed to fewer, longer periods) may be a more effective strategy for

increasing MVPA (Copeland et al., 2012b). Future research should examine variations in children's activity levels specifically during outdoor play to determine the duration of OA that provides the most MVPA. In addition, studies should be designed to examine the influence of the duration of OA, and any additional benefits derived from providing multiple opportunities for OA throughout the day.

Play equipment. A review of the determinants of children's PA in terms of playground attributes found moderate evidence supporting the relationship between playground equipment and children's PA (Broekhuizen, Scholten, & Vries, 2014). Consistent with our findings, the presence of certain types and/or quantities of play equipment available (fixed and portable) has been positively correlated with children's activity levels (Bower et al., 2008; Dowda et al., 2009). However, unlike the current study which used a single equipment score (0 - 12) representing the number of categories (jumping, ride-on, twirling, etc.) of fixed and portable equipment available indoors and out, many other studies examined the effects of fixed and portable equipment separately. Vanderloo (2015) found that preschoolers were more sedentary when a larger number of fixed (but not portable) structures were available. Authors postulated that the inverse relationship may be because fixed play equipment, like slides or climbing structures, do not encourage running or walking movements that are readily measured by accelerometers. Alternately, researchers observed that, although children were sedentary for 66% of their time outdoors, they were more active and less sedentary when the playground had more fixed equipment (Sugiyama et al., 2012). Because portable play equipment is often less expensive and can be used in multiple locations, purchasing additional portable equipment may be a more feasible approach for most childcare centers with limited resources.

Staff-led structured activities. The current study did not find a relationship between the amount of SLSAs provided and children's MVPA or SED. Although significant variances were observed between classrooms (0 – 50 min/d), it may be that the activities provided were not intense enough to generate accelerometer-derived MVPA, even for those children receiving the most SLSAs. The existing body of evidence concerning the relationship between SLSA and children's activity is limited and mixed. One study, comparing children's activity levels on days when SLSAs were provided and on days when they were not, found that children were more active and less sedentary on days that included SLSA sessions led by the classroom teacher, even with no specific direction on what type of activities to provide (Van Cauwenberghe et al., 2013).

In contrast, an evaluation of the impact of a randomized control trial to increase children's activity through increasing SLSAs found that children's step counts per minute did not increase in the intervention group, even though they participated in more SLSAs (Finch et al., 2014). Generally, SLSAs delivered by trained experts (PE teachers or members of the research team) or well-trained staff are more effective at increasing children's PA than when delivered by classroom teachers (Alhassan & Whitt-Glover, 2014; Reilly, 2008). In order to create more effective SLSAs, future research should evaluate PA intensities specifically during bouts of SLSA and findings should be used to inform teacher trainings.

Indoor/outdoor play space. It would seem obvious that when provided larger spaces for play, children would modify their behaviors to include more intense activities, such as tag or other running games. However, the current study did not find a relationship between the amount of indoor or outdoor play space, and children's PA and SED behaviors. Due to outliers in the data, a median split was utilized to categorize centers into two groups (more/less space). It may be that this split did not allow for relationships to be observed. In contrast, Dowda (2009) cited

playground size as a key characteristic at centers with the highest levels of PA and the least SED, which is consistent with other studies (Boldemann et al., 2006; Cardon et al., 2009). Because play space is often limited and is generally not modifiable, future research should aim to identify the minimum amount of play space below which children's activity may be hindered. This type of information may be more important for policy makers than simply providing evidence about the relationship between play space and children's activity.

Strengths and Limitations

Limitations of this study include the use of a cross-sectional design and a limited number of licensed childcare centers within one geographic area, which may constrain the generalizability of study findings. The limited number of children in some of the classrooms made it difficult to examine correlates separately for boys and girls, hence, important potential relationships may have been overlooked. In addition, score used to measure teachers PA-promoting behaviors were calculated using responses from the head teacher only, but most classrooms had multiple teachers that provided activity and sedentary opportunities.

Additionally, the use of a 3-day evaluation period is less than the recommendation to provide reliable estimates of PA through accelerometry, although other studies have used similar or fewer days to evaluate children's PA (Alhassan, 2007; Bower, 2008; Copeland, 2016; Gagne, 2013; Henderson, 2015; Sugiyama, 2012). Finally, many of the social correlates were self-reported using non-validated questionnaires and obtained from a small sample of teachers (N = 22), which may have limited the power to observe significant relationships.

Despite the limitations mentioned above, this study has many strengths, including the use of objective, reliable, and validated measures of children's MVPA and SED, and statistical analyses that accounted for clustering of children within classrooms. In addition, we evaluated a

broad range of potential correlates across three domains of the SEM. We utilized a multi-method approach, including direct measurements and data derived from parents, teachers, and childcare directors. Finally, data were collected over the course of a few weeks, reducing seasonal and weather-related influences.

Conclusion and Implications

This study advances the current literature by identifying three correlates of preschooler's activity behaviors at childcare, two of which are modifiable. This research supports existing findings that children who are offered more outdoor play time and more diverse play equipment are more active and less sedentary. Because portable play equipment is often less expensive and can be used in multiple locations, purchasing additional portable equipment may be a more feasible approach for most childcare centers with limited resources. Although inconclusive, this was the first study to utilize psychosocial constructs from the SCT to explore the relationship between teachers' knowledge, attitudes and behaviors, and children's MVPA and SED. It is our intention that these findings can be used to strengthen policy guidelines and to create more effective teacher training programs that aim to improve children's activity patterns at childcare.

SUMMARY

In an effort to improve the health behaviors of young children attending licensed childcare centers, Fargo, ND, implemented new regulations that established specific requirements for children's activity, beverages served, screen time limits, and teacher training. The current study examined the PA components of this policy. The overall aim of this dissertation was to utilize findings to provide specific and practical recommendations for childcare centers with existing policies and other jurisdictions considering similar policies.

The purpose of the first study was to determine whether children attending intervention centers (with a municipal PA policy) and children attending comparison centers (without a municipal PA policy) had different activity and sedentary patterns while at childcare. Because achieving the intended policy outcomes (increased PA and decreasing SED) is dependent upon policy guidelines being met (> 30 min/d SLSA and > 60 min/d OA), a secondary aim was to measure the proportion of children meeting the guidelines, and evaluate whether compliance was associated with measured levels of MVPA and SED. A preliminary step in developing new and strengthening existing policies that aim to improve children's PA behaviors at childcare is to identify environmental aspects of the childcare setting that influence these behaviors. Therefore, the purpose of the second study was to identify correlates (child-level, teacher-level and classroom-level) of preschoolers' MVPA and SED behaviors.

