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Measuring general activity levels in children and adolescents using self-report: youth activity profile

Yang Bai
Iowa State University

Measuring general activity levels in children and adolescents using self-report: youth activity profile

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Yang Bai

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Program of Study Committee:
Gregory J. Welk, Major Professor
Senlin Chen
Michelle Ihmels

Iowa State University

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ABSTRACT

The Youth Activity Profile (YAP) is an online physical activity (PA) assessment tool to assess children's PA at school (PAS), PA at home (PAH) as well as sedentary behavior (SED). To date, no primary study has evaluated the utility of the YAP for use in school physical education programs. **Purpose**: The primary purpose of this study was to evaluate grade and gender-related patterns of YAP scores in a large sample of 5th to 8th grade school children. A secondary goal was to examine relationships between PA levels and sedentary behavior and field measures of physical fitness (PF). **Methods:** Data were collected through a participatory network of schools that receive training and support through the FITNESSGRAM program. A total of 3165 youth from 31 elementary and middle schools completed the YAP and a total of 5339 youth from the same schools completed the FITNESSGRAM test. Age and gender differences in YAP scores were tested by a two way (grade x gender) mixed model analyses of variance. Data from the YAP and FITNESSGRAM were also aggregated by grade level and combined to examine associations between PA and PF. Partial correlations (Pearson) were used to control for school level clustering. **Results:** Significant main effects were found for gender ($F = 66.20$, $p < 0.0001$) and grade ($F = 4.40$, $p<0.01$) for PAS. Similar main effects were observed for PAH (gender: $F = 31.41$, $p < 0.0001$; grade: $F = 8.28$, $p<0.0001$) but the interaction term was also statistically significant ($F(3, 3120) = 5.85$, $p < 0.01$]. Boys were found to be more active than girls and activity is higher among younger than older children. A significant main effect for grade ($F = 13.39$, p

<0.0001) was found for SED but non-significant effects were found for gender and the interaction. The PAS indicator had a significant positive correlation with aerobic capacity ($r=0.42$, $p<0.01$) and a significant negative correlation with BMI ($r=-0.34$, $p<0.05$). The SED indicator had a significant negative correlation with aerobic capacity ($r=-0.29$, $p<0.05$) and a significant positive correlation with BMI ($r=0.66$, $p<0.01$). **Conclusions:** The YAP is able to capture the typical PA and SED patterns. The relatively high correlations between PA, SED, and PF support the validity of the YAP. The YAP provides a useful tool to facilitate evaluation and tracking of physical activity in school and at home. The web-based features and easy data management offer promise for use of YAP in large school-based tracking studies or population surveillance.

Chapter Ⅰ: GENERAL INTRODUCTION

Introduction

Childhood and adolescence are important periods of life due to dramatic changes in various physiological and psychological aspects, and also due to healthy/unhealthy lifestyle and behaviors are formed during this time (Ruiz & Ortega, 2009). Behaviors established in childhood tend to track into adolescence and adulthood. Overweight/obese youth are at a five times greater risk of obesity in early adulthood compared with children at the same age with normal weight (Thompson et al., 2007). The unique needs for children warrant specific activity guidelines to promote physical activity in children. The US Department of Health and Human Services published the new US physical activity guidelines in 2008, which suggest children and adolescents should accumulate 60 minutes or more of physical activity daily.

Schools have been called upon by many professional agencies and public health groups to play a key role in promoting physical activity. Many states have established guidelines that call for youth to obtain at least 150 minutes of physical activity per week (essentially half of the daily recommendation since children are in school half the day). Surprisingly, there has been little work focused on developing instruments that can evaluate and track children's level of physical activity at school. Physical education has tended to focus on assessments of health related physical fitness, but emphasis is also needed to help students establish lifelong physical active patterns (Pate & Hohn, 1994). Coordinated fitness testing certainly has value when used appropriately in physical education. However, it can also send the wrong message by only focusing youth on achieving fitness rather than on also being physically active (Welk, 2008). Corbin suggested changing physical education focus from fitness to physical activity since when instruction time is limited, fitness is hard to enhance (Corbin, 2002). The development of easy to use physical activity assessments that can be used within a school setting would help children learn about the importance of physical activity and help schools evaluate their effectiveness in promoting physical activity. A variety of tools are available to assess physical activity but self-report instruments provide the most potential for large scale use since they are easy to use and inexpensive (Welk, Corbin, & Dale, 2000).

