Preschool physical activity behaviors during outdoor time

Jenelle L Young

University of Nevada, Las Vegas

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PRESCHOOL PHYSICAL ACTIVITY BEHAVIORS
DURING OUTDOOR TIME

by

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Associate of Arts
Utah Valley State College
1999

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A thesis submitted in partial fulfillment
of the requirements for the

Master of Science Degree in Sports Education Leadership
Department of Sports Education Leadership
College of Education

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Examination Committee Chair

Dean of the Graduate College

Examination Committee Member

Examination Committee Member

Graduate College Faculty Representative
ABSTRACT

Preschool Physical Activity Behaviors During Outdoor Time

by

Jenelle L. Young

Dr. Doris L. Watson, Examination Committee Chair
Associate Professor of Sports Education Leadership
University of Nevada, Las Vegas

Obesity is increasing for preschool children and a better understanding of preschool physical activity (PA) may help combat obesity. The purpose of this study was to examine preschool PA behaviors during outdoor time. Girls (n = 9) and boys (n = 12) from the UNLV preschool (M age = 59.6 months) wore a pedometer and were observed once during morning outdoor time and once during afternoon outdoor time using the modified OSRAC-P. Focus groups were conducted with 6 girls and 6 boys who drew pictures, talked about outdoor time favorites, and identified their favorite place to play using photographs. Steps per minute and PA level scores were highly correlated. The 2 sex by 2 outdoor times repeated measures ANOVA revealed that boys were more active than girls, however there was no time main effect or interaction. Direct observation data provided information regarding the PA level, type, and context of PA behaviors.
# TABLE OF CONTENTS

ABSTRACT ............................................................................................................................. iii

LIST OF TABLES ................................................................................................................... vi

ACKNOWLEDGEMENTS ................................................................................................... vii

CHAPTER 1 INTRODUCTION ......................................................................................... 1
  Purpose of the Study ........................................................................................................... 5
  Hypothesis Statements ....................................................................................................... 6
  Definition of Terms ............................................................................................................ 7

CHAPTER 2 REVIEW OF LITERATURE ...................................................................... 11
  Motor Development of Preschool Children .................................................................... 11
  Preschool Physical Activity Research Instruments ........................................................ 13
  Factors Influencing Preschool Physical Activity ........................................................... 26

CHAPTER 3 METHODS ................................................................................................... 33
  Setting & Participants ....................................................................................................... 34
  Data Collection Instruments ............................................................................................. 40
  Procedures ......................................................................................................................... 43
  Data Analysis .................................................................................................................... 52

CHAPTER 4 RESULTS ...................................................................................................... 57
  Physical Activity Behaviors of Preschool Children ...................................................... 57
  Sex Differences in Physical Activity .............................................................................. 62
  Contexts Promoting Physical Activity ........................................................................... 64
  Where Children Spent Outdoor Time ............................................................................ 68
  Favorite Contexts and Where Children Played .............................................................. 68
  Reasons For A Center Or Activity Being Their Favorite ............................................... 70

CHAPTER 5 DISCUSSION ............................................................................................... 73
  Sex Differences In Physical Activity .............................................................................. 73
  Established Physical Activity Habits ............................................................................... 77
  Contextual Influences on Physical Activity ................................................................... 77
  “Fun” In Physical Activity ............................................................................................... 80
  Benefits From Physical Activity Participation ............................................................ 81
  Implications ....................................................................................................................... 84
  Limitations ....................................................................................................................... 88
  Future Directions ............................................................................................................. 90

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LIST OF TABLES

Table 1  Percent Overweight 2- to 5-year-old children in the US, 1999-2002 ............. 4
Table 2  Summary of Studies of Preschool Physical Activity Using Accelerometers
         and Direct Observation..................................................................................... 18
Table 3  A Comparison of Two Studies Validating an Accelerometer or Pedometer
         with CARS ........................................................................................................... 23
Table 4  Percent of Time Spent in Each Activity Level of CARS Scores in Three
         Preschools ............................................................................................................ 25
Table 5  OSRAC-P Physical Activity level Categories and Examples ......................... 43
Table 6  How Will the Research Questions be Answered? ......................................... 56
Table 7  Percent of Intervals and Number of Intervals Preschoolers Spent in Each
         PA Center ............................................................................................................ 61
Table 8  Preschoolers Involvement in Additional PA Center Activities ...................... 62
Table 9  Average PA Level and Step Counts for Preschoolers During Outdoor
         Time ..................................................................................................................... 63
Table 10 Time Spent in Each PA Level at Each Center by Percent and
         Number of Intervals ........................................................................................... 67
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CHAPTER 1

INTRODUCTION

The benefits associated with physical activity (PA) such as disease prevention and increased quality of life have been well documented. Physical inactivity (PIA) as a health risk has also been supported by the literature. In 2000, tobacco use, poor diet and PIA combined, contributed to the highest number of deaths in the United States (Mokdad, Marks, Stroup & Gerberding, 2005). Poor diet and PIA were linked to at least 350,000 deaths in the United States or approximately 15.2% of the total number of deaths (Mokdad et al., 2005). Considering the rising number of deaths linked to poor diet and PIA, if current trends continue, poor diet and PIA may surpass tobacco as the leading cause of death (Mokdad, Marks, Stroup, & Gerberding, 2004).

The importance of acquiring adequate amounts of PA to promote good health was highlighted in the 1996 Surgeon General Report, Physical Activity and Health compiled by the U.S. Department of Health and Human Services (USDHHS), the Centers for Disease Control and Prevention (CDC), the National Center for Chronic Disease Prevention and Health Promotion, and the President’s Council on Physical Fitness and Sports. The first major conclusion listed in the executive summary of the 1996 Surgeon General Report indicates that people of all ages benefit from PA (U.S. Department of Health and Human Services [USDHHS], 1996).
Through the collaborative effort of these government agencies it was concluded in the 1996 Surgeon General Report that people of all ages benefit from PA, however, specific attention has not been given to infants, toddlers, and preschoolers by these organizations. According to the National Association for Sport and Physical Education (NASPE), organizations such as the CDC, National Institute of Health (NIH), and the American College of Sports Medicine (ACSM) have publicized the relationship between PA and health, but have failed to address the importance of PA for young children from birth to 5-years-old (NASPE, 2002). An example of PA recommendations lacking specific attention to children from birth to 5-years-old are recommendations from the CDC that combine children and adolescents into one group and provide one set of PA recommendations for children and adolescents (Centers for Disease Control and Prevention [CDC], n.d.).

NASPE recognizes the need for specific attention to the PA needs of this young population and thus has created PA guidelines for young children from birth to five-years-old. Released in 2002, these PA guidelines provide specific recommendations on PA needs of the infant, toddler, and preschool population. NASPE Active Start recommendations (2002) give five foundational principles to explain why guidelines for PA are needed specifically for children birth to 5-years-old. The premises include: (1) PA might lower the prevalence of obesity and coronary risk factors, (2) the foundation for a lifetime of PA begins in childhood, (3) young children have specific needs for weight control and PA, (4) the health benefits of an active lifestyle are well known, and (5) research shows that PA of infants and young children is an important component of early brain development and learning (NASPE, 2002). The guidelines also provide
information on who is responsible for ensuring that children meet these PA recommendations. The guidelines recommend that preschoolers accumulate at least 60 minutes of structured PA a day and at least 60 minutes of unstructured PA each day. Furthermore, 3- to 5-year-old children should be sedentary no longer than 60 minutes at a time with the exception of sleeping (NASPE, 2002).

Research indicates that obesity of young children and adults in the United States continues to become more prevalent. Data collected in the National Health and Nutrition Examination Surveys (NHANES) shows the trend toward increased weight-for-height in the general preschool population with an even greater trend of being overweight among preschool girls. The prevalence of overweight 4- and 5-year-old girls in NHANES III (1988-1994) was 10.8% which is almost twice the number of overweight girls (5.8%) from NHANES I (1971-1975) (Ogden, Troiano, Briefel, Kuczmarski, Flegal, & Johnson, 1997). This increase in overweight preschool girls was statistically significant between NHANES I and III (p < .01). The proportion of overweight Non-Hispanic, African American girls of the same age increased even more dramatically to 12.6% by 1994 (Ogden et al., 1997). In addition, the NHANES III survey indicates that Mexican-American children had the highest prevalence of overweight. Table 1 displays NHANES data regarding overweight 2- to 5-year-old boys and girls in the United States for the period of 1999-2002 with Mexican-American children showing the highest prevalence of overweight at 13.1% compared to the Non-Hispanic population averaging slightly less than 9% (USDHHS, 2006).
Table 1

Percent Overweight 2- to 5-year-old children in the US, 1999-2002

<table>
<thead>
<tr>
<th>Race/Ethnicity</th>
<th>All</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>10.3</td>
<td>9.9</td>
<td>10.7</td>
</tr>
<tr>
<td>Non-Hispanic White</td>
<td>8.6</td>
<td>8.2</td>
<td>9.1</td>
</tr>
<tr>
<td>Non-Hispanic Black</td>
<td>8.8</td>
<td>8</td>
<td>9.6</td>
</tr>
<tr>
<td>Mexican-American</td>
<td>13.1</td>
<td>14.1</td>
<td>12.2</td>
</tr>
</tbody>
</table>

*Statistics from CDC Health Data for All Ages (HDAA)*

Obesity is also on the rise in preschool-aged children and physical activity literature provides evidence that obesity tracks into adulthood (Guo, Wu, Chumlea, & Roche, 2002). Guo et al. (2002) compared body mass index (BMI) values in childhood and adulthood and found that adults who were obese tended to have a higher BMI in childhood. Findings indicated that children with BMI-for-age values above the 85th percentile were much more likely to become obese adults (Guo et al., 2002). Since the literature indicates that obesity tracks into adulthood, preventative measures are important during childhood. The preschool years are especially important because one of the three critical periods for the development of obesity occurs toward the end of the preschool years. The critical period between 4- to 6-years-old is called adiposity rebound, a time when BMI tends to increase again after an initial decrease during infancy (Dietz, 1997).

Another important consideration is the large number of children enrolled in early childhood education programs and childcare facilities in the United States.
Approximately 57% of preschool-aged children (3- to 5-years-old) were enrolled in childcare centers and early childhood education programs in 2005, an increase from 53% in 1991 (Federal Interagency Forum on Child and Family Statistics, 2006). With a higher proportion of children in childcare facilities away from home, addressing the obesity epidemic beginning with this population is not only an issue for United States families, but also for public health organizations and childcare centers.

In summary, there is evidence from the literature that obesity is becoming more prevalent even in the preschool population. Obesity tends to track into adulthood and the preschool years are a critical period for developing healthy habits to avoid becoming overweight or obese during the period of adiposity rebound. Evidence in the literature also suggests that PA is not only an important consideration in the prevention of obesity, but that adequate participation in PA provides cognitive and affective benefits (Gallahue & Ozmun, 2006; NASPE, 2002). The prevalence of obesity in our youngest children and the well-established support in the literature for the benefits of PA participation provide support for the necessity of PA research with preschool children, especially considering the limited research that exists on the PA patterns and behaviors of preschool children.

Purpose of the Study

The purpose of this study was to examine PA behaviors of preschool children during outdoor time in a preschool setting. Six research questions guided this investigation: (1) what are the PA behaviors of preschoolers (4- to 5-year-olds) during outdoor time; (2) are there significant differences between preschool boys' and girls' PA based on sex and the time of day when the activity takes place; (3) which contexts during outdoor time seem to
promote the greatest amounts of PA; (4) where do the children spend a majority of outdoor time; (5) are the children’s favorite places to play the same as the contexts where children spend most of their time during observations; (6) what are the reasons children give for a certain context or activity being their favorite?

Hypothesis Statements

Research Question 1: Hypothesis

I hypothesize that the PA levels found in this population of 4- to 5-year-olds will be higher than those found in previous research where much of the observations were done during the typical preschool day and not limited to outdoor playtime.

Research Question 2: Hypothesis

I hypothesize a moderate to strong correlation between PA level measures of pedometer counts and the direct observational measure. I hypothesize that boys will engage in higher levels of MVPA than girls, however I do not have any hypothesis as to whether children will be more active during their morning outdoor time or during the afternoon outdoor time.

Research Question 3: Hypothesis

I hypothesize that physical activity data and the contextual measure of the proportion of time children spend at a given center will likely be related. Data may show that children tend to engage in higher levels of PA at certain centers.
Definition of Terms

Definitions of terms used in this manuscript are organized alphabetically. Certain definitions are unique to this study and therefore are defined by the author while other terms are defined using the cited sources.

**Accelerometers**

Accelerometers are small motion sensors worn on the waist, wrist, or ankle that measure quantity and intensity of movement and have the capability of storing data, which is then processed on a computer. The cost of an accelerometer ranges from $600 to $1,200 (Berlin, Storti, & Brach, 2006). Accelerometers may be uniaxial (records vertical acceleration), biaxial (records acceleration in two planes), or triaxial (records acceleration in three planes) (Berlin et al., 2006).

**Body Mass Index (BMI)**

Body mass index (BMI) is an anthropometric measure derived by dividing weight in kilograms by height in meters squared (Public Health Agency of Canada [PHAC], 2003). BMI is used to determine whether a person’s weight falls within a healthy range.

**Centers**

Classrooms were organized into centers based on themes. Examples of centers in the classroom were art, writing, music, and science. On the playground the term “centers” was also used to describe the contextual measure that was investigated. The specific contexts on the playground included the bike path, fixed playground, grass, playhouse, jungle gym, and sandbox center. Within this manuscript the words context and centers may be interchangeable.
Early Childhood

Early childhood is defined as the years between 2- to 5-years-old (Gallahue & Ozmun, 2006).

In Situ Observations

In situ observations are practice observations taking place in the natural setting (Brown, Pfeiffer, McIver, Dowda, Almeida, & Pate, 2006).

Modified OSRAC-P

The modified Observational System for Recording Physical Activity in Children-Preschool Version (OSRAC-P) is the observational system used in this study to quantify preschool physical activity behaviors. The modified OSRAC-P is made up of three categories including PA level, PA type, and PA centers. The modified OSRAC-P is a modification of the OSRAC-P created by Brown et al. (2006).

Outdoor Time

Outdoor time is essentially recess at the preschool when the four preschool classes are scheduled to play on the playground together (ages 3- to 5-years-old). Outdoor time is held in the morning from 8:30-9:30 a.m. and from 11:30 a.m. to noon. In the afternoon outdoor time is from 1:30 p.m. to 2:00 p.m. and again in the late afternoon until parents pick up their children from preschool.

Physical Activity Center Category

The physical activity (PA) center category is the category within the modified OSRAC-P where observers coded the context (center) on the playground where children participated in the highest level of PA recorded in a given interval. If children moved
through more than one center at the same level of activity then the observer coded the center where the child was at the end of the observational interval. The PA center additional information is the second part of the PA center category. The PA center additional codes included physical education, sensory table, blocks, reading, and music. During each interval observers coded which center children were in and additionally coded whether children participated in one of the five previously listed activity contexts.

*Physical Activity Level Category*

Physical activity level category is the first category in the observational system used in this study. The intensity of the PA of the participants was coded between one (stationary) to five (fast movement) and then the average was taken from all observational intervals to determine an average PA level score.

*Physical Activity Type Category*

The PA type category is the second category coded in the modified OSRAC-P in which the observer records the type of PA the child completed that corresponds with the highest PA level coded for that interval. The physical activity types include climb, crawl, dance, jump/skip, lie down, pull/push, rough and tumble, ride, rock, roll, run, sit/squat, stand, swim, swing, throw, and walk.

*Pedometer*

Pedometers are a type of motion sensor (De Vries, Bakker, Hopman-Rock, Hirasing, & Mechelen, 2006; Sirard & Pate, 2001) that are a relatively small device worn on the waistband to measure vertical oscillations. Pedometers are relatively low cost (ranging from $10-$200), (Berlin et al., 2006). The Digi-Walker SW-701 was the pedometer used.
in this study and is approximately two inches wide, one and a half inches tall, and .75 inches thick and it weighs less than one ounce (New-Lifestyles, 2006).

Reproducibility

Reproducibility is the extent to which a motion sensor is free of measurement error. Reproducibility is determined by a combination of the intra-instrument reliability (i.e., test-retest reliability) of the motion sensor and the inter-instrument reliability (De Vries et al., 2006).
CHAPTER 2

REVIEW OF LITERATURE

This chapter will review literature regarding preschool physical activity. First, background information on the motor development of preschool children will be presented followed by a review of the instruments used to research preschool PA. Next, the literature on the PA behaviors of preschool children will be reviewed. Finally, factors influencing PA behaviors of preschool children, including gender differences, will be noted. When conducting this literature review, studies on the PA behaviors of older children and adolescents were more prevalent than studies with preschool aged children. Therefore, as the literature on PA of preschool children is reviewed, some instances require referencing research completed with an older population. In this literature review, when a study cannot be found where the participants are preschool children, studies with older study participants will be reviewed.

Motor Development of Preschool Children

During early childhood height and weight gains are slower than gains during infancy (Gallahue & Ozmun, 2006). Between the ages of 2- to 5-years-old growth slows to an average gain of two inches and five pounds per year (Gallahue & Ozmun, 2006). Physical differences between boys and girls are minimal during this time period (Gallahue &
Ozmun, 2006). However, girls mature more quickly than boys (Eaton & Yu, 1989). Girls reach 50% of their adult height on average by 1.75 years compared to 2 years for boys. Puberty is also earlier for girls than boys and girls’ growth ceases at an earlier age than boys (Eaton & Yu, 1989).