Findings from Paper 1

Children participated in approximately 30 min/h of SED (4 hours/d) and 6 min/h of MVPA (46 min/d), which is significantly less than the policy guidelines of at least 60 minutes of daily MVPA. After controlling for gender differences and clustering of activity levels within classrooms, no significant differences in MVPA or SED were observed between groups.

At first glance, these findings seemed surprising considering our hypothesis that children in the intervention centers would be more active and less sedentary due to the policy mandates that were in place. But it is important to note that a higher proportion of children at comparison centers met the requirement for SLSA (57%) than at intervention sites (45%), even though intervention classrooms were required to plan and document at least 30 minutes of SLSAs daily. Similarly, a higher percentage of children in the comparison group met the requirement for OA (77%) than at intervention sites (72%). While there were no differences between children who met and did not meet the SLSA recommendation, children in the intervention centers (but not in the comparison group) who met the OA guideline (>60 min/d) accrued significantly more MVPA and less SED than children who did not.

Findings from Paper 2

Considerable variances were observed in MVPA and SED among classrooms. The mean time spent in MVPA ranged from 1.6 to 13.0 min/h, whereas time in SED ranged from 17.0 to 40.0 min/h. Twenty percent of the variation in children's MVPA and 29% of the variation in children's SED was attributed to contextual variables at the classroom level, indicating that PA behaviors were dependent on the center/classroom attended. In addition, boys were more active and less sedentary than girls, and children who played outdoors for longer periods and had access to different types of play equipment were significantly more active and less sedentary. The hypothesis that children's PA and SED would reflect the PA-specific attitudes, knowledge, and behaviors of their teachers was not observed.

Policy Recommendations

The current PA ordinance stipulates that preschoolers 1) accumulate at least 60 min/d of MVPA, 2) are not sedentary for more than 60 minutes at any one time, 3) participate in at least

30 minutes of SLSAs each day, and 4) play outdoors for at least 60 minutes each day. During the 3-day evaluation period, only 25% of children accrued 60 minutes or more of MVPA, 45% participated in at least 30 minutes of SLSAs, and 72% were offered at least 60 minutes of outdoor play time. Overall, children participated in almost 4 hours of SED activities and only about 45 minutes of MVPA daily. In other words, although children were active for about half of the day, over three-quarters of this time was spent participating in light activities, such as seated play, slow walking, or reading. Considerable variances were observed in MVPA (25 – 100 min/d) and SED (105 – 365 min/d) among classrooms, possibly indicating that policy guidelines were being implemented differently across classrooms/centers. Furthermore, these findings are likely an optimistic representation of preschoolers' habitual PA behaviors throughout the year, as the weather was mild during much of the evaluation period.

Findings indicate that existing policy guidelines and compliance to the guidelines can be strengthened. In order to improve the likelihood that intended policy outcomes will be achieved and sustained, findings from this and other research highlight the need for more comprehensive and consistent teacher trainings. Well-trained teachers and staff are the key to improving compliance, efficacy of active opportunities (including SLSAs and OA), and may also provide a viable, low-cost solution for measuring compliance on a consistent basis.

Suggestions for Improved Teacher Trainings

In the childcare setting, teachers' PA or SED-promoting behaviors and children's activity patterns are closely linked. Preschoolers are highly responsive to instruction and encouragement from adults, and teachers' knowledge, experiences, and personal characteristics directly influence how teachers interact with children in their care (Mehtälä et al., 2014). Thus, the IOM (2011) recommends that childcare providers receive continuing education and training that

encourage PA and decrease SED behaviors. Research supporting the link between teacher training and children's PA is present throughout the literature (Mehtälä, Sääkslahti, Inkinen, & Poskiparta, 2014).

A review of PA-focused interventions at childcare revealed that the most successful interventions utilized specialized, well-trained staff (Ward et al., 2010). Similarly, a review of educational strategies to promote PA in preschools highlighted that activity levels of the children were correlated with the teachers' behaviors and training (Kreichel et al., 2012). Additionally, childcare providers themselves identified "additional training" as an effective and efficient means to improve children's PA behaviors (Tucker et al., 2011). However, Ward (2015) suggests "there may be a thin line between educators being over-involved and under-involved in PA promotion" (p. 1066). Whereas children who are normally inactive may benefit from teacher involvement and direction, the same level of teacher involvement may act to stifle activities of children who are habitually active on their own (Ward et al., 2015). Therefore, it is essential that teachers receive substantial training on how to effectively incorporate active opportunities in ways that elicits the best outcomes.

Providing additional trainings may not improve teachers' knowledge and behaviors if teachers cannot attend due to lack of funds or other barriers. Teachers in this study cited the following barriers to attending trainings: lack of time, lack of offerings, finding trainings to fit into schedule, lack of communication for when trainings are offered, and lack of interest/motivation in the content. A possible low-cost solution to overcome many of these barriers may be to provide extensive training for one lead teacher or staff member at each center, either through a series of online trainings or face-to-face meetings. As the center's "PA-leader", this teacher would be responsible to deliver the trainings to his/her peers during a time that works

best for teachers/staff and provide modifications based on the personal needs of each teacher. In addition, the PA leader would be available to answer questions as they arose, serve as a role model for other teachers to follow, and help monitor compliance.

Compliance

The relatively low percentage of children who met policy guidelines, and the fact that compliance can fluctuate from day to day, underscores the importance of assessing compliance in real time, versus a yearly compliance check that simply requires teachers to document a daily plan for scheduled SLSAs and OA. Similar compliance issues were observed in an evaluation of policy regulations in licensed childcare centers in New York City. A majority of center staff (77%) reported meeting the 30 min/d requirement for SLSA; but when observed over a 2-day period, only 30% of classrooms actually met this guideline (Lessard et al., 2014). However, authors noted that policy-specific teacher training improved the likelihood of compliance with PA regulations, possibly by provided teachers with skills necessary to successfully implement the policy regulations (Lessard, et al., 2014). Therefore, our first suggestion for improving teacher trainings is to provide specific content for meeting policy guidelines, the importance/outcomes of policy compliance, and possible methods to reduce fluctuation of compliance from day to day.

