10-21-2013

The Contribution Of Physical Education And Structured Recess To 6th Grade Students' Overall Daily Physical Activity

Ashley Aileen Gutierrez
Illinois State University, ashley.gutierrez@pekin.net

Follow this and additional works at: http://ir.library.illinoisstate.edu/etd

Recommended Citation
THE CONTRIBUTION OF PHYSICAL EDUCATION AND STRUCTURED RECESS TO 6TH GRADE STUDENTS’ TOTAL DAILY PHYSICAL ACTIVITY

Ashley A. Gutierrez

The purpose of this study was two-fold. First, this study examined the percentage of the daily threshold (12,000 steps) physical education (PE) class and recess contribute to 6th grade students’ overall daily physical activity (PA). This study also examined the relationships between gender, physical activity outside of school, body mass index (BMI) and steps during both recess and PE. A total of 138 students, 11-13 years old, enrolled in the 6th grade from one elementary school in the Midwest participated. Students completed the PA Questionnaire for Older Children (PAQ-C) which assesses PA from the last 7 days, and wore a pedometer to measure steps taken for 6 consecutive PE classes and recess sessions. Additionally students’ body mass index (BMI) percentiles were calculated. Boys took more steps during PE and recess than girls (approximately 30% more), and reported marginally higher PAQ-C scores. The overall contribution of recess and PE to the daily step goal ranged from 7.1% to 9.6% of the target step count of 12,000. All three PA variables were positively correlated with one another (all $p < 0.05$) and children that took more steps during recess and PE tended to have lower BMI.
percentiles (both $p < 0.05$). However, when all three variables were entered into the multiple linear regression model simultaneously, only steps taken during PE was predictive of BMI percentile (total model $r^2 = 0.145$, $p = 0.001$). Results suggest that PE and recess at this school contributed a low percentage of steps to students’ overall target step count goal. Additionally, students who are more active in PE and recess have lower BMI. However, only steps in PE was predictive of BMI percentile. These results suggest that further research is needed to explore PA in schools along with potential interventions to increase PA.
THE CONTRIBUTION OF PHYSICAL EDUCATION
AND STRUCTURED RECESS TO 6TH GRADE
STUDENTS’ TOTAL DAILY
PHYSICAL ACTIVITY

ASHLEY A. GUTIERREZ

A Thesis Submitted in Partial
Fulfillment of the Requirements
for the Degree of
MASTER OF SCIENCE
Department of Kinesiology and Recreation
ILLINOIS STATE UNIVERSITY
2013
THE CONTRIBUTION OF PHYSICAL EDUCATION AND STRUCTURED RECESS TO 6TH GRADE STUDENTS’ TOTAL DAILY PHYSICAL ACTIVITY

ASHLEY A. GUTIERREZ

COMMITTEE MEMBERS
Skip M. Williams, Chair
Margaret M. Coleman
Deborah A. Garrahy
Kelly R. Laurson
ACKNOWLEDGEMENTS

I would like to thank my family, namely my husband, Tony, and my parents, John T. and Norma Wiser. Without your support throughout these past 3 years, this thesis would not have come to fruition. Thank you Tony, for your constant love, support, and encouragement, without them, I am not sure I would have made it (especially on those nights I was procrastinating!!). There are no words to express my love for you. Luvs.

Thank you also, Mom and Dad, for the countless nights you spent with the kids while Tony was working and I was at school, attending meetings in regards to my thesis, or at the library writing, as well as for editing my paper. Your love and support have been and are greatly appreciated. Thank you also for being such great role models in our family and leading by example in regards to attaining a higher education. I love you both.

A.A.G.
## CONTENTS

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACKNOWLEDGEMENTS</td>
<td>i</td>
</tr>
<tr>
<td>CONTENTS</td>
<td>ii</td>
</tr>
<tr>
<td>TABLES</td>
<td>iv</td>
</tr>
<tr>
<td>CHAPTER</td>
<td></td>
</tr>
<tr>
<td>I. THE CONTRIBUTION OF PHYSICAL EDUCATION</td>
<td>1</td>
</tr>
<tr>
<td>AND STRUCTURED RECESS TO 6TH GRADE STUDENTS’</td>
<td></td>
</tr>
<tr>
<td>TOTAL DAILY PHYSICAL ACTIVITY</td>
<td></td>
</tr>
<tr>
<td>Introduction</td>
<td>1</td>
</tr>
<tr>
<td>Methods</td>
<td>3</td>
</tr>
<tr>
<td>Participants</td>
<td>3</td>
</tr>
<tr>
<td>Setting</td>
<td>4</td>
</tr>
<tr>
<td>Instrumentation</td>
<td>4</td>
</tr>
<tr>
<td>Demographic Information</td>
<td>4</td>
</tr>
<tr>
<td>Body Mass Index (BMI)</td>
<td>5</td>
</tr>
<tr>
<td>Physical Activity Questionnaire for</td>
<td>5</td>
</tr>
<tr>
<td>Older Children (PAQ-C)</td>
<td></td>
</tr>
<tr>
<td>Pedometers</td>
<td>5</td>
</tr>
<tr>
<td>Procedures</td>
<td>6</td>
</tr>
<tr>
<td>Data Analysis</td>
<td>6</td>
</tr>
<tr>
<td>Results</td>
<td>7</td>
</tr>
<tr>
<td>Discussion</td>
<td>8</td>
</tr>
<tr>
<td>Conclusions</td>
<td>14</td>
</tr>
<tr>
<td>II. EXTENDED REVIEW OF RELATED LITERATURE</td>
<td>19</td>
</tr>
<tr>
<td>Introduction</td>
<td>19</td>
</tr>
<tr>
<td>Adolescent Physical Activity</td>
<td>19</td>
</tr>
<tr>
<td>Title</td>
<td>Page</td>
</tr>
<tr>
<td>----------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>Adolescent Daily Physical Activity Participation</td>
<td>19</td>
</tr>
<tr>
<td>Adolescent Physical Activity in Physical Education Class</td>
<td>23</td>
</tr>
<tr>
<td>Adolescent Physical Activity in Unstructured and Structured Recess</td>
<td>28</td>
</tr>
<tr>
<td>Physical Activity Measurements in Physical Education</td>
<td>35</td>
</tr>
<tr>
<td>Self-Report Physical Activity Questionnaires</td>
<td>36</td>
</tr>
<tr>
<td>Pedometers</td>
<td>38</td>
</tr>
<tr>
<td>Reactivity in Pedometers</td>
<td>41</td>
</tr>
<tr>
<td>Conclusions</td>
<td>43</td>
</tr>
<tr>
<td>REFERENCES</td>
<td>44</td>
</tr>
</tbody>
</table>
### TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Descriptive Statistics by Sex</td>
<td>16</td>
</tr>
<tr>
<td>2. Partial Correlations for Body Mass Index Percentile and Physical Activity</td>
<td>17</td>
</tr>
<tr>
<td>3. Multiple Linear Regression Predicting Body Mass Index Percentile from Physical Activity</td>
<td>18</td>
</tr>
</tbody>
</table>
CHAPTER I

THE CONTRIBUTION OF PHYSICAL EDUCATION AND STRUCTURED RECESS TO 6TH GRADE STUDENTS’ TOTAL DAILY PHYSICAL ACTIVITY

Introduction

According to the Centers for Disease Control and Prevention (CDC, 2013b), over a third of the children in the United States (U.S.) are overweight or obese. Activity levels are decreasing for reasons such as lack of safe areas to play, lack of community recreational programs, increased amount of screen time with media outlets, as well economic reasons (lack of program funding and familial budgetary choices) (CDC, 2012b; Gordan-Larson, McMurray & Popkin, 2000; Knowles, Niven, & Fawkner, 2011). Middle School aged children should receive at least 60 minutes of physical activity (PA) every day, as well as accumulate 12,000 steps per day (Colly, Janssen, & Tremblay, 2012; National Association for Sport and Physical Education & American Heart Association, 2012; President’s Council on Physical Fitness, 2001; & Vincent & Pangrazi, 2002). During adolescence, it has also been shown that girls’ PA is significantly less than boys’ PA (Flohr, Todd, & Tudor-Locke, 2006; Tudor-Locke, Lee, Morgan, Beighle, & Pangrazi, 2006, Vincent & Pangrazi, 2002). Children who are not attaining this amount of PA have a higher chance of premature death from heart disease, developing Type II
diabetes, high blood pressure, certain cancers, and increased risk of anxiety and depression (CDC, 2013a). A good setting to address and increase PA levels may be schools, because of the amount of time students spend there each day.