The development of fine and gross motor skills occurs through play and children learn how their bodies are capable of moving (Gallahue & Ozmun, 2006). As children play they are characteristically “active and energetic and would often rather run than walk, but they still need frequent short rest periods” (Gallahue & Ozmun, 2006, p. 177). The development of motor skills involving balance and coordination are important to develop in early childhood. As children mature and gain more control over their movements, motor skills involving speed, agility, and power become more important to acquire. Though children are developing motor skills rapidly bilateral movements such as skipping are more difficult for children to develop than unilateral movements like hopping (Gallahue & Ozmun, 2006).

Motor skill development as well as the nervous system and certain parts of the brain are still developing through early childhood. Part of the development of the nervous system is the process known as Myelination. During myelination a coating of fat is added to the nerves to aid in the transportation of signals through the nervous system. Myelination is almost complete by the end of early childhood. Children begin to execute more complex movements after the completion of myelination of the cerebellum (Gallahue & Ozmun, 2006), which is the part of the brain associated with movement (Waite-Stupiansky & Findlay, 2001).
In early childhood children are in the preoperational thought phase and are very egocentric, lacking the ability to think from another person’s point of view (Gallahue & Ozmun, 2006). During this phase of development cognitive development characteristics highlighted by Gallahue & Ozmun (2006) include (1) the ability to verbally express thoughts and ideas increase constantly, (2) the ability to imitate actions and symbols are fueled by a lively imagination and (3) learning is occurring through constant play.

Furthermore, because children think egocentrically, they think that everyone thinks the way they do. This egocentric view of the world tends to lead to reluctance to share with other children. Children may also have difficulties playing with others without quarreling. Children tend to be fearful when they encounter new situations and want to remain in situations that they feel secure and comfortable. Children are beginning to determine right from wrong and their self-concept is developing rapidly (Gallahue & Ozmun, 2006).

Preschool Physical Activity Research Instruments

The three instruments used in PA research of preschool children that will be reviewed are direct observation, accelerometers, and pedometers. Studies validating instruments to measure the PA of preschoolers compared accelerometers or pedometers to previously validated direct observation systems such as the Children's Activity Rating Scale (CARS) and the Children’s Physical Activity Form (CPAF) (Fairweather, Reilly, Grant, Whittaker, & Paton, 1999; Finn & Specker, 2000; Kelly, Reilly, Fairweather, Barrie, Grant, & Paton, 2004; Mckee, Boreham, Murphy, & Nevill, 2005; Reilly, Coyle, Kelly, Burke, Grant, & Paton, 2003; Sirard, Trost, Pfeiffer, Dowda, & Pate, 2005).
The Children's Activity Rating Scale (CARS) was developed by Puhl, Greaves, Hoyt, and Baranowski (1990) and categorizes PA into five categories. Activities range from being coded as a “1” (resting), representing energy expenditure equal to the resting metabolic rate to “5”, representing activities that are strenuous or very strenuous (Puhl et al., 1990). Observers code the PA level of the child at the beginning of each minute and then record changes in the activity level of the child during that minute. Coding rules for CARS include are: (1) within each minute an activity level is only coded once with a maximum of five levels that can be recorded in one minute; 2) an activity must occur at least 3 seconds before that activity is coded; and 3) activities can be recorded with varying levels of intensity (Puhl et al., 1990).

CARS was developed and validated in a two-part study. During the first part of the study, 10 to 12 hour observations of 3- to 4-year-old children (n = 192) were completed between one to four times over 12-months. Two randomly assigned observers alternated observing one child throughout the day by observing in 2-hour shifts. To calculate interobserver agreement (IOA = 84.1%) the observers observed 30-minutes each day simultaneously and independently. In the second part of the study CARS was validated with 5- to 6-year-old children (n = 13 girls, 12 boys). Height, weight, and skinfolds were measured. VO\textsubscript{2} was measured and heart rate was monitored for eight activities that represent the CARS levels. Results of a 2 Time by 2 Gender repeated measures ANOVA revealed that there were no differences in gender for VO\textsubscript{2} or heart rates. Heart rates and VO\textsubscript{2} were significantly different between all CARS levels, indicating that CARS levels discriminated between levels of energy expenditure (Puhl et al., 1990).
Children’s Physical Activity Form (CPAF)

The Children’s Physical Activity form (CPAF) was validated against heart rate values as a measure of 8- to 10-year-old (n = 36) children’s physical activity (O’Hara, Baranowski, Simmons-Morton, Wilson, & Parcel, 1989). Children wore heart rate monitors while being simultaneously observed with the CPAF during physical education. During one-minute intervals, observers used the CPAF to code the children’s movement into four categories of intensity (1 = stationary to 4 = rapid trunk movement) (O’Hara et al. 1989). Observers recorded the level of activity each minute by checking off numbers on a form. Activities that last less than 15-seconds are not recorded. Similar to CARS, the observers recorded all levels of activity in which the child participates and none of the categories can be recorded more than once per minute (Kelly et al., 2004). The average correlation reported by O’Hara et al. (1989) between heart rates and CPAF scores was .64 with a range of .26 to .90. Thirty-four of the thirty-six correlations were significant (p < .05). Results of a time series regression analysis revealed that heart rate in the previous minute and the corresponding activity score accounted for 72% of the variance in heart rate values. O’Hara et al. (1989) concluded that the CPAF is a valid tool for assessing the physical activity of children.

OSRAC-P Direct Observation System

The Observational System for Recording Physical Activity in Children-Preschool Version (OSRAC-P) (Brown et al., 2006) is a direct observational system created from the previously validated CARS and CASPER-II observation systems. The Children’s Activity Rating Scale (CARS) was chosen to measure PA level for the OSRAC-P to give a better picture of MVPA (Brown et al, 2006). Four investigators collaborated to create
the eight categories that comprise the OSRAC-P including: (1) activity level, (2) activity type, (3) location, (4) indoor activity context, (5) outdoor activity context, (6) activity initiators, (7) group composition, and (8) prompts (Brown et al., 2006).

After developing the categories of the OSRAC-P, four observers were trained to an 80% interval-by-interval agreement level across three consecutive days. IOA was collected for 13% data collected from three preschools. Most disagreements occurred in the physical activity code when one observer coded “1” (stationary) and the other observer coded “2” (stationary with limb movement). Results of the preliminary study showed that children spent most time in the stationary and limbs category (range = 80.6% to 87.5%). Children at different preschools spent between 8.6% to 13% in level three (slow-easy) and only 1.8% to 5% in levels four (moderate) and five (fast movements) (Brown et al., 2006).

Accelerometers

Previously accelerometers were validated to measure PA for children 6- to 16-years-old (Puyau, Adolph, Vohra, & Butte, 2002). To ensure the validity of using accelerometers for PA research with preschool other studies have attempted to validate and determine count cut-offs for preschool children. Table 2 compares 5 studies that assessed the ability of accelerometers to collect PA information for preschool children. Studies summarized in table 2 were published between 1999 and 2005. Studies were only included in table 2 if the main purpose was to either validate an accelerometer for measuring preschoolers’ PA or to develop count cut-offs for activity levels defined by previously validated observation systems.
In the first study summarized in Table 2, Fairweather et al. (1999) conducted a two-part study. First the authors tested the hip placement of the accelerometer because the right hip placement is more popular in the literature as the placement site (Fairweather et al., 1999). During two days of free-living conditions 10 children wore accelerometers on both hips. A t-test found a significant difference between counts on the right and left hip even though correlations between the right and left hip counts were high (r = .79, p < .01). The differences between right and left hips were about 5% and were similar to inter-instrument differences between instruments previously tested. Therefore, the authors concluded that the differences between left and right hip placement is probably of limited importance, however standardization of hip placement was advised (Fairweather et al., 1999).

After testing the hip placement site for accelerometers, Fairweather et al. (1999) proceeded to the second part of the study, where 11 preschool children (4-years-old) wore an accelerometer while simultaneously being observed with CPAF. Observations were completed during a 45-minute exercise class. The CSA-7164 accelerometer counts were highly correlated with CPAF scores. From this study it was concluded that the accelerometer can be valid in measuring the PA of preschool children.

In the second study summarized in Table 2, Finn and Specker (2000) had 40 preschool girls and boys (3- to 4-years-old) wear the Actiwatch accelerometer during approximately 6 hours of preschool (M = 5.9 hours) while being simultaneously observed by CARS. The 3-minute CARS scores and 3-minute accelerometer counts were moderately correlated (r = .74). Correlations were higher in children who were more
active. Finn and Specker (2000) concluded that results from their study favor the use of the Actiwatch for monitoring preschool-aged children’s PA.

### Table 2

Summary of Studies of Preschool PA Using Accelerometers and Direct Observation

<table>
<thead>
<tr>
<th>Study</th>
<th>Participants</th>
<th>Instruments</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fairweather et al., 1999</td>
<td>11 (8 girls, 3 boys)</td>
<td>CSA-7164</td>
<td>CSA and CPAF score</td>
</tr>
<tr>
<td></td>
<td>4-years-old</td>
<td>CPAF</td>
<td>(r = .87, p &lt; .01)</td>
</tr>
<tr>
<td></td>
<td>1-40-50 min class</td>
<td>1 observer</td>
<td>Left and right hip placement</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(r = .79, p &lt; .01)</td>
</tr>
<tr>
<td>Finn &amp; Specker, 2000</td>
<td>40 (24 girls, 16 boys)</td>
<td>Actiwatch</td>
<td>Significant correlation between</td>
</tr>
<tr>
<td></td>
<td>3-4 years old</td>
<td>CARS</td>
<td>CARS and Actiwatch (r = .74)</td>
</tr>
<tr>
<td></td>
<td>6 hr - preschool day</td>
<td>8 observers</td>
<td></td>
</tr>
<tr>
<td>Reilly et al., 2003</td>
<td>30 (10 girls, 20 boys)</td>
<td>CSA/WAM-7164</td>
<td>Count cut-off determined for</td>
</tr>
<tr>
<td></td>
<td>3-4 years old</td>
<td>7164</td>
<td>PIA &lt; 1100 counts/min</td>
</tr>
<tr>
<td></td>
<td>100 min. at nursery</td>
<td>CPAF for PIA</td>
<td></td>
</tr>
<tr>
<td>Kelly et al., 2004</td>
<td>78 (48 girls, 30 boys)</td>
<td>CSA-7164 &amp; Actiwatch</td>
<td>CSA/MTI output and CPAF</td>
</tr>
<tr>
<td></td>
<td>3-4 yr old</td>
<td></td>
<td>(r = .72, p &lt; .001)</td>
</tr>
<tr>
<td></td>
<td>1- 30-45 min class</td>
<td>CPAF</td>
<td>Actiwatch output and CPAF</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4 observers</td>
<td>(r = .16, p &gt; .05)</td>
</tr>
<tr>
<td>Sirard et al., 2005</td>
<td>269 (144 girls, 125 boys)</td>
<td>ActiGraph</td>
<td>Count cut-offs established</td>
</tr>
<tr>
<td></td>
<td>preschools, 3-5-years-old</td>
<td>Modified</td>
<td>Cut-offs significantly different for</td>
</tr>
<tr>
<td></td>
<td>5-3 min activities (establish</td>
<td>CARS</td>
<td>all CARS categories (p &lt; .05)</td>
</tr>
<tr>
<td></td>
<td>cut-offs n = 16), preschool</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>day (n = 269 to test cut-offs)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*CARS = Children’s Activity Rating Scale, CPAF = Children’s Physical Activity Form, n = sample size, PA = physical activity, PIA = physical inactivity*
Reilly et al. (2003) attempted to quantify physical inactivity (PIA) in 3- to 4-year-old children who attended nursery school by developing accelerometer count cut-offs for PIA. Thirty preschool children (3- to 4-year-olds) wore the Computer Science Applications WAM-7164 accelerometer and were simultaneously observed with the CPAF. By comparing observation data and accelerometer data Reilly et al. determined that accelerometer output of less than 1100 counts per minute was the appropriate count cut-off for PIA. In other words, when children were coded as being in the sedentary categories of CPAF (PA coded as 1 or 2) the accelerometer counts were less than 1100 counts per minute. Reilly et al. (2003) concluded that since accelerometers have now been validated to measure physical activity and physical inactivity that these motion sensors could be used more widely.

Kelly et al. (2004) aimed to validate two accelerometers for measurement of PA of preschool-aged children. In this study 78 children ranging in age from 3- to 4-years-old wore accelerometers and were simultaneously observed with the CPAF during a 39- to 45-minute structured-play class. Teacher-led play varied in level of intensity throughout the class. Results of the study showed that the CSA-7164 output was moderately correlated with CPAF scores ($r = .72$). The Actiwatch output and CPAF scores had a low correlation ($r = .16$). The authors concluded that the comparison of direct observation and sensor counts revealed that the CSA-7164 was more accurate that the Actiwatch for recording preschool PA.

Lastly, Sirard et al. (2005) intended to establish accelerometer count cut-offs and validate the accelerometer as a measurement PA of preschool-aged children. First, count cut-offs were established by having 16 children wear accelerometers during five 3-minute
activities. Once cut-offs were established, 3- to 5-year-old children from 9 preschools (n = 269) wore accelerometers and were simultaneously observed by CARS during the entire preschool day to test the count cut-offs. Results showed that the count cut-offs established were significantly different for all CARS categories (p < .05). Sirard et al. (2005) concluded that using the established cut-offs for physical activity levels, the amount of time preschool children spend in each intensity level can be determined.

Out of the studies listed in Table 2 that have been summarized, two of the five studies completed observations during an activity class and the other three completed observations during the typical preschool day. Three of the studies used the CPAF and the other two studies used CARS to validate accelerometers for use with preschool children. In all five studies the authors concluded that accelerometers are a valid instrument for assessing preschool PA.

_Pedometers_

Pedometers are another instrument that may be used to quantify PA and have been validated to assess PA among children and adolescents (Michaud, Cauderay, Narring, & Schutz, 2002). The literature also provides support for the pedometer as a valid, easy to use, and economical alternative to measuring PA in both research and practice (Tudor-Locke, Williams, Reis, & Delores, 2002). Pedometry has also been recommended as a viable option because of the practicality of using pedometers (Scruggs, Beveridge, & Watson, 2003). Although pedometers have been recommended in the literature as a low-cost and simple assessment tool, little research has been completed using pedometers to measure the PA of preschool children.
Boldemann et al. (2006) investigated the effect of the preschool environment on the physical activity of 4.5- to 6.5-year-old preschool children (n = 197) and sun exposure in 11 preschools. Outdoor environments were assessed and weight and weight data were collected to calculate BMI. Parents filled out a questionnaire that was validated and tested for reliability with information about the child, their family, and the child’s outdoor play. The preschool staff also filled out a questionnaire about the outdoor environment that had been tested for validity and reliability. One week prior to data collection the preschool staff at every preschool were trained to manage pedometers, dosimetry, record keeping, and classification of weather. Children wore an SW-200 Digi-Walker pedometer or MLS 2000 pedometer to measure physical activity. Pedometers were sealed and attached to large bands fastened firmly around the waist with the pedometer above the right hipbone while dosimeters were pinned to the shoulder. Data was collection for at least five days for more than 90% of the children (Boldemann et al., 2006).

Boldemann et al. (2006) reported steps per minute from pedometer counts to enable comparisons with children who had absences. Data were analyzed with the Statistical Package Software (SPSS) with a linear mixed model analysis. Steps per minute were higher for boys (20.9 steps/min) than girls (18 steps/min) (p < .001). Steps per minute ranged from 8.8 to 37.2 for boys and 8.9 to 30 for girls. Time spent outdoors and leisure time activities that involved PA were positively related to steps per minute for girls (p < .01) and age was positively related to boys’ steps per minute (p < .05). A linear mixed model analysis revealed that children who attended preschools that obtained high environment scores had increased steps by about 3.6 steps per minute or by 20% (p < .001). Therefore children attending a preschool with the high environment score would
have an increase of 1500-2000 steps across a 7-hour at preschool day. Boldemann et al. (2006) concluded that whenever possible, access to spacious environments with trees and shrubbery and built in shade should be part of preschool layout.

The next study reviewed that used pedometry as the measure of preschool physical activity, was a study by McKee et al. (2005). Using the Digi-Walker DW-200 McKee et al. (2005) examined the validity of pedometry as a measurement of PA with 3- to 4-year-old preschool children. Each child (n = 30) wore a pedometer during a one-hour observation period during nursery school. During the observation, children were simultaneously observed with CARS. The correlation reported by McKee et al. (2005) comparing 3-minute CARS scores to 3-minute pedometer counts was high (r = .86). McKee et al. (2005) concluded that the Digi-Walker is a low cost and non-invasive way to assess PA of preschool children.