Gender Differences

Consistent with most research, we found that boys were significantly more active and less sedentary than girls. Currently, definitive explanations for this phenomenon are nonexistent (Pate et al., 2004), but it may be partly due to sociocultural factors that presume and encourage boys to engage in more “rough-and-tumble” play. While gender is not modifiable, knowing that there is a gender gap in preschoolers’ activity patterns provides valuable insight when creating teacher

trainings. Therefore, our second recommendation to improve teacher training is to highlight these gender differences and provide specific guidance on providing effective prompts and supports that specifically target girls' activity and sedentary behaviors.

Staff-Led Structured Activities

SLSAs delivered by well-trained teachers have been more effective at increasing children's PA (Alhassan & Whitt-Glover, 2014; Reilly, 2008). The current policy requires that teachers participate in a minimum of 2 hours of PA-specific training each year, which may not be enough to improve teachers' knowledge, self-efficacy and willingness to provide SLSAs at the *level* necessary to improve preschoolers' PA and SED patterns. This need is reflected, both in the low level of compliance to the SLSA guideline (only 45% of children had > 30 minutes SLSA), and in the limited effectiveness of SLSAs, regardless of duration (children who participated in SLSAs for longer periods had similar levels of MVPA and SED than children who participated for much shorter periods).

Teachers in this study identified barriers to providing SLSAs, including lack of knowledge about which types of activities promote MVPA, low personal fitness levels, pessimistic beliefs about the effectiveness or necessity of providing SLSAs, safety concerns, and lack of time, space, knowledge, ideas, and confidence. Thus, our third recommendation to improve teacher trainings is to address each of these barriers (real or perceived) and provide feasible solutions for each. With these barriers removed or addressed, teachers may be more likely to provide effective SLSAs that improve children's overall PA levels.

Outdoor Activities

Positive relationships between time spent outdoors and improved PA behaviors are consistent throughout the literature (Copeland et al., 2016; Henderson et al., 2015; Tandon et al.,

2015; Vanderloo et al., 2013). In this study, approximately 72% of children played outdoors for 60 minutes or longer and these children engaged in significantly more MVPA and less SED than children who played outdoors for less than 60 min/d. However, it is important to note that even children who met this guideline averaged less than 60 min/d of MVPA, indicating a need for additional supports.

Preschoolers tend to perform short bursts of MVPA followed by longer periods of lower intensity PA or SED activities. When observed outdoors, children were most active for the first 10 to 15 minutes, indicating that preschoolers may not be able to engage in MVPAs for extended periods of time (Brown et al., 2009b; Cardon et al., 2009; Pate et al., 2013). Our fourth recommendation is twofold: 1) instead of simply requiring a minimum duration for daily OA, guidelines should require more frequent (and shorter) opportunities for outdoor play, and 2) while teachers don't necessarily need to participate in or lead activities, teachers should be trained to provide short (5 minutes or less) bouts of intense activity while on the playground and throughout the day.

Play Equipment

Consistent with other research, we found that children with access to many different types of play equipment were more active and less sedentary than those with access to fewer types of equipment. In fact, studies have found that the amount of portable playground equipment was a stronger predictor of preschoolers' PA levels than the amount of OA provided (Alhassan et al., 2007; Dowda et al., 2009; Hannon & Brown, 2008). Inexpensive play equipment like balls and hoops have been found to stimulate higher levels of PA than larger, fixed equipment like jungle gyms, and can be used in multiple ways indoors and out. Because portable play equipment is often less expensive and can be used in multiple locations, purchasing

additional portable equipment may be a more feasible approach for most childcare centers with limited resources. Therefore, our final recommendation is to provide specific training on how to utilize portable equipment during outdoor/indoor play, and possibly incorporated into SLSAs.

Future Research

As similar policies are implemented in the future, longitudinal studies to examine changes in activity and sedentary behaviors pre- and post-policy implementation should be employed. This type of research provides a clearer view of the direct impact of policy implementation on children's PA and SED behaviors. Because differences in PA and SED patterns between girls and boys is consistent throughout the literature, studies should evaluate correlates of PA separately. Finally, in order to create more effective SLSA and OA, future research should evaluate intensities and variations of children's PA specifically during bouts of SLSA and outdoor play. Furthermore, research should assess the impact of the duration of OA, and any additional benefits derived from providing multiple (shorter) opportunities for OA throughout the day. The accumulation of findings from this and other studies will provide critical guidance for designing and strengthening childcare policies that aim to shape preschoolers' PA behaviors for a lifetime.

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APPENDIX A. CENTER INVITATION TO PARTICIPATE

Greetings! In order to learn more about how to prevent or reduce childhood obesity, and to keep our children healthy as they grow, we are inviting your childcare center to participate in a research project to evaluate children's physical activity and sedentary patterns. We will use the findings from this project to create a "best practices" guideline that centers can use to help kids be as active as possible, using the resources that are available to you.

The goals of this study are to evaluate whether: 1) children are meeting local policy recommendations (Fargo centers only) and national physical activity standards, 2) children attending Fargo centers (with a physical activity-specific policy) have similar physical activity patterns than do children attending centers without a physical activity-specific policy, 3) teachers' actions and behaviors are related to children's activity patterns, 4) certain factors (training, education, barriers) are related to the actions and behaviors mentioned above, and 5) a center's organizational or built environment (policies, space, equipment) is related to children's activity patterns.

If you agree to participate in this project, you and select preschool teachers/staff members will be asked to help our research team with the data collection process. Please see the enclosed form for a detailed description of your role in the research if you agree to participate.

Participating in this project is *voluntary*. There is absolutely no penalty if your center is not willing or able to work with us. However, we hope that you will participate because we can learn a lot from you! **Participating childcare centers will receive a \$100 gift card to be used to purchase activity-promoting materials, and participating teachers will receive a \$50 thank you gift for their participation and time.**

If we don't hear from you, we will call you in a few days to ask if your center is interested in participating. At that time, we will answer any questions you may have. If you decide to participate, a member of the research team will visit your center to explain the project in more detail and provide you with any necessary materials.

For your records, we have included a copy of the Project Fact Sheet that outlines more specifically the goals, objectives and activities related to this project. If you have any questions, please contact Michelle Strang at 701-412-1618 or by email at michelle.strang@ndsu.edu. Thank you so much for your time. We look forward to talking with you!

