# THE RELATIONSHIP OF FUNDAMENTAL MOVEMENT SKILLS AND LEVEL OF PHYSICAL ACTIVITY IN SECOND GRADE CHILDREN

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Declines in physical activity (PA) and increases in obesity levels in children have prompted increasing interest in understanding children's PA behavior. The mastery of fundamental movement skills (FMS) is a potential correlate of the involvement of children's participation in PA as stated in the Surgeon General's Report (1996) and in the *Youth Physical Activity Promotion Model* (Welk 1999). This research study investigated the relationship between FMS and PA in second grade children. It is hypothesized that a positive moderate correlation exists between FMS and PA. Body mass index (BMI) was tested as a moderator of the relationship of FMS and PA. The study investigated the associations among total FMS, manipulative skills, locomotor skills, habitual PA, organized PA, sedentary behavior, and BMI for males and females. To assess FMS a process-oriented technique was used. Mann-Whitney and t-tests were used to test for gender differences and Spearman correlations, and Hierarchical Regression analyses were used to test relationships. Gender differences were observed for total FMS, manipulative skills, and step count, therefore further analyses were conducted separately for males and females. The strength of the relationship of FMS and PA in second grade children in this study was gender and skill specific. Habitual PA was positively correlated with total FMS and manipulative skills for males. No significant correlations were found for females. The organized PA was positively correlated with total FMS for males and females and locomotor skills for females. BMI was not a moderator of the correlations of habitual PA and FMS. These results expanded previous research conducted with product-oriented FMS assessments in elementary school children. Results of this study are important for PE teachers and parents. Physical education and physical activity intervention programs must target motor skill development, especially the manipulative skills, which appears to be needed for increasing children's PA behavior.

## TABLE OF CONTENTS


**PREFACE.......................................................................................................... IX**

**1.0 INTRODUCTION.......................................................................................... 1**

**1.1 FACTORS INFLUENCING PA BEHAVIOR OF CHILDREN ............................ 2**

**1.1.1 Behavioral and Environmental Factors ........................................................ 3**

**1.1.2 Psychosocial and Demographic Factors ........................................................ 6**

**1.1.3 Genetic, Physiological and Developmental Factors ...................................... 8**

**1.2 THE INTERACTION OF FACTORS AFFECTING PA IN CHILDREN ......... 10**

**1.3 PHYSICAL ACTIVITY ASSESSMENT ISSUES ............................................... 10**

**1.3.1 Measuring the construct Physical Activity in children................................ 11**

**1.3.2 Nature of children's physical activity.......................................................... 12**

**1.3.3 Pedometers...................................................................................................... 14**

**1.3.4 Proxy-questionnaire........................................................................................ 15**

**1.4 ASSESSMENT OF FUNDAMENTAL MOVEMENT SKILLS........................... 17**

**1.4.1 Test of Gross Motor Skills (TGMD-2) ........................................................ 18**

**1.5 FMS IN CHILDREN'S PA RESEARCH.............................................................. 21**

**1.6 RESEARCH QUESTIONS.................................................................................... 22**

**2.0 METHODS ........................................................................................................ 24**

**2.1 DESIGN.................................................................................................................. 24**

2.2 SAMPLE SELECTION .......... 24
2.3 DATA COLLECTION .......... 25
2.3.1 Step count (Habitual PA) .......... 26
2.3.1.1 Procedures .......... 26
2.3.2 Proxy-questionnaire (Organized PA) .......... 28
2.3.2.1 Procedures .......... 28
2.3.3 Test of Gross Motor Skills .......... 30
2.3.3.1 Equipment .......... 30
2.3.3.2 Examiners Competence .......... 30
2.3.3.3 Procedures .......... 31
2.3.4 Body Mass Index measurements .......... 33
2.3.4.1 Equipment .......... 33
2.3.4.2 Procedures .......... 34
2.4 DATA ANALYSIS .......... 34
3.0 RESULTS .......... 35
3.1 GENDER DIFFERENCES .......... 36
3.2 FMS AND PA CORRELATIONS .......... 37
3.3 BMI AS A MODERATOR OF THE RELATIONSHIP OF FMS AND PA .......... 39
4.0 DISCUSSION .......... 41
4.1 GENDER DIFFERENCES .......... 41
4.2 CORRELATIONS BETWEEN FMS AND PA .......... 43
4.2.1 Habitual PA and FMS .......... 44
4.2.2 Organized PA and FMS .......... 46

4.3 THE RELATIONSHIP OF TIME SPENT IN SEDENTARY ACTIVITIES AND BMI WITH PA AND FMS ..... 49

4.4 METHODOLOGICAL LIMITATIONS AND FUTURE RESEARCH ..... 51

4.5 FINAL CONSIDERATIONS ..... 53

BIBLIOGRAPHY ..... 55

APPENDIX A ..... 61

APPENDIX B ..... 64

APPENDIX C ..... 75

APPENDIX D ..... 85

## LIST OF TABLES


Table 1. Gender Differences in FMS and Habitual PA (average steps/hour)............................... 36

Table 2. Gender Differences in BMI, Organized PA, and Sedentary Activities ......................... 37

Table 3. Spearman Correlations Among PA, FMS, and BMI for males & females..................... 38

Table 4. Interaction term (total FMS x BMI) as a predictor of Habitual PA................................ 39

Table 5. Interaction term (Manipulative x BMI) as a predictor of Habitual PA .......................... 40

## LIST OF FIGURES

Figure 1. Description of activities for participation in organized PA by Males and Females...... 49

# PREFACE

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# 1.0 INTRODUCTION

The importance of encouraging physical activity (PA) behavior among children relies on the underlying assumption that the behavior will become part of the person's life and continue into adulthood. Concerns about the abrupt declines in PA among adolescents (Malina 2001; Trudeau, Laurencelle, & Shephard, 2004) have prompted increasing interest in understanding PA behavior. The Surgeon General's Report on Physical Activity and Health (U.S. Department of Health and Human Services, 1996) pointed out the major correlates of PA during childhood. One of the Surgeon General's (1996) 12 moderators of children's PA behavior to increase general knowledge and promote the recommended changes in the PA behavior is sport competence. The mastery of fundamental movement skills (FMS), which are prerequisite to sport competence, seems to be a potential correlate of the involvement of children in physical activity. If FMS performance is indeed related to PA levels, then it is important to develop FMS at an early age to promote PA.

The development of motor skills was also incorporated into the *Youth Physical Activity Promotion Model* (Welk, 1999). Motor skill ability was highlighted as an enabling factor that provides the skills needed for to youth in order to be physically active. Youth who are skilled are more likely to be successful in PA and seek opportunities to be active, whereas children with poor motor skills are less likely to achieve the same level of success and therefore participation in PA. The Youth Physical Activity Promotion Model offers a guideline for the implementation of PA programs for kindergarten, elementary, middle, and high school children. However, the factors incorporated in the model have not been fully investigated to account for developmental differences. Little is known about the correlation between motor skills and PA with elementary school aged children since the majority of the studies in this area have been done with older children and adolescents (McKenzie et al., 2002; Okely, Booth, & Patterson, 2001; Reed, Metzker, & Phillips, 2004; Wrotniak, Epstein, Dorn, Jones, & Kondilis, 2006). Furthermore, the existing research with elementary school children has used less comprehensive, non-validated instruments to assess PA and/or FMS (Beurden, Barnett, Zask, Dietrich, Brooks, & Beard, 2003; Graf et al., 2004). Therefore the purpose of this research is to investigate the relationship between FMS and PA using validated instruments.  The factors underlying children’s PA behavior and the assessment of children’s PA and FMS are discussed next.

## 1.1 FACTORS INFLUENCING PA BEHAVIOR OF CHILDREN

Potential determinants of PA in childhood were examined in two reviews (Kohl & Hobbs 1998; Sallis, Prochaska, & Taylor, 2000). Together they evaluated over 40 possible correlates of PA in children and examined over 110 research studies. Identifying the determinants of PA behavior in children is important in order to design effective intervention programs. The consistent correlates of PA in children were narrowed to a few, which are presented here with the classification proposed by Kohl and Hobbs. Significant associations were present on behavioral / environmental, psychosocial / demographic, and physiological / developmental variables.

### 1.1.1 Behavioral and Environmental Factors

A number of significant correlates of children's PA were found for the environmental and behavioral factors. Some of these environmental factors have been extensively studied allowing researchers to draw conclusions about the correlation between these variables and children's PA behavior. According to Kohl and Hobbs (1998) and Sallis et al. (2000), consistent behavioral and environmental predictors of PA that have been strongly supported by research are (1) time spent outdoors, (2) access to facilities and programs, (3) healthy diet and (4) previous PA. An additional variable that has been studied is the amount of time spent on sedentary activities, although the reviews do not support the association between time spent on sedentary pursuits and children's PA level.

The rationale underlying the concept that decreased opportunity for PA is correlated to sedentary pursuits is that sedentary behavior is thought to be a barrier for time spent outdoors. Studies on children's PA level have demonstrated that time spent outdoors is significantly higher for active children when compared to their inactive peers (Kohl & Hobbs, 1998). Since sedentary pursuits such as television viewing and video game playing reduce the opportunity to be outdoors, they also limit the opportunity for children to be active. Time spent outdoors has been demonstrated to be weak to moderately correlated to children's PA level for preschool to secondary school age children (Baranowski, Thompson, DuRant, & Baranowski, 1993; Burdette, Whitaker, & Daniels, 2004). Time spent outdoors is worthy of future evaluation because of its association with environmental factors such as seasonality and safety of surroundings.

Time spent outdoors and consequently PA levels may be influenced by the season (Kohl & Hobbs, 1998). Children's PA levels are highest in the summer and spring while they drop in the fall reaching the lowest level in the winter. However, seasonal variability in children's PA level is not always observed (Ridgers, Stratton, Clark, Fairclough, & Richardson, 2006). In the climate of northwest England, no differences were found in children's PA level during recess across seasons. Perhaps, PA level did not change because there was only a 9 degree Celsius variation in average temperature between summer and winter. Thus, the restriction in time spent outdoors appears to be dependent upon the intensity of the weather variability rather than the season.

Another reason restricting time spent outdoors is the lack of safety of surroundings. Lack of safety can reduce children's motivation to be outside or be actual barriers of time spent outdoors by parental control. Fox and Riddoch (2000) indicated that between 1971 and 1990 fewer children walked or cycled to school, and fewer parents gave their children permission to play outdoors on their own. Weir, Etelson and Brand (2006) demonstrated the influence of parent's perception of neighborhood safety and children's physical activity in the New York City area. Inner city children engaged in less physical activity than suburban children. The children's PA level was negatively associated with parental anxiety about neighborhood safety. Neighborhood safety may not entirely explain the discrepancy in activity level between inner city and suburban children; nevertheless, it is a crucial component to increasing opportunities for PA. Along with safety, access to facilities and programs is another major environmental determinant of children's PA level (Kohl & Hobbs, 1998; Sallis et al., 2000).

The access to recreational facilities in the neighborhood environment is positively associated with children's PA level. Higher numbers of neighborhood parks and recreational facilities are associated with greater PA levels in young children (Roemmich, Epstein, Raja, Yin, Robinson, & Winiewicz, 2006). A child's decision to play outside or stay at home depends, in part, on the available alternatives. Successful interventions demonstrated that increased children's PA level may be also reached by making recreational areas in and out of school more appealing to children through structural remodeling (Zask, Beurden, Barnett, Brooks, & Dietrich, 2001; Stratton & Mullan, 2005). Promotion of friendly PA areas must be reinforced at the preschool level to increase children's PA behavior at early age since previous PA is a correlate of children's PA behavior.

Previous PA is consistently related to current PA in children (Malina, 1996), providing indirect support for prospective studies that show a moderate level of tracking of PA over time (Telama & Yang, 2000; Trudeau et al., 2004; Telama, Yang, Viikari, Malimaki, Wanne, & Raitakari, 2005). Previous PA demonstrated to be a powerful correlate when previous participation was based on community sport teams; therefore, community activity program participation should be encouraged in children. The interaction among physiological, developmental and psychological variables may explain the association of PA with previous PA in children and adolescents. First, children who are more physically active at young ages tend to develop better fundamental movement patterns, which may build on more specialized sport skills. In addition, research reports that more active children and adolescents show increased fitness level and strength, which are also directly correlated to the amount of physical activity participation (Malina, 2001). It is not clear whether these correlations are causes or consequences. Regardless, these physiological variables appear to influence psychosocial determinants of physical activity such as self-efficacy and perceived physical competence. The psychosocial factors affecting children's PA level will be discussed next.

Time spent in sedentary pursuits such as watching TV or playing video games has been thought to be a determinant of children's PA level; however, comprehensive reviews have found no association between PA and time spent on sedentary pursuits (Kohl & Hobbs, 1998; Sallis et al., 2000). On the other hand, television viewing has been demonstrated to be a predictor of obesity in children (Dietz & Gortmaker, 1985). The association of sedentary activities with increased BMI raised some questions about how sedentary pursuits affect the energy balance. The increase in obesity reported with television viewing research may be related to a combination of factors such as increased opportunity for dietary intake (Craeynest, Crombez, Houwer, Deforche, Tanghe, & Bourdeaudhuij, 2005), decreased metabolic rates and opportunity for moderate to vigorous PA (Klesges, Shelton, & Klesges, 1993).

### 1.1.2 Psychosocial and Demographic Factors

Much of the work that examines the correlates of PA behavior has focused on psychological and social factors. Children and adolescent's PA behavior correlates to self-efficacy, perceived competence, and social support from parents (Heitzler, Martin, Duke, & Huhman, 2006; Hume, Salmon, & Ball, 2005; Sallis et al., 2000; Welk & Schaben, 2004).

Positive correlations of PA participation and self-efficacy have been observed for children and adolescents (Kohl & Hobbs, 1998) with stronger correlations during adolescence. The construct "self-efficacy" refers to the confidence of an individual to perform a task. There are two ways to explain the differences in the strength of the relationships. First, adolescents are more self-conscious than young children and are not as willing to engage in the trial and error process necessary to learn and develop sport skills. Second, while children are usually focused on the process of learning and on the fun component of games and sport activities, adolescents seem to be focused on the outcome. When the individual's major focus is the outcome, failing to successfully accomplish a task negatively reinforces the behavior.

A similar construct “perceived physical competence” is strongly associated with PA behavior in children (Sallis et al., 2000; Welk, Wood, & Morss, 2003; Welk & Schaben, 2004). Perceived competence differs from self-efficacy as it refers to an overall belief in one’s physical capabilities (Welk and Schaben, 2004). Welk et al. (2003) explains that perceived competence influences PA behavior because people seek out ways to display competence and hide incompetence. In that sense, the psychological determinant of perceived competence is for children as self-efficacy is for adolescents. The findings of self-efficacy and perceived competence studies demonstrate the need for developing gross motor skills at young ages. When opportunities for optimal motor skill development are available, most children are eager to experience different types of movement. Conducive environments for motor skill development can be both formal sport/activity practice and free playtime in enriched environments such as playgrounds and parks. Since, in general, most children in urban cities have limited outdoors play areas, parents or guardians must provide support for increasing children’s opportunity to be active and develop proper motor skills (Kohl & Hobbs, 1998). Different types of social support for children’s PA have been investigated for all those who may influence the child’s PA behavior.