Physical education (PE) is an important subject within the school setting when considering the amount of PA a student achieves, since they spend upwards of six to seven hours in school per day (Flohr, et al., 2006; Tudor-Locke, et al., 2006, Vincent & Pangrazi, 2002). It has been shown that middle school students can achieve as much as 17% (2,046 steps) of their daily steps during PE days when PA is based on 12,000 steps a day (Flohr & Todd, 2003; Flohr, et al., 2006). Similarly, Tudor-Locke, et al. (2006) found students took an average of 1,417 steps during a 30 minute PE period, which accounted for ~18% of their daily PA. When comparing boys and girls in PE, no significant difference has been shown (Flohr, et al., 2006; Tudor-Locke, et al., 2006).

Additionally, within the school setting, recess can also play a significant role in the contribution of students’ overall daily PA. Tudor-Locke, et al. (2006) found that lunch time (time eating lunch and unstructured recess) provided the biggest portion of PA obtained during the school day. When a 15 minute, unstructured recess, time was factored in, in addition to the aforementioned lunch time, students received roughly 30 percent of their daily PA when based on an average daily count step of 12,000 steps per day. Further supporting this finding, Beighle, Morgan, LaMasurier, & Pangrazi (2006) found that elementary school students receive nine percent of their daily steps during an unstructured recess, with an average step count of 1,090 during a 15 minute recess period. When comparing girls’ and boys’ PA during recess, it has been shown that boys
participate in significantly more PA (Beighle, et al., 2006; Brusseau, et al., 2011; Tudor-Locke, et al., 2006).

While many studies have examined PA throughout the segmented day, there has been little current research examining the amount of steps students take in schools that do not offer daily PE, but do offer a structured, daily recess. Additionally, there are few studies that have compared the amount of PA in PE and structured recess (Smith & Biddle, 2008). The purpose of this study was two-fold. First, to examine the percentage of the daily threshold (12,000 steps) PE class and structured recess contribute to sixth grade students’ overall daily PA. Additionally, our goal was to examine the relationship between gender, PA outside of school (PAQ-C), body mass index (BMI), and steps during both recess and PE.

Methods

Participants

All 6th grade students from one elementary school in a large, rural community in the Midwest were invited to participate in the study. Students and primary caregivers were informed of the study’s procedures. The primary caregivers provided informed consent and the students provided assent to participate in the study. Prior to data collection this study was approved by the University Institutional Review Board and school administrators. A total of 138 students (72 males, 66 females) between the ages of 11-13 years (M= 11.7, SD = 0.6) participated. The race of participants included White Non-Hispanic (97.1%), Multi-racial (2.2%) and African American (0.7%).
Setting

Participants attended PE twice a week and were taught by a certified PE teacher. The average class had 24 students. PE lessons were 30 minutes in length and included Pickleball activities (e.g. skills, drills, lead-up games and tournament play). The PE lessons were taught in the school’s gymnasium, which is the size of a regulation basketball court and holds four Pickleball courts.

Recess occurred before lunch and was approximately 20 minutes. The planning and execution of the structured recess was a main focus for the assistant principal. Therefore, each recess had planned activities which were set up by the assistant principal with some input by the PE teacher. Each activity was supervised for appropriate behavior (e.g. playing fairly, using appropriate language, using the equipment appropriately, etc). The playground was a blacktop surface, approximately 115 feet by 170 feet. It was split into three areas which include the following activities: four square courts, six basketball hoops, and a space for jump ropes. The participants had access to equipment for all activities. The participants were not allowed to move freely throughout the playground, rather they were required to pick an activity at the beginning of recess and continue with it until recess was over. Also, the participants had the option to walk around the school on the sidewalk with a recess supervisor.

Instrumentation

Demographic Information. All demographic information (race, gender, and age) was gathered by accessing the principal investigator’s student database from a secure school computer.
**Body Mass Index (BMI).** In the current study a BMI value was calculated. A BMI value was found by dividing a participant’s body mass by height squared (kg/m²). According to the CDC (2011), BMI has been found to be a reliable indicator of body fatness, but is not a direct measure of body fat. It has been shown to correlate with direct measures of body fat such as under water weighing and dual energy x-ray absorptiometry (CDC, 2011; Mei et al., 2002). It is easy to perform, as well as inexpensive. For children and adolescents, BMI is referred to as BMI-for-age because it takes into consideration age and sex. In the current study, participants’ BMI measurements occurred within the school day, but outside of PE. The school health clerk performed the measurements. The principal investigator recorded the measurements into the BMI for schools tool, as offered by the CDC (2011).

**Physical Activity Questionnaire for Older Children (PAQ-C).** The PAQ-C was used and is a self-administered, seven-day recall instrument (Kowalski, Crocker, & Donen, 2004). Participants completed the investigator-led PA self-report questionnaire during the school day, but outside of their PE class. Once the surveys were completed, scores were compiled into an excel worksheet.

**Pedometers.** The New Lifestyles SW-701 Digi-Walker was utilized to assess the number of steps taken by participants during PE classes and recess sessions. According to the New Lifestyles website (n.d.), it works best for those who are not considered obese and for those traveling at a speed greater than 2.5 mph. The SW-701 was shown to have the smallest mean error (-0.1) when compared with nine other pedometers (Schneider, Crouter, Lukajic, & Bassett, 2003).
Procedures

Data collection occurred over a six-week period. During the first week, participants were instructed how to attach, wear and use the pedometer in an appropriate manner. The participants practiced picking up, attaching, wearing, and returning their pedometers in both PE class and recess prior to data collection.

In weeks two- through six, step counts in six consecutive PE classes, occurring two times a week, and six outdoor structured recesses were recorded. The class was observed by the principal investigator to ensure that tampering was not taking place. If tampering was observed, the participant was identified and that data was thrown out. Immediately following the conclusion of the PE class and recess, participants were instructed to remove their pedometers and return them to the appropriate place. An investigator recorded the steps from each pedometer on a data sheet and reset the pedometer to zero for the next class or recess session. Throughout the six week collection period, participants were measured for height and weight, by the school health clerk, and completed the PAQ-C during school hours.

Data Analysis

Statistical analysis was completed using IBM SPSS (Statistical Package for the Social Sciences) Version 21 (IBM Corp, 2012). Descriptive statistics were computed for all variables and are presented as means ± SD. Independent t- tests were used to examine gender differences and a Pearson chi-square test for independence was used to compare the percent overweight and obese in boys and girls. Partial correlations were computed to examine how well the variables were related to one another independently, while controlling for sex and age. Finally, a multiple linear regression was used to examine the
shared contribution of gender, PA outside of school (PAQ-C), BMI, and steps during both recess and PE to BMI percentile. Four separate models were used: Model 1, age and sex, Model 2, age, sex and PAQ-C, Model 3, age, sex, PAC-Q and recess steps, and Model 4, age, sex, PAC-Q, recess and PE steps.

**Results**

Inclusion criteria for this study were attending four out of six PE classes and four out of six recesses. Every student met that criterion. Descriptive statistics for all variables are located in Table 1. The independent samples t-test indicated boys were significantly different than girls in terms of scoring higher on the PAQ-C than girls (3.05 ±0.60 versus 2.80 ±0.57, p<0.05), taking more steps during recess (1,150 ±375 versus 890 ±327, p<0.05), the percent contribution of recess to the 12,000 step threshold (9.6 ±3.1 versus 7.4 ±2.7, p<0.05), taking more steps during PE (1,116 ±301 versus 847 ±219, p<0.05), the percent contribution of PE to the 12,000 step threshold (9.3 ±2.5 versus 7.1 ±1.8, p<0.05) and the total contribution to the 12,000 step threshold both PE and recess make (18.9 ±4.7 versus 14.5 ±3.4, p<0.05).

The partial correlations were adjusted for age and sex. Results indicated statistically significant associations between the following variables (see Table 2): BMI percentile and PE steps (-0.318, p<0.05), recess steps (-0.191, p<0.05), and PE/recess contribution (-0.305, p<0.05); PAQ-C and PE steps (0.214, p<0.05), recess steps (0.318, p<0.05), and PE/recess contribution (0.339, p<0.05); PE steps and recess steps (0.286, p<0.05) and PE/recess contribution 0.735, p<0.05); and Recess steps and PE/recess contribution (0.860, p<0.05). There was no significant association found between BMI percentile and PAQ-C.
Four models of multiple linear regression were conducted for predicting BMI percentile from PA (see Table 3). Each model was found to be a significant predictor for BMI percentile: Model 1 (age + sex), $p=0.028$, $r=0.051$, Model 2 (age + sex + PAQ-C), $p=0.028$, $r^2=0.065$, Model 3 (age + sex + PAQ-C + recess steps), $p=0.013$, $r^2=0.090$, and Model 4 (age + sex + PAQ-C + recess steps + PE steps), $p<0.001$, $r^2=0.159$). The predictor $\beta$-coefficient for PE steps within Model 4 was also found to be significant, $-0.028$, $p<0.001$, respectively.