Findings by McKee et al. (2005) converged with previous findings in the literature. For example, when comparing 3-minute CARS scores to 3-minute pedometer counts McKee et al. (2005) found a similar correlation (r = .86) to the correlation (r = .74) found by Finn and Specker (2000) when comparing 3-minute CARS scores and 3-minute accelerometer counts. The mean CARS score and proportions of time spent in each level of activity were also similar in both studies with children spending a majority of time in low-level activities. Similar findings between the study completed by McKee et al. (2005) and the study by Finn and Specker (2000) are summarized in table 3.
Table 3

A Comparison of Two Studies Validating an Accelerometer or Pedometer with CARS

<table>
<thead>
<tr>
<th></th>
<th>Finn &amp; Specker 2000</th>
<th>McKee et al. 2005</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Participants</td>
<td>40</td>
<td>30</td>
</tr>
<tr>
<td>Age of Participants</td>
<td>3- to 4-year-olds</td>
<td>3- to 4-year-olds</td>
</tr>
<tr>
<td>Length of Observation</td>
<td>6 hours</td>
<td>1 hour</td>
</tr>
<tr>
<td>Correlation of CARS scores to sensor counts</td>
<td>( r = .74 )</td>
<td>( r = .86 )</td>
</tr>
<tr>
<td>(Accelerometer)</td>
<td>(Pedometer)</td>
<td></td>
</tr>
<tr>
<td>Mean CARS score</td>
<td>1.6</td>
<td>1.7</td>
</tr>
<tr>
<td>Frequency of CARS scores Below 2.0</td>
<td>66%</td>
<td>64.6%</td>
</tr>
<tr>
<td>Frequency of CARS scores Between 2.0-2.9</td>
<td>26%</td>
<td>32.6%</td>
</tr>
<tr>
<td>Frequency of CARS scores Between 3.0-3.9</td>
<td>5%</td>
<td>2.5%</td>
</tr>
<tr>
<td>Frequency of CARS scores 4.0 or above</td>
<td>Less than 1%</td>
<td>0.2%</td>
</tr>
</tbody>
</table>

Another study that used pedometers to assess the PA of 3- to 5-year-old children was completed in Hong Kong (Louie & Chan, 2003). Preschool boys and girls from one rural preschool and two urban preschools (n =148) wore a Digi-Walker SW-200 pedometer during one 25-minute activity class. The format of the activity class was five minutes of teacher led warm-up and stretching activities followed by twenty minutes of free play. PA during the class was measured by the step counts from the pedometers and CARS observation scores. To determine the reliability of pedometry, Louie and Chan (2003) computed Pearson product-moment correlations between step counts and CARS scores.
A 2 Gender by 3 Age Group analysis of variance (ANOVA) was used to analyze differences in PA. A Tukey post hoc follow-up test revealed that 4- to 5-year-old preschool children were more active than 3-year-old children. The 4- and 5-year-old children were equally active.

A 2 Gender by 2 School (1 rural and 2 urban) ANOVA was used to calculate differences in activity by gender and play space. Pedometer counts and CARS scores were significantly correlated ($r = .64, p < .05$). Boys were also significantly more active than girls by both pedometer counts and CARS scores ($F = 22.38, p < .01$). Frequencies of CARS observations scores were converted into the percent of time spent in each activity level of CARS and can be seen in table 4 for all participants in this study. The mean pedometer step counts reported for boys were 1470 (SD = 638) and 1147 (SD = 544) for girls. Preschool children from the rural school with a larger outdoor play space (outdoor space = 800 m$^2$, indoor space = 200 m$^2$) had significantly higher levels of PA than children from both urban schools with smaller play spaces (school B indoor space = 240 m$^2$, school C indoor space = 250 m$^2$).

The discrepancy between activity levels of children at different preschools was attributed to the difference in the size of the play spaces. Another difference between the rural school and the two urban schools was that the rural school had an outdoor play area as well as an indoor play space (Louie & Chan, 2003). Therefore, the increased PA level in the rural school may have been due to the size of play space and the accessibility to outdoor play.
Table 4

<table>
<thead>
<tr>
<th></th>
<th>AL 1</th>
<th>AL 2</th>
<th>AL 3</th>
<th>AL 4</th>
<th>AL 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td>10.2%</td>
<td>42%</td>
<td>35.8%</td>
<td>11.6%</td>
<td>0.5%</td>
</tr>
<tr>
<td>Girls</td>
<td>9.9%</td>
<td>46.5%</td>
<td>34.8%</td>
<td>8.5%</td>
<td>0.3%</td>
</tr>
<tr>
<td>Boys</td>
<td>10.3%</td>
<td>38.9%</td>
<td>36.5%</td>
<td>13.7%</td>
<td>0.6%</td>
</tr>
</tbody>
</table>

AL = Activity Level

Practicality and Feasibility of Pedometers

Accelerometers have some advantages as an assessment tool of preschool PA. Still, pedometers make more sense as a practical and objective measure of PA because of a variety of reasons. Pedometers compact design may make them comfortable and easy for preschool children to wear. The pedometer is also a practical assessment tool because pedometers are easy to use and inexpensive (ranging from $10-$200), and could potentially be used by preschool teachers or parents to ensure that children are engaging in adequate amounts of PA (Berlin, Storti, & Brach, 2006). By comparison accelerometers are a greater burden to the researcher to analyze data, are much more expensive (ranging from $600-$1,200), and would not be a feasible classroom assessment tool (Berlin et al, 2006).

In summary, direct observation has been used as a criterion method to validate other measurement tools, including the accelerometer and pedometer. Direct observation methods validated for use with preschool-aged children include CARS and CPAF.
Though validity data on the OSRAC-P has not been published yet, it was created based on previously validated systems. Both the accelerometers and pedometers have been validated to measure the PA of preschool-aged children.

Factors Influencing Preschool Physical Activity

Outdoor Play

Two benefits of outdoor play are that (1) children learn about themselves and their peers through outdoor play experiences and (2) children develop their perceptual abilities (Waite-Stupiansky & Findlay, 2001). Children may also be able to acquire a large portion of the recommended amounts of daily physical activity through outdoor play (Ridgers, Stratton, & Fairclough, 2006). Ridgers et al. (2006) conducted a search for studies published between 1970 and 2004 that measured PA during school playtime with children between 4- to 12-years-old. Ridgers et al. (2006) reported only one study with preschool-aged participants indicating that research on PA of preschool children in school playtime is limited.

Burdette, Whitaker, and Daniels (2004) compared accelerometer data to parental reports of time their children spent outdoors. The purpose of their study was to provide evidence to support proxy reports as a feasible measure to obtain large samples of preschool PA data (Burdette et al., 2004). Two parental proxy reports of time spent outside were compared to tri-axial accelerometer data collected from 250 preschool-aged children (Mage = 44 months). Children wore accelerometers for three days and parents recorded outdoor playtime over the three days on a checklist as well as reported the usual amount of minutes of daily outdoor playtime their child had during the previous month.
(Burdette et al., 2004). Results showed that children spent an average of 146-minutes a day playing outdoors (SD = 113 minutes). Accelerometer counts and parental proxy reports were significantly correlated ($r = .33, p < .001$ for checklist; $r = .20, p < .003$ for recall). From these results it was concluded that parental-report measures of outdoor play should be investigated future as a survey method to provide a way to measure the PA of large groups of preschool-aged children (Burdette et al., 2004). Another method used by Burdette et al. (2004) was a 60-minute focus group with six mothers from the study. The mothers agreed that most of their child’s gross motor play happened outdoors and that it is much easier for them to estimate the typical amount of time their child spent outdoors than to estimate the amount of minutes spent in gross motor play.

**Activities and Markings on the Playground**

Another factor that may influence the PA of preschool children is the type of activity available to children as well as the markings on the playground. In one study, 15 schools in England received funds to redesign the playground using the sporting playground zonal design (Ridgers, Stratton, Fairclough, & Twisk, 2007). The playgrounds were organized into three color-coded areas: (a) a red sports area, (b) a blue multi-activity area and (c) a yellow quiet play zone. Markings on the playground were relevant to the PA behavior and social behaviors typical for each area. Each school received soccer goal posts, basketball hoops and fencing (in the red sports area) and seating (in the yellow quiet zone). Eleven other schools matched for socioeconomic status acted as controls for the 15 schools that received the intervention. Small physical education equipment was available at all schools (balls, jump ropes, etc.).
Using heart rate telemetry and accelerometry, PA of children was measured on one day during baseline, follow-up 1 (6-weeks after baseline), and follow-up 2 (6-months after baseline). Ridgers et al. (2007) used multilevel modeling to determine effects of the playground redesign intervention. Results showed that the moderate to vigorous physical activity (MVPA) and vigorous physical activity (VPA) of children at the schools with redesigned playgrounds increased significantly. Children at intervention schools engaged in 4% more MVPA and 2.4% more VPA. Effects were also stronger for children who were less active at baseline. Ridgers et al. (2007) concluded that playground markings and physical structures are effective interventions to increase the PA of children for a longer-term.

Time of Day

Time of day may have an affect on the level of activity preschoolers engage in during outdoor time. When conducting this literature review, no research was found that has analyzed PA levels of the preschool population by time of day. However, Jago, Anderson, Baranowski and Watson (2005) studied time of day as a factor affecting PA in adolescents. One hundred eighth grade boys and girls wore an accelerometer for four full days (Thursday through Sunday) and kept a physical activity diary during this time. Raw data from the accelerometer \( r = .44, p < .001 \) and accelerometer count cut-offs \( r = .41, p < .001 \) were significantly correlated with the PA diary. Significant differences were found by day by time by gender \( p < .001 \), and time by gender \( p = .005 \), and day by gender \( p = .002 \) with boys being less sedentary than girls. Boys also participated in higher levels of moderate to vigorous (MVPA) physical activity during late afternoon on
everyday except Sunday. Boys also had higher levels of MVPA during the daytime (6 a.m.-3 p.m.) time segment on all four days of the week (Jago et al., 2005).

**Obesity**

Jago et al. (2005) also measured height and weight of the eighth grade participants and calculated age and gender specific BMI percentiles based on the revised CDC guidelines. All subjects were divided into three categories based on BMI percentile (normal ≤ 85th percentile, at risk of overweight ≤ 85-95th percentile, and overweight > 95th percentile). No significant affect was observed for BMI on level of PA for any of the participants. A possible explanation for the lack of affect of weight on PA is the alarmingly low level of activity among all adolescents within the study. Participants spent large amounts of time spent in sedentary activities (Jago et al., 2005).

Similarly, Trost, Sirard, Dowda, Pfeiffer, and Pate (2003) conducted a study in which participants were categorized according to their BMI from the CDC growth charts. Overweight was defined as having a BMI at or above the 85th percentile. Data were collected from 3- to 5-year-old children (n = 245) and their parents. Based on direct observational measures and accelerometry they found that overweight boys were significantly less active than non-overweight boys. No significant difference was found between overweight girls and non-overweight girls. The authors suggested that due to the very low levels of activity in both groups of girls, this may have created a floor effect and no difference could be seen.

**Physical Activity Sex Differences**

Differences between girls and boys PA levels have been observed in studies of children, adolescents, and preschool children (McKee et al. 2005; Ridgers et al, 2006).
The literature on PA provides ample evidence that boys tend to be more physically active than girls. The literature suggests that boys (4- to 12-years-old) participate in more PA than girls during school playtime (Ridgers et al., 2006). Boys also tend to participate in more MVPA than girls (Jago et al., 2005; McKee et al., 2005; Ridgers et al., 2006; Sirard & Pate, 2001) and girls have been found to spending more time in low-level activities and less time in light-to-moderate activities than the boys (McKee et al., 2005).

A literature review conducted by Eaton and Enns (1986) quantitatively integrated results from 127 studies by calculating the $d$ scores for each study. The $d$ scores represent the standardized difference between male and female means (Eaton & Enns, 1986). Scores were also adjusted to give studies with larger sample sizes more weight. The results found that males were generally more active than females (Eaton & Enns, 1986).

Though much of the literature reports that boys are more active than girls, some studies also provide evidence to the contrary. Girls have been found to be equally active and even more active than boys in studies completed outside of the United States. For example, Mota, Silva, Santos, Ribeiro, Oliveira, and Duarte (2005) measured the total daily PA of 22 children 8- to 10-years-old ($M = 8.9$) by having participants wear an accelerometer for three-week days. Results showed there was no significant difference between accelerometer counts between boys and girls. Girls also participated in a significantly higher proportion of MVPA during recess than boys (girls = 38%, boys = 31%). The higher participation in MVPA at recess for girls also contributed significantly to girls’ achievement of the international health-related PA guidelines with girls achieving 19% of recommended MVPA and boys achieving 15% during recess (Mota et
Thus, one of the factors influencing sex differences in PA may be culture (Ridgers et al., 2006).

Experience in PA settings may be one factor leading to sex differences in PA levels. In one study, a group of Hispanic preschool children with a risk of developmental delay were taught for nine weeks with a focus on locomotor skill and object control. At pre-test, the boys scored better than girls on the locomotor and object control subscales of the Test of Gross Motor Development, however at post-test a difference was no longer seen (Goodway, Crowe, & Ward, 2003). Consequently, with the right instruction or experiences, girls may be equally skilled as boys in locomotor skills and object control. Perceived competence in such skills may in turn affect a child's choice to participate in lifetime physical activities (NASPE, 2002).

The context of PA observations may also be another contributing factor to contradictory findings in PA sex differences. Though Mota et al. (2005) reported that girls participated in more MVPA during recess than boys, the contrary has also been suggested in the literature: that in an unstructured setting such as recess boys tend to be more physically active than girls in whereas sex differences are less apparent in structured PA contexts (Mota et al., 2005). One example of research in a structured PA setting is a study completed by Kelly et al. (2004). Equal levels of PA were found for 78 boys and girls (3- to 4-years-old) through accelerometer counts and simultaneous observation with CPAF. The structured PA context was a 30- to 45-minute teacher-led PA class as the observational period (Kelly et al., 2004) whereas other studies reviewed that reported differences between boys and girls PA levels used the typical preschool day, recess, or activities in the home as observational periods.
In conclusion, motor development of preschool children was discussed briefly regarding psychomotor, cognitive, and affective development. Sex differences in physical development for preschool-aged children are minimal. Instruments validated for measuring the PA of preschool-aged children include direct observation, accelerometers, and pedometers. Numerous factors may influence the PA of preschool-aged children including outdoor play, activities and markings on the playground, time of day, obesity, and sex. Though contradictory findings exist on sex differences in PA behaviors, evidence to show that boys tend to be more active than girls seems more abundant, however evidence for reasons as to ‘Why?’ are less common in the literature (Ridders et al., 2006).
CHAPTER 3

METHODS

In this manuscript, evidence from the literature has been highlighted suggesting that there is a need to explore the PA of preschool children. The six research questions examined in this study were, (1) what are the PA behaviors of preschoolers (4-5-year-olds) during outdoor time; (2) are there significant differences between preschool boys’ and girls’ PA based on sex and the time of day when the activity takes place; (3) which contexts (centers) seem to promote the greatest amounts of PA; (4) where do the children spend a majority of their outdoor time; (5) are the children’s favorite places to play the same as the centers where children spent most of their time during observations; (6) what are the reasons children give for a certain context or activity being their favorite?

The research questions were examined using a mixed methods approach, incorporating both quantitative and qualitative methodologies. This chapter will describe the methods that were used in this study beginning with information on the setting and participants in this study along with detailed information regarding the preschool children, facilities, and condition of the outdoor playground during data collection. Next the instruments and data collection procedures will be discussed. Last, data analysis will be explained relative to specific analyses that were employed to answer each of the six research questions.
Setting and Participants

The study took place at the preschool located on the main campus of the University of Nevada, Las Vegas (UNLV), housed in the Lynn Bennett Early Childhood Education Center (LBECEC). Accredited through the National Association for the Education of Young Children (NAEYC), the preschool provides excellent facilities and strives to provide a developmentally appropriate educational experience for the whole child (University of Nevada, Las Vegas [UNLV], 2005). The preschool is a program of the Department of Special Education at UNLV and therefore has a focus on providing curriculum to meet individual needs of every student.

Participants in this study were 4- to 5-year-old preschool children from the two oldest classes at the UNLV preschool. A total of 15 girls and 21 boys volunteered to participate in the study (n = 36). Parents signed consent forms for their child to participate in the study. From the volunteers, complete data were obtained for 9 girls and 12 boys (n = 21). The average age of the 21 participants with complete data sets was 58 months. The mean age for boys was 3 months older than the girls (girls M age = 58 months, boys M age = 61 months). The UNLV Institutional Review Board (IRB) and LBECEC Advisory Committee approved the study.

Participants were from either the Bumble Bee (n = 19) or Rainbow class (n = 17). The Bumble Bee and Rainbow classrooms were organized into a variety of areas called “centers”. Examples of centers within the classrooms were library, science, dramatic play, music, blocks, art, snack, and writing. The wall on the East side of each classroom is entirely made up of windows and a garage door that opens onto an outdoor patio. Each class has a private patio that is approximately 415 square feet with a garden on the
perimeter and a tree in the center of the patio. Often the garage door is left open so that
the patio becomes an extension of the classroom space. Typically the patio is used for
activities that may be too messy inside such as activities with water. Children also care
for their class garden daily.

According to information from the website for the LBECEC, the preschool
environment is organized in an attempt to give preschool children “opportunities to learn
through exploration and interaction with their environments” (UNLV, 2005). The outdoor
playground is approximately 14,695 square feet with a jungle gym (1,120 square feet),
playhouse (855 square feet), fixed playground equipment (2,745 square feet), sandbox
(175 square feet), grassy terrain (5,800), and a bike path (4,000 square feet).

Figure 1. Physical Activity Centers on the UNLV Preschool Playground.
Just as the classroom is organized by “centers” for this study, the areas of the playground were also conceptualized into centers. In order to assist the reader in gaining a better understanding of the preschool playground, a description will be given as if you (the reader) had taken a walk out of the Bumble Bee or Rainbow classrooms and explored the playground during data collection. A diagram of the preschool playground as it was divided into centers can be seen in figure 1. It may also be helpful to refer to Appendix 1 to see pictures of the playground.

*Jungle Gym Center*

After walking out of the Bumble Bee and Rainbows classroom, first you would have visited the jungle gym center (1,120 square feet) on your right, past the patio of the Bumble Bee classroom. Playing in the jungle gym center would be a rare occasion during data collection because due to the number of staff available the jungle gym was only open during three outdoor times. The jungle gym center was the very last center to be opened to children during data collection. You would take a right-hand turn after the cinderblock wall of Bumble Bee patio and walked south on the sidewalk toward the jungle gym center. Once you arrived at the end of the sidewalk, a gate about 3 feet high would still bar the way into this center and must be opened to get in. The surface of the jungle gym center is covered with a playground material that is made to cushion a child’s fall. The jungle gym center has a fixed climbing apparatus, a metal balance beam, and a wider and taller variation of a plastic balance beam with a step in the middle of the beam. The jungle gym center has a limit of 6 children playing at a time. If more children want to play they must line up on the sidewalk next to the gate until the preschool staff
supervising the jungle gym asks other children to leave to give new friends the
opportunity to play in the jungle gym.