Social support from significant others is one of the most studied psychosocial correlates of PA in children. The most significant individuals in a child’s life are the parents; thus they are the ones that are most likely to influence behavior during younger ages. Parents may influence children through modeling, by providing appropriate and supportive environments, or through an interaction of the two (Kohl & Hobbs, 1998; Sallis et al., 2000). Children of parents who are more physically active tend to be more active themselves (Moore, Lombardi, White, Oliveria, & Ellison, 1991; Hovell, Bohdan, & Sallis, 1996). Stronger associations are observed when parental support is defined as providing transportation and access to PA programs and facilities. While parents play a major role in influencing children's physical activity behavior, siblings and friends are more important influences for adolescents (Kohl & Hobbs, 1998).

Demographic variables have also been investigated as potential determinants of children's PA. SES and ethnicity, which are factors strongly correlated with adult's PA behavior, are not significantly related to children's PA levels (Kohl & Hobbs, 1998; Sallis et al., 2000). This data reinforces the need for research for all children. Research on biological factors may more clearly identify components that need to be included in intervention programs.

### 1.1.3 Genetic, Physiological and Developmental Factors

Understanding potential physiological and developmental determinants of physical activity behavior among children is of extreme importance for designing intervention programs. The strongest correlate of PA in children is gender, males demonstrating higher levels of PA than girls (Faucette, Sallis, McKenzie, Alcaraz, Kolody, & Nugent, 1995; Goran, Gower, Nagy, & Johnson, 1998; Hovell et al., 1996; Hovell, Sallis, Kolody, & McKenzie, 1999; Telama & Yang, 2000). Other physiological variables of interest are body mass index (BMI), and FMS; however, research studies have demonstrated less consistent results for these variables (Kohl & Hobbs, 1998; Sallis et al., 2000).

Research studies tracking PA from childhood to adolescence demonstrated that the expected negative association between age and PA levels is not observed within early childhood (Sallis et al., 2000). Declines of PA are noticeable during the transition from elementary to middle school or later. An interaction between age and gender is also apparent during this period of time.

Gender differences in PA participation have been demonstrated in 81% of the available literature suggesting that boys are nearly twice as active as girls in moderate to vigorous PA (Sallis et al., 2000). Quantitative gender differences in PA level are more evident after 10-years-of-age and these differences are accentuated through late childhood and adolescence. Sallis and colleagues (2000) estimated that depending upon the type of physical activity assessment used, there could be between 1.8 and 2.7% per year decline reported in physical activity among boys between 10- and 17-years-old. Estimated declines for girls were higher, ranging from 2.6 to 7.4% per year. This period is critical for children, especially girls, to be active and will most likely affect their PA behavior during adulthood. Decline in children's PA levels may be related to other biological factors such as BMI and FMS levels.

With increasing obesity levels in the US youth population, inclusion of BMI as a correlate of children's PA became imperative. Whether BMI can be considered a determinant of PA level during childhood is uncertain since contradictory results have been often demonstrated (Davies, Gregory, & White, 1995; Hovell et al., 1996; Sallis et al., 2000). In a review of correlates of PA in children, Sallis et al. (2000) reported that BMI appears to be unrelated to the children's PA level, as roughly half of 32 studies fail to demonstrate an association between BMI and physical activity during childhood. Perhaps, the nature of the relationship between BMI and PA is not that of a correlate but of a moderator variable. While BMI is not consistently related to PA, it is often related to FMS. Higher BMI values are associated with poorer body gross motor development (Graf et al., 2004; Wrotniak et al., 2006) and with lower performance on locomotor skills (Okely, Booth, & Chey, 2004).

## 1.2 THE INTERACTION OF FACTORS AFFECTING PA IN CHILDREN

It is likely that PA behavior is influenced by an interaction of variables rather than by a single factor acting alone. In accordance with this multi-factorial view, Welk (1999) proposed a model for the promotion of physical activity in youth. This ecological model suggests that multiple levels of environmental influence (social, cultural, physical) both directly and indirectly influence PA behavior at different intensities. The factors related to physical activity were classified as correlates that predispose, reinforce, or enable physical activity behavior. This research study was designed to evaluate the youth physical activity promotion model to determine its application by clarifying the strength of the relationship between the motor skill level and the PA behavior of second grade children. Motor skill performance is a developmental factor included within the enabling category in the model.

Results from research studies investigating the correlation of FMS and PA are inconclusive. Differences in research design, the type of FMS tests, and the methods of assessing PA have contributed to the equivocal findings. The varied aspects and limitations of FMS and PA assessment techniques are described in the following sections.

## 1.3 PHYSICAL ACTIVITY ASSESSMENT ISSUES

Four major issues in children’s PA measurement techniques are discussed. First, the measurement tools are limited in measuring the construct physical activity. Second, traditionally used measurement techniques have been developed for adult populations and later implemented with children. Understanding the unique aspects of children’s movement patterns is essential to selecting appropriate assessment techniques. Third, accuracy and consistency of measurements vary greatly depending on the age of the subjects and the type of measure. It is of utmost importance to select assessment tools that have been validated for the population being tested. It is not within the scope of this literature review to discuss all existing measurement techniques but only the ones that are pertinent to this research study.

### 1.3.1 Measuring the construct Physical Activity in children

No single instrument is sufficiently sensitive to detect all the parameters and dimensions of PA, therefore, numerous assessment tools were created to account for the different characteristics of the PA behavior. The broad definition of the construct physical activity makes it difficult to measure. PA is typically defined as “any bodily movement produced by the skeletal muscles that results in energy expenditure” p. 126 (Caspersen, Powell, & Christenson, 1985). Energy expenditure, therefore, reflects total physical activity. However, direct measures of energy expenditure, using the available techniques (Doubly Labeled Water and Indirect Calorimetry) are mainly used in laboratory studies as parameters of validation for less stringent instruments (Sirard & Pate 2001). A more practical definition of PA depends on how it is measured and scored.

The literature on Children’s PA has investigated levels of physical activity in terms of habitual PA (Shephard, 2002; Reed et al., 2004; Fisher et al., 2005) or organized and non-organized activities (Beurden et al., 2003; Burdette et al., 2004; Ridgers et al., 2006). Participation in organized PA can take place in sport practices, community PA programs, and physical education (PE) classes while non-organized PA participation is described as free playtime. Contemporary children’s PA assessment techniques such as motion sensors, observational techniques, and questionnaires are widely accepted as measures of habitual and organized PA. These instruments may report an estimation of energy expenditure or measures of frequency, intensity, and duration or exercise (Welk, Corbin, & Dale, 2000).

Each type of assessment technique carries certain strengths and weaknesses. Even the most accurate assessment technique, Double Labeled Water (DLW), has certain limitations. The main disadvantage of the DLW is that the total energy expenditure reported includes aspects other than physical activity such as resting metabolism and the thermo dynamic effect. Objective techniques, on the other hand, allow us to measure and estimate energy expenditure resultant from locomotor skills. Pedometers and accelerometers measure body movement and provide an estimate of PA usually measured by movement count. Motion sensors neglect the energy expenditure resultant from upper body movements. Questionnaires and diaries have the potential to assess total PA; however, they are limited by their smaller precision. These subjective techniques have been found to be most useful in the assessment of formal, discrete or routine units of activity such as sports and recreational activities (Fox & Riddoch, 2000).

### 1.3.2 Nature of children's physical activity

An added difficulty to measuring physical activity specifically for children is the nature of their activity. Rowland (1998) notes that the young of nearly all species are naturally active and present higher PA levels than those more mature. While adults stimulate the central nervous system by a variety of activities, infants and toddlers rely almost exclusively on movement. This suggests children have an innate biological necessity of being active for normal growth and development. Besides higher PA levels, children also differ from adults in their pattern of PA.

Children’s patterns of PA are described as intermittent vigorous PA rather than continuous PA patterns.

Insight into the nature of children’s PA habits has been provided by a research study using a coding system calibrated against indirect calorimetry (Bailey, Olson, Pepper, Porszaz, Barstow, & Cooper, 1995). While adults’ PA patterns are characterized by continuous periods of low to high intensity, children’s PA patterns are usually demonstrated by short, intermittent bouts of vigorous PA with frequent rest periods of longer duration. The tempo of children’s PA was demonstrated by recording the intensity of children’s PA every 3 seconds for a continuous 12-hours-period during free play or habitual activity in an ecological setting. It was also demonstrated that children do not remain inactive for extended periods of time, given that 95% of the time rest periods are shorter than 4 minutes 15 seconds.

The reasons for the sporadic patterns of children’s PA are both metabolic and biomechanical. At young ages, children are developing basic motor skill patterns, so their movements are less efficient and require greater energy expenditure (Gallahue & Ozmun, 2002). Also, biological differences in metabolism restrict children’s performance in vigorous PA for long periods of time. Prepubescent children have not yet fully developed the capacity for rapid glycogenolysis, therefore, the propensity for children to perform short, sprint type exercise of 5 to 10 seconds is understood (Brooks, Fahey, White, & Baldwin, 2000).These findings have led to recommendations for designing or adapting assessment tools that accurately detect trends of physical activity behavior in children (Welk et al., 2000).

Observational techniques, motion sensors, and questionnaires are examples of recommended pediatric assessment tools that accurately measure children’s PA (Welk et al., 2000), yet, not all these tools are accessible and practical. Observational techniques usually are extremely time consuming and costly, while the most advanced motion sensors (accelerometers) are still very expensive. Since time and cost is a constraint in non-funded research, more viable and less expensive instruments such as pedometers and proxy-questionnaires are used in this research study. The advantages, limitations, validity and reliability of the selected instrument are discussed next.

### 1.3.3 Pedometers

An alternative motion sensor device to measure PA in children is the pedometer. Pedometers have been validated against criterion standards and more precise direct measurement devices for assessing children's total PA. Estimated energy expenditure based on pedometer counts show high correlations to direct observation (Kilanowski, Consalvi, & Epstein, 1999), tri-axial accelerometers (Rowlands, Eston, & Ingledew, 1999), and oxygen consumption (Eston, Rowlands, & Ingledew, 1998). Correlations between estimates of energy expenditure with pedometer counts and measures based on tri-axial accelerometer assessment tools range from .85 to .88 (Rowlands et al., 1999). If the goal is to measure total physical activity levels, pedometers may offer the best solution for a low cost, valid, and reliable objective monitoring tool.

Pedometers provide an objective indicator of step counts, a marker of total volume of activity. Advances in technology increased accuracy of these electronic devices making them reliable and widely available instruments for PA assessment research. The accuracy among several pedometers has been assessed by counting steps in controlled laboratory experiments (Crouter, Schneider, Karabulut, & Basset, 2003; Schneider, Crouter, & Basset, 2004). The Yamax Digi-Walker SW-200 pedometer was among the most reliable and accurate instruments (Crouter et al., 2003). This model has been extensively used in validation studies (Kilanowski et al., 1999; Sirard & Pate, 2001) and was also used as a criterion for assessing other brands in ecological settings (Schneider et al., 2004).

It is important to follow the recommendations and understand the limitations of the instrument. The pedometer placement is of crucial importance as it was demonstrated that the same model shows higher correlations with direct observation and accelerometer measures if the pedometer was placed on the waist rather than ankles or wrist (Sirard & Pate, 2001). Furthermore, to reliably assess PA patterns in children, a minimum of 4 days of monitoring has been recommended (Janz, Witt, & Mahoney, 1995). Potential limitations with the use of pedometers include no applicability for measuring PA of upper body movements, risks of equipment failure, loss, and tampering. Utilization of any type of monitor may introduce participant bias. Participants may modify their behavior due to the constant reminder that their physical activity level is being assessed.

### 1.3.4 Proxy-questionnaire

Researchers have often used subjective measurement techniques, such as self-report and proxy questionnaires to estimate children and adolescent's PA level (Aaron, Kriska, Dearwater, Cauley, Metz, & LaPorte, 1995; Bender, Brownson, Elliott, & Haire-Joshu, 2005; Burdette et al., 2004; Manios, Kafatos, & Markakis, 1998; Murphy, Alpert, & Christman, 1988; Okely et al., 2001). The popularity of these measurement techniques is due to the low cost, easy administration, and the possibility of gathering a variety of behavioral information from the same instrument. However, the administration of self-report and proxy-questionnaires with children also present inherent problems such as recall bias (Sallis, 1991) and low reliability (Whiteman & Green, 1997).

Proxy-questionnaires rather than self-report must be used with young children. The utilization of self-report questionnaires must be avoided with children younger than 10 years because the children's sporadic PA pattern combined with their relatively low cognitive capacity reduce their ability to accurately recall intensity, frequency, and duration of physical activities (Sallis, 1991; Sirard & Pate, 2001). Relying on adults, parents or teachers, instead of children's responses can avoid recall errors.

Proxy-questionnaires must focus on objective facts (i.e. frequency of organized activities) rather than subjective behaviors (i.e. changes in intensity of PA). Several researchers agree that only the formal, discrete units of exercise or activity are likely to be assessed with proxy-questionnaires with any degree of reliability (Fox & Riddoch, 2000; Sirard & Pate, 2001). In fact, Whiteman and Green (1997) suggest that objective rather than subjective facts produce higher agreement between the criterion and proxy respondents. For objective information, respondent's agreement with the criterion ranged from .73 to .91 while correlations for subjective information ranged from .04 to .64. In addition, there is evidence that requiring proxy-respondents to provide objective information may also reduce an additional common source of respondent bias such as deliberate misrepresentation and social desirability (Murphy et al., 1988). For this study, a proxy-questionnaire was adapted from a self-report questionnaire with the intent to assess children's organized PA behavior.

Aaron et al. (1995) designed and validated the Past Year Physical Activity Questionnaire for adolescents. This self-report instrument has been successfully used to assess organized and leisure PA with adolescents (Koutedakis & Bouziotas, 2003; Christodoulos, Fouris, & Tokmakidis, 2006). Given that self-report questionnaires are not recommended for young children and to our knowledge there is no proxy-questionnaire investigating organized children's

PA, the Past Year Physical Activity Questionnaire has been modified as a proxy-questionnaire to assess organized children's PA behavior.

## 1.4 ASSESSMENT OF FUNDAMENTAL MOVEMENT SKILLS

A number of FMS tests have been used in previous research investigating the relationship between FMS and PA. The lack of validity and of a comprehensive approach to the FMS compromises most of the research studies. Furthermore, motor behavior specialists suggest that FMS should be evaluated with the use of process-oriented rather than product-oriented assessment techniques.

Non validated FMS tests have compromised the internal validity of some research studies (McKenzie et al., 2002; Reed, Metzker, Phillips, 2004). Other tests were valid but not representative of the entire gross motor skill development due to the use of limited number of movement skills (Fisher et al., 2005; Graf et al., 2004; Okely et al., 2004; Okely et al., 2001). The exception to the rule is the research study by Wrotniak et al. (2006). Wrotniak and colleagues assessed children's motor abilities with a valid and comprehensive test of balance, gross, and fine motor skills, the Bruininks-Oseretsky test of motor proficiency. The problem with this instrument is that it utilizes a product-oriented assessment technique.