**Discussion**

The most important findings from this study were the role PE and structured played in contributing to 6th grade students’ overall PA. Additionally, boys were found to be significantly more physically active than girls and participants with higher BMI percentiles were found to be less active than their counterparts with lower BMI percentiles during both PE and recess. As mentioned above, PE was found to account for 8.2 ±2.5% of the overall daily PA or 987 ±296 steps, whereas structured recess was found to account for 8.5 ±3.1 percent or 1,025 ±375 steps. The combined overall contribution of both PE and recess (50 minutes combined) was found to be 16.8 ±4.7 percent. When broken down into steps per minute (SPM), participants took 40.8 SPM overall. These findings are well below participants in the fourth- through sixth-grade, who took 50.9-59.5 SPM during their PE and recess times (Brussseau, et al., 2011; Tudor-Locke, et al., 2006). However, it is important to note the previous studies did not have structured recesses and also included periods that allowed for free play, lunchtime (time spent eating lunch and free time following the conclusion of eating) for 40 minutes and an additional recess for 15 minutes. This factor alone allowed for more opportunity for the participants
to be physically active, which could account for the higher step rates overall. Also, it is thought the focus of the PE classes during the current study played a notable role in the amount of steps participants took during PE when compared with previous studies. This will be further explained the following paragraphs.

The sixth grade participants in this study took an average of 987 ±296 steps during a 30 minute PE class, accounting for roughly eight percent of their overall daily PA. When broken down into SPM, participants took 32.9 SPM during PE. These findings were well below the research findings for PE, of the same grade, 43.4-47.3 SPM (Alderman, Benham, Beighle, Erwin & Olson, 2012; Tudor-Locke, et al., 2006). Their counterparts’ steps in a 30 minute PE accounted for 11-12% of the overall daily PA (Alderman, et al., 2012; Tudor-Locke, et al., 2006). A possible explanation for the difference in results could be the focus of the lessons. Research has shown that adolescents’ perception in skill ability and actual skill ability play a role in PA (Hill & Hannon, 2008; Reed, Metzker, & Phillips, 2004). Specifically, Hill and Hannon (2008) report that lower skill students “perceive their inability to perform the basic skills will limit their success in competitive situations,” (p. 186). In the current study, Pickleball skills and tournament play were the main foci of the lessons. Because none of the students had played Pickleball or had any experience with a racket sport in PE, a lower amount of PA during PE may be explained via perceptions of skill level and actual skill level. However, it is important to note this is an assumption based on previous research, as skill level and/or skill perceptions of Pickleball were not measured in the current study and that limited skill improvement could be expected in only six, 30 minute PE lessons.
Current pedometer-determined PA literature in PE has shown mixed results in regards to gender differences in PE (Alderman, et al., 2012; Brusseau, et al., 2011; Flohr, et al., 2006; Tudor-Locke, et al., 2006). In the current study, an examination of gender showed boys took more steps than girls in PE. A possible explanation for this is that as adolescents age, they become less physically active, girls more so than boys (Pate, Dowda, O’Neill, & Ward, 2007). It is important to note the biological difference between the boys and girls in this study. It has been reported that girls mature roughly two years before boys (12 years versus 14 years) (Malina, Bouchard, & Bar-Or, 2005; Tanner, 1989). Sherar, esliger, Baxter-Jones & Tremblay (2007) reported boys ages 10-13 were engaged in significantly more MVPA overall than girls. Additionally, it has also been shown that boys prefer playing competitive sports more so than girls (Couturier, Chepko, & Coughlin, 2007; Hill & Hannon, 2008). Therefore, the way in which Pickleball was perceived by the girls in this study may have played a role in the amount of PA they accumulated in PE.

A 20 minute structured recess accounted for roughly nine percent of sixth graders’ overall daily PA. Participants took an average of 1,025 ±375 steps (51.25 SPM). Participants in the current study were found to receive more pedometer-determined PA during a structured recess than reported in previous research findings (grades one through four) who were reported to take 870 ±250 steps during a 15 minute (58 SPM) structured recess, accounting for seven percent of their overall daily PA (Stellino-Babkes, Sinclair, Partridge, & McClary-King, 2010). Differences in findings between the current study and prior research may be explained via the way the recess was structured. In the current
study participants had four activities from which to choose from each day, whereas the participants in the work of Stellino-Babkes, et al. (2010) participated in one activity each week. Perhaps having a choice in activities in which to participate on a daily basis explains why participants in this study had a higher level of pedometer-determined PA. According to Self-Determination Theory, Deci & Ryan (1985), a basic need of all people is the need to engage in activities of one’s choosing and to be their origin of one’s behavior. Research in motivation has shown that choice can play a role in what drives a person to be physically active. When given a choice, it has been shown that motivation to participate in physical activities can increase in students in grades five and six (Cox & Williams, 2008). Further studies conducted with only one activity offered versus many activities offered during a structured recess may help determine if PA is more influenced by the structure of the recess or the number of activities offered during the structured recess.

Current research in both pedometer- and accelerometer-determined PA during a structured recess has shown that boys are more physically active than girls (Huberty, et al. 2011; Ridgers, Stratton, Fairclough, & Twisk, 2007; Stellino-Babkes, et al., 2010). Our study supports the existing literature in terms of the effect of gender and PA levels in structured recess. Our examination of structured recess steps showed that boys (1,150 ±375) accumulated significantly more steps than girls (890 ±327) during a 20 minute structured recess. This accounted for roughly 10% and 7% of overall daily PA, as well as 64 SPM and 49.4 SPM for boys and girls, respectively. The overall contribution to daily PA, as well as step rates were found to be similar for boys (909 ±257 steps and 58 SPM)
and marginally larger for girls (825 ±2360 steps and 55 SPM) in a study that examined structured recess steps of boys and girls (825 ±2360) in first through fifth grade participants (Stellino-Babkes, et al., 2010). Further examination should include activities geared towards increasing overall PA girls receive while in recess.

Significant gender differences were also found in the PAQ-C. Boys on average scored 3.05 ±0.60, whereas girls scored 2.80 ±0.57. Albeit a small difference between scores, the results add to current research that boys are more physically active overall than girls. Tudor-Locke, et al., (2006) also reported a significant difference in gender for middle school participants (13,000 ±4,398 steps versus 10,455 ±3,648 steps) in PA outside of school on weekends for boys and girls, respectively. These findings continue to suggest that the importance of PA needs to be continually emphasized to girls and perhaps even offer examples of PA in which girls may be more interested to take part in while outside of school.

Participants with higher BMI percentiles were found to be less active than their counterparts with lower BMI percentiles during both PE and recess. These findings are in line with those from a study conducted by Gao, Oh & Sheng (2011) which found a significant difference in PA levels during PE between middle school students labeled overweight and healthy-weight. It was reported that students with a BMI percentile greater than 85 percent spent significantly less time in MVPA (61.1%) and significantly more time being sedentary (13.5%) during PE than those with a healthy BMI (68.2% and 7.6%, respectively). Likewise in structured recess, Stellino-Bakes, et al. (2010) reported higher PA levels in participants with a healthy BMI percentile as compared with those
with a BMI percentile greater than 85 percent (912 ±250 steps versus 810 ±258 steps) in a 15 minute time period. The findings in the current study continue to highlight the importance PE and structured recess can play in the amount of PA a student receives during the school day, even more so for those with higher BMI percentiles.

The data in the current study show a low percentage of steps contributing to overall daily PA, thus it is important to note how schools can contribute more to increasing PA. A comprehensive school physical activity program (CSPAP) is one that incorporates PA “programming before, during, and after the school day” (National Association for Sport and Physical Education, 2008, p. 1). While it makes sense that PE and recess, be it structured or unstructured, allows for PA to occur during the day, there are many other opportunities for PA to occur at school. For example, a focused PA break can be taken throughout the day in the classroom. These breaks could be as easy as getting the students up and doing simple calisthenics. PA opportunities should also be offered prior to school starting as well as after school. These activities can include “intramural sports (volleyball or basketball), self-directed activities (walking or jogging clubs), classes (dance, yoga, or martial arts, and activity clubs (jump rope, hiking, and fitness)” (NASPE, 2008, p. 3). It is important to give attention to the interests of the student body, so as to offer activities, both competitive and non-competitive, in which they would be willing to participate. The timing of when such activities are offered should also be considered, so as to offer PA opportunities that are able to be taken advantage of by all the students (NASPE, 2008).

It is important to also note of limitations to the study. There was not enough space in the gym for all participants to be engaged in PA during the game play portion of the
lessons taught. The average class size was 24, and the setup of game play only allowed for four courts of doubles to play at one time, thus accounting for ¾ of the class to be active at one time. The other ¼ not participating in game play were responsible for refereeing the games and reporting the scores at the end of the five minute games.