Sincerely,



Michelle Strang, MS, RD, LD
Graduate Researcher
North Dakota State University



Dr. Abby Gold, PhD
Principal Investigator
North Dakota State University

APPENDIX B. DIRECTOR CONSENT FORM

Title of Research Study: Individual, Interpersonal and Organizational Determinants of Children's Physical Activity at Childcare

This study is being conducted by: Dr. Abby Gold abby.gold@ndsu.edu and Michelle Strang michelle.strang@ndsu.edu from the Department of Public Health and North Dakota State University (NDSU).

Why am I being asked to take part in this research study? North Dakota State University is conducting a study to assess children's activity and sedentary behaviors while at childcare. All licensed childcare centers serving preschool-aged children in the Fargo-Moorhead area have been invited to participate. We are asking for your participation because you are a director at one of these centers. Your opinions, thoughts and knowledge are extremely valuable to the outcome of this project!

What is the reason for doing the study? There are two main goals of this project: 1) to measure how much physical activity children are getting at childcare, and 2) to examine factors within the childcare center (center size, play space, teachers' actions, etc.) that may influence children's activity. Results from this research will be used to create a "best practices" guideline, which will highlight the most effective approaches to increase children's activity levels at daycare, given the available resources.

What will I be asked to do? Your participation requires that you complete the Director Survey/Site Inventory with a member of our research team at your convenience. The survey was designed to obtain information about a center's organizational and built environment that may influence the duration and intensity of children's physical activity.

Where is the study going to take place, and how long will it take? The study will take place at your childcare center for three consecutive days. However, you will not need to be present for this portion of the research. The Director Survey/Site Inventory will take approximately 1 hour to complete.

What are the risks and discomforts? Common risks in this type of research include loss of confidentiality and emotional, psychological distress and or social implications. It is not possible to identify all potential risks in research procedures, but the researchers have taken reasonable safeguards to minimize any known risks.

What are the benefits to me? Although your participation may not have a direct benefit to you, the information we collect will be used to create a "best practices" guideline that your center may use when adopting or revising policies and procedures aimed at helping children increase their activity while at childcare.

What are the benefits to other people? Learning and adopting healthy behaviors during the preschool years can help reduce a child's risk of developing weight-related diseases throughout

their life. Ultimately, findings from this study may help to prevent childhood obesity by shaping children's physical activity and sedentary patterns early in life.

Do I have to take part in the study? Your participation in this research is your choice. If you decide to participate in the study, you may change your mind and stop participating at any time without penalty or loss of benefits to which you are already entitled.

What are the alternatives to being in this research study? Instead of being in this research study, you can choose not to participate.

Who will see the information that I give? We will keep private all research records that identify you and your center. Your information will be combined with information from other people taking part in the study. When we write about the study, we will write about the combined information that we have gathered. We may publish the results of the study; however, we will keep your name and other identifying information private.

If you withdraw before the research is over, your information will be removed at your request, and we will not collect additional information about you.

Will I receive any compensation for taking part in this study? You will not receive any personal compensation, but all participating centers will receive a \$100 gift card to purchase materials that foster children's physical activity.

What if I have questions?

Before you decide whether to accept this invitation to take part in the research study, please ask any questions by contacting the researchers, Dr. Abby Gold at abby.gold@ndsu.edu or 701-231-7478, or Michelle Strang at michelle.strang@ndsu.edu or 701-241-5881. If at any time during or after the study you have more questions, please feel free to ask.

What are my rights as a research participant?

You have rights as a participant in research. If you have questions about your rights, or complaints about this research, you may talk to the researchers or contact the NDSU Human Research Protection Program by:

- Telephone: 701.231.8995 or toll-free 1.855.800.6717
- Email: ndsu.irb@ndsu.edu
- Mail: NDSU HRPP Office, NDSU Dept. 4000, PO Box 6050, Fargo, ND 58108-6050.

The role of the Human Research Protection Program is to see that your rights are protected in this research; more information about your rights can be found at: www.ndsu.edu/irb.

Documentation of Informed Consent:

You are freely making a decision whether to be in this research study. Signing this form means that

1. you have read and understood this consent form
2. you have had your questions answered, and
3. you have decided to be in the study.

You will be given a copy of this consent form to keep.

Your signature

Date

Your printed name

Signature of researcher explaining study

Date

Printed name of researcher explaining study

APPENDIX C. TEACHER CONSENT FORM

Title of Research Study: Individual, Interpersonal and Organizational Determinants of Children's Physical Activity at Childcare

This study is being conducted by: Dr. Abby Gold abby.gold@ndsu.edu and Michelle Strang michelle.strang@ndsu.edu from the Department of Public Health and North Dakota State University (NDSU).

Why am I being asked to take part in this research study? North Dakota State University is conducting a study to assess children's activity and sedentary behaviors while at childcare. All licensed childcare centers serving preschool-aged children in the Fargo-Moorhead area have been invited to participate. We are asking for your participation because you are a preschool teacher/caregiver at a participating center. Your opinions, thoughts and knowledge are extremely valuable to the outcome of this project!

What is the reason for doing the study? There are two main goals of this project: 1) to measure how much physical activity children are getting at childcare, and 2) to examine factors within the childcare center (center size, play space, teachers' actions, etc.) that may influence children's activity. Results from this research will be used to create a "best practices" guideline, which will highlight the most effective approaches to increase children's activity levels at daycare, given the available resources.

What will I be asked to do? Your participation requires that you complete the Teacher Survey before the start of the evaluation. The survey was designed to obtain information about teachers' actions and behaviors that may influence the duration and intensity of children's physical activity, and factors that may affect those actions and behaviors mentioned above.

Prior to the evaluation period, you will be asked to assist the research team with the following tasks: 1) distribute and collect parent consent forms, 2) identify children who have parental consent, and 3) help weigh and measure participants. For three consecutive days during the study, you will be asked to: 1) help place and remove accelerometers from children when they arrive and leave for the day, and before/after naps, and 2) document start/end times for outdoor play, staff-led physical activity, and naptime.

Finally, because you will be assisting in the data collection process, you will be asked to watch a short video and complete a 5-question assessment concerning the basic ethical principles of research and rights of research participants. Please see the attached forms, Project Fact Sheet and Teacher Data Collection Process, for more information about your role in this research project.