A variety of self-report instruments are available to measure youth PA but it is important to consider their relative advantages and disadvantages for school applications (Sallis & Saelens, 2000). The most commonly used and validated self-report instruments include Physical Activity Questionnaire (PAQ), Self-administered Physical Activity Checklist (SAPAC), and the Previous Day Physical Activity Recall (PDPAR). In addition, the FITNESSGRAM program developed a computerized self-report instrument based on the PDPAR (ACTIVITYGRAM) that has considerable potential for school-based PA assessment (FITNESSGRAM Manual). It has been shown to provide valid estimates of physical activity but it has not been widely adopted in schools due to the requirement to collect and enter data over several days. Simpler self-report tools may be needed to facilitate the adoption of these tools in schools.

Among the available validated self-report instruments, the most promising tool may be PAQ. The PAQ is a self-report tool designed to assess student activity during school session. It is also easy to use and quick to administer (Crocker, 1997). There are two versions of PAQ depending on age and school setting. Be specific, PAQ-Children (PAQ-C) includes nine items, and eight items for PAQ-Adolescent (PAQ-A). Each question scored on a 5-point scale and combined for a total physical activity score. The values are averaged to create a composite score with a higher value indicative of a higher activity level (Crocker, 1997). One Strength of the PAQ is that it quantifies a general physical activity level for a whole week rather than trying to estimate overall frequency, intensity and duration with detailed questions. The PAQ also provides specific information about activity levels at different periods of the day (e.g. morning, lunch, recess, physical education, after school etc.). Similar to the ACTIVITYGRAM, this feature may assist in activity promotion efforts. Key advantages are that it is simple, easy to complete, and easily administrated in school settings with a large-scale population (Kowalski, Crocker, & Donen, 2004).

Several studies have supported the psychometric characteristics of the PAQ. Studies have shown that the PAQ has acceptable item-scale properties, reliability, internal consistency, sensitivity to gender and season differences (Crocker, 1997), all of which indicate that PAQ-C is a valid questionnaire to assess children's general level of physical activity. A more recent validation study also confirmed the good internal consistency and concurrent validity of PAQ (Janz, Lutuchy, Wenthe, & Levy, 2008). In addition, Janz et al. (2008) showed a higher association between the PAQ-A and MVPA than associations between the PAQ-A and total PA minutes.

The PAQ has good potential for use in school-based testing but additional research is needed to evaluate gender and age-related patterns and relationships with other indicators such as physical fitness. Admittedly, health-related fitness testing is the predominant approach in physical education system, though debates of fitness testing have been increasing in recent years (Cale, Harris, & Chen, 2007; Corbin, Pangrazi, & Welk, 1995; Rowland, 1995). Silverman et al. (2008) addressed the value of administering and interpreting health-related fitness tests in fitness education. However, incorporating both the physical activity assessment and fitness testing in fitness education might better develop fitness and physical activity plans and help increase students' knowledge and motivation for physical activity (Welk, 2008). The PAQ is a practical and easy to use, self-report survey that has considerable potential for use in school based programming.

Purpose of the Study

The goal of the present study is to evaluate the utility of a modified version of the PAQ (Youth Activity Profile - YAP) designed for use in schools. The YAP provides separate estimates of school activity, out of school activity and sedentary behavior. Six of the items are based conceptually on items from the existing PAQ while four additional items were developed to capture activity at other time periods (both at school and at home). The YAP also includes five additional items designed to capture sedentary behavior. Reducing sedentary behavior is an important priority for youth activity promotion so it is important to have an estimate of this behavior.

The primary goal of the study was to evaluate age and gender-related patterns in YAP scores in order to better understand and to capture descriptive information about levels of physical activity (and sedentary behavior) in school children. A secondary goal was to examine relationships between physical activity and physical fitness. This is intended to provide an evaluation of the validity of the YAP tool and to provide insights about how it might complement fitness evaluations in physical education. Collectively, the study will help to evaluate the value of incorporating both physical activity assessment and physical fitness testing together in PE curriculum.