Modified rules to the game also limited movement, as the participants were restricted to staying on his/her side of the court (they weren’t allowed to cross over the dividing line on their side of the court). The rules were made so as to ensure participants were getting equal opportunity to play, thus not allowing one person to play the whole court. PA may have been different had the participants been playing an invasion type of game, allowing for more movement throughout the game. A second limitation is the way in which the recesses were structured. Participants were not allowed to move freely from one activity to another, if a participant became bored, they simply stopped what they were doing.

Supervisors in the current structured recesses were not trained to nor told to encourage engagement in PA during recess, rather they were there to ensure proper behavior (no inappropriate use of words, fighting, etc.) was occurring. Additionally, the timing of the study and age level of the participants studied. This study took place at the end of the school year with the oldest age group at the school, therefore it is possible that the participants were bored of all the activities offered during recess and would rather spend their time ‘hanging out with their friends’ than engage in meaningful PA during the time allotted for recess.

Conclusions

This study is important as it is the first to examine both the contribution of PE and structured recess to adolescents’ total daily PA. The understanding of PA contributions
during PE and structured recess, as well as throughout the entire school day, are important in designing and structuring opportunities for adolescents to engage in PA as they accounted for 16.8% of the participants’ total daily PA. These findings are even more important when taking into consideration the BMI percentiles of adolescents, as PA was found to significantly decrease with all PA variables except in self-reported PA. Therefore special emphasis for creating opportunities to be engaged in PA during both recess and structured recess, should concentrated on those who have BMI percentiles greater than the 85th percentile, as well as on girls, as they were also shown to have significantly lower levels of PA during the same time periods.
<table>
<thead>
<tr>
<th></th>
<th>Boys (n = 72)</th>
<th>Girls (n = 66)</th>
<th>Combined (N = 138)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>11.7 (0.6)</td>
<td>11.7 (0.6)</td>
<td>11.7 (0.6)</td>
</tr>
<tr>
<td>Body Mass Index (kg/m²)</td>
<td>21.5 (4.8)</td>
<td>21.6 (5.5)</td>
<td>21.5 (5.1)</td>
</tr>
<tr>
<td>Body Mass Index Percentile</td>
<td>70.1 (26.4)</td>
<td>66.2 (27.8)</td>
<td>68.2 (27.0)</td>
</tr>
<tr>
<td>Percent Overweight/Obese (%)</td>
<td>36.1%</td>
<td>31.8%</td>
<td>34.1%</td>
</tr>
<tr>
<td>PAQC (steps)</td>
<td>3.05 (0.60)</td>
<td>2.80 (0.57)*</td>
<td>2.93 (0.59)</td>
</tr>
<tr>
<td>Steps during PE</td>
<td>1116 (301)</td>
<td>847 (219)*</td>
<td>987 (296)</td>
</tr>
<tr>
<td>Contribution of PE to 12K Target (%)</td>
<td>9.3 (2.5)</td>
<td>7.1 (1.8)*</td>
<td>8.2 (2.5)</td>
</tr>
<tr>
<td>Steps during Recess</td>
<td>1150 (375)</td>
<td>890 (327)*</td>
<td>1025 (375)</td>
</tr>
<tr>
<td>Contribution of Recess to 12K Target (%)</td>
<td>9.6 (3.1)</td>
<td>7.4 (2.7)*</td>
<td>8.5 (3.1)</td>
</tr>
<tr>
<td>Total Contribution to 12K Target (%)</td>
<td>18.9 (4.7)</td>
<td>14.5 (3.4)*</td>
<td>16.8 (4.7)</td>
</tr>
</tbody>
</table>

* Statistically significant difference between boys and girls (p<0.05)
Table 2. Partial Correlations for Body Mass Index Percentile and Physical Activity

<table>
<thead>
<tr>
<th>Variable</th>
<th>BMI Percentile</th>
<th>PAQC</th>
<th>PE Steps</th>
<th>Recess Steps</th>
<th>PE/Recess Contribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMI Percentile</td>
<td>--</td>
<td>-0.120</td>
<td>-0.318*</td>
<td>-0.191*</td>
<td>-0.305*</td>
</tr>
<tr>
<td>PAQC</td>
<td>--</td>
<td>--</td>
<td>0.214*</td>
<td>0.318*</td>
<td>0.339*</td>
</tr>
<tr>
<td>PE Steps</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>0.286*</td>
<td>0.735*</td>
</tr>
<tr>
<td>Recess Steps</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>0.860*</td>
</tr>
<tr>
<td>PE/Recess Contribution</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>0.860*</td>
</tr>
</tbody>
</table>

*Statistically significant correlations ($p<0.05$)
<table>
<thead>
<tr>
<th>Model</th>
<th>Model $p$-value</th>
<th>Predictor β-Coefficient ($p$-value)</th>
<th>Model $r^2$</th>
<th>$r^2$ Change from Previous</th>
</tr>
</thead>
<tbody>
<tr>
<td>1: Age + Sex</td>
<td>0.028*</td>
<td>--</td>
<td>0.051</td>
<td>--</td>
</tr>
<tr>
<td>2: Age + Sex + PAQC</td>
<td>0.028*</td>
<td>--</td>
<td>0.065</td>
<td>0.014</td>
</tr>
<tr>
<td>PAQC</td>
<td></td>
<td>-5.442 (0.164)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3: Age + Sex + PAQC + Recess Steps</td>
<td>0.013*</td>
<td>--</td>
<td>0.090</td>
<td>0.025</td>
</tr>
<tr>
<td>PAQC</td>
<td></td>
<td>-2.992 (0.463)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recess Steps</td>
<td></td>
<td>-0.013 (0.060)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4: Age + Sex + PAQC + Recess Steps + PE Steps</td>
<td>&lt;0.001*</td>
<td>--</td>
<td>0.159</td>
<td>0.069</td>
</tr>
<tr>
<td>PAQC</td>
<td></td>
<td>-1.227 (0.757)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recess Steps</td>
<td></td>
<td>-0.008 (0.259)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PE Steps</td>
<td></td>
<td>-0.028 (0.001)*</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Indicates Statistically Significant Predictor
CHAPTER II
EXTENDED REVIEW OF RELATED LITERATURE

Introduction

The purpose of this study was twofold. First, this study examined the percentage of the daily threshold (12,000 steps) PE class and structured recess contribute to sixth grade students’ overall daily PA. This study also examined the relationships between gender, overall PA, BMI, and steps during both PE and recess. The current review of literature is broken down into the following sections: adolescent PA (daily PA participation, PA participation in PE, and PA participation in recess), PA measurements, and body composition.

Adolescent Physical Activity

Adolescent Daily Physical Activity Participation

It is recommended by many organizations that adolescents get 60 minutes of PA each day, as well as accumulate 12,000 steps per day (National Association for Sport and Physical Education & American Heart Association, 2012; President’s Council on Physical Fitness, 2001; USDHHS, 2008; & Vincent and Pangrazi, 2002). Research has shown that participating in daily PA can lead to decreasing one’s risk of premature death from heart disease, developing Type II diabetes, high blood pressure, certain cancers, and an increase risk of anxiety and depression (CDC, 2013a). There is much research in the literature regarding adolescent daily PA participation.
Beighle, et al. (2012) examined steps taken during two different seasons of the year: fall and winter. A total of 105 students (40 boys and 65 girls) in grades three thru five from one elementary school in the Southeastern U.S. participated. The MLS 2505 pedometer was used to record data. The study lasted four days in October and four days in February. Participants wore two different pedometers: a ‘school’ pedometer to be worn during the school day, and an ‘out-of-school’ pedometer to be worn in the evenings until bedtime and in the morning until entering the classroom. Data was recorded from the ‘school’ pedometer at the end of the school day, whereas data recorded from the ‘out-of-school’ pedometer occurred upon the participant arriving at school. It was found overall, participants took 8,650 steps a day. Boys took an average of 1,849 more steps a day than girls, 9,794 steps verses 7,945 steps, respectively. The steps by participants in this study do not meet the recommend 12,000 steps a day, rather they took 3,350 less steps, or only attained 72% of the recommended daily amount.

Likewise, Alderman, et al. (2012) studied the PA of middle school students over a five day period. The purpose of this study was to describe PA during PE and non-PE days. Two hundred seventy-nine students (159 boys, 120 girls) in the fifth and sixth grades ($M$ age 11.8 years) from one middle school in the Rocky Mountain region of the US participated. Measurements needed for BMI were taken on the first day of data collection. The Walk4Life LS252 pedometer was used to record data. Participants wore pedometers for five consecutive days and were instructed to put on the device when they woke up and to take it off at bedtime. Data was recorded at specific times of the day (at the beginning of the first class period, at the end of the last class period, bedtime, and at the beginning and end of PE class on PE days). It was found that middle school students
took an average of 12,002 steps each day. Boys were not found to take significantly more steps each day than girls, 12,092 steps and 11,903 steps, respectively. It was reported that those in the least, moderate and most active groups had an average BMI of 19.8, 18.6, and 18.1, respectively. A significant difference was found between the least active group and the moderate and active groups, in terms of BMI. Based on the results of this study, an inverse relationship exists between BMI and PA levels. It was also found that the participants in this study met the threshold of 12,000 steps a day.