Where is the study going to take place, and how long will it take? The study will take place at your childcare center for three consecutive days, chosen by the center director/staff. The survey should take about 10 minutes to complete, and the additional tasks before the evaluation period starts should take approximately 1 hour of your time.

What are the risks and discomforts? Common risks in this type of research include loss of confidentiality, emotional or psychological distress, and/or social implications. It is not possible to identify all potential risks in research procedures, but the researchers have taken reasonable safeguards to minimize any known risks.

What are the benefits to me? Although your participation may not have a direct benefit to you, the information we collect will be used to create a “best practices” guideline that your center may use when adopting or revising policies and procedures aimed at helping children increase their activity while at childcare.

What are the benefits to other people? Learning and adopting healthy behaviors during the preschool years can help reduce a child’s risk of developing weight-related diseases throughout their life. Ultimately, findings from this study may help to prevent childhood obesity by shaping children’s physical activity and sedentary patterns early in life.

Do I have to take part in the study? Your participation in this research is your choice. If you decide to participate in the study, you may change your mind and stop participating at any time without penalty or loss of benefits to which you are already entitled.

What are the alternatives to being in this research study? Instead of being in this research study, you can choose not to participate.

Who will see the information that I give? We will keep private all research records that identify you and your center. Your information will be combined with information from other people taking part in the study. When we write about the study, we will write about the combined information that we have gathered. We may publish the results of the study; however, we will keep your name and other identifying information private.

If you withdraw before the research is over, your information will be removed at your request, and we will not collect additional information about you.

Will I receive any compensation for taking part in this study? As compensation for your time and assistance, you will receive a \$50 gift card.

What if I have questions?

Before you decide whether to accept this invitation to take part in the research study, please ask any questions by contacting the researchers, Dr. Abby Gold at abby.gold@ndsu.edu or 701-231-7478, or Michelle Strang at michelle.strang@ndsu.edu or 701-241-5881. If at any time during or after the study you have more questions, please feel free to ask.

What are my rights as a research participant?

You have rights as a participant in research. If you have questions about your rights, or complaints about this research, you may talk to the researchers or contact the NDSU Human Research Protection Program by:

- Telephone: 701.231.8995 or toll-free 1.855.800.6717
- Email: ndsu.irb@ndsu.edu

- Mail: NDSU HRPP Office, NDSU Dept. 4000, PO Box 6050, Fargo, ND 58108-6050.

The role of the Human Research Protection Program is to see that your rights are protected in this research; more information about your rights can be found at: www.ndsu.edu/irb .

Documentation of Informed Consent:

You are freely making a decision whether to be in this research study. Signing this form means that

4. you have read and understood this consent form
5. you have had your questions answered, and
6. you have decided to be in the study.

You will be given a copy of this consent form to keep.

Your signature

Date

Your printed name

Signature of researcher explaining study

Date

Printed name of researcher explaining study

APPENDIX D. PARENT INFORMATION AND CONSENT FORM

Title of Research Study: Individual, Interpersonal and Organizational Determinants of Children's Physical Activity at Childcare

This study is being conducted by: Dr. Abby Gold abby.gold@ndsu.edu and Michelle Strang michelle.strang@ndsu.edu from the Department of Public Health and North Dakota State University (NDSU).

Why is my child being asked to take part in this research study? Your child is invited to participate in a research study to evaluate preschoolers' physical activity patterns while at childcare. Your child has been selected because he/she is between the ages of 3 and 5, and attends (full time) a licensed childcare facility that has agreed to participate in this study. Similar centers throughout Fargo, Moorhead, West Fargo and the surrounding areas have also been invited to participate.

What is the reason for doing the study? There are two main goals of this project: 1) to measure how much physical activity children are getting at childcare, and 2) to examine factors within the childcare center (center size, play space, teachers' actions, etc.) that may influence children's activity. Results from this research will be used to create a "best practices" guideline that childcare centers can use to help children learn and adopt healthy behaviors early in life.

What will my child be asked to do? We will not try to change your child's normal routine at childcare. To measure your child's activity, we will ask him/her to wear a small piece of equipment (called an accelerometer) on an elastic belt around their waist while at childcare. In addition, we will measure and weigh your child in a private location with help from his/her classroom teacher. The study will be done over a three-day period and will be supervised by childcare staff. We will explain carefully to your child that the accelerometer helps us measure how they move and play during the day, and the height and weight measurements will help to see how they are growing.

Accelerometers are small devices which sense and record movement. The accelerometers cannot be broken and do not have moving parts. Accelerometers are attached to an elastic waistband that is worn on the outside of clothing, and will not touch the child's skin. Each accelerometer is protected in a soft plastic case.

At the beginning of each day during the study, your child will be fit with an accelerometer when he/she arrives at the childcare center. Your child will always be asked whether or not he/she wishes to participate in the study by wearing the accelerometer. The accelerometer will be removed at naptime. Upon waking, your child will be asked again if he/she wishes to continue participating in the study by wearing the accelerometer. Children who wish to continue will be re-fit with the accelerometer. If at any time your child indicates that he/she does not want to wear the accelerometer, it will be removed. At the end of the day, the accelerometer will be removed by your child's teacher and stored at the center.

Finally, if you decide to allow your child to participate in this study, you will be asked to fill out a short (4 question) survey asking about your child's age, gender, ethnicity, and your level of education.

Where is the study going to take place, and how long will it take? The study will take place at your child's childcare center for three consecutive days. Again, we are simply measuring the duration and intensity of children's physical activity. We will not disrupt the normal schedule other than to weigh and measure participants on the first day of the study.

What are the risks and discomforts? There is no known health or injury risks associated with wearing an accelerometer, besides falling directly onto the device. Such a fall may cause localized swelling, bruising, or discomfort. However, the risk of such an injury from falling directly on top of the accelerometer is no greater than the risk of falling on a toy that is being carried or laying on the ground.

In addition, as a parent/guardian of a participating child you do not need to worry about your child damaging the accelerometer. The accelerometer is contained within its own protective case made of durable plastic. If an accelerometer is damaged by a participant, you will not be held liable for that damage and will not be expected to pay for any costs associated with repairing or replacing the device.

Are their benefits to my child? Your child is not expected to receive any direct benefit from being in this research study. However, we will provide you with a summary of the amount of time your child spent participating in different types of physical activity during the three day study, if you wish.