Recent trends to assess movement skills have been using process-oriented measures. Product-oriented assessment techniques evaluate the outcome of the movement skills, while process-oriented assessment techniques evaluate the form of the movement skills. For example, when testing an overhand throw, product-oriented tests report the distance and/or accuracy of the throw, while the process-oriented tests report whether the form of the movement skill incorporates the item criteria observed in a mature pattern. Process-oriented assessments of FMS must be used rather than product-oriented assessments because they more accurately identify specific characteristics of the movement, reflecting the developmental skill level instead of physical growth and maturational levels of children.

FMS measurement instruments must also include a large number of representative movement skills in different subsets to account for the different aspects of gross motor skill development. Holistic FMS assessments incorporate locomotor, manipulative and stability skills. However, not all subsets are necessary for all age groups. A developmentally appropriate FMS test for children ages 6- to 10-years must include a combination of locomotor and manipulative skills (Gallahue & Ozmun, 2002). Stability skill testing, which measures balance skills, is not required because the onset of these skills occurs very early in development; thus, a ceiling effect may be observed with 6- to 10-years-old children.

To be meaningful, a test has to incorporate skills closely related to activities and sports in which children are most likely to participate. The locomotor and the manipulative skills are first mastered separately by the child and later gradually combined and enhanced in a variety of ways to become sport skills. The selection of an appropriate test requires clinical observation on the purpose of the assessment and children’s characteristics (Wiart & Darrah, 2001). For the purpose of this research study, the Test of Gross Motor Development (TGMD-2) was used as the test of gross motor skills for second grade children.

### 1.4.1 Test of Gross Motor Skills (TGMD-2)

The Test of Gross Motor Development (TGMD, 1985) is a valid and reliable process-oriented fundamental movement skill test that was recently revised (Ulrich, 2000). The purpose of the

TGMD-2 is to measure the gross motor development of children from 3 years, 0 months to 10 years, 11 months of age. Among the primary goals of the TGMD-2 is to serve as a measurement instrument in research involving gross motor development. The TGMD-2 provides normative data to the US population.

The test is composed of two subtests that measure gross motor skills of children. Twelve fundamental movement skills are grouped into two subtests: (a) locomotor subtest and (b) object control subtest. The locomotor subtest is intended to measure gross motor skills that require coordinated movements of the body as the child moves. The object control subtest is intended to measure children's general ability on manipulative skills. The six skills that comprise the locomotor subtest are: run, gallop, hop, leap, horizontal jump and slide. The six skills that comprise the object control subtest are: striking a stationary ball, stationary dribble, catch, kick, overhand throw and underhand roll. Each skill has a set of performance criteria and the child's performance is assessed using a 0 or 1 for each trial. All skills have 4 criteria except "leap", which has only 3, and "hop", which has 5 performance criteria. The item criteria for overhand throw are listed as an example: (1) windup is initiated with downward movement of hand/arm; (2) the child rotates hip and shoulder to a point where non-throwing side faces the wall; (3) weight is transferred by stepping with the foot opposite to the throwing hand; and (4) follow-through beyond ball release diagonally across the body.

TGMD-2 provides gender/age normative tables for children from 3- to 10-years-old (Ulrich, 2000). The standardization sample comprised of 1,208 individuals living in 10 states (California, Illinois, Indiana, Kansas, Maryland, Minnesota, Missouri, New York, Texas and Wisconsin). The data was collected during the fall of 1997, spring of 1998 and fall of 1998. The normative characteristics of the test include geographic area, gender and race, residence (urban or rural), educational level of parents, and lastly disability status. The normative scores used in the test are standard scores, percentiles and age equivalents.

Ulrich (2000) provides evidence for reliability, testing content sampling (internal consistency), time sampling (test-retest), and inter-scorer differences. The test manual reports Coefficient Alphas above .90 for selected groups (males, females, European American, African American, Hispanic American and Asian American), leading the test author to state that the TGMD-2 “is about equally reliable for all the subgroups investigated supporting the idea that the test contains little or no bias relative to those groups”.

Validity support is provided for content, internal and external structure, and generalization evidence (Ulrich, 2000). Content evidence of the TGMD-2 is addressed by examining the rationale underlying the selection of format and items. Three content experts judged whether the specific gross motor skills used in the test were representative of the gross motor skill domain. This can be said to be a more qualitative content analysis. To obtain a more quantitative analysis of the test content, the author used a conventional items analysis, more specifically item discrimination and items difficulty. Generalization evidence and internal structure evidence were analyzed by several methods such as age differentiation, group differentiation, and factor analysis. Based on the information provided above, it appears that the TGMD-2 is a valid measure of gross motor ability and examiners may use the test with relative confidence.

## 1.5 FMS IN CHILDREN'S PA RESEARCH

Motor development specialists often suggest that developing and refining fundamental movement skills by the end of primary school is necessary for children, adolescents and even adults to enjoy recreational activities (Gallahue & Cleland, 2003). Research studies have recently tested the hypothesis that children with better motor skills may be more likely to engage in PA than their peers with poorer motor skills (Beurden et al., 2003; Fisher et al., 2005; Graf et al., 2004; Okely et al., 2004; Okely et al., 2001; Reed et al., 2004; Wrotniak et al., 2006). For the most part, FMS and PA research has demonstrated weak to moderate positive associations (Fisher et al., 2005; Okely et al., 2004; Okely et al., 2001; Wrotniak et al., 2006), with some exceptions where no associations have been reported (McKenzie et al., 2002; Reed et al., 2004). With such inconsistency, two major questions cannot be fully answered. First, is there a relationship between FMS and children's PA behavior? Second, assuming a relationship exists, how strong is the correlation between PA and FMS? Several factors that may account for the variation in the research findings include biological factors such as gender, age, and BMI.

Kohl and Hobbs (1998) suggest that the greater PA level observed for males is related to differential development of motor skills and differences in body composition during growth and maturation. Their assumption is reasonable since gender differences in PA follow a similar timeline as gender differences in FMS. Studies of children's movement skills typically show no gender differences during early childhood; however, differences increase over time and are found for middle school age children (Goran et al., 1998; Heitzler et al., 2006). Due to the reported interactions between gender and age in the studies of PA and FMS in children, it is recommended that gender and age are controlled for in either the research design or in the statistical analysis.

Another biological factor that is consistently incorporated and accounted for in children's PA and FMS research is BMI (Davies et al., 1995; Hovell et al., 1996; Sallis et al., 2000). The observed correlations ($r = -.16$ to $.29$) of FMS and BMI (Graf et al., 2004; Okely et al., 2004; Wrotniak et al., 2006) raise a question about the nature of the relationship of BMI and FMS, and how an interaction between these two variables may affect the correlation between FMS and PA. The relationship between BMI, FMS, and PA needs to be evaluated further.

## 1.6 RESEARCH QUESTIONS

Overall, this research study expanded the body of literature by using previously validated measurement tools, where possible, to investigate the association between FMS and PA level in second grade children. This research study answered the following questions: Are there gender differences in fundamental movement skill performance of second grade children? Is fundamental movement skill performance a significant correlate of physical activity level in second grade children? If there is a significant association between FMS and PA levels, does BMI moderate the association between FMS and PA?

PA levels were examined in terms of habitual PA (step count) and organized PA (minutes of participation in organized PA). For the purpose of this study, the habitual PA was defined as average step count per hour. The organized PA variable was defined as PA participation in developmental sport activities and organized leisure activities led by an instructor, teacher, or coach. Organized physical activities are settings where children are active and have the most opportunities to enhance movement skills. Based on previous findings, the main hypothesis was that FMS and PA levels (habitual and organized) are positively correlated for male and female second grade children.

# 2.0 METHODS

## 2.1 DESIGN

This study employed a non-experimental, cross-sectional design to investigate the relationship between children's FMS and PA. The variables investigated in the study were total FMS, manipulative skills, locomotor skills, habitual PA, organized PA, BMI, and sedentary activity. An interaction term between FMS and BMI was included to investigate whether BMI moderates the association of FMS and habitual PA behavior.

## 2.2 SAMPLE SELECTION

The sample was selected from a population of 183 second-grade students from a public elementary public school in IL. All second grade children were given the opportunity to participate in the research study. Nevertheless, only data from children who were healthy and free from diagnosed orthopedic, neurologic, physical impairments or developmental conditions were included in the data analysis. Seventy-six children (42 males and 34 females) were initially included in the sample. The mean age was 7.8 years (SD=.6) for males, and 7.8 years (SD=.3) for females.

Parents were contacted through a letter sent by the school Principal explaining the research study and encouraging their participation (see appendix B). The participation of a child depended on active collaboration of one or both parents, who were asked to assist the child with pedometer use, to record pedometer daily step count, and to complete a PA proxy-questionnaire. The informed consent was obtained prior to the inclusion of the child in the study.

## 2.3 DATA COLLECTION

Data collection took place during the months of September and October, 2007. Children, whose parents had signed the informed consent, received a packet from their classroom teacher to take home. The packet included all the necessary instruments and information to collect and record PA data. Children were asked to wear the pedometer for six days. Parents were also provided with the researchers' contact information and encouraged to call in case of any questions or doubts about the pedometer/questionnaire's instructions, or malfunction and loss of the pedometer. The organized PA proxy-questionnaire was to be completed anytime during the week and returned with the pedometer's data. Children were instructed to return the pedometer, the PA diary and proxy-questionnaire to the classroom teacher on the next school day after finishing data collection. The FMS test and BMI measures were done during the physical education class time in the same week the pedometer measures were done. Children and parents who completed all phases of the study received two pedometers and a complete assessment of the child's FMS.

### 2.3.1 Step count (Habitual PA)

A YamaxDigi-Walker SW-200 pedometer was used to estimate the child weekly step count.

#### 2.3.1.1 Procedures

Classroom teachers gave a packet to the children whose parents had signed the informed consent and instructed them to give it to their parents. In the packet, parents were provided with an electronic pedometer, a diary booklet (6-day Physical Activity Diary), directions on how to wear the pedometer and record the data and the organized PA questionnaire (see appendix C).

Parents were instructed to have their child begin wearing the pedometer one day after they received the packet. Parents had detailed instructions on how and when their child should wear the pedometer, and how to record the data daily. The instructions and diary booklet were self-explain and had been previously tested in a pilot with 5 parents and children.

Step counts were measured for 6 consecutive days. Children were asked to wear the pedometers for 4 weekdays and 2 weekend days, meeting the recommendations of at least 4 days of activity measurement (Trost, Pate, Freedson, Sallis, & Taylor, 2000). Parents were instructed to encourage their child to wear the pedometer throughout the day, from waking to going to bed, except during showering, bathing, swimming or sleeping. They were also instructed in the positioning of the pedometer on their child (on the belt or waistband above the thigh midline of the dominant side) and to talk to their child about not tampering with the pedometer. During the motor skills testing sessions, researchers also reinforced the importance of not opening the lid of the pedometer.

Parents maintained a record of the time the pedometer was attached in the morning and removed at bedtime as well as the daily number of steps. The pedometer was reset every morning by the parents before it was attached to the child's waistline. Parents also recorded the time and reason if the pedometer had been removed during the day.

In the diary, parents were asked daily if that day had been a typical day in their child's life. If there was any situation that deviated from a regular day, they were asked to report that event. Researchers decided whether atypical days should be excluded from the analysis. The criteria for excluding days were as follow: traveling, illness, other reasons resulting in missing a school day (e.g. death in the family), and increased or decreased physical activity habits caused by events that were not part of the child's typical activities in or out of school (e.g. participation in a road race, not allowed outside due to extreme weather conditions or parental control). The pedometer and the diary booklet were returned to the classroom teacher on the next school day after measurements had been completed. Only subjects who reported useful data on at least 4 days including one weekend day were included in the analysis.

The outcome variable used in the data analysis was the estimated average step count per hour per week (see Equation 1). Calculating this variable required averaging the number of hours for the number of weekdays and weekend days. In the calculation, the daily total step count (total-SC) and daily total hours (total-hr) the pedometer had been worn were extracted from the PA diary. The total-SC in weekdays were added and then divided by the number of total hours the pedometer had been worn on those days. This calculation yielded an average step count (average-SC) for weekdays. Repeated procedures were done with the weekend data. In order to account for the difference in the number of days that the data had been recorded across children, the average-SC weekdays was multiplied by 5 and added to the daily average-SC weekends multiplied by 2 and then divided by 7. The product of this calculation was the estimated average step count per hour per week.

**Equation 1.** Habitual PA

$$\text{Aver step count per hour} = \left(\left(\frac{\Sigma\text{wkdays total-SC}}{\Sigma\text{wkdays total-hr}} \times 5\right) + \left(\frac{\Sigma\text{wkend days total-SC}}{\Sigma\text{wkend days total-hr}} \times 2\right)\right) / 7$$

### 2.3.2 Proxy-questionnaire (Organized PA)

A proxy-questionnaire was adapted from the "Past Year Physical Activity Questionnaire" (Aaron et al., 1995).

#### 2.3.2.1 Procedures

In the packet sent by the classroom teacher, parents received a proxy-questionnaire about their child's participation in organized PA during the previous year as well as instructions on how to complete and return it.

Parents were asked to indicate all the organized PA in which their child had participated in the past year. A list of activities was provided to facilitate recall. Blank spaces were also provided to allow recording of activities not listed. For the activities about which parents indicated the child's participation, detailed information was collected regarding the frequency and duration of participation in this activity over the past year. The frequency of activity was reported as days per week and the months of participation during the past twelve months. Duration was reported as the number of hours or fraction of an hour per day. The past year proxy-questionnaires yielded an estimate of the average number of minutes per week spent in each activity during the previous year (see Equation 2). The average minutes from all activities were summed to derive an overall average weekly-organized physical activity participation time over the past year.

**Equation 2.** Organized PA

Average minutes per week: (Months/year X 4.3 wk/month X days/wk X min/day) / 52.2 weeks

In addition a measure of inactivity was included in the questionnaire. Parents responded to questions that assessed their child's average participation in sedentary activities during weekdays and weekend days. The activities listed in the questionnaire are watching TV, playing video games or computer games, surfing the Internet, doing school-homework, and reading. Blank spaces are provided to allow recording of activities not listed. The outcome measures are also frequency and duration. The outcome variable, estimated weekly sedentary activity, is calculated by the formula:

**Equation 3.** Sedentary Activity

Estimated min of sedentary activity per week =

($\Sigma$sed act. minutes Weekday X 5) + ($\Sigma$sed act. minutes Weekend X 2)

Finally, parents were asked to provide demographic and health information. Parents were asked whether their child had any physical condition that prevented him/her from participating in physical activity for more than 30 days in the past year. If yes, parents had to specify the month in which the child was incapacitated from participation in physical activity. Parents also reported the ethnicity, gender, and date of birth of the child. The estimated fill in time for the proxy-questionnaire was about 10 minutes. The proxy-questionnaire was returned to the teacher in the packet with the pedometer and diary booklet once all the data had been collected.