Brusseau, et al. (2011) conducted a study examining PA patterns of fourth and fifth-grade children. The purpose of the study was to describe elementary school children’s daily pedometer-determined PA patterns during PE, recess, lunchtime, at school, outside of school and total day. A total of 829 students (400 boys, 429 girls) from six schools in one Southwestern state participated. Each participant had their weight and height measured. BMI was calculated using the BMI-for-age growth chart as provided by the CDC. The Yamax SW-200 pedometer was used to record data. Participants were instructed to wear the pedometer at all times unless they were taking part in water activities or sleeping. Data collection lasted for five consecutive days and occurred at the beginning of each day, as well as before and after PE class, recess, lunchtime and when they left school at the end of the day. It was reported that participants on average took 12,027 steps a day. Boys were found to take significantly more steps than girls overall, 13,082 steps and 11,065 steps, respectively. Significant differences were reported across three weight statuses (normal, ≤ 85%, overweight, >85 and ≤95% and obese, ≥95%) for total day. Specifically, normal weight participants had higher step counts than obese
participants, ≈12,500 steps and ≈11,000 steps, respectively. Therefore it was concluded that an inverse relationship existed between PA level and weight. It also concluded that boys take more steps than girls, and that the participants in this study met the 12,000 steps a day threshold.

Flohr, et al. (2006) examined PA patterns in young seventh grade adolescents (M age 12.29 years). The purpose of this study was to evaluate PA patterns based on data collected for two weeks in a row. Forty-four students from one school (19 boys and 25 girls) participated in the study. The Yamax DW-200 Digi-Walker pedometer was used to record data. Participants were instructed to wear the pedometer at all times unless they were doing something that involved water (i.e., swimming, showering, etc). The following was recorded in a logbook for each participant: “daily walking time, bedtime, time they put on the pedometer, the time school ended, and the time spent in PE class. They also recorded the number of steps before school and after PE class, at the end of school, and at the end of the day,” pg. 311. Twenty-two of the participants were active in organized after-school programs such as soccer, football, volleyball, cross-country, and cheerleading. As a whole, the participants averaged 11,392 steps a day. It was found that participants who engaged in after school physical activity (ASPA) took an average of 12,984 steps a day, whereas those that did not participate in ASPA took an average of 9,838 steps a day. Significant gender differences were found between all days, weekend days, and health education days, but not between PE days. Boys attained an average of 12,490 steps a day, while girls attained 10,557 steps a day. The participants in this study met the threshold of 12,000 steps a day. Additionally it was found that boys took more steps than girls on a daily basis.
Similarly, Tudor-Locke, et al. (2006) conducted a study examining the PA patterns of sixth grade students. The study consisted of eighty-eight (34 males, 54 females) participants from four classrooms in one elementary school in the Southwest U.S. Height and weight were measured and BMI was calculated. Participants wore the Walk4Life LS2500 pedometer for two consecutive weeks. The pedometers were worn starting in the morning and were removed before the participants went to bed. Throughout the duration of the study, researchers were present in the school to remind participants to record the amount of steps taken at certain points during the day (at the beginning of their first class, at the end of their last class of the day, at the end and the beginning of the classes that took place before and after lunch, at the beginning and end of PE class and at bedtime. Results indicated participants took an average of 14,426 steps a day. Boys took significantly more steps per day than girls, 16,421 and 12,332 steps, respectively. It was reported that BMI was not correlated with pedometer-determined PA. Thus this research supports the notion that boys take more steps on average than girls do on a daily basis. Participants exceeded the recommended threshold of 12,000 steps a day by 2,426 steps.

**Adolescent Physical Activity in Physical Education Class**

Research has shown incorporating daily PE is important when considering the amount of PA a student achieves because it is a time in which students are able to be physically active for an extended amount of time each day (Flohr, et al., 2006; Tudor-Locke, et al., 2006, Vincent & Pangrazi, 2002). It has been recommended that schools offer daily PE that lasts for 45 minutes, totaling 225 minutes a week (Institute of
School districts should provide quality PE curriculums in which students are engaged in moderate-to-vigorous physical activity (MVPA) for at least 50% of the time (Institute of Medicine, 2013; Scruggs, et al., 2003; Scruggs, Beveridge, Watson, & Clocksin, 2005).

Alderman, et al. (2012) studied the PA of middle school students (grades five and six) over a five day period. The purpose of this study was to describe PA during PE and non-PE days. Two hundred seventy-nine students (159 boys, 120 girls) with an average age of 11.8 years, from one middle school in the Rocky Mountain region of the US participated. Measurements needed for BMI were taken on the first day of data collection. The Walk4Life LS252 pedometer was used to record data. Participants wore pedometers for five, consecutive days and were instructed to put on the device when they woke up and to take it off at bedtime. Data was recorded at specific times of the day (at the beginning of the first class period, at the end of the last class period, bedtime, and at the beginning and end of PE class on PE days). Of the 279 participants, 106 had three days of PE, 132 had two days of PE and 41 had one day of PE. While this study did not report the length of the PE classes, it did report that participants took an average of 1,302 steps while in PE class. A significant gender difference was found on PE days. Boys took an average of 1,428 steps during PE, whereas girls took 1,176 steps, accounting for 12% and 10% of the daily threshold (12,000 steps/day), respectively. It was reported that those in the least, moderate and most active groups had an average BMI of 19.8, 18.6, and 18.1, respectively. A significant difference was found between the least active group and the moderate and active groups. However, no difference was found between the moderate and active groups. Thus, an inverse relationship was found to exist between
BMI and PA levels. It was found that 49% of the students (37% of boys, 61% of girls) met the daily threshold on days with PE, whereas only 20% (13% of boys, 27% of girls) met the daily threshold on non-PE days. Therefore, PE can play a significant role in contributing to adolescents’ total daily PA.

Similarly, Brusseau, et al. (2011) conducted a study examining PA patterns of fourth and fifth-grade children. The purpose of the study was to describe elementary school children’s daily pedometer-determined PA patterns during PE, recess, lunchtime, at school, outside of school and total day. A total of 829 students (400 boys, 429 girls) from 6 schools in one Southwestern state participated. BMI was calculated using the BMI-for-age growth chart as provided by the CDC. The Yamax SW-200 pedometer was used to record data. Data collection lasted for five consecutive days. PE was found to account for 13.5% (1,620 steps) of the participants’ overall daily PA. No significant difference was found between gender. Boys took 1,662 steps in PE, whereas girls took 1,581 steps. Significant differences were reported across three weight statuses (normal, \( \leq \) 85%, overweight, >85 and \( \leq 95\% \) and obese, \( >95\% \)) in PE. Specifically, participants in the normal weight group had significantly more steps in PE than those in the overweight group. Those in the overweight group had significantly more steps in PE than those in the obese group. Therefore it can be concluded that an inverse relationship exists between PA in PE and weight status. Additionally, PE is an appropriate segment of the school day in which meaningful PA can and should occur.

Flohr, et al. (2006) examined PA patterns in young seventh grade adolescents (\( M \) age 12.29 years). The purpose of their study was to evaluate PA patterns based on data collected for two weeks in a row. Forty-four students from one school (19 boys and 25
girls) participated in the study. The monitoring period included the participants receiving one week of PE and one week of health education. PE lessons focused on softball and soccer with the intent to keep students active as much as possible. The Yamax DW-200 Digi-Walker pedometer was used to record data. The “time spent in PE class”, as well as “the number of steps before school and after PE class” were recorded in a logbook for each participant, pg. 311. On PE days, the participants were reminded to log the step count before the class started and after the class ended. It was found that on average, young seventh-grade students achieve as much as 17% (2,046 steps) of their daily steps during PE days when PA is based on 12,000 steps a day. Significant gender differences were not found between PE days. Seventh grade boys participating in a 50 minute PE class took 2,379 steps, while girls took 1,782 or 11% and 13% of their overall daily PA, respectively. It was concluded that PE plays a significant role in contributing to adolescents’ total daily PA.