Chapter Ⅱ: LITERATURE REVIEW

The Benefits of Physical Activity for Youth

Physical activity is recognized to have important benefits for all segments of the population. The U.S. Department of Health and Human Services has published official physical activity guidelines which are regarded as the first official physical activity guideline for Americans. The Guidelines provide specific recommendations for the type and amount of PA needed for different segments of the population including children and adolescents, adults, the elderly, and those with special needs. A review by Warburton et al. (2006) summarized the various health benefits of regular physical activity. According to the review, physical activity has been shown to improve body composition, promote glucose homeostasis, enhance insulin sensitivity, reduce blood pressure, improve lipid lipoprotein profiles (e.g., through reduced triglyceride levels, increased high density lipoprotein [HDL] cholesterol levels and decreased low-density lipoprotein [LDL]-to-HDL ratios), reduce systemic inflammation and blood coagulation, promote autonomic tone and enhance cardiac and endothelial function. In short, regular physical activity is absolutely critical for good health.

Physical activity is important for all segments of the population but there is considerable interest in promoting physical activity in youth. This is due in large part to concerns over the increasing prevalence of obesity, but also to the growing consensus about the importance for good health. Childhood and adolescence are important periods of life because of dramatic changes in various physiological and psychological aspects, such as hormonal regulation, body composition, transient changes in insulin sensitivity (Ruiz & Ortega, 2009). More significantly, many lifestyle habits established during childhood and adolescence periods tend to track into adulthood (Ruiz & Ortega, 2009). Preventing obesity in early life is critical since evidence suggests that overweight youth have a five times greater risk of being overweight than normal weight children of the same age (Thompson et al., 2007).

The unique needs for children warrant unique activity guidelines. The new US guidelines suggest that children and adolescents should accumulate 60 minutes or more of physical activity daily. The amount of physical activity recommended to youth is twice that of adults, not only because youth have more freedom and greater needs for physical activity, but also because forming a healthy lifestyle at an early age has an influence on lifestyle later on. The United States is not the only country that has adopted national physical activity guidelines for youth. A number of other countries including Australia, the United Kingdom, and Canada have published their own guidelines. Though there are minor discrepancies between them, all of the guidelines suggest that youth should engage in at least 60 minutes of moderate intensity physical activity on a daily basis.

The message of formalized youth physical activity guidelines has generated considerable interest in understanding and promoting levels of physical activity in children and adolescents. Schools have been targeted as one of the most promising settings for reaching and impacting youth. A number of health and education agencies have established specific recommendations for physical activity in schools. A variety of assessment tools are also available but they differ in validity and feasibility. This literature review will summarize the various options for assessing physical activity in youth and provide background information for the proposed research. Emphasis will be based on more practical methods that can be used in schools since there is specific interest in documenting levels of activity during the school day.

Physical Activity Measurement Techniques

Various instruments of assessment are available for measuring physical activity among children and adolescents. Sirard and Pate (2001) classified physical activity measurement into three categories: primary measures (e.g. direct observation, doubly labeled water, and indirect calorimetry), secondary measures (e.g. heart rate, pedometer, and accelerometers), and subjective measures (e.g. self-report, interviews, proxy-reports, and diaries). However, not all of them are appropriate for use in school and physical education settings. For instance, doubly labeled water (DLW) is considered to be the standard of physical activity measurements for its accuracy in evaluating energy expenditure, but it is not appropriate for use in assessing physical activity in school settings and physical education. DLW also has its own limitations. For example, it is expensive making it impractical for large scale studies. It is also time-consuming, typically requiring 7-14 days to complete. Most importantly, the only indicator obtained from DLW is total energy expenditure. Other important physical activity information, such as intensity, duration, type, frequency and domain, must be obtained in some other way.

Welk and Wood (2000) reviewed tools that could be effectively used in school based settings to evaluate activity in youth. The review emphasized three of the most popularly utilized physical activity assessment tools including heart rate monitors, pedometers and self-report instruments. These methods are briefly summarized below.

Heart Rate Monitors

Heart rate monitors provide a parameter of a person's physiological response to certain intensities of activity based on the linear relationship between heart rate and oxygen consumption (VO_2). Sirard et al indicated that the usage of heart rate monitors within physical education programs can help students learn the function of the cardiovascular system and how to monitor time spent in individualized target heart rate ranges (Sirard & Pate, 2001; Welk, 2008). However, heart rate monitors have numerous limitations in school setting physical activity assessment (Armstrong, 2006; Welk & Woods, 2000). First, it is costly, making it difficult to use in large samples of school participants. Secondly, heart rate can be influenced by other factors like anxiety, environment, illness, stress, individual emotion, personal fitness level, type of muscular contraction, caffeine and some medications (Armstrong, 2006; Welk & Woods, 2000). Those parameters might limit heart rate monitor accuracy.