### 2.3.3 Test of Gross Motor Skills

The TGMD-2 has been comprehensively investigated for reliability and validity (Ulrich, 2000). High reliability for content sampling and time sampling (coefficient alphas .91 and .96) reflects the high degree of homogeneity among items within the test and sub-tests, and the extent to which a child's performance is constant overtime. For content validity, a detailed discussion of the rationale that underlies the selection of items and the choice of test formats was provided, in addition to the results of conventional item analysis.

#### 2.3.3.1 Equipment

The equipment required for the test is specified in the TGMD-2 manual. The following equipment was used: an 8-inch playground ball, a 4-inch lightweight ball, a basketball, a tennis ball, an 8-inch soccer ball, a softball, a bean bag, traffic cones, a plastic bat, a batting tee, and masking tape. Testing also required two video cameras, tripods, mini DV tapes, and batteries for recording and later analysis of children's movements.

#### 2.3.3.2 Examiners Competence

A total of three testers and three camera operators participated in the data collection. Two of the examiners were already experienced with the TGMD-2 test, while the third person was trained prior to administering the test to the children. The camera operators were also trained prior to the testing sessions.

For the test administration, training testers were provided with a script (see appendix D) of the motor skills, information about equipment use and set-up, cues on what to focus when demonstrating the skills to the children, and information about appropriate feedback and encouragement given to the children during the skill performances. On the first day of testing, the floor was marked with masking tape to facilitate consistency of equipment set-up during the subsequent testing days.

Testers involved with the video recording were trained prior to participation in the test administration. The videographers used two digital Panasonic GS500 camcorders. They were provided with the script of directions for skill testing, camera set-up, operation, and placement for each skill. During the object control skills, the camera position remained the same throughout the entire test. During the locomotor skills, the camera position had to be changed once from a diagonal to a perpendicular position. Adjustments on zooming and angles were explained in detail for each skill.

**2.3.3.3 Procedures**

The testing followed standardized test procedures as provided in the test manual (Ulrich, 2000). Arrangements were made to accommodate the test in a safe environment for the children and to minimize administration time and distractions. Children were taken out of the physical education classes in the beginning of the class and returned to the gym after the testing session was over. All children finished the motor skill tests in one session. Four examiners were involved in the test administration in each of the testing session. Two stations were set-up such that one tester and one videographer were at each station, so that the locomotor and object control skill testing could be done simultaneously.

For each session, two to four children were scheduled to participate in the motor skill test. The children were equally divided between the locomotor and the object control skills sub-tests. Each sub-test skill set lasted approximately 10 minutes and they were conducted simultaneously. After both sub-tests were completed, children switched stations and initiated the other sub-test skill set. The total testing time ranged between 20 to 25 minutes. Variation in testing time was due to the number of children being tested and the children's behavior during the test.

Testers provided a verbal description and an accurate demonstration of each skill. They read directions to the subjects as stated in the script and followed-up by performing the skills emphasizing the criteria to be assessed. Children were allowed questions after the demonstration, and if necessary, the testers provided one additional demonstration. Feedback was given only in terms of power of movements rather than in the form of movements. Children were asked to perform skills with high speed and power, such as "run *fast* from one cone to the other" or "throw the ball *hard* at the wall". If the child jogged instead of running or weakly threw the ball at the wall, they were asked to repeat the trial with increasing speed or force. This occurred approximately 10% of the time during the motor skill tests. Qualitative feedback of the movements was not given to the child.

Two sub-tests of motor skills were tested and scored: The locomotor skills included running full speed for 50 feet, galloping for 25 feet, hopping on preferred foot for 15 feet, leaping over a beanbag, horizontal jump, and slide for 25 feet. The manipulative skills included striking a 4-inch lightweight ball off a tee, stationary dribble with a basketball, catching a 4-inch plastic ball, kicking a soccer ball, overhand throwing a tennis ball, and underhand rolling a softball. Each motor skill had a set of behavioral components, which represented mature patterns of the motor skills. These behaviors were presented as performance criteria and varied in number from three to five among the motor skills.

Raw scores were calculated by totaling the correctly performed criteria for two trials for the 6 locomotor and the 6 manipulative skills. Each of the two trials was scored independently in a coding sheet (see appendix D). The scorer marked either one point for correct and no point for incorrect performance of the behavioral component. Both the locomotor and object control skill sub-tests had a maximum score of 48 and a minimum of zero points. The sum of both sub-tests yielded the total gross motor skill raw score (total FMS). Raw scores of the TGMD-2 test were used in the data analysis. The use of raw scores is recommended for research purposes either to make group comparisons or to compute correlation coefficients (Ulrich, 2000).

The principal investigator scored the motor skills video recordings. The video recordings were uploaded into a Mac computer using the IMovie software. Once in the digital format, motor skill test performances could be viewed at regular speed, slow motion or frame-by-frame. The scoring process lasted approximately two months. The administration and scoring directions provided in the TGMD-2 manual were consistently followed. Examiner reliability was evaluated by a two-month test-retest using five randomly selected subjects from the final sample. The reliability test yielded a correlation coefficient of .91 attesting the high degree of consistency of scoring by the examiner.

### 2.3.4 Body Mass Index measurements

#### 2.3.4.1 Equipment

A digital TANITA scale was used to measure weight in kilograms. A stadiometer was used for measurements of height to the closest centimeter.

#### 2.3.4.2 Procedures

Height and weight measurements were taken and recorded by the same administrator of the TGMD-2 test, as soon as the skill test was over. BMI scores were calculated by the formula weight/height$^2$. This outcome variable was used as a continuous variable in the data analysis.

## 2.4 DATA ANALYSIS

The mean and SD for age were computed for both males and females. Data from all variables were examined for normality using the Shapiro-Wilk statistical test. Based on the test for normality, parametric and non-parametric analyzes were used. Independent t-tests were used to examine gender differences in the step count and the fundamental movement skill variables. Mann-Whitney tests were used to examine gender differences in the variables in which the assumption of normality was not met. Since gender differences were found, correlations were calculated separately for males and females. Spearman Rho correlations were computed to examine the relationships among step count, organized PA, sedentary activity, total FMS, locomotor skills, manipulative skills, and BMI. Hierarchical regression analysis was used to investigate whether the BMI accounts for a significant amount of variance in the association between FMS and children's PA.

# 3.0 RESULTS

This chapter is organized into three sections according to the research questions: gender differences, FMS and PA correlations, and the investigation of BMI as a moderator of the relationship between FMS and PA. In the first section, a description of whether gender is a factor in the performance of FMS and PA variables is presented. The correlation section depicts whether the fundamental movement skills are associated with the physical activity variables. Finally, hierarchical analysis demonstrates whether BMI is a moderator in the relationship between FMS and PA. The final pool of subjects is described before presenting the results for each research question.

Seventy-six children were initially included in the study and given pedometers to wear. Twenty-eight children were excluded from the final data set: twenty-one children and/or parents were not compliant with the study requirements and failed to complete and return the diary, the questionnaire, or both; three parents/children dropped out of the study a few days after starting data collection; two children completed the requirements but did not have four typical days of step count data, and two children were diagnosed with a disability. Therefore, forty-eight children (27 males, 21 females) were included in the sample. Gender groups were similar in age (males M = 7.6, SD = .3, females M = 7.8, SD = .4), race (males 90.5% Caucasian, females 85.2% Caucasian), and BMI (males M = 17.2, SD = 2.8, females M = 17.0, SD = 3.2).

## 3.1 GENDER DIFFERENCES

Significant gender differences were found for total FMS, manipulative skills, step count, and organized PA (see Tables 1 & 2). Independent t-tests found that males performed significantly better than females in the total FMS score, t (46) = 2.649, p = .01. The sub-test scores demonstrated that gender differences are observed only for manipulative skills, t (46) = 2.586, p = .01, but not for locomotor skills, t (46) = 1.522, p = .14.Gender differences were observed in the habitual PA measure. The weekly average number of steps per hour was significantly higher for males than for females, t (46) = 2.498, p = .02. Non-normal distributions were observed for BMI, organized PA, and sedentary activity. No gender differences were observed in the participation in organized PA (U = 198, p = .08) or in the time spent in sedentary activities (U = 270, p = .78).

**Table 1.Gender Differences in FMS and Habitual PA (average steps/hour)**

| Variables | Gender | N | Mean | SD | t-value | p-value |
|---|---|---|---|---|---|---|
| Total FMS | Males | 27 | 62.6 | 7.7 | 2.729 | .01 |
| | Females | 21 | 57.4 | 4.9 | | |
| Locomotor | Males | 27 | 30.9 | 3.6 | 1.522 | .14 |
| | Females | 21 | 29.2 | 3.7 | | |
| Manipulative | Males | 27 | 31.8 | 5.8 | 2.586 | .01 |
| | Females | 21 | 28.1 | 3.1 | | |
| Step Count | Males | 27 | 1104 | 340 | 2.498 | .02 |
| | Females | 21 | 882 | 254 | | |

**Table 2. Gender Differences in BMI, Organized PA, and Sedentary Activities (Mann-Whitney U)**

| Variables | Gender | N | Mean | SD | Median | Min/Max | U-value | p-value |
|---|---|---|---|---|---|---|---|---|
| BMI | Males | 27 | 17.2 | 2.8 | 16.1 | 13.9 / 23.7 | 270 | .78 |
| | Females | 21 | 17 | 3.2 | 16.4 | 12.5 / 26.2 | | |
| Organized PA (min/week) | Males | 27 | 92 | 72 | 75 | 0 / 320 | 198 | .08 |
| | Females | 21 | 171 | 149 | 160 | 0 / 590 | | |
| Sedentary Activity (min/week) | Males | 27 | 1321 | 596 | 1035 | 285 / 2155 | 224 | .22 |
| | Females | 21 | 1129 | 469 | 1215 | 540 / 2870 | | |

## 3.2 FMS AND PA CORRELATIONS

Since gender is a factor in the FMS performance of second graders, the associations among FMS and PA variables were analyzed by gender. The results of Spearman correlations among the PA variables (step count, organized PA, and sedentary activity), the motor skills variables (total FMS scores, manipulative, and locomotor), and BMI are included in Table 3.

For males, there were significant moderate associations between average step count per hour and total FMS scores ($r = .39$; $p = .02$), and manipulative skill scores ($r = .46$; $p = .01$). No associations were found for the average step count per hour and locomotor skill scores, or BMI. The same trend of results is observed for the association between organized PA and the motor skills variables. Participation in organized PA was also moderately associated with total FMS scores ($r = .38$; $p = .02$) and with manipulative skills ($r = .35$; $p = .04$). There were no significant associations between the participation in Organized PA and locomotor skills or BMI.

Average time spent in sedentary activities was not significantly correlated to the motor skill variables but was significantly correlated to BMI. The typically observed association between BMI and sedentary activity was replicated in this study and significant at the .05 level for males (r = .34; p = .04). In addition, the time spent in sedentary activities was correlated to habitual PA (r = -.41; p = .02).

Analysis of the associations of variables demonstrated fewer significant results for females. There were no significant results in the correlations between habitual PA and the motor skill variables. The participation in organized PA demonstrated significant moderate correlations to the locomotor skills (r = .56; p = .01), and to total FMS (r = 41, p = .03). None of the other associations were significant.

**Table 3. Spearman Correlations Among PA, FMS, and BMI for males & females**

| PA Variables | Gender | Total FMS | | Manipulative | | Locomotor | | BMI | |
|---|---|---|---|---|---|---|---|---|---|
| | | r | p | r | p | r | p | r | P |
| Step count | Males | .39 * | .02 | .46 ** | .01 | .12 | .28 | -.27 | .09 |
| | Females | .26 | .13 | .35 | .06 | .21 | .18 | .03 | .44 |
| Organized PA | Males | .38 * | .02 | .35 | .04 | .31 | .06 | .08 | .35 |
| | Females | .41* | .03 | -.11 | .33 | .56 ** | .01 | -.32 | .08 |
| Sedentary Act | Males | -.06 | .38 | .03 | .45 | -14 | .25 | .34* | .04 |
| | Females | -.01 | .49 | -.19 | .20 | .16 | .24 | .20 | .19 |

Note. * Significant correlation at p = .05 (1-tailed); ** Significant correlation at p = .01 (1-tailed)

### 3.3 BMI AS A MODERATOR OF THE RELATIONSHIP OF FMS AND PA

The third question in this research study examined whether BMI moderated the relationship between FMS and the habitual PA measure. This analysis was performed only for significant associations with habitual PA, in this case the total FMS and the manipulative skills for males. The Hierarchical Multiple Regression analyses conducted to investigate the effect of the interactions between BMI and the motor skills in the prediction of habitual PA demonstrated similar results.

The hierarchical regression analysis indicated that 25% of the variability in step count was predicted when the total FMS skills was included in the regression model (see Table 4). No significant additional portion of the variability in step count was predicted when the BMI and the interaction term were added to the model.

**Table 4. Interaction term (total FMS x BMI) as a predictor of Habitual PA**

| | $R^2$ | $\triangle R^2$ | $\triangle F$ | P |
|---|---|---|---|---|
| Step 1<br>Total FMS | .254 | ----- | 8.530 | .007 |
| Step 2<br>Total FMS, BMI | .325 | .070 | 2.500 | .127 |
| Step 3<br>Total FMS, BMI, total FMS x BMI | .326 | .001 | .037 | .850 |

The same results were observed for the second regression analysis calculated with BMI, the manipulative skills, and the interaction term as predictor variables (see Table 5). A significant portion of the variability in step count (28%) was explained by the manipulative skills in the first step. After the manipulative skills had been accounted for, no significant additional portion of the variability in step count was predicted when the BMI and the interaction term were added in steps 2 and 3.Therefore, given this data BMI is not a moderator in the correlations between habitual PA and total FMS, and between habitual PA and manipulative skills.

**Table 5. Interaction term (Manipulative x BMI) as a predictor of Habitual PA**

| | $R^2$ | $\triangle R^2$ | $\triangle F$ | p |
|---|---|---|---|---|
| Step 1<br>Manipulative | .275 | ---- | 9.464 | .005 |
| Step 2<br>Manipulative, BMI | .357 | .083 | 3.094 | .091 |
| Step 3<br>Manipulative, BMI, manip x BMI | .368 | .011 | .397 | .535 |

# 4.0 DISCUSSION

The main results of this study indicated that proficiency of fundamental movement skills is significantly associated with PA, although, the association is dependent upon gender and the type of motor skill. Tentative explanations for the observed associations of FMS and PA for males and females follow a brief discussion of gender differences. The two PA measures (habitual and organized PA) were analyzed separately since they measure different constructs of PA. Additional analysis of the sedentary activities and BMI are discussed further. Finally, major limitations of this research study and guidelines for future research are offered.

## 4.1 GENDER DIFFERENCES

Males demonstrated greater proficiency in the total FMS score than females. When dividing the scores into the two sub-tests, the gender difference was present only for the manipulative skills, with males outperforming females. The observed gender differences in FMS were not predicted for the age group tested in this study, yet they are not a surprise. Previous research has demonstrated the same trend of results with primary school children (Graf et al., 2004; Wrotniak et al., 2006) and adolescents (Okely et al., 2001). In a meta-analysis, French and Thomas (1985) found gender differences in product scores for throwing as early age three but not for any other manipulative or locomotor skill until adolescence. The data for throwing here appears to support their findings, since males outperformed females ($t$ (46) = 2.304, $p$ = .03). Although biological disposition cannot be completely ruled out, gender differences in the motor skill level of pre-pubescent children may be mostly attributed to social and environmental factors. A gender role stereotyping favoring boys over girls participation in physical activity and sport may be present very early in life (Gabbard, 2007). Also, it has been demonstrated that males receive stronger support than females from fathers and peers to begin and continue in sports (Hovell et al., 1996; Sallis et al., 2000). These potential interfering social factors may influence not only the motor skill development but also the physical activity behavior of children.