Similarly, Tudor-Locke, et al. (2006) conducted a study examining the PA patterns of sixth grade students. The study consisted of 88 (34 males, 54 females) participants from four classrooms in one elementary school in the southwest U.S. Height and weight were measured and BMI was calculated. Participants wore the Walk4Life LS2500 pedometer for two consecutive weeks. Throughout the duration of the study, researchers were present in the school to remind participants to note the amount of steps taken at the end of PE class. Sixth grade students were reported to take an average of 1,419 steps during a 20 minute PE class, accounting for ~ 12% of their daily PA. The steps taken were equivalent to students being engaged in MVPA for 26% of the time, well below the recommended 50%. There was no significant difference found between
gender. Girls took an average of 1,410 steps during PE, and boys took an average of 1,429 during the same time. It was reported that BMI was not correlated with pedometer-determined PA. Therefore PE can play a significant role in contributing to adolescents’ total daily PA.

Likewise, Fairclough and Stratton (2005) used heart rate monitors to assess the PA levels of students in years seven through nine in England. One hundred and twenty-two students (62 boys and 60 girls) from five high schools participated. The monitoring period occurred over a 12-week period that included 66 lessons focusing on team games, striking games, individual games, movement activities, individual activities, fitness, and swimming. Participants attended a same-sex PE class twice a week which was taught by a PE teacher of the same sex. The Vantage XL heart rate monitor was used to collect data. On average, participants engaged in MVPA and vigorous PA (VPA) for 34.3 ±21.8 and 8.3 ±11.1% of the time spent in PE. Boys were found to engage in MVPA significantly more than girls, 39.4 ±19.1% and 29.1 ±23.4% (p <0.01), respectively during the same time. Additionally boys were found to engage in significantly more VPA (10.3 ±11.4% and 6.2 ±10.4%, p <0.05). It was concluded that team games encouraged the highest levels of PA. While the authors reported PE to benefit adolescents’ health, it was noted that curriculum should focus on lessons that emphasize MVPA goals.

The work of Kulinna, Martin, Lai, Kliber and Reed (2003) examined how PA in PE is influenced by grade, gender, and type of activity. Five hundred and five participants (284 boys and 221 girls) ranging in grades three through 12 from 21 schools in the Midwest participated. Participants wore the Polar Accurex Plus heart rate monitor
for one class. A heart rate monitor is another way to monitor PA levels in a PE for one class. The monitors began recording at the beginning of the class and continued to record the participants’ heart rates every 15 seconds until the end of the class. On average, participants spent 51.02% of the class in their target heart rate zone (THRZ). In terms of THRZ, main effects were found for grade, $F(1, 497) = 6.49, p < .05$ and for activity, $F(1, 497) = 17.31, p < .01$. It was reported that elementary students spent significantly more time in their THRZ while participating in individual activities (55.47%) than in team sports (49.37%), whereas high school students spent significantly more time in their THRZ while participating in team sports (57.79%) than in individual activities (35.87%). Gender, however, was not found to be significant. Therefore, different types of physical activities: team and individual, encourage different types of PA responses. Thus, it was concluded consideration should be given to the grade level when planning a PE curriculum in order to meet PA goals.

**Adolescent Physical Activity in Unstructured and Structured Recess**

Grolier International Dictionary (1986) defines recess as “a cessation of the customary activities of an engagement, occupation, or pursuit” (pg. 1088). In school terms, it is a time that occurs every day that is not related to school curriculum and allows for students to participate in leisure activities (Smith & Biddle, 2008). A structured recess, therefore, would include the aforementioned criteria, but would have organized activities planned with supervision that would include the areas of appropriate behavior as well as appropriate engagement in the activities. Recess dates back as far as the 1800’s in the US, when students would participate in such activities as catch, ball games, and chasing and fleeing games (Kahan, 2008). Recess allows for many benefits for students
including social (sharing, cooperation, teamwork, conflict resolution), emotional (stress relief, confidence, autonomy), physical (elevated heart rate, movement) and cognitive (creativity, problem solving skills, verbal communication) (Sindelar, 2004). Sindelar (2004) also reports that recess also benefits teachers, as it gives them a break from daily teaching, and can allow for personal and professional growth.

NASPE (2006) offers the following recommendations regarding recess: recess should be offered at least once a day for 20 minutes, it should not serve as a replacement to PE, students should not be held out of recess due to unfinished work or poor behavior in class or elsewhere in the school, there should be enough space so that students can play safely, recess should occur outside as much as weather permits, ample, developmentally appropriate equipment should be offered, the concept of safety is taught and enforced at all times, recess should not precede or come right after PE class, and recess should not interfere with PE class, should they be sharing the same space. The Institute of Medicine (2013) further recommends that schools adopt recess policies that require students to be engaged in MVPA for at least 50% of the time spend in recess.

Due to the increase of overweight and obese children, researchers are beginning to examine the contribution recess has on PA participation among youth. In a study by Brusseau, et al. (2011) the PA patterns of fourth and fifth-grade children were examined during PE, recess, lunchtime, at school, outside of school and total day. A total of 829 students (400 boys, 429 girls) from six schools in one Southwestern state participated. BMI was calculated using the BMI-for-age growth chart as provided by the CDC. Participants were instructed to wear the Yamax SW-200 pedometer for five consecutive days during recess and lunchtime. While the breakdown of lunchtime (time spent eating
lunch and unstructured recess after eating) was not reported, it was found that lunchtime, which lasted 40 minutes overall, provided a large portion of PA obtained during the school day. Participants on average took 1,512 steps during the entire lunch period (eating and recess), accounting for ~13% percent of their daily overall PA, when based on the 12,000 steps a day threshold. Boys were found to take significantly more steps (1,753) than girls (1,289) during this 40 minute period. Four of the six schools offered a 15 minute additional, unstructured recess. Participants were found to take 1,071 steps on average, accounting for nine percent of their daily PA. It was also found that boys took significantly more steps on average than girls on average during the additional, unstructured, 15 minute recess (1,254 steps and 917 steps, respectively). Significant differences were reported across three weight statuses (normal, ≤ 85%, overweight, >85 and ≤95% and obese, ≥95%) for lunch recess. Specifically, participants in the normal weight group had significantly more steps during the lunch recess than those in the obese group. No significant differences were found during the additional recess time. Thus recess allows for important PA opportunities for adolescents.

Likewise, Tudor-Locke, et al. (2006), examined the PA patterns of sixth grade students throughout the day. The study consisted of 88 (34 males, 54 females) participants from four classrooms in one elementary school in the Southwest US. Height and weight were measured and BMI was calculated. Participants wore the Walk4Life LS2500 pedometer for two consecutive weeks. Throughout the duration of the study, researchers were present in the school to remind participants note the amount of steps taken at end of lunchtime and recess. It was found the 40 minute lunch break (eating lunch, 25 min, and unstructured recess time, 15 min) provided a large portion of PA
obtained during the school day. Participants on average took 2,284 steps during the
entire lunch period (eating and recess), which accounts for 19% of their daily overall
PA, when based on the 12,000 steps a day threshold. Participants were found to take
1,342 steps on average during an additional 15 minute unstructured recess, accounting
for 11% of their daily PA. It was also found that boys took significantly more steps on
average than girls on average during both the 40 minute lunch break (2,695 steps and
1,873 steps, respectively) and the additional unstructured, 15 minute recess (1,622 steps
and 1,062 steps, respectively). It was reported that BMI was not correlated with
pedometer-determined PA. When considering both lunchtime and recess, it was found
that adolescents attained 30% of their overall daily PA. Therefore, these times (recess
and lunchtime) are important contributors to overall daily PA.

Similarly, Beighle, et al. (2006) examined pedometer steps during unstructured
recess and outside of school. Participants included 271 (121 boys, 150, girls) third-,
fourth- and fifth-graders from one suburban school in the Southwest US. Participants
wore the pedometer for four days in a row. Participants’ height and weight were
measured, and BMI was calculated. Participants wore the Walk4Life MLS-2505
pedometer for the 15 minute unstructured recess four days in a row. Researches were
present to ensure the entire time of 15 minutes was given, as well as to monitor the
participants. Once recess was finished, participants returned to their classrooms, removed
the pedometers. Data was recorded, the pedometers were reset and the participants picked
up their assigned pedometers at the end of the day, wearing them until bedtime. The next
morning the pedometers were collected as the participants were in their classrooms and
the data was recorded. It was found that elementary students receive nine percent of their
daily steps during recess with an average step count of 1,090 during a 15 minute recess period. It was also found that boys took significantly more steps (1,262) than girls (918 steps) during this same time. It was concluded that recess is “an important source of PA for youth and should be part of each school day” pg. 518.