*Playhouse Center*

Instead of taking a right on the sidewalk toward the jungle gym center, heading left
leads to the playhouse center (855 square feet) equipped with a playhouse, shopping cart,
plastic food, plates, and two baby dolls. Under the covered playhouse center there is also
an art activity, a sensory table, and a rug with toy cars. The art activity during data
collection was typically sidewalk chalk or butcher paper with markers. Occasionally
paints were used for the art activity on butcher paper. The sensory table activities varied
from water, to beans, or fine ground coffee. During the summer there is also a fountain
that shoots water upward from the ground for children to play in, however this fountain is
not used during the Fall or Spring.

*Fixed Playground Center*

North of the playhouse center is the fixed playground center (2,745 square feet).
Within this center there are three ramps, two steps, bars to climb on, a climbing wall, and
two slides. To the west of the fixed playground equipment there is a red spinning chair, a
tire swing, and two traditional swings. All equipment in the fixed playground center is in
a covered area except the swings. Like the jungle gym center, the fixed playground center
is floored with a semi-soft and thick flooring to protect children from injuries if they fall.
Within the fixed playground center on the side closest to the playhouse center, there was
a semi-circular table with four chairs that had three to four choices for children including
blocks, puzzles, and other manipulative toys. Reading activities were also located within
the fixed playground center on the opposite side of the ramp from the blocks. The reading
activity was equipped with a plastic container of books, a plastic picnic table, and two beanbag chairs. Other equipment available to children within the fixed playground center were 3 Hoppi balls and 7 rainbow-colored streamers.

**Sandbox Center**

Just around the corner, directly east of the playhouse area is the circular sandbox (175 square feet). The sandbox is another area covered with a blue canopy. Within the sandbox children had the choice of a variety of digging equipment including three planter boxes, buckets, hand shovels, larger shovels, a rake, sand sifters, and three large trucks.

**Grass Center**

Directly around the sandbox as well as to the east of the sandbox is a large grassy area (5,800). Within the grass are more than 12 trees and slopes of varying steepness. Within the middle of the large grass area an obstacle course was set up for children to play on. The obstacle course was a little different each day with a variety of hula hoops, cones, poly hands, and poly feet, stepping blocks, and wooden balance beams. Two smaller sections of grass are also located toward the eastern-most part of the playground.

**Bike Path Center**

The bike path (4,000 square feet) is a large concrete sidewalk that surrounds the grass and sandbox. Arrows are painted on the bike path to show the direction the bikes need to travel. At the west side of the bike path an assistant was stationed to help children get helmets on before they rode on the tricycles. Bikes available to children to ride were two small tricycles, 1 bigger tricycle, and two wagons. If you traveled along the bike path you would have passed by the restrooms where a picnic table was set up with blocks.
As you continued east on the bike path you would have passed by the multipurpose room patio where there were two large exercise balls and one smaller ball. Though the balls initially started on the multi-purpose room patio, often children would push the exercise balls to other parts of the playground to play with. After going across a bridge-like part of the bike path you would have made a right-hand turn and would have been heading downhill toward the front entrance to the playground.

Just to the east of the front entrance there is a game of hopscotch painted on the sidewalk. As you head back on the bike path heading west, you may have noticed that the level of the path is again at a very slight incline. Finally, turning right just as you passed the sandbox you would have passed by a section of sidewalk where 3 shapes are painted onto the ground. In this area there was also about a five-foot tall basketball hoop with balls under the hoop to shoot with.

Outdoor Time

Outdoor time is a designated time for all classes within the preschool (ages 3- to 5-years-old) to play on the outdoor playground. Outdoor time is scheduled from 8:30-9:30 a.m., 11:30 a.m. to noon, from 1:30-2:00 p.m. and from 4:00-5:30 p.m. Classroom assistants are assigned areas to supervise during outdoor time. Children are allowed to play anywhere that the playground is “open” (areas of the playground with assistants to supervise the children). A playground supervisor oversees outdoor time and helps to ensure that outdoor time runs smoothly.

In this thesis, outdoor time will be considered a movement classroom for children. Therefore the areas of the playground will be referred to as centers just as different areas inside the classroom are called centers. During outdoor time children have free choice of
six centers to play in. Outdoor time centers include the bike path center, jungle gym center, fixed playground center, grass center, playhouse center, and sandbox center. Originally the “jungle gym” center was going to be called the climbing center, however, the preschool children and staff refer to this area as the jungle gym. Thus, the center coded as “climbing” on the data collection form (Appendix 2) will be referred to in this paper as the jungle gym. Additionally within certain centers children are able to participate in activities such as the sensory table, blocks, puzzles or reading. Children may also use certain physical education equipment anywhere on the playground. Music activities were never set up during outdoor time during data collection. Observations took place during outdoor time and observers recorded the center where the PA occurred for each observational interval.

To be sure that opportunities offered to children were similar across outdoor time during data collection, researchers for this study assisted in playground set-up and checked each day to ensure that equipment available to children was the same for the morning and afternoon outdoor time throughout the study. Equipment included various sizes and textures of balls, streamers, Hoppi balls, exercise balls, tricycles and wagons, blocks, books, puzzles, dramatic toys, a sensory table, art activity, and equipment used in the obstacle course.

Data Collection Instruments

The Modified OSRAC-P Direct Observation System

The direct observation system used in this study was a modified version of the Observational System for Recording Physical Activity in Children-Preschool Version
(OSRAC-P) (Brown et al., 2006). Though 8 categories comprise the OSRAC-P, for the purposes of this study, the first two observational categories from the OSRAC-P were used to collect data on the PA intensity and type of activity of the focal child. Categories from the OSRAC-P that were irrelevant to the research questions were eliminated. For example, the location and indoor activity context categories were eliminated because all observations were during outdoor time making this category irrelevant. Brown et al. (2006) found that prompts happened so rarely that many times they were unable to calculate IOA because of a lack of data.

Because activity prompts were rarely observed during the creation of the OSRAC-P, the prompt codes category was not used in this study. Another reason prompts were not coded during this study is that the large space where observations took place would have made it difficult to hear prompts even if they occurred. Therefore trained observers for this study did not need to hear and code prompts. Elimination of six categories from the OSRAC-P that were irrelevant to the research questions also decreased the necessary training needed to obtain appropriate agreement percentages. Observers for this study were volunteers and therefore it was not practical to have each observer trained as extensively as paid observers used in the creation of the OSRAC-P. Brown et al. (2006) reported that 7 weeks of daily in situ observations were necessary for initial training.

Eliminating irrelevant categories from the OSRAC-P made it possible to complete three observational intervals per minute instead of only two. This modification resulted in time-sampling data that may be more indicative of what occurred in real time. The OSRAC-P is a momentary time sampling system where there is a 5-second observe and 25-second coding period. To answer the current research questions there were only three
categories in the modified OSRAC-P and therefore the modification of a 5-second observation period followed by a 15-second coding period was employed. This increased observation intervals to three each minute instead of two observation intervals per minute. During a 30-minute observation with the modified OSRAC-P there were 90 intervals recorded whereas the OSRAC-P records data for 60 intervals within the same time frame.

For the purposes of this study, the first two observational categories (PA level and PA type) from the OSRAC-P were used to collect data on the physical activity intensity and the type of activity in which the focal child engages. Table 5 displays the five levels of intensity coded when using the OSRAC-P physical activity level category. The OSRAC-P codes for PA level are very similar to CARS codes because the OSRAC-P was developed using CARS (Brown et al., 2006). Coding rules of the modified OSRAC-P are listed in Appendix 2. The third category was designed for this specific preschool and was called the physical activity center category. The activity center category was used to collect contextual information on where children spent time. It was more appropriate to create a context category than to use the outdoor context category from the OSRAC-P because there were at least 3 codes within that category that did not apply to this preschool. For example, “time out” is one of the codes for the OSRAC-P and this preschool has a policy that they do not use time out as a disciplinary tool, therefore children would have been in this category for zero percent of the observations. Refer to Appendix 2 to see a copy of the coding form that was used for data collection.
Table 5

OSRAC-P Physical Activity Level Categories and Examples

<table>
<thead>
<tr>
<th>Category</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 = Stationary activity</td>
<td>(Lying, sitting, standing squatting)</td>
</tr>
<tr>
<td>2 = Stationary activity with movement</td>
<td>(Standing and coloring)</td>
</tr>
<tr>
<td>3 = Slow easy translocation</td>
<td>(2.5 m.p.h. walk, 0% grade)</td>
</tr>
<tr>
<td>4 = Medium or moderate translocation</td>
<td>(2.5 m.p.h. walk, 5% grade)</td>
</tr>
<tr>
<td>5 = Fast or very fast translocation</td>
<td>(2.5 m.p.h. walk, 10% grade)</td>
</tr>
</tbody>
</table>

(Puhl et al., 1990; Brown et al., 2006)

Pedometers

The Digi-Walker SW-701 was used for data collection for this study because of the ease of use, low cost, and relatively low burden to the researcher in data analysis. To ensure reliability of the pedometers, 8 randomly assigned participants (4 girls, 4 boys) wore a pedometer above both the right and left hipbone for approximately 30-minutes during outdoor time. The step counts from the left and right hip were compared using a paired samples t-test. Results of the t-test showed that there was no difference between right and left hip step counts ($t = -.36, p > .05$). Therefore, during the remainder of data collection children only wore a pedometer on their right hip.

Procedures

Using direct observation as a quantitative data collection instrument required appropriate observer training. The two-week time period of in situ observations (practice
observations in the natural setting) for observers also enabled the researchers to practice
data collection procedures. During the first week of in situ observations children did not
wear pedometers. This first week acted as a week of overall observation to understand
how the classroom protocols work and to conceptualize what the best methods for the
distribution of the pedometers would be. Before allowing children to wear the
pedometers, the primary investigator, scheduled times to come to each classroom and talk
to the children during circle time. Circle time is a time in the classroom where all
children sit on a circular rug to listen to stories or receive instructions from their teachers.

Followed by an introduction by the classroom teacher the researcher showed the
children what a pedometer looks like, what it does and what the rules were for wearing
the pedometers. The preschool has two rules: 1) keep yourself and your friends safe and
2) keep your equipment safe. Keeping the pedometer safe became a part of the preschool
rule of keeping equipment safe. The children were given examples of what was okay to
do with the pedometers and what was not. The children were asked not to play with or
even touch their own pedometer or a friends’ pedometer.

An analogy was given to the children that if the pedometers were touched that they
would not work correctly. Touching the pedometers was compared to “telling the
pedometer a lie”. If the numbers were wrong it would be like the pedometer was telling
us a lie and we want the pedometers to tell the truth. Weeks after this first circle time
children were observed repeating the rules to the researchers as they received their
pedometer. For example, as one girl was getting her pedometer she said something like,
“I know why we don’t touch our pedometers. Because then they would tell us a lie.”
On the day after introducing the pedometers in circle time the children were given pedometers to wear during outdoor time. Children were very excited to wear the pedometers during the first day of outdoor time and many children spent time showing their friends and preschool staff their pedometers. They were interested in seeing what number they had and what number pedometer their friend had. Children had to be reminded that it was not okay to touch their pedometer or a friends' pedometer. Children were also seen opening their pedometers on the first day. After outdoor time the teachers and researchers reminded the children that it was not okay to touch their pedometers or open them. The next day children were again reminded of the rules as they received their pedometers and seemed far less reactive to wearing the pedometers. Other children would even report friends to the preschool staff or researchers if they saw friends break the pedometer rules. In this way the children helped each other learn that it was not okay to touch or open the pedometers. Children were required to wait until the end of outdoor time when the researchers or their assistants opened the pedometers if they wanted to hear the number of steps they had taken. If children asked to see the number of steps they had taken at the commencement of outdoor time, researchers showed each child who asked. Because children knew they could see their steps they seemed to have an easier time following the rules of keeping the pedometers safe by keeping them closed.

Both classes wore the pedometers during the second week of in situ observations for the morning and afternoon outdoor time. All children had at least four opportunities to wear the pedometer prior to data collection. Height and weight data were also collected during the second week of the in situ observations to determine the BMI of the sample of preschoolers. Height was measured (to the nearest cm) twice using a measuring tape.
fastened to the wall. If there was a discrepancy in measurement one and two, the child
was measured again to ensure accuracy in measurements. Weight was measured in
kilograms (to the nearest .01 kg) with an electronic scale. Both height and weight
measurements were completed without shoes.

Observer Training

Four trained observers completed all observations. Each observer was required to
memorize the codes for all categories from the modified OSRAC-P. It was also
recommended that observers complete quizzes on the definitions of the PA level and PA
type categories. Two of the observers completed the quizzes with a score of 100% on two
consecutive days (Brown et al., 2006). Each observer was given an OSRAC-P training
manual (written and audio format), a training power point presentation, and a DVD to
practice coding. After reviewing the materials, all observers attended an orientation
session to discuss protocol for observations, continue training on coding rules, and to
practice coding PA level and PA type categories from the practice DVD. At the
orientation session observers became more familiar with the system by coding the PA
level and PA type for part of the DVD of a 4-year-old girl playing in the park and then
discussing the intervals coded.

In situ observations took place during two weeks from the 5th through the 8th of
March and again from the 19th to the 22nd of March. At the end of in situ observations,
another observer meeting was held on March 23rd to further define categories and clarify
information for coding. Data collection began on the 26th of March and was completed on
April 11th 2007. In situ observations were continued for each observer until at least 85%
agreement was reached for each category. Though six observers initially began training
only data from four observers were used because two observers were not able to reach a high enough interobserver agreement level for all three categories. The average number of observations it took for the four observers to reach at least 85% agreement in each category was 10.25 observations. Observers were trained on the modified OSRAC-P through the completion of situ observations, attendance at the orientation meeting, discussions before and after observations, and attendance at the follow-up training meeting. Observers spent an average of approximately 19 hours in training before data collection began.

Data Collection

Observations took place during the morning outdoor time (8:30 a.m. to 9:30 a.m.) and the afternoon outdoor time (1:30 p.m. to 2:00 p.m.). Each child wore a pedometer and was observed using the modified OSRAC-P data collection form during two outdoor times (one morning and one afternoon observation). The pedometer was put on before leaving the classroom for the outdoor time and the children were assisted by the trained research assistant to ensure proper pedometer placement above the right hipbone and to reset the pedometer to zero.

Because fewer children arrive at the preschool before morning outdoor time begins, the Bumble Bees and Rainbows are combined into one classroom. During the in situ observations (2 weeks) and data collection (2.5 weeks) children who were dropped off at the preschool by 8:30 a.m. were given the opportunity to wear a pedometer during the morning outdoor time regardless of whether they were a participant in the study. Because every child wore a pedometer if they chose to, children were unaware of when they were
the focal child to be observed. Children also had practice wearing the pedometers to reduce the likelihood of reactivity to the pedometers.

To ensure anonymity, each child was assigned a code that corresponded with all data collected for that child. The data code was written on the data collection forms before collecting data for that child. To keep track of which child wore a specific pedometer names were attached with Velcro to the box that organized the pedometers. This method made it easy to make sure children being observed that day had the correct number of pedometer. No equipment was lost or damaged during data collection and there were no battery problems.

Children were observed once in the morning and once in the afternoon. During the afternoon outdoor time full 30-minute observations could not be completed because of the added time of distributing pedometers and because the afternoon outdoor time is only 30-minutes in length. The morning observations ranged from 25- to 30-minutes in duration and the afternoon observations ranged from 25- to 28-minutes. The average observation length was approximately 29-minutes in the morning and 27-minutes in the afternoon. The results of an independent samples t-test showed that there was no significant difference between the length of observations for boys and girls in the morning (t = .981, p > .05) or afternoon (t = .006, p > .05).

At the beginning of the study a randomized list was made of the participants. This randomized list was used to select children for observations. The randomized lists were separated for girls and boys in order to spread out the observations evenly. The lists were also separated by classes (Bumble Bees and Rainbows) to avoid collection of all data on
one classroom before the other. Throughout data collection the number of children from each class and from each sex remained relatively equal.

The pedometers were reset to zero at the beginning of each outdoor time. Each observer was assigned a "focal child" to observe and code data. After pedometers were distributed to the children, the observers cued their ipod to the auditory cues. At the beginning of the auditory cues a voice said, "The observation will begin in 10-seconds". Following the 10-second warning the first interval began with a cue to "observe one". After 5-seconds passed at the beginning of the 15-second coding period the observer was again cued to "record one". The auditory cues repeated for the entire 30-minute interval (i.e. observe 22...record 22...observe 23...record 23...etc.). At the culmination of the 30-minute observation the observer was again cued to collect the step counts from the focal child. Observers collected step counts immediately following the last "record" interval in the observation by approaching the child and asking them if they could check their pedometer.

*Interobserver Reliability*

Interobserver agreement (IOA) was calculated interval-by-interval for each category by dividing agreements (A) by the number of agreements plus disagreements (D) multiplied by 100 (IOA = A / (A + D) x 100). IOA levels during in situ observations averaged 72.2% for the PA level category, 87% for the PA type category, and 86.9% for the PA center category. After each in situ observation observers met to discuss the observation and clarify coding rules. Brown et al. (2006) recommended completing IOA checks for one of every 12 observations per focal child or 10-16% of observations. During data collection, 19% of all observations were completed with two observers.
coding the physical activity behaviors of the same focal child simultaneously and independently. The average IOA levels during data collection were 93.1% for the PA level category, 96.7% for the PA type category, and 99.2% for the PA center category.