Males demonstrated a significantly higher habitual PA level than females. This result is in agreement with two review articles that report gender as a consistent predictor of PA in children and adults (Kohl & Hobbs, 1998; Sallis et al., 2000). Sallis reported that 81% of the research studies included in the review of children's PA correlates, boys were significantly more active than girls. These results contradict the results of children's participation in organized PA in this study.

Gender is not a factor of the time spent in the participation of organized PA. In the present study, the advantage of males in the PA levels is not observed when PA is measured by participation in organized physical activities. The similarity in organized PA participation may be explained by the choice of activities by males and females. The percentage of participation in organized PA within groups was high for both males and females, with 96.3% and 89.5% of the subjects reporting participation in at least one organized PA in the previous year. However, males' choice of activities included typically seasonal activities (e.g. basketball, baseball, football, soccer) while females chose to participate in year-round physical activities more often (e.g. gymnastics, swimming, cheerleading, dance). Males tried out more activities than females, but females persisted longer in the chosen activities. On average, boys participated in 2.8 activities during the previous year with an average of 2.6 months of participation in each activity, while girls participated in fewer activities (2.2) but for a longer duration (4.4 months of participation per activity). This explains the similarity between groups in the average minutes per week spent in organized PA during the previous year. Whether the choice of activities represents availability of PA programs for males and females, parental choice, or children's choice is unknown and requires further investigation.

## 4.2 CORRELATIONS BETWEEN FMS AND PA

The principal question investigated in this research study examined the association between fundamental movement skills and physical activity in second grade children. It is crucial to understand the practical difference of the two PA measures used in the study. Habitual PA typically refers to the overall movement (time or distance) measured by pedometer or accelerometer counts. On the other hand, organized PA usually refers to the participation in physical activities that are reasonably structured in which there is a pre-determined schedule and instruction. The two measures of PA, therefore, assess two different constructs, and have mainly been used independently in previous research (Beurden et al., 2003; Fisher et al., 2005; Graf et al., 2004; McKenzie et al., 2002; Okely et al., 2001; Reed et al., 2004; Wrotniak et al., 2006). The present research, to our knowledge, was the first to incorporate both measures in the same study. It demonstrates that habitual PA measured by step count does not correlate to the time spent in the participation of organized PA for males ($r = .12$; $p = .55$) and females ($r = .07$; $p =$

.77). That is, children who spend more time participating in organized activities are not necessarily more active when assessing the physical activity of the child during the entire day. The correlations of the two PA constructs with the FMS variables are discussed separately.

### 4.2.1 Habitual PA and FMS

Gender is a factor in the relationship of FMS and habitual PA. There were significant correlations between habitual PA and FMS for males but not for females. It seems that for second grade females the proficiency of the FMS does not influence the level of activity (step count), nor does the level of habitual PA influence the development of FMS. For second grade males, on the other hand, these two variables are closely related. Discussion of the habitual PA and FMS for males follows.

The association between total FMS and the habitual PA (step count) is moderately positive for males. That is, boys with a higher total FMS score had a higher weekly average step count per hour. These results parallel previous research measuring habitual PA with accelerometers (Fisher et al., 2005; Wrotniak et al., 2006) and pedometers (Reed et al., 2004). The present findings, however, show slightly stronger correlations between habitual PA and motor skills ($r = .39$ to $.46$) in comparison to previous research findings that reported correlation coefficients between .18 and .35 (Reed et al., 2004; Fisher et al., 2005; Wrotniak et al., 2006). The difference may be due to the use of a more sensitive motor skill assessment instrument. The aforementioned studies have used product-oriented assessments to examine the relationship of physical activity to fundamental movement skills among children and adolescents. This study applied a process-oriented motor skill assessment, which increased the potential for accurately detecting qualitative aspects or components of motor skills. The greater accuracy in the motor skill assessment may have resulted in higher correlation coefficients.

The observed correlation between FMS and habitual PA in males reflects greater proficiency of the manipulative skills. Step count was significantly correlated to the proficiency in manipulative skills but not the proficiency of locomotor skills. The stronger association of manipulative skills may be a result of the greater variability in scores (SD = 5.8) compared with the variability in scores of the locomotor skills (SD = 3.1). Typically, children demonstrate an earlier onset of acquisition and mastery of locomotor skills than manipulative skills (Gallahue & Ozmun 2002). It may be the case that second grade children are more advanced in the acquisition of locomotor skills, demonstrating a more homogeneous performance level within the group, while a greater range of performance level (from immature to near mature patterns) is observed for manipulative skills. For this reason, the use of manipulative skills may be more appropriate to discriminate motor skill proficiency and its correlation to physical activity in primary school aged children.

The correlation of manipulative skill to habitual PA supports the Youth Physical Activity Promotion Model. Proficiency in manipulative skills may both directly and indirectly increase the willingness of participation in PA. Excellence on fundamental movement skills enables children's participation in PA and may increase their perceived competence in games and sport activities. The foundation for this notion is provided by numerous research studies linking motor skills to perceived competence in physical activities, self-efficacy, and physical activity participation (Cliff, Wilson, Okely, Midkle, & Steele, 2007; Raudsepp & Liblik, 2002; Rudisill, Mahar, & Meaney, 1993; Skinner & Piek, 2001). Because children usually value what they are good at doing and pursue things they value, we would expect strong links between the two dimensions. Future investigations are needed to understand the extent to which actual competence and perceived competence in motor skills affect the PA level of second grade children.

Wrotniak and colleagues (2006) suggested that there might be a threshold in the motor skill development that results in higher physical activity levels for children. They observed that children in the greatest quartile of motor proficiency were significantly more physically active than children in the lowest quartile of motor proficiency. Our findings partially support the notion of an existing threshold at which children may be most physically active; however, this threshold is specific to the development of manipulative skills. In this research study, female's manipulative skill proficiency level and habitual PA level are significantly lower than those of males. Although, little is known about the modifiable factors affecting children's PA behavior, this data provides insight into a potential threshold in the manipulative skill development as a determinant of PA. The reason males reach the development threshold more quickly than females may be due to increased participation in organized PA that are predominantly characterized by object control skills.

### 4.2.2 Organized PA and FMS

Typically, a positive relationship would be expected between the FMS and the participation in organized PA since these activities in general promote the development of motor skills. The expectation was partially met for both male and female second grade children; however, the nature of the relationship varies considerably by gender. For males, the results yield significant positive associations of organized PA with total FMS and with manipulative skills. Results for females demonstrated significant associations of organized PA with total FMS and with locomotor skills.

For males, the nature of the associations between organized PA and FMS was similar to the associations between habitual PA and FMS. Again, the organized PA associations with the total FMS and manipulative skills were stronger than the association with locomotor skills. Okely et al. (2001) proposed that a positive relationship between FMS and PA should be expected. They suggested that movement skills and physical activity, particularly organized PA, might be reciprocal determinants. That is, having high fundamental movement skill level may increase options for participation in PA, as well as increased participation could lead to further development of motor skills. Our results partially support this statement as we see increased participation of males in manipulative skill based organized activities and increased participation of females in locomotor skill based organized activities. However, the idea of reciprocal determinants with young children must be further investigated, as it may be more suitable for older children and adolescents. During the first years of primary school age, children are still very similar in the level of skill development and may therefore select their participation in organized PA by levels of enjoyment, or peer and parental influence. The present correlation results reinforce how critical it is that adequate time and resources be devoted to skill development by participating in organized PA, especially during kindergarten and early elementary school years, when a window of opportunity exists to maximize learning new skills (Gabbard, 2007).

For females, the significant correlations between participation in organized PA and motor skills are in agreement with previous findings of Okely et al. (2001) who found a statistically significant relationship between time spent in organized physical activity and locomotor skills in adolescent females. Collectively, results from these two studies suggest that this association may be long lasting. Increased locomotor skills in elementary school years may result in continued participation in organized PA and higher overall motor skill proficiency levels later in adolescence. In addition, the absence of a correlation between habitual PA and total FMS, locomotor, or manipulative skills suggests that opportunities for females to develop motor skills are more strongly dependent on participation in organized PA.

The findings of positive relationships with organized PA were anticipated considering that skills incorporated in the sub-tests were seen in most of the preferred organized PA reported by the proxy-respondents. The nature of the relationships for both males and females appears to be related to the type of organized PA in which children participate (see Figure 2). While males devoted 59% of the time in organized PA participation to activities that are characterized by manipulation of objects (eg. Baseball, basketball, field hockey, football, volleyball, soccer, and tennis), females spent only 11% of their time participating in these activities. Popular organized activities among females were swimming (55%), gymnastics, dance, cheerleading, martial arts, and ice-skating (combined 30%). For all these activities, moving and controlling the body in space is the main objective; thus, there is great potential for the development of locomotor skills. Perhaps because of the child or parent's choice, or the lack of available gender specific sport programs, females do not typically participate in object control activities, which are the activities that would allow them to develop higher manipulative skill levels. The same is true for the locomotor skill based activity participation for males. Overall, it seems that the development of FMS is directly related to the choice of participation in physical activities for males and females.

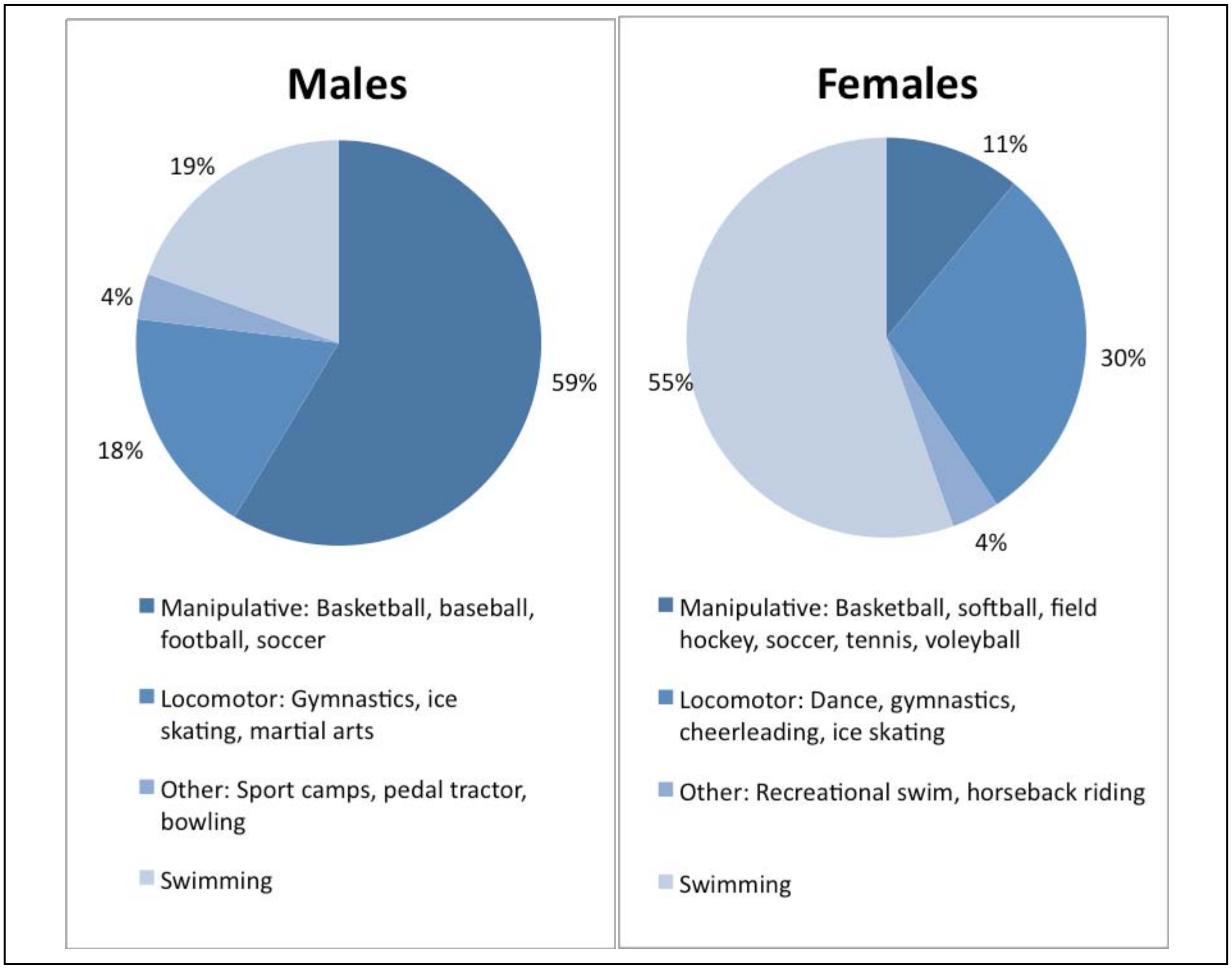


**Figure 1.Description of activities for participation in organized PA by Males and Females**

## 4.3 THE RELATIONSHIP OF TIME SPENT IN SEDENTARY ACTIVITIES AND BMI WITH PA AND FMS

The relationships of PA and FMS have also been investigated in parallel with participation in sedentary activities and BMI. The participation in sedentary activities was negatively associated with habitual PA and positively associated with BMI for males. Previous children's research has demonstrated this association, in particular for the time spent watching TV (Sallis et al., 2000; Zask et al., 2001). TV viewing is believed to be a barrier to time spent outdoors, which is significantly associated with PA level in children (Kohl & Hobbs 1998). Higher levels of TV viewing may also increase potential for food intake influencing BMI levels. None of the other associations with time spent in sedentary activities were significant for males and females.

No significant correlations were found for BMI and PA or the FMS variables. These results contradict previous findings that have reported negative associations between childhood obesity and physical activity, as well as childhood obesity and motor proficiency. Significant associations of BMI and FMS had been demonstrated for first (Graf et al., 2004) and fourth graders (Okely et al., 2004). In addition it has been demonstrated that 8- to 10-years-old children with greater BMI levels participated less in moderate and vigorous PA and had poorer motor proficiency (Wrotniak et al., 2006). Base on this evidence, it was expected that significant correlations would be found. Perhaps, a larger number of subjects would allow for stronger correlations. Additional research is required to clarify these findings.

An exploratory investigation examined whether different levels of BMI moderated the relationship between habitual PA and FMS. Hierarchical analyses were calculated only if an association between habitual PA and the motor skill variables were found. Interaction factors were calculated between BMI and the motor skills to determine whether BMI moderated the significant correlations observed for males. The results indicated that BMI does not contribute significantly to the prediction of PA after accounting for the FMS and the manipulative skills. Thus, the relationship between the motor skills and habitual PA in second grade males is unrelated to the child BMI status.