The previous reported research studies examined unstructured recesses. Schools are implementing recess interventions to help ensure students are active, thus recesses are becoming more structured (Elder, McKenzie, Arredondao, Crespo, & Ayala, 2011; Huberty, et al., 2011; Ridgers, Stratton, Fairclough & Twisk, 2007; Stellino-Babkes, et al., 2010; Verstraete, Cardon, DeClercq &DeBourdeaudhuij, 2006). Elder, et al. (2011) examined the effects of structured recess on Latino children’s PA during recess. The study involved observational data as at the beginning and at the end of the interventions as part of the “Adeventuras para Niños” (APN) study. Thirteen elementary schools, with an average enrollment of 667 children, from south San Diego County, California participated. The study lasted 5 semesters. APN staff trained promoturas to implement the changes to recesses. The changes included using colorful game markings (basketball courts, etc), activity cards at designated areas, walking clubs, and “Super Adventuras” (a program that was offered to each school twice a month that offered station activities such as parachute games, aerobic dance, rope jumping, and obstacle courses). PA was measured by direct observation using the System for Observing Play and Leisure Activity in Youth. A total of 137 areas outside were used for observation, averaging 10.5 per school. Results showed girl increased participation in vigorous PA (VPA) and MVPA after a year post intervention, as well as a significant decrease in the amount of girls spending time walking at recess when compared to baseline measurements (28.2% and
34.8%, respectively). However, the percentage of boys over the same time period, were found to have decreased VPA and significantly decreased MVPA one year following the intervention (66.1% and 71.9%, respectively). While promising results were indicated, overall, it was found that the interventions “did not result in an increase in MVPA or a decrease in sedentary behavior,” pg 1755.

The purpose of the study conducted by Huberty, el al. (2011) was to determine the effectiveness of a structured elementary recess via staff training, additional equipment and playground markings on the amount of moderate physical activity (MPA) and VPA. Ninety-three students, in grades three through five from one public and one parochial school in the Midwest US participated. Participants wore the ActiGraph accelerometer one week each at baseline and post intervention. Stopwatches and logs were used to record time participated in PA through the day. The structured recesses consisted of specific activities zones with activity cards describing the activity. Because of space differences, there were five activity zones at the parochial school and seven at the public school. Activities were planned research team members, the PE teachers, and recess staff member, meeting twice a week. Activities were changed when the zone had decreased participation. Participants were allowed to switch zones throughout their recesses. The height and weight of the participants were assessed in the presence of the school nurse, and BMI was calculated. It was reported that MPA during recess significantly increased from 18.1% to 31.2% and VPA during recess significantly increased from 7.2% to 16.8%. Boys (p=0.004 for MPA) were found to more active than girls (p< 0.001 for MPA and VPA) during recess. BMI was found to have a small, negative, non-significant effect on MPA(-0.1, p=0.033) and VPA (-0.01, p=0.711). It was concluded that a structured
recess could increase PA, thus adding to participants’ overall goal of receiving 60 minutes of PA each day.

Stellino-Babkes, et al., 2010 examined structured recesses and if three specific, different activities offered each week would affect if student recess PA. Sixty-five, first-through fourth-graders (30 males and 35 females) from one elementary school in a medium-sized town in the Midwestern US participated. Participants wore the Yamax Digi-Walker DW-701 pedometers every day during their 15 minute recess for the four weeks of the study. Each week offered a different activity: week 1, no intervention activity, week 2, circuit course, week 3, obstacle course, and week 4, Frisbee. BMI was calculated for each participant using the BMI-for-age growth chart as provided by the CDC. An average of 870 steps was taken during the 15 minute recess. Boys were significantly more active than girls across all four weeks, 909 steps and 825 steps, respectively. Participants with a healthy BMI (<85%) were found to be more physically active than those that were obese or overweight (>85%). Significant differences were found between the four weeks. Participants were significantly more active during week 1 and week 2 when compared to week 4. Thus it is important to take into consideration demographical factors (sex and BMI percentile), in order to design activities that increase PA during a structured recess.

Likewise, Ridgers, et al. (2007) studied PA levels during structured recesses in order to examine the effect of playground redesign on MVPA and VPA. Two hundred ninety-seven children, ages 5-10, from 26 elementary schools from one large urban city in Northwest England participated. Fifteen schools (76 boys, 73 girls) participated in the redesign and 11 schools (74 boys and 74 girls) served as the control. Height and weight
measurements were taken and BMI was calculated. Participants wore the ActiGraph accelerometer twice (once before the design and six weeks after the design took place) from the start of the day until they were removed at the conclusion of the final recess of the day. Staff at the schools were encouraged to explain the zones during class time and encourage the use of the zones during recess. The height and weight of each participant was measured and BMI was calculated and recorded. Results indicated a positive, yet non-significant, effect for MVPA and VPA of those receiving the structured recess. Boys were found to engage in significantly more MVPA (7.2%) and VPA (3.1%) than girls during recess. BMI was found to have a negative effect, albeit small, on PA during recess for MVPA and VPA. It was concluded that it is important to consider all factors (age, sex, length of recess, and playground design) when implementing a structured recess so as to offer equal opportunities for PA to all participating in said recess.

**Physical Activity Measurements in Physical Education**

There are many ways to measure Pain various settings: self-reported logs or questionnaires, systematic observation, pedometers, heart rate monitors, and accelerometers. Pedometers were utilized in this research study as the primary means of measuring PA in PE and structured recess. Additionally, the Physical Activity Questionnaire for Older Children (PAQ-C) was used to measure students daily PA over the past seven days. Furthermore, body mass indices were used as a means to describe the overall health of the participants and how that related to their PA levels. The following section includes a literature review on the validity and reliability of self-report PA questionnaires, pedometers, and BMI.
Self-Report Physical Activity Questionnaires

Self-report PA questionnaires are becoming important tools used in measuring PA in children (Janz, Lutuchy, Wenthe, & Levy, 2008; Kowalski, et al. 2004). They are easy to administer, require little time to fill out, and do not cost much to use (Crocker, Bailey, Faulkner, Kowalski, & McGrath, 1997; Kowalski, et al., 2004). For the purpose of this study, the Physical Activity Questionnaire for Older Children (PAQ-C) was used. The PAQ-C is a self-administered, seven-day recall instrument (Kowalski, et al., 2004). It was developed to assess 4th–8th grade students’ general levels of PA. The PAQ-C can be administered in a classroom setting and provides a summary PA score based on nine items all scored on a 5-point scale (Kowalski, et al., 2004).

Crocker, et al. (1997) conducted three different studies and reported that the PAQ-C is a valid and reliable measurement tool of PA. Item and scale properties were examined in the first study. Ninety females and 125 males, ages 9-15, from two different public schools completed the PAQ-C. Participants from within each school were administered the questionnaire on the same day, with two days between measurements for each school. It was found that all item scale correlations were above 0.30. Scale reliability was found to be acceptable for females (α = 0.83) and males (α = 0.80).

Test re-test reliability, internal consistency, and sensitivity to gender differences were examined by Crocker, et al., 1997. Eighty-four participants (41 females, 43 males) from one public school, ages 9-14, in grades four through eight completed the PAQ-C twice during the day, with one week between measurements. Test re-test reliability was found to be acceptable for both females (0.82) and males (0.75). Internal consistency for the first assessment was (α = 0.79) and (α = 0.89) for the second assessment. Males were
found to be significantly more active than females in both week 1 $t(82) = 1.93$, $p < 0.05$ and week 2 $t(82) = 1.97$, $p = <0.05$.

Crocker, et al. (1997) examined the reliability of PAQ-C using the average of two or three scores. Two hundred (102 females, 98 males) participants in the Saskatchewan Pediatric Bone Study, ages eight to 16 completed the PAQ-C two or three times: twice in their classrooms at school, and the third at the Royal University hospital. The PAQ-C was modified for those in high school in that the recess item was deleted and the activities were changed to represent more activities that high school students would participate in. Based on generalizability theory, it was found that the average of two or three scores were reliable for participants 12 years or younger ($G = 0.80$ and $G = 0.86$, respectively), as well as for participants 13 years or older ($G = 0.85$ and $G = 0.90$, respectively).

Convergent and construct validity of the PAQ-C was examined by Kowalski, Crocker and Faulkner (1997). Eighty-nine students (51 female, 38 male), ages 8-13 years old, were recruited from the Saskatoon Public School System. Each participant completed a behavioral conduct measure, athletic competence measure, the PAQ-C, an activity rating, and a daily MVPA measure. Additionally, a teacher’s rating of student PA was also completed. Convergent validity was supported in that the PAQ-C was moderately related with the activity rating ($r = 0.63$), MVPA ($r = 0.53$), and teacher’s rating of PA ($r = 0.45$). Construct validity was supported by the moderate relationship between the PAQ-C and the athletic competence measure ($r = 0.48$).

Based on the research, the PAQ-C is a valid and reliable method for assessing the PA of older children. It’s low cost, ease of administration, and ease of use for those
actually participating in it, make it a reasonable choice for those studying large groups of children.