**Focus Group Procedures**

Mixed methods can give a more complete picture of a given phenomena. By including focus groups in this study a richer perspective regarding preschool PA was obtained. In preparation for conducting the focus group the researchers had a meeting to discuss protocol for the focus groups. A pilot focus group was completed with four participants (2 girls, 2 boys) who did not have complete data sets. Data collection was completed on Wednesday afternoon and the pilot focus group was held on the following Monday at 10:15 a.m. in the research room of the preschool. The pilot focus group was used to refine protocols and questions for the focus groups. After the completion of the pilot focus group the researchers discussed what worked well and what could be improved for the actual focus groups.

On the day of the focus groups the researchers met again immediately before the focus group began to review the procedures of the focus groups. Twelve randomly chosen participants (6 girls, 6 boys) attended a focus group for approximately 15 minutes during the preschool day. Three focus groups were conducted with four children in each group. Children were greeted as they came into the research room and invited to sit down at the table. The microphone was turned on to audio record the focus group onto a laptop computer and a digital video camera was used to video record the focus group.

The facilitator of the focus group greeted the children and talked about how every day when the children come to preschool they have the opportunity to play on the
playground. The facilitator continued by having the children think of what they do during outdoor time and then to think of their favorite thing to do during outdoor time. Next, the facilitator asked the children to draw, “My favorite things to do during outdoor time”. The children mentioned out loud some of their favorite things to do and began drawing with their choice of crayons or markers on 8 1/2 x 11 inch white paper.

After giving the children approximately 5 minutes to draw, one of the three facilitators asked the children to, “tell me about your picture”. As the children talked about their picture facilitators wrote exact quotes of what the children said. Open-ended questions were used to encourage children to talk about their drawings and their favorite things to do during outdoor time. Facilitators avoided asking leading questions or yes or no questions.

After children talked about their pictures of their favorite things to do during outdoor time, the facilitator took the children on an “imaginary trip” through the playground. Pictures of the playground were shown to children as the facilitator talked about all the different centers on the playground. After talking about the playground, the facilitator asked, “If I told you that you could only choose one place on the playground to play where would you play? You can only choose one place, so point to your very favorite place to play.” Children pointed to the picture of their favorite place to play and the children’s responses were written down. Clarifying questions were used to ask children exactly what they were pointing to in the picture of their favorite place to play.

One of the main purposes of the focus groups was to provide a richer and detailed description of preschool children’s PA, especially related to the why of PA behaviors. Therefore, informal follow-up interviews were conducted with participants during centers...
in their classroom the week following the focus groups. During these informal interviews the researcher talked to children to find out why they had chosen a specific center as their favorite place to play. Children seemed more comfortable and open to sharing their thoughts in the one-on-one informal setting. One child in particular who had not been very cooperative in focus groups, answered questions easily when talking to the researcher one-on-one. After greeting each child the researcher said, “Last week you told me that the swings are your favorite place to play during outdoor time. Why are the swings your favorite place to play?” As the child responded the researcher wrote down exact quotes from the children. After responding to the first question, the researcher then asked, “Why else?” or “Are there any other reasons you like the swings.”

Data Analysis

The purpose of this study was to analyze PA behaviors of preschool children during outdoor time. Six research questions guided this examination:

Physical Activity Behaviors During Outdoor Time

The first research question was: What are the PA behaviors of preschoolers (4- to 5-year-olds) during outdoor time? To answer this question, descriptive statistics were reported for step counts, PA level, PA type, and PA centers.

Boys’ versus girls’ Physical Activity Behaviors

The second research question was: Are there significant differences between preschool boys’ and girls’ PA based on sex and the time of day when the activity takes place? To determine if boys and girls were similar in weight-for-height characteristics a simple independent t-test was conducted between boys’ and girls’ BMI values. Next, to
provide more evidence that pedometers are valid for measuring PA with preschool children, step counts and PA level scores were correlated.

The research design was a mixed-model design using outdoor time as the within groups factor and sex as the between groups factor. A repeated measures MANOVA was to be the initial statistical analysis, however, upon completion of data collection, the researcher found that the data violated one of the assumptions of the MANOVA statistic. A MANOVA works best if the dependent variables are only moderately correlated. When dependent variables are highly correlated this is called multicollinearity. In the “SPSS Survival Manual” it states, “correlations up around .8 or .9 are reason for concern” (Pallant, 2005, p. 255). The suggestion if this happens is to either remove one of the two highly correlated variables or to combine the two scores into one score. In order to avoid violating the assumption of multicollinearity, since the two dependent variables were highly correlated, PA level and steps per minute were combined to make one composite score. With the two dependent variables combined into a composite the appropriate statistical analysis becomes the ANOVA.

Before computing results of the ANOVA the dependent variables (PA level and steps/min) were made into one composite score for morning and afternoon. In SPSS 14.0 scores were saved as standardized scores (z-scores). After standardizing PA level scores and steps per minute, the two morning scores for each participant and two afternoon scores were averaged by adding the morning PA level z-scores to the morning steps z-scores and dividing by two. The averages of the standardized scores were used when conducting the ANOVA. A repeated measures ANOVA with a two sex (girls and boys) by two outdoor times (morning and afternoon) was conducted using a composite score of
the mean steps per minute and mean PA level scores as the dependent variable. Data analysis was completed using the Statistical Package for the Social Sciences (SPSS) 14.0.

*Contexts that Promote Physical Activity*

The third research question was: Which contexts seem to promote the greatest amounts of PA? To find out which contexts promoted the greatest physical activity, PA level data was matched with the centers data interval-by-interval using SPSS 14.0. Results of interval-by-interval analyses revealed the percentage of time children spent at each center in each of the five PA levels. This data was analyzed as a group as well as for boys and girls separately. For each center the average PA level was calculated as a group and separately for boys and girls.

*Where Children Spent Outdoor Time*

The fourth research question was: Where do the children spend a majority of outdoor time? Again, SPSS 14.0 was utilized to determine where children spent most of outdoor time. Frequencies were calculated by dividing the number of intervals children spent at each center by the total number of intervals. The data analysis was completed for the group as a whole as well as for girls and boys separately.

*Favorite Contexts During Outdoor Time*

The fifth research question was: Are the children’s favorite places to play the same as the contexts where children spent most of their time during observations? To answer research question five, the percentage of time spent in each center was compared to focus group interview responses to determine whether children spent most of their time in the areas or activity they reported to be their favorite. The actual data collection forms were
reviewed to determine if the child spent most of their time in at least one of the observations in their favorite center or activity.

**Why Children Enjoyed Specific Contexts**

The sixth research question was: What are the reasons children give for a certain context or activity being their favorite? Drawings, focus group interview responses, and follow-up interview responses were used to conduct a domain analysis. After analyzing data and constructing domains based on patterns seen in the data, a taxonomic representation was prepared to display data. Observational data was also incorporated into the domains.

A summary of data analysis procedures can be found in Table 6. The methodology of this study was designed to answer the six research questions presented on the physical activity behaviors of preschool-age children. The quantitative method of direct observation was coupled with pedometry to measure the PA behaviors of preschool children. The direct observation yielded results of PA level, type, and center of preschool children during outdoor time. In situ observations were used to train observers and to practice data collection procedures. After the completion of data collection, focus groups were employed to gain a better understanding of the PA of preschool children in this study. Quantitative data was analyzed using SPSS 14.0 and qualitative data from focus groups were analyzed through a domain analysis.
Table 6

How Will the Research Questions be Answered?

<table>
<thead>
<tr>
<th>Research Question</th>
<th>Data</th>
<th>Data Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. PA behaviors of preschoolers during outdoor time</td>
<td>1. Step counts</td>
<td>Descriptive statistics</td>
</tr>
<tr>
<td></td>
<td>2. Observational data</td>
<td>Frequency distributions</td>
</tr>
<tr>
<td>2. Differences between preschool boys’ and girls’ PA based on gender and the time of day?</td>
<td>1. Weight</td>
<td>T-test for BMI scores</td>
</tr>
<tr>
<td></td>
<td>2. Height</td>
<td>Correlation (step count and PA level)</td>
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<tr>
<td></td>
<td>3. Step counts</td>
<td>Repeated measures ANOVA 2 sex x 2 outdoor times (DV = composite score of steps/min &amp; PA level score)</td>
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<td></td>
<td>4. PA level scores</td>
<td></td>
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<tr>
<td>3. Which centers promote the greatest amounts of PA?</td>
<td>1. PA centers scores</td>
<td>Compare PA level interval-by-interval to center</td>
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<tr>
<td></td>
<td>2. PA level scores</td>
<td></td>
</tr>
<tr>
<td>4. Where do the children spend a majority of their outdoor time</td>
<td>1. PA center scores</td>
<td>Number of intervals at a given center divided by total intervals</td>
</tr>
<tr>
<td></td>
<td></td>
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<tr>
<td>5. Are the children’s favorite places to play the same as the centers children spent most of their time during observations</td>
<td>1. Focus group drawings and interviews</td>
<td>Percentage of time spent in centers compared to focus group findings</td>
</tr>
<tr>
<td></td>
<td>2. PA center scores</td>
<td></td>
</tr>
<tr>
<td>6. What are the reasons children give for a center or activity being their favorite?</td>
<td>1. Focus group drawings and interviews</td>
<td>Domain analysis Taxonomic representation</td>
</tr>
</tbody>
</table>

ANOVA = analysis of variance, DV = dependent variable, PA = physical activity
CHAPTER 4

RESULTS

The purpose of this study was to explore the PA behaviors of preschool children at a University preschool during outdoor time. Children in the study were 4- to 5-year-olds (n = 21) that were enrolled in preschool for the full day for two, three, or five days a week. Modified OSRAC-P observational data and step counts were collected on girls (n = 9) and boys (n = 12) during one morning and one afternoon outdoor time. The observations ranged from 75 to 90 five-second observational intervals across a 25- to 30-minute observation. Results of the data collected for these participants will be presented in this chapter.

Physical Activity Behaviors of Preschool Children

The first research question was: What are the PA behaviors of preschoolers (4- to 5-year-olds) during outdoor time? Results for research question one will be presented from data that were collected for the three modified OSRAC-P categories (PA level, PA type, and PA center). Step counts as measured by the Digi-Walker SW-701 will also be included as part of the PA level results. Frequency data for PA level, PA type, and PA center categories have not been analyzed statistically and therefore differences reported for research question do not infer significance, they are merely descriptive in nature.
PA Level Results

The PA level results revealed how active the children in this study were during morning and afternoon outdoor time by intensity (PA level scores) and by quantity (step counts). The PA level category scores are an average of the modified OSRAC-P observation data where PA was categorized from least intense (1 = stationary) to most intense (5 = fast movement). The mean PA level score is an average of all PA level scores across the entire observation, divided by the total number of intervals. Morning PA level scores were 2.64 (SD = .44) and afternoon PA level scores were 2.68 (SD = .41). The mean PA level scores for morning outdoor time was 2.45 for girls (SD = .34) and 2.78 for boys (SD = .47). During the afternoon outdoor time the PA level scores were 2.45 for girls (SD = .17) and 2.85 for boys (SD = .46).

The quantity of PA movement was measured using the Digi-Walker SW-701 at the same time as the direct observation. Pedometers were placed on the participants above the right hipbone and worn during all direct observation periods. At the conclusion of each observation, research assistants were cued to report the step counts for that observation. The average number of pedometer counts for morning observations were 1283 steps (SD = 743) with a similar average for afternoon observations of 1284 steps (SD = 620). Mean step counts for girls during morning outdoor time was 940 steps (SD = 580) or 32 steps per minute (SD = 19) and 1540 steps for boys (SD = 770) or 56 steps per min (SD = 29). The average steps during afternoon observations were 947 steps for girls (SD = 318) or 36 steps per minute (SD = 13) and 1536 steps for boys (SD = 681) or 57 steps per minute (SD = 25). Step counts ranged from 192 to 2124 steps for girls and 389 to 2774 steps for boys.
PA Type Results

The second observational category in the modified OSRAC-P is the PA type category. The PA type category represents what the child was doing during the most intense PA level recorded for the five-second-observation interval (Brown et al., 2006). The PA type was based on the PA level recorded in that interval. Preschool children in this study spent a total of 72.6% of their time participating in activities coded as “stand” (33.1%), “sit/squat” (20.9%), and “walk” (18.6%). Girls spent 21.5% more time in the “stand” category than boys (girls = 45.1%, boys = 23.6%). Boys spent 8.6% more time in the “sit/squat” category than girls (girls = 16.1%, boys = 24.7%). Boys also had 3.7% more intervals coded as “walk” than girls (girls = 16.6%, boys = 20.3%).

The next most common PA types children participated in were “throw” (6.9%), “run” (5.7%), “jump/skip” (3.6%), and “push/pull” (2.9%). Boys were coded participating in 191 throwing actions while girls were coded completing throwing actions 45 times (girls = 3.0%, boys = 10.1%). Boys also ran 5.1% more than girls (girls = 2.9%, boys = 8%). Boys PA type was coded as “jump/skip” 4.1% more than girls (girls = 1.3%, boys = 5.4%). Girls PA type was coded as “push/pull” 1.7% more than boys (girls = 3.8%, boys = 2.1%).

Many of the PA types could be coded as a variety of intensities depending on the level of intensity and repetitions completed within the observational interval. For example, if a child jumped once it may be coded as activity level one, whereas if the child jumped twice it may be coded as level four, and three jumps or more during one 5-second interval may be coded as level five. A few of the PA types were analyzed to determine the PA level scores of children during certain PA types. During the intervals
children participated in throwing activities their average PA level score was 3.53 (SD = 1.0). Girls averaged a PA level score of 2.84 (SD = .88) and boys averaged a PA level score of 3.69 (SD = .95) when the activity type was coded as throw. Swinging was an activity where children also had an increased PA level score of 3.11 (SD = .87). During intervals coded as swinging girls averaged a PA level score of 3.13 (SD = .86). Boys were only observed participating in swinging during one interval where the child was coded as activity level two. When children participated in pushing or pulling activities their PA level was 3.32 (SD = .80). Girls had a PA level of 3.29 (SD = .82) while boys averaged a PA level of 3.38 (SD = .77) during pushing and pulling activities.

**PA Center Results**

The third category in the modified OSRAC-P is the PA center category. The PA center category shows where children in this study spent time during outdoor time. Percentages were calculated for the PA center category by dividing the number of intervals spent in a given center by the total number of observational intervals. Observational data showed that preschool children in this study spent a majority of their time at the bike path center (35.1%), fixed playground center (32.5%), and playhouse center (17.4%). The fourth most common place to play was the grass center (11.5%). Girls spent 13.4% less time than boys in the fixed playground center (girls = 25.1%, boys = 38.5%) and girls spent 13.4% more time in the playhouse center (girls = 24.9%, boys = 11.5%). Table 7 displays the frequencies and percentage of intervals children spent in each center.
Table 7
Percent of Intervals and Number of Intervals Preschoolers Spent in Each PA Center

<table>
<thead>
<tr>
<th>PA Type</th>
<th>Both</th>
<th>Girls</th>
<th>Boys</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bike Path</td>
<td>35.1% (1191)</td>
<td>36.3% (546)</td>
<td>35.1% (1191)</td>
</tr>
<tr>
<td>Fixed Playground</td>
<td>32.5% (1104)</td>
<td>25.1% (377)</td>
<td>38.5% (727)</td>
</tr>
<tr>
<td>Playhouse</td>
<td>17.4% (592)</td>
<td>24.9% (374)</td>
<td>11.5% (218)</td>
</tr>
<tr>
<td>Grass</td>
<td>11.5% (390)</td>
<td>10.5% (158)</td>
<td>12.3% (232)</td>
</tr>
<tr>
<td>Sandbox</td>
<td>1.6% (53)</td>
<td>1.1% (16)</td>
<td>2% (37)</td>
</tr>
<tr>
<td>Jungle Gym</td>
<td>.7% (23)</td>
<td>.1% (1)</td>
<td>1.2% (22)</td>
</tr>
<tr>
<td>Other</td>
<td>.7% (23)</td>
<td>1.5% (22)</td>
<td>.7% (23)</td>
</tr>
<tr>
<td>Can’t Tell</td>
<td>.5% (18)</td>
<td>.7% (10)</td>
<td>.5% (18)</td>
</tr>
</tbody>
</table>

Results listed by: percent of time spent at each center and (number of intervals)

Additional information was also coded in the PA center category when children were participating in certain activities. For example, additional information was coded if children were involved in activities with physical education (PE) equipment, blocks, reading, sensory table, or music. PA center additional information percentages were calculated by dividing the number of intervals children spent involved in the additional context codes by the total number of intervals in the observation. PE was coded during 25% of observational intervals with boys using PE equipment 14.2% more than girls (girls = 16.9%, boys = 31.1%). Blocks were used during 10.6% of the observations and boys used blocks 14.6% more than girls (girls = 2.3%, boys = 16.9%). Girls played at the
sensory table 3% more than boys (girls = 7.5%, boys = 4.5%). Reading was coded for girls during 2.9% of the time and .3% for the boys. Music was never coded as additional PA center information. Table 8 shows the percentages of time children spent involved in additional contexts and were derived from dividing the total number of intervals spent in PA center additional contexts by the total number of observational intervals for girls, boys, and both.