What are the benefits to other people? We will also provide your child's daycare center with an overall summary (not each child separately) of the amount of physical activity that children got during the evaluation. More importantly, we will use the results of this study to create a best practices guideline, which will highlight the most effective ways to increase children's activity levels while at daycare. As a token of thanks, your child's daycare center will receive a \$100 gift card to purchase activity-promoting materials, and your child's teacher will receive a \$50 gift card.

Does my child have to participate in the study? Your child's participation is voluntary and he/she may quit at any time. Your decision to allow your child to participate will not affect your or your child's ability to attend the childcare center or any other benefits to which they are otherwise entitled.

What are the alternatives to being in this research study? If your child does not participate in this research, their normal routine will not be altered in any way

Who will have access to my child's information?

We will keep private all research records that identify your child. Your child's information will be combined with information from other people taking part in the study. When we write about the study, we will write about the combined information that we have gathered. We may publish

the results of the study; however, we will keep your child's name and other identifying information private.

Data and records from this project are owned by North Dakota State University and the investigator. You may view information collected from your child by making a written request to the principal investigator. You may view only information collected from your child, and not information collected about other children participating in the project.

Can my child's participation in the study end early? If you decide to allow your child to participate, you are free to withdraw your permission and to discontinue their participation at any time. Furthermore, if you decide to allow your child to participate, he/she still has the final say as to whether or not he/she wants to participate. Your child will be asked whether he/she wants to participate in the study at the beginning of each day and several times throughout the day. If at any time your child indicates that he/she does not want to wear the accelerometer or participate in the study, it will be removed by a member of the childcare staff.

What if I have questions?

Before you decide whether to accept this invitation to let your child participate in the research study, please ask any questions you may have by contacting the researchers, Dr. Abby Gold at abby.gold@ndsu.edu or 701-231-7478, or Michelle Strang at michelle.strang@ndsu.edu or 701-241-5881. If at any time during or after the study you have more questions, please feel free to ask.

What are my child's rights as a research participant?

Your child has rights as a participant in research. If you have questions about your child's rights or complaints about this research, you may talk to the researchers or contact the NDSU Human Research Protection Program by:

- Telephone: 701.231.8995 or toll-free 1.855.800.6717
- Email: ndsu.irb@ndsu.edu
- Mail: NDSU HRPP Office, NDSU Dept. 4000, PO Box 6050, Fargo, ND 58108-6050.

The role of the Human Research Protection Program is to see that your rights are protected in this research; more information about your rights can be found at: www.ndsu.edu/irb .

Documentation of Informed Consent:

You are freely making a decision whether to be in this research study. Signing this form means that

7. you have read and understood this consent form
8. you have had your questions answered, and
9. you give your permission for your child to be in the study.

You will be given a copy of this form to keep.

Your signature

Date

Your printed name

Your Child's Name

Signature of researcher explaining study

Date

Printed name of researcher explaining study

APPENDIX E. PARENT/GUARDIAN SURVEY

Please do not complete this survey until you have read and signed the attached consent form.

To help us evaluate your child's physical activity patterns while at daycare, please answer the questions below. Your responses will be used for research purposes only and all information provided will be kept strictly confidential.

Thank you!

1. What is your child's date-of-birth? _____/_____/_____ (Month/Day/Year)
2. What is your child's gender? Male Female (Circle One)
3. What is your child's race/ethnicity? (Circle One)
 - a. White/Caucasian
 - b. Black/African-American
 - c. Hispanic or Latino
 - d. Asian or Pacific Islander
 - e. Native American
 - f. Other: Please specify _____
4. What is the highest level of education you have completed? (Circle One)
 - a. Some high school
 - b. High school graduate
 - c. Some college
 - d. Trade/technical/vocational training
 - e. College graduate
 - f. Post graduate

APPENDIX F. IRB APPROVAL FORM



March 2, 2016

Abby Gold
Masters of Public Health

IRB Approval of Protocol #PH16195, "Individual, Interpersonal and Organizational Determinants of Children's Physical Activity at Childcare"

Co-investigator(s) and research team: Michelle Strang, Wonwoo Byun, Mary Larson, Kjersten Nelson, Joel Hektner, Keith Bennett, Raihan Khan, Heather Kroeker, and classroom teachers (TBD)

Approval period: 3/2/2016 to 3/1/2017
Continuing Review Report Due: 2/1/2017

Research site(s): area child care facilities, to be determined
Funding Agency: n/a
Review Type: Expedited category # 4, 7
IRB approval is based on revised protocol materials and consent documents (received 2/29/2016).

Additional approval is required:
o prior to implementation of any changes to the protocol (Protocol Amendment Request Form).
o for continuation of the project beyond the approval period (Continuing Review/Completion Report Form). A reminder is typically sent 4-6 weeks prior to the expiration date; timely submission of the report is your responsibility. To avoid a lapse in approval, suspension of recruitment, and/or data collection, a report must be received, and the protocol reviewed and approved prior to the expiration date.

A report is required for:
o any research-related injuries, adverse events, or other unanticipated problems involving risks to participants or others within 72 hours of known occurrence (Report of Unanticipated Problem or Serious Adverse Event Form).
o any significant new findings that may affect risks to participants.
o closure of the project (Continuing Review/Completion Report Form).

Research records are subject to random or directed audits at any time to verify compliance with IRB regulations and NDSU policies.

Thank you for cooperating with NDSU IRB procedures, and best wishes for a successful study.

Sincerely,

Digitally signed by Kristy Shirley
DN: cn=Kristy Shirley, o=NDSU
ou=Institutional Review Board,
email=kristy_shirley@ndsu.edu, c=US
Date: 2016.03.02.16:18:07-0600'

Kristy Shirley, CIP, Research Compliance Administrator

For more information regarding IRB Office submissions and guidelines, please consult www.ndsu.edu/irb. This Institution has an approved FederalWide Assurance with the Department of Health and Human Services: FWA00002439.

INSTITUTIONAL REVIEW BOARD

NDSU Dept 4000 | PO Box 6050 | Fargo ND 58108-6050 | 701.231.8995 | Fax 701.231.8098 | ndsu.edu/irb

Shipping address: Research 1, 1735 NDSU Research Park Drive, Fargo ND 58102

NDSU is an E.O./AA university.