Overall, results regarding the correlations of FMS, BMI, and PA variables demonstrate that FMS may be a significant variable to be included in children's PA intervention programs or future analysis of children's PA. Caution should be taken when discussing the findings due to some research limitations. The limitations of this research study and the directions for future research were discussed in the next session.

## 4.4 METHODOLOGICAL LIMITATIONS AND FUTURE RESEARCH

There are methodological limitations to consider regarding this research design, the instrumentation, and the sample size. First, there is a limitation with the research design because of the cross-sectional and correlational nature of the study no statements can be made about causality regarding physical activity and fundamental movement skills. Second, regarding instrumentation, the pedometer is a widely used and validated tool to measure physical activity but does not assess intensity of physical activity. The use of tri-axial accelerometers could provide a more precise measure of physical activity with variations of intensity and duration of exercise. In addition, even though proxy-questionnaires are reliable organized PA assessment instruments to be used with elementary school children, the use of proxy-respondents (parents or guardians) is susceptible to recall and social desirability. Third, limitations with the sample size may compromise the power of analyses and the generalizability of the results. The power of the statistical tests was affected by the low sample size. A significant reduction in the number of subjects was caused by the low compliance of children and parents with the pedometer use and data recording. Besides, the sample included primarily white children in a small town located in a rural area in IL. Research is needed on more diverse populations to establish the generalizability of the findings.

To date, few studies have been conducted to measure the association of FMS with PA in primary school aged children. To better clarify the topic, research efforts must be extended. Some guidelines for future research follow.

Large population studies are needed to expand the present findings by investigating the relationship between physical activity and motor skills using process-oriented assessments. Larger empirical studies have previously investigated the motor skills with product-oriented assessment techniques, possibly masking the strength of the relationship between physical activity and movement skills to some extent.

Longitudinal and intervention research studies would provide information on the nature of the relationships of the multiple factors that influence PA in youth. This research study in combination with previous research provides support for the relationship between fundamental movement skills and children's physical activity. This information reinforces the claim that improvement in motor skills through interventions may directly and indirectly influence physical activity behavior in youth (Welk, 1999). As an enabling factor, higher motor skill proficiency may result in greater success in physical activities and consequently leading the child to seek out more opportunities to be active.

The development of FMS may indirectly affect PA behavior by influencing the child's perception of competence. This is important since perceived competence is among the 12 moderators of physical activity in youth listed in the Surgeon General's Report of 1996. With respect to competence, evidence shows that children's perceptions may be more important than actual ability in the prediction of PA behavior (Welk, 1999). On the other hand, perceived competence is also intrinsically related to the actual competence (Rudisill et al., 1993; Skinner & Piek 2001; Raudsepp & Liblik 2002). Additional research is necessary for making gender and age specific delineations.

### 4.5 FINAL CONSIDERATIONS

Overall, the strength of the relationship of FMS and PA in second grade children in this study was gender and skill specific. These associations were also slightly higher than those reported in previous studies when a process-oriented gross motor skill assessment was used. It is also demonstrated that the type of organized PA in which children participate is correlated to the level and the type of motor skill development in second grade children. Furthermore, habitual PA was only related to the manipulative skills in males. Higher levels of manipulative skill proficiency of males combined with increased habitual PA suggests there may be a threshold of manipulative motor proficiency above which children may be most physically active. Perhaps, males have higher manipulative skill scores and reach the development threshold more quickly due to their increased participation in organized PA that are predominantly characterized by object control skills.

These finding are of extreme importance to physical education teachers, PA intervention program coordinators, and parents. The physical education classes are one of the most conducive environments to the development of motor skills. If manipulative skills are in fact a determinant of habitual PA, it is necessary that physical educators reinforce learning of object control skills in the PE curriculum of primary school children. Community based physical activity programs should also incorporate the development of the manipulative skills as one of the components seeking out for increased PA levels. Parents must be aware of the potential gender role stereotype in childhood sport activities. Females should participate more in object control based sport activities. Young children of both gender need exposure to physical activity programs and sports that incorporate the entire range of motor skills.

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# APPENDIX A

## RECRUITMENT LETTER

[redacted] **ELEMENTARY SCHOOL**

[redacted]

DATE
Dear Parents:

Joining us from the University of Pittsburgh, School of Education is Oldemar Mazzardo, a PhD candidate in the Department of Health and Physical Activity. Mr. Mazzardo, a certified physical education teacher with a Masters Degree in motor development, is interested in studying the promotion of physical activity participation in second grade children. His study titled “The Relationship Between Fundamental Movement Skills and Level of Physical Activity in Second Grade Children” has been approved by [redacted] (school Superintendent) and myself. There are no costs for participating in this study. Participation in this research study is voluntary. Mr. Mazzardo has prepared the information below and is available to answer any questions.

Please feel free to discuss the following information with your daughter or son.

**WHAT IS THE PURPOSE OF THIS STUDY?**

The purpose of Mr. Mazzardo’s research is to examine if there is a relationship between fundamental movement skills and physical activity participation. This research study will test the Fundamental Movement Skills and the Physical Activity levels of your child.

- Fundamental Movement Skills are motor skills common to daily living. Children will be asked to participate in a movement test during the physical education class which includes the following skills: run, gallop, hop, leap, horizontal jump, slide, striking a ball, dribbling a basketball, catch, kick, overhand throw, and underhand roll.
- Habitual Physical Activity will be measured by pedometer counts and parental questionnaire. The pedometer is a small gadget that counts the number of steps your child takes in a day. Each participating child will be asked to wear the pedometer for 6 consecutive days.The participating parent will record the number of steps every night before bedtime.
- Organized Physical Activity will be measured by a parental questionnaire that asks about children’s organized physical activity participation in the past year. Height, weight, and playtime habits will also be recorded.

**We DO NOT want your child to modify his/her daily activities.**

If you and your child complete all aspects of the study, each of you will receive a pedometer (2 per household). This will be useful in monitoring your level of daily physical activity. Another benefit of participating in this research study is receiving an individualized physical activity and motor development evaluation for your child.

If you are interested in participating in this study, please read the consent form, initial all pages and sign the last page of the consent form.

Sincerely,

PRINCIPAL’S NAME
Director, [redacted] Elementary School

## Contact Information


| | |
|---|---|
| Principal Investigator | Oldemar Mazzardo<br>412 708-2320<br>mazzardojr@gmail.com |
| Co-Investigator | Fabio Fontana, PhD<br>217 218-1334<br>fefontana@eiu.edu |

# APPENDIX B

## PHYSICAL ACTIVITY ASSESSMENT DOCUMENTS

All documents sent home with the children in the parent's packet are listed and included:

- Cover letter
- Instructions for using the pedometer
- Organized PA proxy-questionnaire
- Diary booklet

Dear Parent,

Thank you for participating in the “physical activity study”.

Included in this packet you will find 4 items:

1. The pedometer,
2. The directions for the pedometer’s use,
3. The 6-day Physical Activity Diary,
4. The Past Year Organized Physical Activity Parental Questionnaire.

First, read the pedometer explanation sheet and ask your child to start wearing the pedometer preferably tomorrow (Tuesday, October 2nd).

If for any reason, your child is not able to start wearing the pedometer on Tuesday, your child may start on Wednesday, October 3rd or Thursday, October 4th. REMEMBER, the pedometer must be worn for 6 consecutive days, including 4 weekdays and 2 weekend days.

Second, complete the “6-day physical activity diary” every night before bedtime.

Third, answer the “Past Year Organized Physical Activity Parental Questionnaire” at a convenient time,

Last, after all procedures have been completed, return all items in the envelope (including the pedometer) to your child’s teacher on the next school day.

You will receive the two pedometers and the complete assessment of your child’s movement skill after all procedures have been completed and returned to the school.

Feel free to contact us at 217 218-1334.

We greatly appreciate your help,

Oldemar Mazzardo and Fabio Fontana

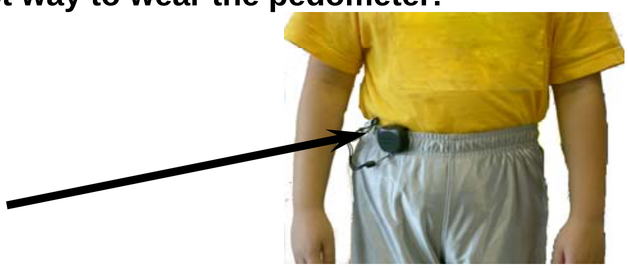
Research Investigators

# DIRECTIONS FOR USING THE PEDOMETER

**What is a pedometer?**
A pedometer is a gadget that counts the number of steps taken in a day. We are asking your child to wear this monitor every day from getting up in the morning until bedtime in the evening.

**How does your child use the pedometer?**
Every morning when your child gets up, push the **yellow** reset button and make sure that the pedometer reads zero - “0”. **PLEASE ASK YOUR CHILD NOT TO OPEN OR TOUCH THE YELLOWBUTTON ON THE PEDOMETER.** After pushing the yellow reset button the information cannot be recovered.
Clip the pedometer on your child’s dominant hip (right hip if your child is right handed, left hip if your child is left handed). The pedometer should slide down over the child’s belt, or waistband of your child’s pants, shorts, or skirt. In it’s correct position, you should be able to read the words “Accusplit Eagle” in an upright position on the front cover. Ask the child to keep the cover closed at all times while wearing it. The pedometer will not work if the cover is open.
Make sure that the pedometer is worn SNUG against your child’s body and that it does NOT move around.
**See picture below for the correct way to wear the pedometer:**

**PEDOMETER**



DO NOT place the pedometer sideways. DO NOT clip the pedometer to a belt loop. The pedometer will only work if it is in it’s correct position.

Your child should wear the pedometer all day, except when bathing, showering, swimming, or during any activity that will cause the pedometer to get wet. **THE PEDOMETER WILL NOT WORK IF IT GETS WET!**

Take the pedometer off at night just before your child goes to bed and write down the number of steps on the diary booklet. If you experience malfunction or any other problems with the pedometer, contact the primary investigator ASAP for a replacement.

DO NOT estimate your child’s daily step count. If for any reason, you cannot record the information for a day, skip that day and keep recording the step count on the following days accordingly.

Please encourage your child to keep the pedometer on the correct position through the day.

Follow these steps during the 6 day period that your child wear the pedometer to ensure that the counts are an appropriate measurement of how many steps your child takes during the day.
If you have any questions, please call the study investigator, Oldemar Mazzardo, at 217 218-1334.

University of Pittsburgh

PAST YEAR ORGANIZED PHYSICAL ACTIVITY PARENTAL QUESTIONNAIRE

ID # _______

# PAST YEAR ORGANIZED PHYSICAL ACTIVITY PARENTAL QUESTIONNAIRE

Organized physical activities in this questionnaire refer to activities that had a scheduled meeting time (weekly, monthly) and were led by an instructor, teacher, or coach.

Please look at the list of activities on the following page and mark "YES" or "NO" if your child participated in this organized physical activity during the past year from ____________________ through ____________________. If there are organized activities that your child participated in during the past year that are not listed, please write these activities in the designated area at the bottom of the page. Be sure to include all organized individual and team activities or sports that your child participated during the past year from ____________________ through __________________. Make sure to include the seasonal sport activities your child is currently participating in.

For each organized activity that your child participated in, please complete the following:

- ✓ Mark off the specific months during which your child participated in the organized activity.
- ✓ Add up the total number of months in the past year that your child participated in the organized activity.
- ✓ Write down the number of days per week (on average) that your child participated in the organized activity.
- ✓ Write down how many minutes (on average) your child participated in the activity each day.

As a reminder, the past year is referring to __________________ through __________________.

ID # ________

# PAST YEAR ORGANIZED PHYSICAL ACTIVITY PROXY QUESTIONNAIRE

| PHYSICAL ACTIVITY | Was the activity done during the past year? | | Please, mark the months your child participated in the activity during the last year. | | | | | | | | | | | | | On average, how often did your child do this activity? | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NO | YES | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | Total Months | Days/ Wk | Mins/ Day |
| Baseball / softball | | | | | | | | | | | | | | | | | |
| Basketball | | | | | | | | | | | | | | | | | |
| Dance Class | | | | | | | | | | | | | | | | | |
| Field Hockey | | | | | | | | | | | | | | | | | |
| Football | | | | | | | | | | | | | | | | | |
| Gymnastics | | | | | | | | | | | | | | | | | |
| Ice Skating | | | | | | | | | | | | | | | | | |
| Ice Hockey | | | | | | | | | | | | | | | | | |
| Lacrosse | | | | | | | | | | | | | | | | | |
| Martial Arts | | | | | | | | | | | | | | | | | |
| Soccer | | | | | | | | | | | | | | | | | |
| Swimming | | | | | | | | | | | | | | | | | |
| Tennis | | | | | | | | | | | | | | | | | |
| Wall climbing | | | | | | | | | | | | | | | | | |
| WRITE OTHER ACTIVITIES: | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |

ID # ________

## SEDENTARY ACTIVITIES

Please look bellow at the list of sedentary activities and mark "YES" or "NO" if your child usually participates in these activities on a typical weekday and on a typical weekend day.

If there are sedentary activities that your child usually participates in that are not listed, please write these activities in the designated area at the bottom of the page.

For each sedentary activity that your child participates in, please complete the following:

✓ Write down how many minutes (on average) your child participates in the activity each day.

| SEDENTARY ACTIVITY | Is this an activity your child usually does? | | On a typical WEEKDAY, how often does your child do this activity? (ON AVERAGE) | On a typical WEEKEND DAY, how often does your child do this activity? (ON AVERAGE) |
|---|---|---|---|---|
| | NO | YES | Mins/Day | Mins/Day |
| Watching TV | | | | |
| Playing video / computer games | | | | |
| Surfing the internet | | | | |
| Doing homework | | | | |
| Reading | | | | |
| OTHER ACTIVITIES (WRITE BELLOW): | | | | |
| | | | | |
| | | | | |
| | | | | |

ID # ________

## HEALTH CONDITION

HAS YOUR CHILD HAD ANY PHYSICAL CONDITION THAT PREVENTED HIM/HER FROM PARTICIPATING IN PHYSICAL ACTIVITY FOR MORE THAN 30 DAYS FROM ________________ TO ________________?