Table 8

Preschoolers Involvement in Additional PA Center Activities

<table>
<thead>
<tr>
<th>PA Type</th>
<th>Both</th>
<th>Girls</th>
<th>Boys</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% (# of intervals)</td>
<td>% (# of intervals)</td>
<td>% (# of intervals)</td>
</tr>
<tr>
<td>Physical Education</td>
<td>25% (907)</td>
<td>16.9% (264)</td>
<td>31.1% (643)</td>
</tr>
<tr>
<td>Blocks</td>
<td>10.6% (385)</td>
<td>2.3% (36)</td>
<td>16.9% (349)</td>
</tr>
<tr>
<td>Reading</td>
<td>1.5% (53)</td>
<td>2.9% (46)</td>
<td>.3% (7)</td>
</tr>
<tr>
<td>Sensory Table</td>
<td>5.8% (211)</td>
<td>7.5% (117)</td>
<td>4.5% (94)</td>
</tr>
<tr>
<td>Music</td>
<td>0% (0)</td>
<td>0% (0)</td>
<td>0% (0)</td>
</tr>
</tbody>
</table>

Sex Differences in Physical Activity

The second research question was: Are there significant differences between preschool boys’ and girls’ PA based on sex and the time of day when the activity takes place? To analyze differences between PA behaviors of boys and girls, a t-test was conducted for BMI between boys ($M_{BMI} = 16.67$, $SD = 2.70$) and girls ($M_{BMI} = $...
15.73, SD = 2.22). The independent samples t-test for BMI between boys and girls revealed that there was no difference between the two groups (t = .86, p > .05). As a result, differences in BMI values cannot be an explanation of sex differences seen in PA.

Table 9
Average PA Level and Step Counts for Preschoolers During Outdoor Time

<table>
<thead>
<tr>
<th></th>
<th>Girls</th>
<th></th>
<th>Boys</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>Morning</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Length of Observation (min)</td>
<td>28.93 †</td>
<td>1.6</td>
<td>28.08 †</td>
<td>2.2</td>
</tr>
<tr>
<td>Total Steps</td>
<td>940*</td>
<td>580</td>
<td>1540*</td>
<td>770</td>
</tr>
<tr>
<td>Steps/Min</td>
<td>32*</td>
<td>19</td>
<td>56*</td>
<td>29</td>
</tr>
<tr>
<td>PA Level</td>
<td>2.45*</td>
<td>.34</td>
<td>2.78*</td>
<td>.47</td>
</tr>
<tr>
<td>Afternoon</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Length of Observation</td>
<td>26.78 †</td>
<td>0.8</td>
<td>26.78 †</td>
<td>1.1</td>
</tr>
<tr>
<td>Total Steps</td>
<td>947*</td>
<td>318</td>
<td>1536*</td>
<td>681</td>
</tr>
<tr>
<td>Steps/Min</td>
<td>36*</td>
<td>13</td>
<td>57*</td>
<td>25</td>
</tr>
<tr>
<td>PA Level</td>
<td>2.45*</td>
<td>.17</td>
<td>2.85*</td>
<td>.46</td>
</tr>
</tbody>
</table>

*Significant at the p < .05 level
†No significant difference was found between the length of observations.
*Total steps were not used in a statistical analysis. Steps/Min and PA Level scores were standardized and formed into a composite score to conduct the ANOVA

PA = Physical activity, SD = Standard deviation, Steps/Min = Steps per minute

63

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A Pearson correlation was conducted between PA level and pedometer counts to provide more evidence for the validity of pedometers in measuring preschoolers' PA. The Pearson correlation showed that the relationship between PA level scores and pedometer counts was strong and that both dependent variables were significantly correlated for morning (r = .91, p < .01) and afternoon observations (r = .87, p < .01). Table 9 shows a comparison of the means and standard deviations for PA level scores and pedometer counts (steps/min and total steps) for girls and boys.

Because of the high correlation between the two dependent variables, before computing results of the ANOVA, the dependent variables were made into one composite score for morning and afternoon as recommended (Pallant, 2005). The composite scores of PA level and steps per minute were used as the dependent variable when conducting the repeated measures ANOVA. Data were entered into a 2 Sex (boys vs. girls) by 2 Times of Day (morning vs. afternoon) mixed-model ANOVA that yielded a significant main effect for sex only, (F(1,19) = 6.384, p < .05), with boys performing more PA in morning and afternoon outdoor times. Neither the time main effect (F(1,19) = .004, p > .05) nor the interaction (F(1,19) = .195, p > .05) were significant.

Contexts Promoting Physical Activity

The third research question was: Which contexts during outdoor time seem to promote the greatest amounts of PA? For each interval of the observations the center where children participated in the highest level of PA during the observational interval was coded. Centers where children participated in the highest percentage of MVPA were the grass center, bike path center, and fixed playground center. The grass center promoted
the greatest amounts of PA with 59.6% of the observational intervals coded as slow-easy to fast (coded as 3-5). MVPA (coded as 4-5) was coded in the grass center 35.2% of the time. Children also had higher PA level scores at the grass center with a mean PA level score of 3.11 (SD = 1.19) for morning and afternoon observations combined. Girls PA level score for intervals spent in the grass center was 2.97 (SD = 1.07) and boys still had a higher mean of 3.21 (SD = 1.26).

The center that promoted the second highest amounts of PA was the bike path center where children spent 51.4% of the time in movement that was slow-easy to fast. At the bike path center children participated in MVPA 20.5% of the time. Physical activity level scores were 2.78 (SD = 1.03) as a group. Girls averaged PA levels of 2.47 (SD = .85) and boys averaged PA level scores of 3.05 (SD = 1.09) at the bike path center. The third highest amounts of PA were coded at the fixed playground center where children participated in slow-easy to fast movements 38.7% of the time and MVPA 15.1% of the time in the fixed playground center. Physical activity level scores at the fixed playground were 2.6 (SD = .92) as a group. Girls averaged PA levels of 2.55 (SD = .87) and boys averaged PA level scores of 2.57 (SD = .94) at the fixed playground center.

The jungle gym center also promoted high amounts of PA, however, it was not listed as one of the top three centers promoting PA because the Jungle gym was usually closed to children during the observations. Data were only coded for one girl (1 interval) and one boy (22 intervals) in the jungle gym. Analysis of the 23 intervals coded in the jungle gym center showed that the children spent 47.8% of the time in the jungle gym center in the activities coded as slow-easy to fast (3-5). In the jungle gym center and 39.1% of activities were coded as MVPA (4-5). Table 10 shows time spent in each PA level by
The percentages listed in Table 10 were calculated in SPSS 14.0 and are the number of intervals spent in each PA level at a given center (1-5) divided by the total number of intervals spent at the center. Physical activity level scores at the jungle gym were 3.17 (SD = .1.37) as a group. The girl who played in the jungle gym had an activity level of 5.0 for the only observational interval in the jungle gym center. The boy who played in the jungle gym averaged a PA level score of 3.09 (SD = .1.34).

Conversely, centers that did not promote PA were the playhouse and sandbox centers. Children were the least active at the playhouse and sandbox centers and spent a majority of their time in sedentary activities. When children were in the playhouse center their PA level was coded as stationary or limbs 82.4% of the time (coded as 1-2). When children were in the sandbox center, 71.1% of the time their PA level was coded as stationary or limbs. The PA level score for children in the playhouse was 2.17 (SD = .65) and in the sandbox PA averaged 2.29 (SD = .45). Girls had a mean PA level of 2.11 (SD = .63) in the playhouse and 2.25 (SD = .45) in the sandbox. Boys had a mean PA level of 2.26 (SD = .68) in the playhouse and 2.31 (SD = .71) in the sandbox.

PA level scores were also analyzed based on the additional PA center context codes of PE, blocks, reading, sensory table, and music. When children participated in blocks, reading, and the sensory table activities their average PA level score was approximately 2.00. The PA center additional context codes revealed that when children used PE equipment their mean PA level score was 2.65 (SD = 1.00). Boys had a PA level score of 3.28 when PE equipment was used and girls had a PA level score of 2.52 (SD = .80).
Table 10

Time Spent in Each PA Level at Each Center by Percent and Number of Intervals

<table>
<thead>
<tr>
<th></th>
<th>Stationary</th>
<th>Limbs</th>
<th>Slow-Easy</th>
<th>Moderate</th>
<th>Fast</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grass Both</td>
<td>2.8% (11)</td>
<td>37.5% (146)</td>
<td>24.4% (95)</td>
<td>15.9% (62)</td>
<td>19.3% (75)</td>
</tr>
<tr>
<td>Girls</td>
<td>3.8% (6)</td>
<td>34.8% (55)</td>
<td>34.2% (54)</td>
<td>15.2% (24)</td>
<td>12% (19)</td>
</tr>
<tr>
<td>Boys</td>
<td>2.2% (5)</td>
<td>39.4% (91)</td>
<td>17.7% (41)</td>
<td>16.5% (38)</td>
<td>24.2% (56)</td>
</tr>
<tr>
<td>Bike Path Both</td>
<td>3.6% (42)</td>
<td>45.1% (534)</td>
<td>30.9% (365)</td>
<td>10.4% (123)</td>
<td>10.1% (119)</td>
</tr>
<tr>
<td>Girls</td>
<td>5.3% (29)</td>
<td>56.4% (306)</td>
<td>28.2% (153)</td>
<td>5.9% (32)</td>
<td>4.2% (23)</td>
</tr>
<tr>
<td>Boys</td>
<td>2% (13)</td>
<td>35.6% (228)</td>
<td>33.1% (212)</td>
<td>14.2% (91)</td>
<td>15% (96)</td>
</tr>
<tr>
<td>Fixed Both</td>
<td>3.4% (37)</td>
<td>57.9% (637)</td>
<td>23.6% (260)</td>
<td>9.5% (104)</td>
<td>5.6% (62)</td>
</tr>
<tr>
<td>Girls</td>
<td>2.9% (11)</td>
<td>58.4% (220)</td>
<td>23.3% (88)</td>
<td>11.9% (45)</td>
<td>3.4% (13)</td>
</tr>
<tr>
<td>Boys</td>
<td>3.6% (26)</td>
<td>57.7% (417)</td>
<td>23.8% (172)</td>
<td>8.2% (59)</td>
<td>6.8% (49)</td>
</tr>
<tr>
<td>Jungle Gym Both</td>
<td>0% (0)</td>
<td>52.2% (12)</td>
<td>8.7% (2)</td>
<td>8.7% (2)</td>
<td>30.4% (7)</td>
</tr>
<tr>
<td>Girls</td>
<td>0% (0)</td>
<td>0% (0)</td>
<td>0% (0)</td>
<td>0% (0)</td>
<td>100% (1)</td>
</tr>
<tr>
<td>Boys</td>
<td>0% (0)</td>
<td>54.5% (12)</td>
<td>9.1% (2)</td>
<td>9.1% (2)</td>
<td>27.3% (6)</td>
</tr>
<tr>
<td>Playhouse Both</td>
<td>6.5% (38)</td>
<td>75.9% (446)</td>
<td>13.9% (82)</td>
<td>1.7% (10)</td>
<td>2% (12)</td>
</tr>
<tr>
<td>Girls</td>
<td>8.9% (33)</td>
<td>74.9% (278)</td>
<td>13.5% (50)</td>
<td>1.1% (4)</td>
<td>1.6% (6)</td>
</tr>
<tr>
<td>Boys</td>
<td>2.3% (5)</td>
<td>77.4% (168)</td>
<td>4.7% (32)</td>
<td>2.8% (6)</td>
<td>2.8% (6)</td>
</tr>
<tr>
<td>Sandbox Both</td>
<td>3.8% (2)</td>
<td>67.3% (35)</td>
<td>26.9% (14)</td>
<td>0% (0)</td>
<td>1.9% (1)</td>
</tr>
<tr>
<td>Girls</td>
<td>0% (0)</td>
<td>75% (12)</td>
<td>25% (4)</td>
<td>0% (0)</td>
<td>0% (0)</td>
</tr>
<tr>
<td>Boys</td>
<td>5.6% (2)</td>
<td>63.9% (23)</td>
<td>27.8% (10)</td>
<td>0% (0)</td>
<td>2.8% (1)</td>
</tr>
</tbody>
</table>

Percentages = # of intervals in a given PA level divided by total # of intervals spent at that center. In parentheses = Actual intervals spent at a given center in each PA level.
Where Children Spent Outdoor Time

The fourth research question was: Where do the children spend a majority of outdoor time? The preschool children in this study spent most of their outdoor time playing in the bike path center (35.1%), the fixed playground center (32.5%), and the playhouse center (17.4%). Children spent the least time in the grass center (11.5%), sandbox center (1.6%), and jungle gym center (.7%). Girls and boys spent nearly equal amounts of time in the bike path center (girls = 36.3%, boys = 35.1%). Boys spent 13.4% more time than girls did in the fixed equipment center (girls = 25.1%, boys = 38.5%) and girls spent 13.4% more time in the playhouse center (girls = 24.9%, boys = 11.5%).

Favorite Contexts and Where Children Played

The fifth research question was: Are the children’s favorite places to play the same as the contexts (centers) where children spent most of their time during observations? Children’s answers from the focus groups showed that 6 of the 12 children who participated in the focus groups spent most of their time in their favorite context for at least one of the two observations. Five of the twelve children said that swings were their favorite, however, only one out of the five children who reported swings were their favorite actually spent a majority of time in the fixed playground center with 48 out of 80 observational intervals (60%) involved in swinging on the tire swing and the traditional swing. One child who reported swings as their favorite place to play spent 72.5% and 83.3% of the observations in the fixed playground center, however, was not involved in swinging during either observation. When this participant drew a picture of swinging as his favorite activity he drew himself waiting in line to swing and drew other children.
actually on the swings. Another favorite place to play reported by three of the children in
the focus group was the sandbox. Only one of the three children who reported that the
sandbox was their favorite place to play actually played for a majority of an observation
in the sandbox. During the afternoon observation this participant spent more time in the
sandbox than any other center (42.4%).

Both participants that reported that their favorite place to play was the hoop and balls
located on the West side of the bike path played there a majority of outdoor time and
their PA type was also coded as throw for a higher amount of time then the group
average. Both of these children spent a majority of their time in the bike path center for at
least one observation. The girl who reported that the hoop and balls were her favorite
place to play spent 70.2% of the intervals during the afternoon observation on the bike
path with 41 out of 83 intervals (49.4%) using PE equipment. “Throw” was coded for this
girl 9 times during the observation (10.8%). All throwing and catching this participant
participated in during this observation was with a member of the preschool staff.

Similarly, the boy who reported the hoop and balls as his favorite place to play
participated in all shooting and dribbling activities with a teaching assistant playing with
him. During the morning outdoor time he spent 68% of his time on the bike path and PE
was coded for 67 out of 75 intervals (89.3%). “Throw” was coded 35 times during the
morning observation (46.7%). During the afternoon outdoor time he spent 46.3% on the
bike path and was involved with dribbling, shooting, and catching activities for a large
portion of the observation. Physical education was coded for 40 out of 82 intervals during
the afternoon (48.8%) and he completed a throwing action 24 times (29.3%).
One participant reported that their favorite place to play was the multi-purpose room patio where the “big blue ball” was. The multipurpose room patio is coded as part of the bike path center. During the morning observation this participant spent 97.5% in the bike path center. PE was coded 79 out of 80 intervals because the participant was playing with the blue exercise ball.

One participant stated that the slides were their favorite place to play. Slides are part of the fixed playground center. During the afternoon observation this participant spent 65.8% of his time in the fixed playground. Though this participant played in the area with the slides, since slides are not coded separately as an activity we do not know how much this participant played on the slides during the observation.

Reasons for a Center or Activity Being Their Favorite

The sixth research question was: What are the reasons children give for a certain center or activity being their favorite? Twelve boys (n = 6) and girls (n = 6) participated in a 15-minute focus group where children drew pictures about their favorite thing to do during outdoor time and talked about their pictures. Children also identified their favorite place to play by pointing to the photograph of the playground that was their favorite place to play. The participants’ favorite activity and context were the same for 8 of the 12 participants. For example, “swinging” was a child’s favorite thing to do and their favorite place to play was “swings”. Therefore, data were combined for both questions of favorite activity and favorite center. Figure 2 is a display of domains constructed through a domain analysis of focus group interviews, focus group drawings, and observations.
Figure 2. Domain Analysis Results: Favorite Activities and Contexts.