APPENDIX G. DIRECTOR SURVEY

Center name: _____

Date: _____

Program Demographics

1. Which of the following best describes your center? (may choose more than one)
 - Licensed _____
 - Accredited _____
 - Parent Aware Star Rating _____ (current)
 - Other (describe) _____

2. How long has your program maintained these standards?
 - Licensure: _____ years
 - Accreditation: _____ years
 - Parent Aware Star Rating (current) _____ years
 - Other (listed above): _____ years

3. How long have you been the director of this or other child care centers? _____ years

4. How many children receive the following food program reimbursement rates:
 - Free _____
 - Reduced _____

5. How many staff provide direct care to children in your center? _____

6. How many children are currently enrolled in your center? _____

SLSA and OA (Activity Tracking form)

7. What was the average amount of time children spent playing outdoors? _____ min/day

8. What was the average amount of time children spent participating in SLSA? _____ min/day

SED Opportunities

9. Is there a TV in the classroom?

- Yes
- No

10. Are there computers in the classroom?

- Yes
- No

11. Is there a video game system in the classroom?

- Yes
- No

12. In an average week, how often do preschool-aged children watch television or videos while in the center?

- More than 5 times/week
- 3-5 times/week
- 1-3 times/week
- Never

13. On an average day, how many minutes do children spend watching television or videos while sedentary?

- More than 1 hour/day
- 30 – 60 minutes/day
- Less than 30 minutes/day
- Never

Play Equipment

14. Our center has the following **portable** play equipment available and in good condition for children to use:

Portable Play Equipment	Indoors	Outdoors
Jumping toys: jump ropes, jumping balls	<input type="radio"/>	<input type="radio"/>
Push-pull toys: big dump trucks, corn poppers, push and ride cars	<input type="radio"/>	<input type="radio"/>
Ride-on toys: tricycles, scooters	<input type="radio"/>	<input type="radio"/>
Twirling toys: ribbons, scarves, batons, hula hoops, parachutes	<input type="radio"/>	<input type="radio"/>
Balance toys: balance beams, plastic floor dots	<input type="radio"/>	<input type="radio"/>
Crawling or tumbling equipment: mats, portable tunnels	<input type="radio"/>	<input type="radio"/>
Throwing, catching and striking toys: balls, bean bags, noodles, rackets	<input type="radio"/>	<input type="radio"/>
Rocking and twisting toys (rocking horse, sit-n-spin)	<input type="radio"/>	<input type="radio"/>
Sand/water play toys (buckets, shovels, scoops)	<input type="radio"/>	<input type="radio"/>
Other: _____	<input type="radio"/>	<input type="radio"/>

15. Our center has the following **fixed** play equipment available and in good condition for children to use:

Fixed Play Equipment	Indoors	Outdoors
Balancing surfaces (balance beams, etc.)	<input type="radio"/>	<input type="radio"/>
Basketball hoop	<input type="radio"/>	<input type="radio"/>
Climbing structures (jungle gyms, ladders, slides)	<input type="radio"/>	<input type="radio"/>
Merry-go-round	<input type="radio"/>	<input type="radio"/>

Pool	<input type="radio"/>	<input type="radio"/>
Sandbox	<input type="radio"/>	<input type="radio"/>
See-saw	<input type="radio"/>	<input type="radio"/>
Tunnels	<input type="radio"/>	<input type="radio"/>
Swinging equipment (swings, rope, etc.)	<input type="radio"/>	<input type="radio"/>
Other: _____	<input type="radio"/>	<input type="radio"/>

Play Space: Indoor/outdoor/classroom

16. How large is the classroom play space? _____ square feet

17. How large is the outdoor play space? _____ square feet

18. How large is the indoor play space (not including classroom)? _____ square feet

Policy/Procedures

19. Our center’s written policy* on physical activity includes the following topics. Please check all that apply: **This can include any written guidelines about your program’s operations or expectations for teachers, staff and children. Policies can be included in parent handbooks, staff manuals and other documents.*

- Amount of time provided each day for indoor and outdoor physical activity
- Amount of time provided each day for staff-led structured physical activity
- Limiting the length of time children are seated/sedentary at any given time
- Teacher practices that encourage physical activity
- Not taking away physical activity time or removing children from long periods of physical activity in order to manage challenging behaviors
- Limiting the amount of screen time each day
- Instructions for providing indoor physical activity during inclement weather

- Professional development/education for staff and teachers (online or in-person for continuing education credits specific to improving children's PA behaviors)

20. Does the center have a posted schedule for free play, outdoor play, or structured PA?

- Yes
- No

21. Does the center have posters, pictures or books displayed (about PA) that children can see?

- Yes
- No

APPENDIX H. TEACHER SURVEY

Please complete this survey at your convenience. It should take about 10 minutes to complete and will be coded by ID number, **so all answers are completely confidential and will only be seen by members of the research team.**

For this survey, the term “physical activity” means any movement of the body that increases heart rate and breathing above what it would be if a child were sitting still.

1. Center Name: _____
2. What is your age?
 - a. 18-29
 - b. 30-39
 - c. 40-49
 - d. 50-59
 - e. 60-69
 - f. 70-79
3. What is your gender? Male Female (Circle One)
4. What is your race/ethnicity? (Circle all that apply)
 - a. Asian or Pacific Islander
 - b. Black/African-American
 - c. Hispanic or Latino of any race
 - d. Native American
 - e. White/Caucasian
 - f. Other: Please specify _____

5. What is the highest level of education you have completed? (Circle One)
- a. Some high school
 - b. High school graduate
 - c. Some college
 - d. Trade/technical/vocational training
 - e. College graduate
 - f. Post graduate
6. How many preschool-aged children are in your direct care? _____
7. How many additional teachers/staff are in direct care of these preschool children? _____
8. How many years have you worked in a childcare setting?
- a. 0-4 years
 - b. 5-9 years
 - c. 10-14 years
 - d. 15-19 years
 - e. 20+ years
9. In the past year, have you participated in trainings or professional development activities that were meant to help you improve children's physical activity? (not playground safety)
- Yes
 - No
10. Which training/programs have you participated in during the past year? (Mark all that apply.)
- Childcare Physical Activity Ordinance Training (2 hours/year)
 - TNT's Mobile Movement Lab (TNT gymnastics)
 - Childcare Alive
 - Childcare Aware (online or in person) training (*specific to physical activity*)
 - Other _____

11. I integrate *physical* movement into traditionally sedentary activities: (*For example, during circle time/reading time*)

- I don't do this
- Once a week or less
- A few days a week
- Once a day
- Several times a day

12. I participate with children during active free play: (*For instance, playing ball or running around with children. This does not include activities that are structured and led by you or another teacher.*)

- I don't do this
- Once a week or less
- A few days a week
- Once a day
- Several times a day

13. I implement teacher-led structured physical activities:

- I don't do this
- Once a week or less
- A few days a week
- Once a day
- Several times a day

14. I provide verbal prompts and/or encouragement to increase children's physical activity: (*For example, saying things like 'can you jump higher'*)

- I don't do this
- Once a week or less
- A few days a week
- Once a day
- Several times a day

15. I _____ utilize indoor space to provide opportunities for physical activities during inclement weather.

- Never
- Rarely
- Sometimes
- Most of the time
- Always

Self-efficacy Scale

Circle ONE option to indicate how much you agree or disagree with each statement.