Pedometers

Pedometers are portable electronic or electromechanical devices that count a person's steps and estimate the distance a person walks over a period of time (Sirard & Pate, 2001). Pedometers have a number of popular advantages. First, pedometers are easily utilized. Secondly, parameters (steps and mileages) from pedometers are easily interpreted. Thirdly, pedometers provide a general activity pattern (Welk, 2008).

There is considerable variability in the reliability and validity of pedometers (Crouter, 2003), but, in general, they have been shown to provide good indicators of daily steps. However, a big disadvantage of pedometers is that they cannot measure non-locomotor activities (Welk, 2008; Welk et al., 2000). Most units also do not directly estimate minutes of physical activity or enable data to be stored internally for tracking and downloading. These characteristics and the costs limit the utility of pedometers for school evaluation.

Self-report Instruments

Self-report instruments have been the most common way to assess physical activity in youth since they are time and cost-effective and easy to administer to large sample sizes (Welk et al., 2000; Welk & Woods, 2000). However, they also have a number of limitations including issues with validity and reliability and difficulties in scoring and interpretation (Welk & Woods, 2000). A number of studies have examined the validity and reliability of different types of self-report instruments. The weak results in some studies have caused some to question the utility of employing self-report instruments with children.

Despite significant limitations, self-report tools still offer considerable potential for school applications (Welk, 2008). Self-report instruments provide a way to teach important principles about physical activity and help youth learn about the recommended types and amounts of physical activity. They also provide a way to evaluate group changes over time or to compare different schools to examine the relative effectiveness of different programs or environments. They provide the most effective way to evaluate school level activity promotion strategies so new methods are needed to overcome limitations highlighted in previous research. A detailed review of different self-report tools is provided in the next section.

Standards from Devellis' theory in Scale Development: Theory and Applications (2011) provide useful guidelines to interpret the psychometric properties of various survey tools. According to his theory, there are four psychometric properties to follow for the items of a questionnaire. First, item means should be close to the center of a range of possible scores. Second, each item should have relatively high variance which allows for differentiating traits among subjects. Third, it is desirable that individual items should be correlated with each other. Fourth, the questionnaire or tool should have good internal consistency (reliability).

Review of Different Self-Report Instruments for Youth

A number of different self-report approaches are available for youth but it is important to consider the relative advantages and disadvantages. Some instruments are based on recalling details of a previous day or series of days, such as the Weekly Activity Checklist, Yesterday Activity Checklist, 3-Day Aerobic Recall, Self-Administration Physical Activity Checklist, Three Day Physical Activity Recall, Previous Day Physical Activity Recall, ACTIVITYGRAM. Other instruments are focused on assessing typical or “general” activity profiles, such as the Physical Activity Rating, Physical Activity and Exercise Questionnaire, Physical Activity Questionnaire for Children, and the Physical Activity Questionnaire for Adolescents.

Instruments also vary in how they collect data on activity. Some instruments are based on detailed lists of activities in which children are asked to indicate if they participate in a certain activity and how often (e.g. Weekly Activity Checklist, Yesterday Activity Checklist, Self-Administration Physical Activity Checklist, Physical Activity Checklist interview, Physical Activity Questionnaire for Older Children, Physical Activity Questionnaire for Adolescents). Other tools use time prompts that have children estimate activity levels during different periods of time (e.g. Previous Day Physical Activity Recall, Three Day Physical Activity Recall, and the ACTIVITYGRAM).

The section below will provide detailed reviews of several of the more commonly used self-report tools (Sallis & Saelens, 2000): Physical Activity Questionnaire for Children and Adolescents, Previous Day Physical Activity Recall, Three Day Physical Activity Recall, ACTIVITYGRAM. The sections below summarize the psychometric properties of various self-report instruments that offer promise for school-based activity assessment.