☐ YES

☐ NO

**If YES**, please mark off which months your child was not able to participate in physical activity?

| | | |
|---|---|---|
| ☐ JAN | ☐ MAY | ☐ SEP |
| ☐ FEB | ☐ JUN | ☐ OCT |
| ☐ MAR | ☐ JUL | ☐ NOV |
| ☐ APR | ☐ AUG | ☐ DEC |

## DEMOGRAPHIC INFORMATION

CHILD'S DATE OF BIRTH: __ __/__ __/__ __ __ __

GENDER: ☐ Male ☐ Female

RACE / ETHNICITY:
☐ African American
☐ Asian
☐ Caucasian
☐ Latin American
☐ Other

## CONTACT INFORMATION

PARENT'S NAME

______________________________

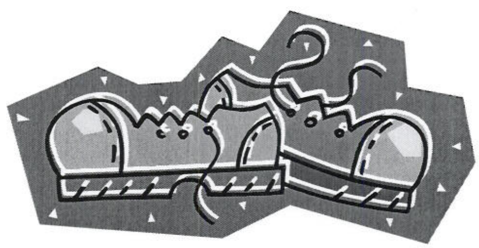
ADDRESS

______________________________

______________________________

PHONE # ______________________________

# 6-Day
# Physical Activity
# Diary



Start Date: __ __ / __ __ / 2007
(month) (day)

End Date: __ __ / __ __ / 2007
(month) (day)

ID Number ________________

**Day 1:** ☐ Sunday ☐ Monday ☐ Tuesday ☐ Wednesday ☐ Thursday ☐ Friday ☐ Saturday

Date: __ __ /__ __ / 2007
(month) (day)

---

Time your child put the pedometer on in the morning: __ __ : __ __ am or pm

Time your child took the pedometer off in the evening: __ __ : __ __ am or pm

The number of steps taken today from the pedometer: ______________

Did your child remove the pedometer for longer than 30 minutes for any reason today such as bathing, swimming. **If YES**, please fill in the time that the pedometer was taken off and time it was put back on.

| Activity 30 Min + | NO | YES Please fill in time | Time Pedometer Removed | Time Pedometer Put Back On |
|---|---|---|---|---|
| Bathing / Showering | ☐ | ☐ | __ __ : __ __ am or pm | __ __ : __ __ am or pm |
| Swimming/ other Water Activities | ☐ | ☐ | __ __ : __ __ am or pm | __ __ : __ __ am or pm |
| Other reason: ____________ | ☐ | ☐ | __ __ : __ __ am or pm | __ __ : __ __ am or pm |

Was this a typical day with respect to you child's activity?. **If NO**, why was day atypical?

| **Was today a TYPICAL DAY?** | ☐ **YES**<br>☐ **NO Please, specify reason(s):** |
|---|---|
| | ☐ Travel<br>☐ Illness<br>☐ Severe Weather Condition<br>☐ Other: ______________________ |

**Day 6:** ☐ Sunday ☐ Monday ☐ Tuesday ☐ Wednesday ☐ Thursday ☐ Friday ☐ Saturday

Date: __ __ /__ __ / 2007
(month) (day)

---

Time your child put the pedometer on in the morning: __ __ : __ __ am or pm

Time your child took the pedometer off in the evening: __ __ : __ __ am or pm

The number of steps taken today from the pedometer: ______________

Did your child remove the pedometer for longer than 30 minutes for any reason today such as bathing, swimming. **If YES**, please fill in the time that the pedometer was taken off and time it was put back on.

| **Activity 30 Min +** | **NO** | **YES** Please fill in time | **Time Pedometer Removed** | **Time Pedometer Put Back On** |
|---|---|---|---|---|
| Bathing / Showering | ☐ | ☐ | __ __ : __ __ am or pm | __ __ : __ __ am or pm |
| Swimming/ other Water Activities | ☐ | ☐ | __ __ : __ __ am or pm | __ __ : __ __ am or pm |
| Other reason: __________ | ☐ | ☐ | __ __ : __ __ am or pm | __ __ : __ __ am or pm |

Was this a typical day with respect to you child's activity?. **If NO**, why was day atypical?

| **Was today a TYPICAL DAY?** | ☐ **YES**<br>☐ **NO Please, specify reason(s):** |
|---|---|
| | ☐ Travel<br>☐ Illness<br>☐ Severe Weather Condition<br>☐ Other: ____________________ |

# APPENDIX C

## TGMD-2 DOCUMENTS

Appendix D includes the following documents used in the data collection and data analysis of the TGMD-2 test: Procedures for TGMD-2 testing and testing script; and examiner coding sheet.

## TGMD-2 TESTING PROCEDURES

1. Bring the designated child from the PE class to the testing location.
2. Prior to starting the TGMD-2 testing session, take measures of height and weight and record it on the testing sheet.
    a. Height: Children will stand tall, without shoes, and with their back against the stadiometer. The subject must be looking straight ahead while the tester will take the measures. Reading should be made to the nearest centimeter.
    b. Weight will be measured by using a TANITA scale. Children will stand on the scale without shoes until the measure can be taken. Reading will be made in kilograms.
3. Prior to testing, the investigator will ask the child to face the camera showing a sheet of paper with his/her ID #.
4. The investigator will ask children to perform some skills with their preferred side.
    a. The preferred hand will be determined by asking the child to write his or her ID number on a piece of paper. The hand the child uses to hold the marker will be recorded.
    b. The preferred foot will be determined by asking the child to balance on one foot. The foot that the child balances on will be recorded prior to starting testing the TGMD-2.
5. Location set up will be done prior to starting test administration.
6. Administer the TGMD-2

## TGMD-2 TESTING SET UP INSTRUCTIONS and SCRIPT

Investigator will read to the child:
*This test has a total of 12 skills. For the first 6 skills I will ask you to move from one place to another in different ways. For the last 6 skills you will demonstrate how well you can control balls in a variety of ways. For all skills, I will explain the task first and then demonstrate the skill. You can ask questions if you do not understand the task after the demonstration. Then, I will ask you to perform each skill twice.*

*Are you ready to start?*

## LOCOMOTOR SUBTEST

**Skill: RUN**

**Location set up:** In an obstacle free space, place two cones 40 feet apart. Make sure there is at least 10 feet of space beyond the second cone for a safe stopping distance.

**Camera set up:** Camera will be positioned perpendicular to the running location at the closest possible distance to visualize the entire running area.

**Directions to the child:**
*Stand beside this orange cone. On my command, run as fast as you can in a straight line from this cone past that orange cone. Reduce speed only after you pass the second cone.*
*The prompting words will be GET READY, GO. You will start running when you hear GO. After finishing, weight on the other side for the second turn.*
============================================================

**Skill: GALLOP**

**Location set up:** In an obstacle free space, place two traffic cones 25 feet apart.

**Camera set up:** The camera will be positioned perpendicular to the delimited location at the closest possible distance to visualize the entire galloping area.

**Directions to the child:**
*Now, I would like you to gallop from this cone to the other and gallop back to the starting point. Please, wait for my command to start.*

**Tester:** Demonstrate galloping to the child from one cone to another.
============================================================

**Skill: SLIDE**

**Location set up:** In an obstacle free space, place two traffic cones 25 feet apart on top of a line on the floor.

**Camera set up:** The camera will be positioned perpendicular to the delimited location at the closest possible distance to visualize the entire sliding area.

**Directions to the child:**

*I would like you to slide from the first cone to the second cone and back to the first one again. You must go and come back facing the same side.*

**Tester:** Demonstrate sliding from one traffic cone to another.

==============================================================

**Skill: HOP**

**Location set up:** In an obstacle free space, place two traffic cones 15 feet apart.

**Camera set up:** The camera will be positioned perpendicular to the delimited location at the closest possible distance to visualize the entire hopping area.

**Directions to the child:**

*I would like you to hop from one cone to the other. Switch foot when you come back. Please, start with your right foot and come back with the left foot. Wait for my command to repeat a second trial.*

**Tester:** Demonstrate hopping from one cone to another and coming back with the other foot.

==============================================================

**Skill: LEAP**

**Location set up:** In an obstacle free space, attach a piece of tape on the floor. Place a beanbag slightly ahead of the line on the floor. Place a traffic cone perpendicular and 5 feet away from line.

**Camera set up:** The camera will be positioned perpendicular to the delimited location at the closest possible distance to visualize the entire leaping area.

**Directions to the child:**

*I would like you to stand by this cone, run towards the line and leap over the beanbag. You have to take off with one foot and land on the opposite foot. Walk back to this cone and wait for a second trial.*

**Tester:** Demonstrate leaping over the lines.

**Skill: HORIZONTAL JUMP**

**Location set up:** In an obstacle free space mark off a starting line by placing a tape on the floor.

**Camera set up:** The camera will be positioned perpendicular to the delimited location at the closest possible distance to visualize the entire jumping area.

**Directions to the child:**

*I would like you to stand behind the tape and jump with both feet as far as you can, making sure you take off and land on both feet. Walk back to the starting position and wait for a second trial.*

**Tester:** Demonstrate jumping from the starting position.
============================================================

## OBJECT CONTROL SUBTEST

**Skill: STRIKING A STATIONARY BALL**

**Location set up:** Place a 4-inch lightweight ball on a batting tee at the child’s waist level 20 feet away from a wall.

**Camera set up:** The camera will be positioned diagonally to the delimited location at the closest possible distance to visualize the child and the batting tee area.

**Directions to the child:**

*With the plastic bat, stand next to the batting tee and strike the ball as hard as you can towards the wall. You will perform this skill twice on my command.*

**Tester:** Demonstrate sliding from one traffic cone to another.
==========================================================

**Skill: STATIONARY DRIBBLE**

**Location set up:** No set up necessary.

**Camera set up:** The camera will be positioned diagonally to the delimited location at the closest possible distance to visualize the child.

**Directions to the child:**

*I would like you to dribble a basketball eight times without moving your feet using the right/left (preferred) hand. Stop by catching the ball with both hands. You will perform this skill twice.*

**Tester:** Demonstrate dribbling with one hand (five times).

**Skill: CATCH**

**Location set up:** Mark off two parallel lines 15 feet apart with tape. Use a 4-inch plastic ball.

**Camera set up:** The camera will be positioned diagonally to the child at the closest possible distance to visualize the child.

**Directions to the child:**

*Please, stand on one line facing me. I will stand on the other line and toss the ball at you using an underhand throw. I would like you to catch the ball with both hands. We will perform this skill twice.*

**Tester:** Demonstrate catching with both hands. Ask the helper to toss the ball.
============================================================

**Skill: KICK**

**Location set up:** Mark off one line 30 feet away from the wall. Place an 8- to 10-inch playground ball on top of a beanbag positioned 20 feet away from the wall.

**Camera set up:** The camera will be positioned perpendicular to the delimited location at the closest possible distance to visualize the entire running and kicking area.

**Directions to the child:**

*Please, stand on the line, and on my command, run to the ball and kick it hard toward the wall. Use your right/left (preferred) foot to kick. You will perform this skill twice.*

**Tester:** Demonstrate running and kicking the ball towards the wall.
=============================================================

**Skill: OVERHAND THROW**

**Location set up:** Mark off the throwing area 20 feet away from a wall. Use a tennis ball.

**Camera set up:** The camera will be positioned perpendicular to the child's throwing delimited location at the closest possible distance to visualize the child.

**Directions to the child:**

*Please, standbehind this line facing the wall. With your right/left (preferred) hand, throw this tennis ballhard on the wall using an overhand throwing motion. You will perform this skill twice.*

**Tester:** Demonstrate overhand throwing to the wall.
=============================================================

**Skill: UNDERHAND ROLL**

**Location set up:** Mark off one line 20 feet away from a wall. In front of the tape, place two traffic cones against the wall 4 feet apart from each other. Use a softball.

**Camera set up:** The camera will be positioned perpendicular to the child's underhand rolling delimited location at the closest possible distance to visualize the child.

**Directions to the child:**

*Please, stand here (mark on the floor) facing the two traffic cones. Using your right/left (preferred) hand roll the ball so that it goes between the cones. Roll the ball hard and as close to the floor as you can. Make sure the ball reaches the wall. You will perform this skill twice.*

**Tester:** Demonstrate underhand rolling between the traffic cones.

## TGMD-2 CODING SHEET

Section VI. Subtest Performance Record

Preferred Hand: Right ☐ Left ☐ Not Established ☐
Preferred Foot: Right ☐ Left ☐ Not Established ☐

### Locomotor Subtest

| Skill | Materials | Directions | Performance Criteria | Trial 1 | Trial 2 | Score |
|---|---|---|---|---|---|---|
| 1. Run | 60 feet of clear space, and two cones | Place two cones 50 feet apart. Make sure there is at least 8 to 10 feet of space beyond the second cone for a safe stopping distance. Tell the child to run as fast as he or she can from one cone to the other when you say "Go." Repeat a second trial. | 1. Arms move in opposition to legs, elbows bent | | | |
| | | | 2. Brief period where both feet are off the ground | | | |
| | | | 3. Narrow foot placement landing on heel or toe (i.e., not flat footed) | | | |
| | | | 4. Nonsupport leg bent approximately 90 degrees (i.e., close to buttocks) | | | |
| | | | | | Skill Score | |
| 2. Gallop | 25 feet of clear space, and tape or two cones | Mark off a distance of 25 feet with two cones or tape. Tell the child to gallop from one cone to the other. Repeat a second trial by galloping back to the original cone. | 1. Arms bent and lifted to waist level at takeoff | | | |
| | | | 2. A step forward with the lead foot followed by a step with the trailing foot to a position adjacent to or behind the lead foot | | | |
| | | | 3. Brief period when both feet are off the floor | | | |
| | | | 4. Maintains a rhythmic pattern for four consecutive gallops | | | |
| | | | | | Skill Score | |
| 3. Hop | A minimum of 15 feet of clear space | Tell the child to hop three times on his or her preferred foot (established before testing) and then three times on the other foot. Repeat a second trial. | 1. Nonsupport leg swings forward in pendular fashion to produce force | | | |
| | | | 2. Foot of nonsupport leg remains behind body | | | |
| | | | 3. Arms flexed and swing forward to produce force | | | |
| | | | 4. Takes off and lands three consecutive times on preferred foot | | | |
| | | | 5. Takes off and lands three consecutive times on nonpreferred foot | | | |
| | | | | | Skill Score | |
| 4. Leap | A minimum of 20 feet of clear space, a beanbag, and tape | Place a beanbag on the floor. Attach a piece of tape on the floor so it is parallel to and 10 feet away from the beanbag. Have the child stand on the tape and run up and leap over the beanbag. Repeat a second trial. | 1. Take off on one foot and land on the opposite foot | | | |
| | | | 2. A period where both feet are off the ground longer than running | | | |
| | | | 3. Forward reach with the arm opposite the lead foot | | | |
| | | | | | Skill Score | |

2

| Skill | Materials | Directions | Performance Criteria | Trial 1 | Trial 2 | Score |
|---|---|---|---|---|---|---|
| 5. Horizontal Jump | A minimum of 10 feet of clear space and tape | Mark off a starting line on the floor. Have the child start behind the line. Tell the child to jump as far as he or she can. Repeat a second trial. | 1. Preparatory movement includes flexion of both knees with arms extended behind body | | | |
| | | | 2. Arms extend forcefully forward and upward reaching full extension above the head | | | |
| | | | 3. Take off and land on both feet simultaneously | | | |
| | | | 4. Arms are thrust downward during landing | | | |
| | | | | | Skill Score | |
| 6. Slide | A minimum of 25 feet of clear space, a straight line, and two cones | Place the cones 25 feet apart on top of a line on the floor. Tell the child to slide from one cone to the other and back. Repeat a second trial. | 1. Body turned sideways so shoulders are aligned with the line on the floor | | | |
| | | | 2. A step sideways with lead foot followed by a slide of the trailing foot to a point next to the lead foot | | | |
| | | | 3. A minimum of four continuous step–slide cycles to the right | | | |
| | | | 4. A minimum of four continuous step–slide cycles to the left | | | |
| | | | | | Skill Score | |
| | | | **Locomotor Subtest Raw Score (sum of the 6 skill scores)** | | | |