- **Fixed Playground**
  - **Table Toys**
    - **Swings**
      - **Fixed Playground**
        - **HOOP & BALLS**
          - **Exercise Balls**
            - **Sandbox**
              - **Digging**
                - **Sensation/Success**
                  - **Social**
                    - **Fun/Favorite**
                      - **FAVORITE**
                        - "Because Funny"
                          - "Because I just like it."
                            - "Cuz it's red and it's my favorite."
                          - "Because I love 'em!"
                            - "I like it cause I get to climb the ladder."
                          - "I like it cause I get to look for something with a rake."
                            - "Well, because I like to talk to a rake."
                          - "Because I like that place!"
                            - "Because that's my favorite."
                              - "I like to play with it."
                          - "I did a hole this big!"
                            - "I like to talk to a rake."
                          - "Because!"
                            - "I like to dig."
                              - "Because!"
                          - "I like to talk to a rake."
                            - "Well, because I like to talk to a rake."
                          - "I like "playing with them."
                            - "Just because I do."
                          - "Because that place!"
                            - "Because that's my favorite."
                              - "I like to play with it."
                          - "Because I like that place!"
                            - "Because I love 'em!"
                              - "I like it cause I get to climb the ladder."
                          - "I like it cause I get to look for something with a rake."
                            - "Well, because I like to talk to a rake."
                          - "Because!"
                            - "I like to dig."
                              - "Because!"
                          - "I did a hole this big!"
                            - "I like to talk to a rake."
                          - "Because!"
                            - "I like to dig."
                              - "Because!"
                          - "I did a hole this big!
The image shows a domain analysis results diagram for favorite activities and contexts, with specific examples of children's preferences and reasons for their choices.
In conclusion, the major findings of this study were obtained through pedometer step counts and simultaneous observations during outdoor time (n = 21). PA level scores and pedometer counts were highly correlated for both morning and afternoon observations. Boys (n = 12) were significantly more physically active than girls (n = 9) shown through a mixed-model repeated measures ANOVA using a composite score of pedometer steps per minute and PA level scores. The grass center promoted the highest amounts of MVPA, however, the children played most in the bike path center, fixed playground center, and playhouse center. The focus group findings showed that half the children played for a majority of time in their favorite place. The domain analysis revealed that children enjoyed certain activities because of the fun involved, the social aspects of participation, or the feeling of accomplishment they felt through PA participation.
CHAPTER 5

DISCUSSION

Data from two and a half weeks of observation revealed information on physical activity behaviors of 4- to 5-year-old preschool children (n = 21) during outdoor time relative to PA levels, PA types, and PA contexts. The results of this study revealed differences in the PA behaviors of preschool boys and girls. Boys were found to be significantly more active than girls by steps per minute and PA level scores during outdoor time. Results of the focus groups revealed favorites and ‘why’ those activities were the favorites of the preschool children interviewed. In this chapter, explanations and implications of the findings will be discussed, limitations will be considered, and direction for future research will be presented.

Sex Differences in Physical Activity

As anticipated there was a strong correlation between PA measures of pedometer counts and the direct observational measure for both morning and afternoon observations. Children with larger step counts also tended to have higher PA level scores (morning r = .91, p < .01, afternoon r = .87, p < .01). The high correlation between step counts and the OSRAC-P PA level scores supports the idea that pedometers are suitable for measuring the PA of preschool children (McKee et al, 2005; Louie & Chan, 2003).
After finding a high correlation between PA level scores and pedometer counts a statistical analysis was conducted to compare the PA of boys and girls during morning and afternoon outdoor times. Similar to the literature, this study found that boys tended to be more physically active than girls (Jago et al., 2005; Ridgers et al., 2006) even as young as preschool age (Louie & Chan, 2003; McKee et al., 2005). Girls averaged approximately 600 fewer steps than boys during the 30-minute observations. One explanation for the lower quantity of steps girls achieved may be the amount of time girls spent in more sedentary PA types. Though data from the PA type category were not analyzed statistically, they revealed that girls participated in a lower percentage of PA types that tend to be active and a higher percentage of PA types that tend to be inactive. For example, girls stood during 45.1% of outdoor time as compared to 23.6% of time boys spent standing.

Active PA types that boys engaged in more than girls were throwing, jumping or skipping, and running. Throwing tended to accompany other higher levels of PA as the child chased the ball to retrieve it or jumped to shoot the ball into the hoop. During the intervals children participated in throwing activities their average PA level score was 3.53. Girls and boys both had higher averages when participating in throwing activities though boys still achieved a higher level of PA than girls during throwing (girls = 2.84, boys = 3.69). Girls were observed completing throwing actions during 3% of the observations while boys spent 10.1% of their time outdoors throwing. Girls’ lower percentage of participation in throwing activities may be a contributing factor to the sex differences observed in PA level.
Though the nature of throwing encouraged an increased level of PA for both girls and boys, the modeling and prompts by preschool staff during throwing may also have been a factor resulting in the increased PA level during throwing activities. As noted by the observers during data collection, children tended to be playing with preschool staff when engaged in throwing for an extended period of time. Therefore the influence of adult modeling and prompts from adults may have affected the PA of the preschool children in this study.

Though prompts and modeling behaviors were not investigated in this study, fewer prompts for girls to be active may have been a contributing factor in the lower PA level seen in girls and may also be an example of societal influences on the PA behaviors of preschool children. It is unknown in this study whether girls received fewer prompts to throw than boys. Boys may be expected to be more active than girls because of established societal gender roles. Gender roles providing expectations for appearance and behaviors may contribute to the sex differences observed. For example, the girls in this study tended to wear clothing less suitable for PA participation such as skirts, dresses, and sandals. Boys generally wore clothing more suitable for engaging in physical activity such as jeans or shorts and a loose fitted shirt, and tennis shoes. Behaviorally boys are expected to be more active and therefore may be encouraged more by staff to be active.

One other finding that may provide some explanation for boys being more physically active than girls is the contextual information of centers children played in and additional context activities children participated. Girls spent 13.4% more time than boys in the playhouse center, which was also the center where children were the least active.

Additional context categories coded the use of PE equipment, blocks, sensory table,
reading, and music. Boys used PE equipment for approximately one third of outdoor time whereas girls engaged in activities using PE equipment approximately one sixth of outdoor time. Boys' increase in PA level during the use of PE equipment was also higher then the increase in PA level for girls during use of PE equipment. Overall boys still obtained higher levels of PA than girls even though boys used blocks a much higher percentage of outdoor time than girls. Girls spent more time at the sensory table and reading activities than boys. During observations when children participated in reading an adult sat down and read to the children, again indicating that adult modeling or prompts guide PA choices of children.

Significant differences were found between the PA of boys and girls, however, the results of the same statistical analysis revealed that preschool children were equally active during morning and afternoon outdoor time. Due to a lack of research found investigating the effect of time on the PA of preschool-aged children, no hypothesis was formed as to whether children would be more active during the morning or afternoon outdoor time. In a study with adolescents Jago et al. (2005) found that boys participated in more MVPA than girls during the late afternoon and during the daytime. Jago et al. found some differences in PA level of adolescents based on the time of day, however, the activity time was recorded across the day. In this study the time of outdoor time had no effect on the physical activity of preschool children. Children were equally as active during the morning and afternoon outdoor time and boys were more active than girls during both times of day.
Established Physical Activity Habits

No significant difference was found between the time of outdoor time and the level of PA children exhibited. Furthermore, children who were active during the morning observation were also active during the afternoon and children who were sedentary were sedentary for both observations indicating that PA habits are already being established. NASPE (2002) stated that a foundation of good PA habits may be important in combating obesity. Evidence from observational and step count data show that preschool children have established PA habits as well as habits determining the types of activities chosen. Habits of dictating the types of activities children participate in also affect how physically active the child is. For example, one participant played at the blocks for the entirety of the morning observation and then played at the sensory table for the entire afternoon observation and through focus group follow-up interviews stated that “table toys” were their favorite. Another participant was observed playing with the exercise ball on numerous occasions during outdoor time and also reported the exercise ball as their favorite in the focus groups.

Contextual Influences on Physical Activity

With children already establishing PA habits, contextual influences that may help children develop healthy PA habits are an important consideration. Increased knowledge of contextual influences on PA behaviors can assist in determination of the best way to provide contexts that promote healthy PA participation. The context in this study that promoted the greatest amounts of PA was the grass center. Attributes of the grass center
that may have contributed to the high levels of PA recorded in the grass center are (a) the rules of the preschool, (b) the slope, and (c) perhaps the obstacle course.

First, one preschool rule to keep the children safe was that children may only run in the grass. If children run in another area of the playground they are asked to use “walking feet” or to “go run in the grass”. Second, the grass center is a terrain with many slopes that also increase PA level. For example, if a child is walking at a slow-easy pace on a flat surface the observer would code a “3” for the level of activity. If the same child is walking at a slow-easy pace up a slope a “4” may be coded because of the increased energy expenditure to climb the hill. Within the grass area children also had the opportunity to play with the obstacle course, which may have encouraged higher levels of PA. Despite the findings that the grass center is where children participated in the most MVPA, the grass center was not the most popular place for children to play. Children only spent 11.5% of time playing in the grass and spent 85% of their time playing in the bike path (35.1%), fixed playground (32.5%), and playhouse (17.4%) centers combined.

Children spent more time on the bike path then any other center and children engaged in the second highest levels of activity in the bike path center perhaps because of (a) the size and position of the bike path, (b) the flat terrain, and (c) the equipment and activities available. First, the position of the bike path surrounding the grass covers a large area and makes the bike path a transitional area. To get to the sandbox or to the grass children must walk across the bike path. Second, the flat terrain seemed to make the bike path a desirable place for children to play catch or kick a ball to each other. Third, the bike path offers a variety of activities and equipment including bikes and wagons, a hoop and balls, two large exercise balls, and hopscotch. The only inactive equipment offered on the bike
path is the table of blocks next to the restroom and therefore a higher level of activity would be expected on the bike path because of the nature of the activities offered.

The fixed playground was the second most popular center and children spent similar percentages of time in the fixed playground (32.5%) as the bike path center (35.1%). The fixed playground was also one of the larger centers (third largest) and promoted the third highest amounts of PA. Boys were more attracted to the fixed playground and spent 38.5% there as compared to the 25.1% that girls spent playing in the fixed playground center. The fixed playground seemed to promote essentially equivalent PA levels for both girls (PA level at fixed playground = 2.55, SD = .87) and boys (PA level at fixed playground = 2.57, SD = .94). The fixed playground center also offers the swings, fixed equipment, Hoppi balls, blocks, and reading activities.

Following the bike path and fixed playground in popularity was the playhouse center ranking as the third highest center where children spent outdoor time. Children spent an average of 17.4% of outdoor time in the playhouse center and it was a center where children were least active. The playhouse is ranked fifth in size (855 square feet), and therefore size must not be the only reason for the amount of time spent in a center. Children may have played more in the playhouse than in the larger grass center because only one activity was offered in the grass whereas four activities were offered to attract the children to the playhouse center. Low activity levels in the playhouse are likely due to the small size of the area as well as the sedentary nature of the activities offered including: an art activity, dramatic play toys, cars and a mat, and a sensory table. Children may also have spent more time in the larger and more active jungle gym center, however this area was only open for three observations.
“Fun” In Physical Activity

To answer why a certain context or activity was their favorite, one child summarized the answers of their peers with the response: “Because it’s fun!” The theme of fun being an important consideration in physical activity participation and obesity prevention has also been supported in the literature. When discussing behaviors that promote healthy weight Gunner, Atkinson, Nichols, and Eissa (2005) cited the Active Start guidelines by NASPE, stating that children need to experience activities that are varied, short, and “perceived as fun” (p. 254). Gunner et al. (2005) continued with the suggestion that providers should educate parents in building “fun and engaging activity into their family’s lifestyle” as a part of every well child visit (p. 254). Furthermore, parents are advised to include PA that is fun into their child’s daily routine (Gunner et al., 2005). Thus, the idea of fun in PA can also assist in the prevention of obesity in our youth by encouraging positive activity habits to be a part of the family routine.

Children liked activities not only because they were “fun”. Children also enjoyed specific activities because they were their “favorite”. In this study children generally played in the places they reported as their favorite during at least one observation indicating that the child’s enjoyment in the activity is a factor in choosing what activities to participate in. The exception to the rule was children who reported swings as their favorite. Of these children only one out of the five who said swings were their favorite played on the swings a majority of an observation. Perhaps the discrepancy in the data of children reporting swings as their favorite and then playing in other contexts is because of the limitations of the swings in the preschool setting including (a) the small number of children who can participate in swinging at one time, (b) the process of waiting in line for
the swings, and (c) the fact that children only have a limited time they are allowed to play on the swings in order to give other children a chance to play.

First, there are only two regular swings and one tire swing enabling up to five children to swing at any given time. Second, children will likely have to stand around waiting in line before they get a turn on the swing. One child who reported swings as his favorite drew himself standing in line waiting for the swings and other children on the swings. Waiting in line for the swings is an everyday occurrence during outdoor time. Third, once the child is swinging, the preschool staff supervising swings gives the child a time limit on the swings to allow other children a turn on the swings. Thus, the nature of swinging inhibits children from participating for a higher percentage of time in this activity. Therefore children spent a majority of their time in the context they reported as their favorite with the exception of the swings, perhaps because of the restricted access children have to the swings.

The favorite activities that are more accessible to the children such as the hoop and balls or exercise ball were used a very high percentage of time by children who reported those contexts as favorites. Children whose favorite was the hoop and balls had a very high number of throws during the observation as well as a high percentage of time spent playing at the hoop and balls. The child whose favorite was the exercise ball played with the exercise ball during every interval except one during one observation.

Benefits from Physical Activity Participation

Children in this study enjoyed participating in activities they perceived as being fun or a favorite as well as for the sensory experience, the sense of accomplishment as they...
mastered a skill, and the social attributes of participation. Through the domain analysis of focus group data the three categories of reasons for participation that were constructed were (1) fun/favorite, (2) sensation/success, and (3) social. For example, one child in the focus groups said that sliding was her favorite thing to do because she got to climb the ladder. Reasons for the PA participation did not include children wanting to achieve health benefits, however, children do benefit from physical activity participation with gains in psychomotor, cognitive, and affective development. Burdette, et al. (2004) noted that PA in preschool children typically occurs during free play. Time spent playing outdoors has also been correlated with PA and has been researched as a measure of physical activity (Burdette, et al., 2004). Therefore the literature indicates a relationship between play and physical activity.

Play is also an important aspect of children’s health, promoting psychomotor, cognitive, and affective development through a variety of experiences (Gallahue & Ozmun, 2006). First, psychomotor development occurs through “play” which has been referred to as a child’s work and is important in the development of fine and gross motor skills. “Children’s play is the primary mode by which they learn about their bodies and movement capabilities” (Gallahue & Ozmun, 2006, p. 174). Second, brain research provides evidence that PA contributes to a child’s brain development (NASPE, 2002). Waite-Stupiansky & Findlay (2001) summarized their literature review on PA and the brain by stating, “All the recent brain study data indicate a clear and positive link between physical activity and brain function” (p. 18). Third, affective growth is also facilitated by play, which contributes to the development of a positive self-concept (Gallahue & Ozmun, 2006). The following quote from the motor development textbook,
“Understanding Motor Development” by Callahue and Ozmun (2006) is applicable to why promoting physical activity and play are important for affective development:

Children engage in new experiences, such as climbing, jumping, running, and throwing objects, for their own sake and for the sheer joy of sensing and knowing what they are capable of doing. Failure to develop initiative and autonomy leads to feelings of shame, worthlessness, and guilt (Gallahue & Ozmun, 2006, p. 176).

If a young child does not have adequate movement experiences to develop a positive self-concept and begins to feel worthlessness, the consequences will negatively affect the psychomotor, cognitive, and affective domains (Gallahue & Ozmun, 2006).

Therefore, ensuring successful participation in PA will continue to result in positive development in the psychomotor, cognitive, and affective domains. Conversely, if a child does not develop skills necessary for participation in PA, the child will be affected negatively in all three domains (Gallahue & Ozmun, 2006). Sigmundsson and Stolan (2003) pointed out that failure to master basic motor skills necessary for survival of everyday life will result in derogatory labels like “clumsy” or “impaired”. However if a child is able to develop confidence and competence in motor skills in early childhood they will be more likely to participate in lifetime activities and sports later in life (NASPE, 2002).

To encourage children to be physically active to obtain the benefits of physical activity participation, parents and caregivers should avoid standing back and becoming a bystander watching their children play. Instead parents and caregivers can play with their child, providing positive modeling of physical activity (NASPE, 2002). One interesting find from the focus groups are that when children drew pictures of people they typically
drew themselves along with other playmates, siblings or parents. When children drew a parent participating in the physical activity with them the parent the children drew was their father. No children mentioned or drew their mother participating with them in the PA during focus groups.

Implications

Five topics have been discussed of findings from this study that converge with previous findings in the literature including: (1) boys tend to be more physically active than girls, (2) PA habits are already well established at preschool age, (3) contextual influences affect PA behaviors (4) the perceived “fun” or enjoyment of an activity is an important element in promoting PA participation, and (5) PA participation benefits children through gains in psychomotor, cognitive, and affective development. Implications of these findings will be discussed and are important for parents, preschool staff and administrators, educators, health-care providers, and policy-makers.

As the literature continues to show that girls tend to be less physically active than boys, action must be taken to promote physical activity especially for girls. Interventions can be researched and implemented, playgrounds can be re-structured, activities can be modified to invite and encourage girls to be more physically active. In the literature, when structured activities have been taught to preschool children, boys and girls have been equal in their physical activity level (Goodway et al., 2003; Kelly et al., 2004) and therefore, incorporating some positive and structured opportunities for PA participation can be investigated. Encouraging girls to be more physically active is important if we are concerned about curbing the rising obesity rates of young girls. Between NHANES I and
III the number of overweight preschool girls doubled (Ogden et al., 1997). With the percent of overweight African-American preschool girls rising at an even faster rate (Ogden et al., 1997) and a higher proportion of Mexican-American children who are overweight (USDHHS, 2006) action must be taken. Research and interventions to reach out to children who have a higher risk for the development of obesity must be considered.

Ways to promote PA in populations who are most at risk need to be investigated and solutions must be sought for promoting healthy PA habits of very young children. For example, contextually the grass was the largest area of the play space at the preschool and it promoted the highest amounts of physical activity, however preschool children spent almost half the amount of time in the grass as they did at the more sedentary playhouse center. Preschool administrators and staff may be able to utilize the grass more effectively to encourage children to play in the grass while participating in engaging activities that promote higher levels of PA.

Evidence indicating that preschool children already have established PA habits indicates that opportunities for development of healthy PA habits must start from a very early age. Prevention of obesity can begin from birth as parents, caregivers, and health care professionals attend to the PA needs of children and establish healthy, fun physical activities as part of the child’s daily routine (Gunner et al., 2005). Once daily PA is a part of children’s routines, children will benefit from the experiences of daily PA and in turn begin to develop skills that will support their continued choice to be physically active (NASPE, 2002). As children see positive models, participate in physical activity, and develop physical activity skills, this development will also facilitate not only
psychomotor development, but also cognitive and affective growth (Gallahue & Ozmun, 2006).