	Strongly Disagree	Disagree	Agree	Strongly Agree
1. I am confident that I can integrate physical movement into traditionally sedentary activities (<i>circle time/reading time</i>)	SD	D	A	SA
2. I am confident that I can participate with children during active free play. (<i>For instance, playing ball or running around with children. <u>This does not include activities that are structured and led by you or another teacher.</u></i>)	SD	D	A	SA
3. I am confident that I can implement teacher-led, structured physical activities.	SD	D	A	SA
4. I am confident that I can provide verbal prompts and/or encouragement to increase children’s physical activity? (<i>For example, saying things like ‘can you jump higher’</i>).	SD	D	A	SA
5. I am confident that I can utilize indoor space to provide opportunities for physical activities during inclement weather.	SD	D	A	SA

Social Support Scale

Circle ONE option to indicate how much you agree or disagree with each statement.

	Strongly Disagree	Disagree	Agree	Strongly Agree
1. I receive support/encouragement from center staff to integrate physical movement into traditionally sedentary activities (<i>circle time/reading time</i>)	SD	D	A	SA
2. I receive support/encouragement from center staff to participate with children during active free play. (<i>For instance, playing ball or running around with children. <u>This does not include activities that are structured and led by you or another teacher.</u></i>)	SD	D	A	SA
3. I receive support/encouragement from center staff to implement teacher-led structured physical activities.	SD	D	A	SA
4. I receive support/encouragement from center staff to provide verbal prompts and/or encouragement to increase children’s physical activity? (<i>For example, saying things like ‘can you jump higher’</i>).	SD	D	A	SA

5. I receive support/encouragement from center staff to utilize indoor space to provide opportunities for physical activities during inclement weather.	SD	D	A	SA
6. I receive support/encouragement from center staff to participate in <u>physical activity-specific</u> trainings/education (listed above)	SD	D	A	SA
<u>Outcome Expectation Scale</u>				
Circle ONE option to indicate how much you agree or disagree with each statement.				
	Strongly Disagree	Disagree	Agree	Strongly Agree
1. I believe that I can increase children’s physical activity if I integrate physical movement into traditionally sedentary activities (<i>circle time/reading time</i>)	SD	D	A	SA
2. I believe that I can increase children’s physical activity if I participate with children during active free play. (<i>For instance, playing ball or running around with children. <u>This does not include activities that are structured and led by you or another teacher.</u></i>)	SD	D	A	SA
3. I believe that I can increase children’s	SD	D	A	SA

physical activity if I implement teacher-led structured physical activities.				
4. I believe that I can increase children’s physical activity if I provide verbal prompt and/or encouragement to increase children’s physical activity? (For example, saying things like ‘can you jump higher’).	SD	D	A	SA
5. I believe that I can increase children’s physical activity if I utilize indoor space to provide opportunities for physical activities during inclement weather.	SD	D	A	SA
6. I believe that I can increase children’s physical activity if I participate in <u>physical activity-specific</u> trainings/education (listed above)	SD	D	A	SA
<u>Observational Learning Scale</u>				
Circle ONE option to indicate how much you agree or disagree with each statement.				
	Strongly Disagree	Disagree	Agree	Strongly Agree
1. I often see other teachers/staff members integrate physical movement into traditionally sedentary activities (<i>circle time/reading time</i>)	SD	D	A	SA

<p>2. I often see other teachers/staff members participate with children during active free play. (For instance, playing ball or running around with children. <u>This does not include activities that are structured and led by you or another teacher.</u>)</p>	SD	D	A	SA
<p>3. I often see other teachers/staff members implement teacher-led structured physical activities.</p>	SD	D	A	SA
<p>4. I often see other teachers/staff members provide verbal prompt and/or encouragement to increase children’s physical activity? (For example, saying things like ‘can you jump higher’).</p>	SD	D	A	SA
<p>5. I often see other teachers/staff members utilize indoor space to provide opportunities for physical activities during inclement weather.</p>	SD	D	A	SA
<p>6. I often see other teachers/staff members participate in <u>physical activity-specific</u> trainings/education (listed above)</p>	SD	D	A	SA

Barriers

Examples may include things like: lack of time, equipment, space, knowledge/confidence, safety concerns, your fitness level, lack of interest/motivation, or don’t believe this is your role as a childcare teacher.

List barriers limiting your ability to:

1. Integrate *physical* movement into traditionally sedentary activities (*circle time/reading time*)

2. Participate with children during active free play. (*For instance, playing ball or running around with children. This does not include activities that are structured and led by you or another teacher.*)

3. Implement teacher-led structured physical activities.

4. Provide verbal prompt and/or encouragement to increase children's physical activity? (*For example, saying things like 'can you jump higher'*).

5. Utilize indoor space to provide opportunities for physical activities during inclement weather.

6. Participate in physical activity-specific trainings/education (listed above)

APPENDIX I. ACTIVITY TRACKING FORM

Activity Tracking Form								
Center Name: _____ Teacher Name: _____								
For each date, please record the start and stop times of each activity and the weather conditions								
Date: _____								
	Outdoor Times			Nap	Staff-Led Activity			Weather/temp
Start Time								
Stop Time								
Notes: (if you did not go outside, why not?, if you did something out of the ordinary explain.)								
Date: _____								
	Outdoor Times			Nap	Staff-Led Activity			Weather/temp
Start Time								
Stop Time								
Notes: (if you did not go outside, why not?, if you did something out of the ordinary explain.)								
Date: _____								
	Outdoor Times			Nap	Staff-Led Activity			Weather/temp
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