## Object Control Subtest

| Skill | Materials | Directions | Performance Criteria | Trial 1 | Trial 2 | Score |
|---|---|---|---|---|---|---|
| 1. Striking a Stationary Ball | A 4-inch lightweight ball, a plastic bat, and a batting tee | Place the ball on the batting tee at the child's belt level. Tell the child to hit the ball hard. Repeat a second trial. | 1. Dominant hand grips bat above nondominant hand | | | |
| | | | 2. Nonpreferred side of body faces the imaginary tosser with feet parallel | | | |
| | | | 3. Hip and shoulder rotation during swing | | | |
| | | | 4. Transfers body weight to front foot | | | |
| | | | 5. Bat contacts ball | | | |
| | | | | | Skill Score | |
| 2. Stationary Dribble | An 8- to 10-inch playground ball for children ages 3 to 5; a basketball for children ages 6 to 10; and a flat, hard surface | Tell the child to dribble the ball four times without moving his or her feet, using one hand, and then stop by catching the ball. Repeat a second trial. | 1. Contacts ball with one hand at about belt level | | | |
| | | | 2. Pushes ball with fingertips (not a slap) | | | |
| | | | 3. Ball contacts surface in front of or to the outside of foot on the preferred side | | | |
| | | | 4. Maintains control of ball for four consecutive bounces without having to move the feet to retrieve it | | | |
| | | | | | Skill Score | |

3

| Skill | Materials | Directions | Performance Criteria | Trial 1 | Trial 2 | Score |
|---|---|---|---|---|---|---|
| 3. Catch | A 4-inch plastic ball, 15 feet of clear space, and tape | Mark off two lines 15 feet apart. The child stands on one line and the tosser on the other. Toss the ball underhand directly to the child with a slight arc aiming for his or her chest. Tell the child to catch the ball with both hands. Only count those tosses that are between the child's shoulders and belt. Repeat a second trial. | 1. Preparation phase where hands are in front of the body and elbows are flexed | | | |
| | | | 2. Arms extend while reaching for the ball as it arrives | | | |
| | | | 3. Ball is caught by hands only | | | |
| | | | | | Skill Score | |
| 4. Kick | An 8- to 10-inch plastic, playground, or soccer ball; a beanbag; 30 feet of clear space; and tape | Mark off one line 30 feet away from a wall and another line 20 feet from the wall. Place the ball on top of the beanbag on the line nearest the wall. Tell the child to stand on the other line. Tell the child to run up and kick the ball hard toward the wall. Repeat a second trial. | 1. Rapid continuous approach to the ball | | | |
| | | | 2. An elongated stride or leap immediately prior to ball contact | | | |
| | | | 3. Nonkicking foot placed even with or slightly in back of the ball | | | |
| | | | 4. Kicks ball with instep of preferred foot (shoelaces) or toe | | | |
| | | | | | Skill Score | |
| 5. Overhand Throw | A tennis ball, a wall, tape, and 20 feet of clear space | Attach a piece of tape on the floor 20 feet from a wall. Have the child stand behind the 20-foot line facing the wall. Tell the child to throw the ball hard at the wall. Repeat a second trial. | 1. Windup is initiated with downward movement of hand/arm | | | |
| | | | 2. Rotates hip and shoulders to a point where the nonthrowing side faces the wall | | | |
| | | | 3. Weight is transferred by stepping with the foot opposite the throwing hand | | | |
| | | | 4. Follow-through beyond ball release diagonally across the body toward the nonpreferred side | | | |
| | | | | | Skill Score | |
| 6. Underhand Roll | A tennis ball for children ages 3 to 6; a softball for children ages 7 to 10; two cones; tape; and 25 feet of clear space | Place the two cones against a wall so they are 4 feet apart. Attach a piece of tape on the floor 20 feet from the wall. Tell the child to roll the ball hard so that it goes between the cones. Repeat a second trial. | 1. Preferred hand swings down and back, reaching behind the trunk while chest faces cones | | | |
| | | | 2. Strides forward with foot opposite the preferred hand toward the cones | | | |
| | | | 3. Bends knees to lower body | | | |
| | | | 4. Releases ball close to the floor so ball does not bounce more than 4 inches high | | | |
| | | | | | Skill Score | |
| | | | **Object Control Subtest Raw Score (sum of the 6 skill scores)** | | | |

# APPENDIX D

## INFORMED CONSENT LETTER

Appendix D includes the informed consent letter.

University of Pittsburgh

*School of Education*

CONSENT TO ACT AS A PARTICIPANT IN A RESEARCH STUDY

TITLE: The Relationship between Fundamental Movement Skills and Level of Physical Activity in Second Grade Children.


| | |
|---|---|
| PRINCIPAL INVESTIGATOR: | Oldemar Mazzardo, MS<br>Graduate Student Assistant<br>University of Pittsburgh<br>Room 5513, Posvar Hall<br>Telephone: 412 708-2320 |
| CO-PRINCIPAL INVESTIGATOR: | Jere D. Gallagher, PhD.<br>Associate Professor<br>University of Pittsburgh<br>Room 5614, Posvar Hall<br>Telephone: 412 648-1774 |
| CO-INVESTIGATOR: | Fabio E. Fontana, PhD.<br>Assistant Professor<br>Eastern Illinois University<br>Room 1405, McAffee Hall<br>Telephone: 217 581-2690 |



| | |
|---|---|
| SOURCE OF SUPPORT: | School of Education Research Grant |

*Why is this research being done?*

Your child is being asked to participate in a research study in which we will test whether “fundamental movement skills” are related to their level of physical activity. Fundamental movement skills are skills that are commonly performed by children. It is believed that these basic skills are general, in that they form the foundation of more advanced sport skills. Specialists suggest that developing these movement skills by the end of primary school is necessary for children, adolescents, and even adults to enjoy participation in recreational activities.

Physical activity participation has been linked to several health indicators, including obesity level. In this research, the relationship of an obesity indicator, Body Mass Index (BMI), and fundamental movement skills will also be investigated. Knowledge about the relationship among fundamental movement skills, physical activity and BMI would suggest the importance of developing fundamental movement skills in order to provide a means of higher levels of participation in physical activity.

*Who is being asked to take part in this research study?*

A total of 70 second grade children at the [redacted] Elementary School will be included in the study. The selection will be on a first come first serve basis. The first 35 male and first 35 female students with parental consent will participate.

Your child is being asked to take part in the study because he / she is a second grader at the [redacted] Elementary School. Second graders have been selected due to the variability in movement skills level encountered within this age group. Mature patterns of fundamental movement skills are typically reached at around 10-years of age. Within second graders, it is usual to find children ranging from low to high levels of skill development.

*What procedures will be performed for research purposes?*

Your child's participation in this research study will require the following procedures:

1. Organized Physical Activity Parental Questionnaire. You(parent or guardian) will respond to a questionnaire about your child's physical activity behavior in the past year. The parental questionnaire has a total of five pages, including a cover sheet, an instruction sheet, and three pages of questionnaire. You will be asked to provide information on your child's *organized physical activity participation*, *sedentary activity participation*, and *demographics*, such as date of birth, gender, and ethnicity. The estimated completion time is about 15 minutes.

2. Habitual Physical Activity.Your child will wear a small, light electronic device (pedometer) that records the number of steps taken throughout the day. Your child will be asked to wear the pedometer all day with the exception of bathing, showering, swimming, or any other activity that might get the pedometer wet. The child's step counts will be monitored for 6 consecutive days. You (parent or guardian) will clip the pedometer on the child's clothes at the waistline every morning and take it off every evening. You will be asked to record the number of steps every evening, and the time and reason if the pedometer was removed for more than 30 minutes throughout the day. A diary is provided for recording the information. Filling out the daily dairy is estimated to take less than 2 minutes.

3. Body Mass Index. The height and weight of your child will be measured prior to the fundamental movement skill tests.

4. Fundamental Movement Skills. Your child will be videotaped during the skills testing. Your child will be asked to perform two trials for each of the 12 movement skills included in the testing protocol. The tested skills are running 50 feet, galloping 25 feet, hopping 15 feet, leap, horizontal jump as far as possible, slide (step sideways for 25 feet), striking a ball from a batting tee with a plastic baseball bat, dribbling a basketball, throwing a tennis ball at a target, catching a midsize ball, underhand rolling a ball, and kicking. The child will listen to the explanation and watch a demonstration of each movement skill prior to performing it.

    Your child will be tested in groups of 2 or 3 children during physical education class time,before school or after school program time. Estimated total testing time for each group is approximately 25-30 minutes.

*What are the possible risks, side effects, and discomforts of this research study?*

1. A potential risk is falling during the fundamental movement skills test. The likelihood of this occurring is rare (less than 1 out of 100 children). The investigator will assure that the test instructions are clearly delivered and that the course is obstacle free.

Although unlikely, if an injury (resulting from falling) does occur during the fundamental movement skill test, the test will be stopped immediately and your child cared for as would be done in any physical education class. Both the principal investigator and the co-investigator are CPR and first aid certified. First aid or additional emergency assistance would be provided by the school nurse or by one of the investigators.

2. A potential risk is breach in confidentiality. We are taking all precautions to prevent a breach of confidentiality.

*What are the possible benefits from taking part in this research study?*

1. Parents will gain knowledge about the average daily step counts of their child compared to CDC national recommendations to promote healthy lifestyle;
2. Parents will gain knowledge about the child's fundamental movement skill level relative to the same age group national standards. This information may help parents detect possible movement skill delays;
3. The participant parent and child completing all aspects of the research protocol will each received a pedometer as an incentive for participation. Pedometers may be useful tools for promoting or monitoring physical activity.
4. It is possible that participants may receive no direct benefit from participating in this research study.

*If I agree to take part in this research study, will I be told of any new risks that may be found during the course of the study?*

You will be promptly notified if any new information develops during the conduct of this research study which may cause you to change your mind about continuing to participate.

*Will I be paid if my child takes part in this research study?*

You or your child will not be paid for study participation. The participant parent and child completing all aspects of the research protocol will each received a pedometer as an incentive for participation. Pedometers may be useful tools for promoting or monitoring physical activity.

*Who will pay if my child is injured as a result of taking part in this research study?*

University of Pittsburgh researchers recognize the importance of your voluntary participation in their research studies. These individuals and their staffs will make reasonable efforts to minimize, control, and treat any injuries that may arise as a result of this research. If you believe that your child is injured as a result of the research procedures being performed, please contact immediately the Principal Investigator listed on the first page of this form.

If your child requires emergency medical treatment for injuries solely and directly related to your child's participation in this research study, it is possible your insurance provided may be billed for the costs, but none of the costs will be your responsibility. If your child's research-related injury requires medical care beyond this emergency treatment, you will be responsible for the costs of this follow-up care unless otherwise specifically stated below. There is no plan for monetary compensation. You do not, however, waive any legal rights by signing this form.

*Who will know about my participation in this research study?*

Any information about your child obtained from this research will be kept as confidential (private) as possible. All records related to your involvement in this research study will be stored in a locked file cabinet. Your child's identity on these records will be indicated by an ID number rather than by your child's name, and the information linking the ID number with your child's identity will be kept separate from the research records. Your child will not be identified by name in any publication of the research results.

Who will have access to identifiable information related to my child's participation in this research study?

In addition to the investigators listed on the first page of this authorization (consent) form and their research staff, the following individuals will or may have access to identifiable information related to your child's participation in this research study:

[redacted] Elementary School personal involved in the research procedures may have access to the research records.

Authorized representatives of the University of Pittsburgh Research Conduct and Compliance Office may review your child's identifiable research information for the purpose of monitoring the appropriate conduct of this research study.

In unusual cases, the investigators may be required to release identifiable information related to your child's participation in this research study in response to an order from a court of law. If the investigators learn that you or someone with whom you are involved is in serious danger or potential harm, they will need to inform, as required by Illinois law, the appropriate agencies.

*For how long will the investigators be permitted to use and disclose identifiable information related to my child's participation in this research study?*

The investigators may continue to use and disclose, for the purposes described above, identifiable information related to your child's participation in this research study for a minimum of five years after final reporting or publication of a project.

*Is my child's participation in this research study voluntary?*

Your child's participation in this research study, to include the use and disclosure of your child's identifiable information for the purposes described above, is completely voluntary. (Note, however, that if you do not provide your consent for the use and disclosure of your child's identifiable information for the purposes described above, your child will not be allowed to participate in the research study.) Whether or not you provide your consent for participation in this research study will have no effect on your current or future relationship with the University of Pittsburgh or [redacted] Elementary School.

*May I withdraw, at a future date, my child's consent for participation in this research study?*

You may withdraw, at any time, your consent for participation in this research study, to include the use and disclosure of your identifiable information for the purposes described above. Any identifiable research information recorded for, or resulting from, your child's participation in this research study prior to the date that you formally withdrew your child's consent may continue to be used and disclosed by the investigators for the purposes described above.

To formally withdraw your child's consent for participation in this research study you should provide a written and dated notice of this decision to the principal investigator of this research study at the address listed on the first page of this form.

Your decision to withdraw your child's consent for participation in this research study will have no effect on your current or future relationship with the University of Pittsburgh or [redacted] Elementary School.

*If I agree to take part in this research study, can I be removed from the study without my consent?*

Your child may be removed from the study if no physical activity data is obtained by the return date. In this case, we will contact you by phone or mail. If you are non-responsive, incapacitated, or not willing to provide the physical activity data, your child will be excluded from further measures.

VOLUNTARY CONSENT/ PARENTAL CERTIFICATION

The above information has been explained to me and all of my current questions have been answered. I understand that I am encouraged to ask questions about any aspect of this research study during the course of this study, and that such future questions will be answered by a qualified individual or by the investigator(s) listed on the first page of this consent document at the telephone number(s) given. I understand that I may always request that my questions, concerns or complaints be addressed by a listed investigator.

I understand that I may contact the Human Subjects Protection Advocate of the IRB Office, University of Pittsburgh (1-866-212-2668) to discuss problems, concerns, and questions; obtain information; offer input; or discuss situations in the event that the research team is unavailable.

By signing this form, I agree for my child to participate in this research study. A copy of this consent form will be given to me/my child.

________________________________________

Printed Name of Child-Subject

"I understand that, as a minor (age less than 18 years), the above-named child is not permitted to participate in this research study without my consent. Therefore, by signing this form, I give my consent for his/her participation in this research study."

______________________________ __________________________

Parent's or Guardian's Name (Print) Relationship to Participant (Child)

______________________________ _______________

Parent or Guardian Signature Date

CHILD ASSENT (to be used with children who are developmentally able to sign)

This research has been explained to me, and I agree to participate.

Signature of Child-Subject Date

Printed Name of Child-Subject

CERTIFICATION of INFORMED CONSENT

I certify that I have explained the nature and purpose of this research study to the above-named individual(s) in writing, and I have discussed the potential benefits and possible risks of study participation in writing. Any questions the individual(s) have about this study have been answered, and we will always be available to address future questions as they arise. I further certify that no research component of this protocol was begun until after this consent form was signed.

| | |
|---|---|
| ________________________________ | ______________________ |
| Printed Name of Person Obtaining Consent | Role in Research Study |
| ______________________________ | ___________ |
| Signature of Person Obtaining Consent | Date |