Physical Activity Questionnaire (PAQ)

The PAQ is a simple self-report tool designed to assess activity over the past week. There are two versions of the Physical Activity Questionnaire which are Physical Activity Questionnaire for Older Children (PAQ-C) and Physical Activity Questionnaire for Adolescents (PAQ-A). The PAQ-C is designed for elementary school children ages 8 to 14 approximately (grades 4-8) while the PAQ-A is designed for high school students ages 14-20 approximately (grades 9-12). Both of the questionnaires are designed to measure general moderate to vigorous physical activity levels during a typical week in school year (Crocker, 1997). The PAQ includes nine items (eight items for PAQ-A), each scored on a 5-point scale. The values are averaged to create a composite score with a higher value indicative of a higher activity level. The first question provides a physical activity checklist including over twenty different kinds of sport and exercise activities asking the students how many times they do each in the past seven days. The next six questions examine their activity level in different school settings at certain periods in the last seven days (PE, recess, immediately after school, evening, weekends). The eighth question requires the students to summarize their general activity levels from among five different statements. The last one asks students to report their frequency in physical activities for each day of the previous week.

The PAQ has both limitations and strengths. A key limitation is that it does not provide a useful outcome measure such as energy expenditure or total minutes of physical activity. Additionally, the PAQ focuses on activity at school and is not appropriate for assessing physical activity during winter and summer breaks. While these are significant limitations, it also has some advantages compared with other self-report instruments such as time efficient, use lunch and evening to enhance recall ability, and short administration time to obtain a past week physical activity pattern.

The original research on the reliability and validity of PAQ-C in measuring general physical activity levels in children was conducted by Crocker et al. in three separate studies. In the first study (Crocker, 1997), 215 students (90 females, 125 males ages 9 to 15) completed the survey to examine the items and scale properties in PAQ-C. With the exception of three items (activity checklist, physical activity class and lunch), the results had relatively high variance and were close to the center of a range of possible scores. When examined by MANOVA, it was found that males were significantly more active than females for most of items ($P<0.05$) except for physical education class ($P>0.08$). The values of all item-scale relations were higher than 0.30. The reliability of the scale is acceptable for both males and females (a=0.80 and a=0.83 respectively). Since the items of the scale generally met the four criterions of psychometric properties DeVellis suggested mentioned above, the PAQ-C turned out to have acceptable item-scale properties.

In a second study (Crocker, 1997), internal consistency, test-retest reliability and the sensitivity to gender differences were examined. 43 boys and 41 girls aged 9 to 14 finished PAQ-C twice within one week. The reliability of PAQ-C was tested and the reported intraclass correlation coefficients were good for both male (r=0.75) and female (r=0.82) participants. However, the PAQ-C activity scores showed significant differences over the two assessments for males (scores increased from 2.85 ± 0.73 to 3.16 ± 0.91) and females (scores increased from 2.56 ± 0.65 to 2.79 ± 0.80). Crocker et al. attributed this change to the change in weather. The internal consistency of the PAQ assessments is high (alphas ranging from 0.79 to 0.89). An evaluation of gender differences indicated that boys were more active than girls for both week 1 [$t(82) = 1.93$, $p < 0.05$] and week 2 [$t(82) = 1.97$, $p < 0.05$]. It can be concluded from this study that the test-retest reliability was reasonably good and that the PAQ-C can differentiate boys and girls physical activity levels.

In a third study (Crocker, 1997), the authors collected data in elementary students and high school students (using a modified version of the PAQ that had the recess item removed and an altered activity list). Data were collected in different seasons (fall, winter and spring) to examine the reliability by generalizability theory. The authors reported that the average of either two or three PAQ-C scores used as a yearly activity composite score were reliable for the younger sample (G = 0.86 and G = 0.80 respectively) and the older sample (G = 0.90 and G = 0.85 respectively). Gender and seasonal differences were also found in the study. The average male activity score was 3.11 which is higher than the female score 2.71. Students exercised more in April than Oct-Nov (3.10 and 2.79 respectively).

These three studies provide evidence to document that the PAQ-C has acceptable item-scale properties, reliability, internal consistency, and is sensitive to gender and seasonal differences. These characteristics support the PAQ-C as a valid questionnaire to assess children's general level of physical activity (Crocker, 1997).

Another newer validation study has provided a more robust evaluation. Janz et al. (2008) conducted an independent validation to examine whether the outcome measures from the PAQ-C and PAQ-A correspond to objectively measured PA from an accelerometry-based activity monitor (concurrent validity). The authors reported relatively high correlation coefficients for total PA and percent of day spent in MVPA (r=0.56 and r=0.63, respectively). The author indicated that this is the highest correlation between any 7-day physical activity recall for youth and an objective measures. In addition, high standardized Cronbach alphas (from 0.72 to 0.88) for both versions suggested good internal consistency. Another significant finding in their study is the higher associations between the PAQ-A and MVPA than associations between the PAQ-A and total PA. This increased confidence in the ability of the PAQ-A to accurately estimate MVPA. This is significant for physical activity promotion and intervention, because it is widely accepted that MVPA is the most beneficial physical activity pattern with health outcomes. Also, most published PA guidelines focus on the accumulation of MVPA.