Implications are also important to consider from findings in this study that diverged from the literature. Results of this study revealed that the average PA level of preschool children during outdoor time was 2.6 during the morning and 2.7 during the afternoon observations. These averages are higher than previous research on preschool PA where average CARS scores were 1.6 and 1.7 (Finn & Specker, 2000; McKee et al., 2005). There may be two explanations for obtaining higher PA level scores than previous studies. First, the previous literature used CARS scores to measure physical activity and in this study the PA level was recorded on the same scale as CARS, however, coding was completed through a time-sampling procedure instead of continuous coding as in CARS (Puhl et al., 1990). A second explanation for the divergence from previous literature is that in previous literature the observation period was during the preschool day (Finn & Specker, 2000; McKee et al., 2005) and in this study the observation period was limited to outdoor time. The higher PA level score is likely due to the nature of the observation period being exclusive to outdoor time as opposed to observing children across the day.

The average step counts were also lower in this study than previous research completed by Louie and Chan (2003) using pedometers with preschool children in a 25-minute activity class. The mean step counts reported by Louie and Chan (2003) for boys was 1470 (SD = 638) and 1147 (SD = 544) for girls. In order to have a direct comparison with results from Louie and Chan (2003) the steps per minute were calculated by dividing the average number of steps by the length of the observation reported. When converted to steps per minute, boys from the study by Louie and Chan (2003) averaged 59 steps per
minute as compared to boys in this study who averaged 56 steps per minute in the morning and 57 steps per minute in the afternoon. Girls in the 25-minute activity class averaged 46 steps per minute as compared to girls in this sample who averaged 32 steps per minute in the morning and 36 steps per minute in the afternoon.

When comparing the steps per minute obtained in previous literature (Louie and Chan, 2003) and the steps per minute of children in this study statistical significance is unknown, however, it seems that boys had similar step counts and that the girls in this study may have been less active than girls in the study by Louie and Chan (2003). The steps per minute for boys in the study in Hong Kong were only two to three steps per minute higher than those found in this study for the boys. Girls from this study had 10 to 14 fewer steps per minute than girls from the three Hong Kong preschools. The divergent information regarding step counts for these samples of preschool children may be explained by one of four reasons. First, the format of the PA class versus children having free choice of play for the entire outdoor time may have influenced the difference. The 25-minute activity class began with children participating in a 5-minute teacher led warm-up followed by free play. Second, cultural differences may exist that affect the physical activity of preschoolers. Third, the sample size of girls in this study was small and perhaps the difference would have been smaller with a larger sample size. Fourth, it is possible that since there was no statistical analysis to compare the two studies that differences in the scores were merely a normal variation among scores.

Even though the findings revealed a higher PA level for the children in this study, the average level of activity was still less than "slow-easy". It would be feasible to provide activities, interventions, and encouragement to increase the amount of MVPA of
preschool children during outdoor time. Second, girls were less active than boys in the study by Louie and Chan (2003), however they obtained higher step counts than girls in this study. The implication of this information is that a short teacher led warm-up may be an effective and simple way to narrow the gap between boys and girls PA levels while still providing children with ample time to choose their activities during play.

Few instruments to measure preschool physical activity exist (Burdette et al., 2004). Therefore, this study also contributes to the body of knowledge on instruments to measure the PA of preschool children. Pedometers have been used rarely in studies with preschool children and thus findings of this study revealing a high correlation between direct observation and pedometer counts scores (morning $r = .91$, $p < .01$, afternoon $r = .87$, $p < .01$) supports the use of the pedometer to measure the PA of preschool children. Furthermore, De Vries et al. (2006) reported that there was no information about the reproducibility of motion sensors (accelerometers or pedometers) with preschool children. Results of the t-test between pedometer counts on right and left hips finding no significant difference between pedometers on each hip suggests that pedometers show an adequate level of reproducibility with preschool children.

Limitations

Limitations from using a direct observational measure are that the time-sampling procedure is not able to represent exactly what happens in real-time. Observer bias may also represent a portion of experimental error and affect the results of data collected. To limit experimental error due to observer bias, observers were trained and high levels of IOA were maintained throughout data collection. Second, limitations from conducting
research in a real-life setting requires that the researcher must make some concessions to make the research work. For example, ideally 30-minute observations during the morning and afternoon time would have enabled perfect comparisons between data, however, in order to obtain a large enough sample of children playing during the morning outdoor time the observation time was adjusted to allow for observations to occur during the second half of the morning outdoor time. This is due to the fact that only 10 to 15 children come to the preschool by 8:25 a.m. to receive their pedometer inside the classroom before playing at outdoor time.

In this study more girls volunteered from the younger classroom and more boys volunteered from the older classroom. Therefore the girls were an average of three months younger than the boys. Due to this difference in age it is possible that the results of girls being less physically active than boys were due to physical maturation and not due to gender differences. However, the literature continues to show that girls tend to be less physically active than boys. Also, in a previous study by Louie and Chan (2003) no difference was found between the PA level of 4- and 5-year-olds.

Limitations that affect the generalizability of the results of this study are the lack of demographic information about the participants and the small sample size. Information about socioeconomic status, parent’s education level, or family PA routines were not obtained from the participants in this study. The addition of this information in future studies may provide more information that will increase the generalizability of the results. The participants from this study were 21 children from a University preschool and therefore may be from families with higher levels of education than the general population. Data was also collected from fewer girls (n = 9) than boys (n = 12).
Future Directions

In the OSRAC-P there are eight categories including categories to code the initiator of physical activity as well as physical activity prompts. Numerous times during data collection observers made notes in the comments section of the data collection form about interactions from preschool staff that either increased or decreased the level of physical activity. In future research a focus on prompts, modeling, and other interactions of adults that increase children’s PA could be very important.

Future research may extend into the home by exploring parents modeling of PA behaviors and incorporation of PA into the child’s daily routine. Within the focus groups children specifically drew their father participating with them in physical activity. No children drew their mother participating with them in physical activities. It would be interesting to explore children’s perceptions of the mother’s versus the father’s role in physical activity and the extent to which mothers’ and fathers’ modeling, cues, and behaviors influence the child’s PA behaviors. McKee et al (2005), Louie and Chan (2003), and this study provides evidence that pedometers are a valid measure of the physical activity of preschool children. All three of these studies also used direct observation as a tool to assess preschool children’s physical activity. Future studies may be able to obtain larger sample sizes and primarily use step counts to continue to assess the physical activity of preschool children.

Evidence from this study suggests that preschool children already have developed habits and they are also developing skills that may make them opt in or out of lifetime activities (NASPE, 2002). Preschool children’s physical activity habits and skills may be improved through effective physical activity interventions. Interventions established
within the preschool setting must have special considerations to assist in increasing girls’
physical activity levels paying special attention to contexts that girls’ enjoy that may
encourage increases in physical activity participation. Two other groups of children that
need special attention in research are African American girls and Mexican American
children because these populations have an even higher prevalence of obesity then the
general preschool population. Interventions incorporated into preschools may also assess
whether children’s physical activity is at an appropriate level by using pedometers as an
ongoing assessment tool in the curriculum.

Since children find it important to participate in activities that they perceive to be
“fun” it is important also to keep the fun in physical activity interventions. Tapping into
children’s creativity and imaginations to make physical activity fun and non-competitive
will be important for children’s continued enjoyment of physical activity as well as their
development in the cognitive and affective domains. Research that looks at the affect of
physical activity not only physically, but cognitively, and affectively could be important
to show the importance of including physical activity as a part of preschool curriculum.

If we can teach children at a young age good physical activity habits and increase the
physical activity of preschool children then we may be able to prevent obesity and the
diseases linked to obesity. As more research is conducted exploring the physical activity
of preschoolers, NASPE and other national and local organizations will have better
information to address the physical activity needs of preschool children and attack the
obesity epidemic from a preventative standpoint.
APPENDIX I

PICTURES OF THE PLAYGROUND
JUNGLE GYM CENTER

- Climbing apparatus in jungle gym
- Balance beams

PLAYHOUSE CENTER

- Playhouse center dramatic play toys
- Sensory table
- Cars and rug
- Markers art activity
Just north of the playhouse center is the blocks/manipulative toys table

Hoppi balls (right) and fixed playground

Reading area

Climbing wall and slide

Fixed playground (looking East)

Spinning seat (front) & swings (rear)
FIXED PLAYGROUND CENTER CONTINUED

Ramp on fixed playground equipment
Reading area (right) & blocks (left)

Rainbow-colored streamers around the corner from the bike path

SANDBOX CENTER

Looking East at the sandbox & grass

Sandbox toys
BIKE PATH CENTER

Just north of the playhouse center is the blocks/manipulative toys table

Hoppi balls (right) and fixed playground

Tricycle at the gas pump

Blocks next to the restroom

Looking toward bike path gas pump from blocks table at the restroom

Northeastern side of bike path. Large blue exercise ball and smaller ball.
BIKE PATH CENTER CONTINUED

Hopscotch at Eastern side of playground

Hoop and balls at Western side of bike path (looking Eastward to the sandbox)

GRASS CENTER

Looking West at the grass

Obstacle course
APPENDIX 2

DATA COLLECTION FORM AND CODING RULES
MODIFIED OSRAC-P OBSERVATION CODING FORM

Data code __________________________________________ Date of observation ____________________________

Start time __________________________ End time __________________________ Observer ____________________________

Right hip: Pedometer # ______ Total # of steps ______ Recorded by ____________________________

Left hip: Pedometer # ______ Total # of steps ______ Recorded by ____________________________

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COMMENTS.

The data collection form has been reduced in size to comply with margin requirements.

PA Level includes: 1 = stationary, 2 = limbs, 3 = slow-easy, 4 = moderate, 5 = fast

PA Type includes: Climb, crawl, dance, jump/skip, lie down, pull/push, rough & tumble, ride, rock, roll, run, sit/squat, stand, swim, swing, throw, walk, other, and can't tell

PA center includes: bike path, blocks, climbing, fixed playground, grass, music, physical education, playhouse, reading, sandbox, sensory table, other, and can't tell

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MODIFIED OSRAC-P CODING RULES

3 Categories of the Modified OSRAC-P
1. PA level: Info about PA intensity
2. PA type: Info about PA type
3. PA center: Info about PA context/environment

Momentary Time Sample
- 5-sec observation interval
  - Observe focal child
- 15-sec record interval
  - Record one code for each of the 3 categories
  - Reorient focus to the focal child

Auditory Cues
- “Observe one” (5-sec interval)
  - Observation begins at the beginning of the word “observe”
  - Observation ends at the beginning of the word “record”
- “Record one” (15-sec interval)
  - Record one code for each of the 3 categories
  - Reorient focus to the focal child

General Rules
1. 5-sec observation window
   - Start at beginning of the initial auditory cue
   - Until the end of the terminal auditory cue
2. Record the highest level of PA exhibited
   - All subsequent categories & codes should be recorded based on the info associated with the coded PA level
3. Locate yourself on the perimeter with a clear view that won’t interfere with play
4. After coding the 3 categories
   - Reorient to the focal child in preparation of next observation interval
5. Do not follow children into restrooms
   - Code the Can’t Tell category
   - Make note in the comments section
6. If you believe that you missed or miss-scored a code during an interval
   - Immediately record interval # in comments section
   - Consult with Dr. Watson or Jenelle about problems

Record Highest Level of Activity
- All other codes correspond with the highest level of activity recorded

Example
- Child runs, walks, and sits during a 5-sec interval
- Code 5 for PA level & “Run” for PA type

PA Level Category and Codes
- 5 levels of intensity based on:
  - Speed or vigorousness (slow/easy to fast)
  - Whether movement is assisted by others
  - Whether movement repeated within observational interval
  - If weight is being moved, held, or translocated
  - Multiple body parts typically intensity is higher
- Any movement classified as limbs, slow easy, or moderate can be “upgraded” to next intensity code if performed more vigorously or requires more effort (carrying heavy object or pushing a swing)
- Stationary activities (code 1) represent resting state
  - Extremely limited or confined movement
- Limb PA (code 2) involves non-vigorous arm, leg, and trunk movement
  - No translocation
    - Both feet have to move to another spot for walking to be coded
  - Can’t tell is coded only if you cannot see focal child or really cannot determine a code
- PA level defined by what child is doing during the 5-sec interval

**PA Level Category Coding Rules**

1. Activities such as riding & jumping (other than running) can be classified as slow-easy, moderate, or fast depending on:
   - Intensity (slow/easy, moderate, fast/vigorous)
   - How often the movement is repeated
   - Example
     - 1 jump = slow-easy movement (code 3)
     - 2 jumps in a row = moderate movement (code 4)
     - 3 or more jumps in a row = fast movement (code 5)

2. Swinging on swing on stomach
   - 3 is coded (slow-easy)- unless child is running or performing higher activity level

3. Two-step rule = If focal child takes one or two steps and does not translocate
   - Category 2-Limbs is coded

4. For movement to be considered 2-Limbs focal child needs to:
   - Bend a major joint or limb
     OR
   - Perform a movement involving 2 joints (NOT including wrist, ankle, fingers, and toes)
     OR
   - Reach for and perhaps grasp an object
     - For example, foot tapping does not count as limb movement, but bringing a cup up to the mouth for a drink is considered limb movement

5. The 90° angle rule:
   - The joint must be at or above 90 for it to be considered limb movement
   - Example:
     - Scratching one’s nose while the elbow is at sides = 1-Stationary
     - Scratching one’s nose with the elbow up and parallel to the ground = 2-Limbs

6. If the focal child is being supported by another object (wall, table) or limb (leaning on
arms), 2-Limbs should be coded

- 2-Limbs should be coded if the child would fall if the object were to be removed

7. Smaller movement at the elbow or knee should also be coded as 2-Limbs, when the movement is repetitive (occurs more than twice).

- If the child is stabilizing him/herself while squatting (feet flat, knees bent), 2-Limbs should be coded due to the shifting of the center of gravity

8. Multiple consecutive throwing actions during an interval coded in an increasing level

- If the focal child throws, catches, and kicks a ball during the observation interval

  • Activity level = 5 and activity type = throw because three throwing actions were performed consecutively

**PA Type Category and Codes**

- Represent what type of activity the focal child is performing at the highest physical activity level recorded

- They literally correspond to exactly what the child was doing during the most intense physical activity for the 5-sec observation interval

- If child is sitting on tricycle and not moving, code Sit/Squat for the PA Type

  • That is the exact behavior the child is engaged

  • Code Bike Path code for PA Center Category

- **PA type is different from PA activity context (center)**

  • PA type = child’s actual behavior

  • PA context (center) = the environmental circumstances associated with the child’s PA

1. A focal child may perform more than one PA type during observation interval

   • PA type must coincide with the activity level recorded for the observational interval

2. If the focal child performs two physical activity types that are within the same physical activity level:

   • Code the last physical activity type performed in the interval

   • Hanging or swinging from a bar = Climb Code

   • Swinging on an actual swing = Swing Code

   • Stomach on a swing and is running around pushing the swing

     • PA Level = 5-Fast

     • PA Type = Swing Code

3. Throw Code is an exceptional case

   • If child throws ball or similar object during the observation period, then the PA type should be coded as THROW

   • If child stands w/out translocating and throws a ball or object then the PA level is 2-Limbs

4. If child walks at a slow-easy pace and throws an object during the five-second-observation interval, the PA Level should be recorded as 3-Slow-Easy Movement, while the Physical Activity Type Code should be Throw.

5. If the child throws the object AFTER the five-second interval is over, the PA Level = 3-Slow-Easy, and the PA Type Code = Walk (If a higher level of activity occurs in the interval, code that)
• Throwing heavier objects will increase the activity level, i.e. throwing a basketball while standing still should be coded as 3-slow/easy and throw.

6. Ride is coded as an PA type only when:
   • Wheels of the riding object are in motion or
   • Child is attempting, with noticeable effort, to pedal or move the riding object
   • If the child is sitting on the bike with no effort to ride then PA type = sit/squat

7. Swing is coded as an activity type when:
   • Swing is in a swinging/pendulum motion
   • If the swing is moving as a function of a child climbing on to it or there is residual movement from a former bout of swinging, coding is based more on the actual activity of the focal child (sit, stand, etc.)

8. Pushing a swing is coded as pull/push for PA type, and fixed for outdoor context.
   • Determination of the activity level is based upon the weight/type of the swing, the number of children on the swing, and the type of movement done by the focal child to aid the push (walk/pivot, run, etc.)

9. Climb is coded as an activity type when the child is climbing OR hanging (depends on child’s weight distribution)
   • If child is grasping an object with an upper body limb(s) and is clearly bearing their weight on that limb(s), physical activity type should be coded as climb.
   • If child is holding onto a bar or rail but their weight remains in the lower body, the PA type should be coded as stand.
     • A “partial climb” (1 leg up and arms holding onto an object) should be coded as 2-limbs for PA level and stand for PA type.

10. Sit should be coded when the child’s knees are bent past 90 degrees.
   • If the child is bending his or her knees and leaning over, stand should be coded.
   • Both of these situations should be coded as 2-Limbs for the PA type since the child’s center of gravity has shifted and they are having to stabilize themselves

Minimizing Children’s Reactivity to Observers

• Maintain appropriate distance
• Avoid looking directly at the focal child immediately after recording
• Discretely reorient focus to focal child
• Do not interact with children/participants
REFERENCES


http://www.cdc.gov/nccdphp/dnpa/physical/recommendations/young.htm


http://www.cdc.gov/nchs/health_data_for_all_ages.htm


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