**Pedometers**

Pedometers have become an increasingly popular method to study PA in field based settings such as PE. A pedometer is an unobtrusive device that is worn on the waist band of a person’s pants that records the number of steps a person takes. There are three ways in which a pedometer is mechanized. Schneider, et al. (2003) states the following:

The first type uses a spring-suspended lever arm that moves up and down in response to the hip’s vertical accelerations. This movement opens and closes an electrical circuit; the level arm makes an electrical contact (metal-on-metal) and a step is registered. The second type of mechanism is a magnetic reed proximity switch. With this mechanism, a magnet connected to a spring-suspended horizontal lever arm within the pedometer moves up and down with each vertical acceleration of the hip. The magnetic field triggers a proximity switch encased in a glass cylinder and a step is counted. The third type uses an accelerometer-type mechanism consisting of a horizontal beam and a piezoelectric crystal. Pedometers using this particular mechanism can distinguish between differing intensities of exercise when estimating caloric expenditure. (p. 1779)

While some pedometers boast their ability to calculate caloric expenditure and distances traveled, they are most accurate in counting steps (Bassett, et al., 1996; Bassett, Cureton & Ainsworth, 2000).
For the purpose of this study, the Digi-Walker SW-701 will be used. The Digi-Walker SW-701 pedometer has an “internal sensor mechanism that uses a coiled spring-suspended lever arm” to measure steps (New Lifestyles, n.d., p.1). It also calculates distance traveled based on the length of the user’s stride (New Lifestyles, n.d.). It also allows for the user to enter his or her weight in order to calculate estimated caloric expenditure. According to the New Lifestyles website (n.d.), it works best for those who are not considered obese and for those traveling at a speed greater than 2.5 miles per hour (mph).

Schneider, et al. (2003) examined the accuracy and reliability of 10 electronic pedometers for counting steps. Twenty (10 male and 10 female) adults (ages 22-69) volunteered for the study. Ten commercially available pedometers were examined: freestyle Pacer Pro, Kenz Lifecorder, New Lifestyles NL-2000, Omron HJ-105, Oregon Scientific PE316CA, Sportline 330 and 345, Walk4Life LS 2525, Yamax Skeletone EM-180, and the Yamax Digi-Walker SW-701. Each participant walked around a 400-meter outdoor track while wearing devices of the same model on both hips. Next the participant would repeat the 400-meter lap with two more devices of the same model worn previously to determine intramodel reliability. This procedure was repeated for each of the 10 models. A researcher walked behind the participant to get actual step counts using a hand-tally counter. Participants wore the same pair of tennis shoes, and took one to four days to complete the study. Placement of the pedometer (right hip or left hip) was not found to be significant. The SW-701 was shown to have the smallest mean error (0.1) when compared with nine other pedometers. It was found that this particular model was
accurate to ±17 steps of an average of 512 steps, or within ±3% of the actual steps taken 95% of the time.

Similarly Crouter, et al. (2003) examined the accuracy and reliability of 10 different pedometers measuring steps taken, distance traveled, and kilocalories at various treadmill speeds. Ten subjects, five males and five females with a mean age of 33 ±12 years participated. The following 10 pedometers were examined: Yamasa Skeletone EM-180, Sportline 330 and 345, Omron HJ-105, Yamax Digi-Walker SW-701, New Lifestyles NL-2000, Kenz Lifecorder, Oregon Scientific PE316CA, Freestyle Pacer Pro, and Walk4Life LS 2525. Participants wore two of the same devices at the mid-line of each thigh on the side of the body. The participants walked on a Quinton Model Q55XT treadmill for five minutes at the following speeds: 54, 67, 80, 94, and 107 m·min⁻¹. Actual steps were counted by a researcher using a hand counter. It was found that the SW-701 did not significantly over- or underestimate actual steps at any speed (P<.05). The SW-701 was shown to be accurate within ±1% of actual steps at speeds of 80m·min⁻¹ and greater.

Smith and Schroeder (2010) examined the accuracy of two different mechanized (spring levered and piezoelectric) pedometers in children while walking, skipping, galloping, sliding, and hopping. Thirty-seven (18 boys and 19 girls) fifth graders with an average age of 11.5 years participated. The SW-701 Digi-Walker (spring levered) and New-Lifestyles® NL-800 (piezoelectric) pedometers were used to collect data. The SW-701 Digi-Walker was placed on the anterior mid-line of the right thigh and the New-Lifestyles® NL-800 was placed immediately to the right of the SW-701. For each locomotor skill (walking, skipping, galloping, sliding, and hopping), researchers took
hand counts, called actual counts (ACs). Participants performed the skills over the length of a regulation basketball court. ACs and pedometer counts were recorded at the end of the locomotor skills. The SW-701 was found to have significantly lower counts than the ACs for skipping, galloping, sliding, and hopping. No significant difference was found for walking.

While pedometers have been shown to accurately measure steps when walking and running, they have been shown to be significantly lower in other types of locomotor movements (Crouter, et al., 2003; Schneider, et al., 2003; Smith & Schroeder, 2010). However, due to the low cost and ease of use, pedometers are still a viable method for measuring PA in both adults and children in a field-based setting.

**Reactivity in Pedometers.** When conducting research that involves pedometers, it is important to be aware of the effects of wearing such devices. Reactivity is defined by a change in one’s normal PA behavior when one’s PA is knowingly being monitored (Puhl, Greaves, Hoyt, & Baranowski, 1990; Welk, Corbin, & Dale, 2000). In terms of PA being measured by pedometers, reactivity would show up as a general decrease or increase, from day to day, in steps recorded across the measuring period (Ozdoba, Corbin, & LeMasurier, 2004; Vincent & Pangrazi, 2002). The following is a brief review of literature regarding reactivity and pedometers.

Vincent and Pangrazi (2002) examined whether reactivity occurs in elementary students when their activity was monitored. Forty-eight second- (7 females, 5 boys), fourth- (10 females, 5 boys), and sixth-graders (10 females, 11 males) from an urban elementary school participated in the study. Following a period of orientation with the pedometers, participants wore sealed pedometers for eight days. Pedometers were put on
at the end of the school day and worn until bedtime. Participants were instructed to put
the pedometer on once they were dressed the next morning. Pedometers were collected
first thing in the morning at school. Data was recorded, pedometer were reset and
resealed, and were handed back to participants at the end of the school day. A MANOVA
revealed there was no significant differences in step counts between the eight days for all
participants ($F_{(7,294)} = 1.25, p = 0.28, power = 0.52$). The steps the participants took did
not significantly change day to day, thus indicating reactivity did not occur.

Similarly, Ozdoba, Corbin, and LeMasurier (2004) examined reactivity in
elementary school children when monitored by unsealed pedometers. Forty-five (24
females, 21 males) fourth-grade students from two classes in one elementary school
participated. The participants wore the pedometers for four consecutive days for two
weeks. In the first week, Class 1 wore sealed pedometers, in the second week both Class
1 and Class 2 wore unsealed pedometers, and in the third week, Class 2 wore sealed
pedometers. The students received their pedometers on Monday morning and were told to
take it off only for bathing or going to bed and to put it back on once they were dressed
the next morning. Pedometers were turned in the next morning into a bin, and participants
filled out a daily pedometer questionnaire. Once the questionnaire was turned in,
researchers took the both the questionnaires and pedometers to another room to record
step counts, reset to zero and sealed (if the treatment called for such), and immediately
returned to the classroom and handed out. There was no significant main effect for sex.
An indication of reactivity would be differences between the first days and last days of
data collection. There was a significant main effect found in that Day 3 was different
from the Day 1 and Day 4. However, when the researchers went back to their records, it
was found that it rained on Day 3 of the first week, thus causing a lower than normal step count. Therefore, the researchers report that there was no indication of reactivity.

Conclusions

In summary, participating in daily PE and recess, be it unstructured or structured, can provide a significant amount towards adolescent’s overall PA. Many studies have shown the contribution of PA from PE and recess: adolescents are receiving roughly 18% of their daily steps, when based on a threshold of 12,000 steps, in PE and recess can account for roughly 20 percent of students’ daily PA. Therefore, if students received both daily PE and recess, the PA acquired could account for upwards of 40 percent. This is an important factor to point out, especially since more and more schools are cutting the time spent in PE by as much as 40 minutes a week (CEP, 2008). While PE seems to offer roughly the same amount of PA for both males and females, recess does not (Beighle, et al., 2006, Stellino-Babkes, et al., 2010, Tudor-Locke, et al., 2006).

Research is limited in regards to the contribution of PE and structured recess to adolescents’ overall PA based on a 12,000 step threshold. Research is also limited in regards to the role BMI plays in each setting in regards to overall PA. Thus, this research examined the contribution of PE and recess to 6th grade adolescents’ overall PA. Additionally, this study also examined the relationships between gender, PA outside of school (PAQ-C), BMI and steps during both recess and PE.
REFERENCES


President’s Council on Physical Fitness and Sports. (2001). *The president’s challenge physical activity and fitness awards program*. Bloomington, IN: PCPFS.