It is noteworthy that the researchers in this study modified both of the surveys in some aspects. First, they added some common midwestern seasonal physical activities (e.g., snowboarding), which made the activities list more appropriate and applicable. Second, Q2 and Q4 were eliminated and Q1 was rescaled based on items associations with the activity monitor in both previous and current research. Third, the rewritten versions are capable of being administered throughout the whole year, including winter and summer breaks, which eliminated the limitation of the PAQ-A and PAQ-C as only being useful for school based assessments. The modifications improved the validity of the PAQ-A and PAQ-C, and supported the rewriting and modifications in the survey. Other changes could be made if the surveys were applied in specific districts and among particular subjects or schools with certain policies (e.g., restricted physical activity during lunchtime) (Janz et al., 2008).

Previous Day Physical Activity Recall

The Previous Day Physical Activity Recall (PDPAR) is a self-report instrument intended to capture the previous day's physical activity patterns of children after school hours from 3:00 pm to 11:30 pm. It is a time-based recall approach and the time period is divided into 17 blocks, 30 minutes each. Children are asked to recall their specific activity from an activity checklist of 35 common activities which are grouped into the following categories: eating, sleep/bathing, transportation, work/school, spare timework, and physical activity. The children are also required to note the intensity of the activity by four levels (very light, light, moderate, or vigorous) per block of time. The PDPAR also provided some cartoon illustrations describing the characteristic of each intensity level to help children to rate their physical activity intensity. Each activity has its own corresponding MET values for all four intensity levels to facilitate the energy expenditure calculation. The PDPAR requires one day recall and uses a segmented day format to facilitate recall.

Weston et al. (1997) tested the validation of PDPAR in youth with pedometer, Caltrac activity counts and heart rate monitor as criterion measurement. A total of 119 students in grades 7-12 were randomly selected to participate in this study. The results showed high test-retest reliability coefficient (r=0.98) which indicated that students' ability to recall the physical activity within one hour is consistent. The investigators reported high inter-rater reliability (r=0.99), indicating that the PDPAR scoring protocol could be coded consistently by different researchers. The estimated energy expenditure from PDPAR was compared against outcome measures from a pedometer and a Caltrac monitor. The correlations between the PDPAR and the other two indicators were high (r=0.88 and r=0.77, respectively). Three other types of analyses derived from heart rate range (HRR) data were conducted. The estimated energy expenditure in each 30 min block had low correlations with corresponding mean HRR. However, higher correlations were detected between mean HRR and mean estimated energy expenditure over the entire after-school time blocks in all participants. Moderate to vigorous activity reported from the PDPAR also showed high correlation with heart rate at or above 50% HRR. Though the study indicated reasonable reliability and validity, several experimental design flaws should be considered. The main limitation was that none of the comparison measures (pedometer, Caltrac counts and heart rate) provide an ideal criterion method. A general limitation of the PDPAR is that it only records one day physical activity pattern which is not long enough to capture the general habitual activity style. The authors recommended collecting data over several days (Weston et al., 1997) and this has become standard practice when the PDPAR has been used.

Trost et al. (1999) conducted a more comprehensive validation study of the PDPAR. The CSA 7164 accelerometer was used to evaluate the validity of PDPAR in 5^{th} grade students. The study found that the correlation between mean MET from PDPAR and CSA counts for each time block was 0.57, which is lower than the correlation in the Weston study (Weston et al., 1997). Self-reported participation in vigorous activity (METS $\geq$ 6) had a higher correlation with the CSA (r=0.38) than corresponding correlations (r=0.19) for moderate activity (METS 3-6). This result indicated less favorable evidence to support the validation of PDPAR in young children, especially for estimating moderate physical activity. This study reached the same conclusion as other studies that the PDPAR is more valid among higher grade students than lower grade students. Despite these limitations, the PDPAR has proven to provide good utility for school based assessments.

3-Day Physical Activity Recall

The Three Day Physical Activity Recall (3DPAR) is a self-report instrument derived from the previous day physical activity recall (PDPAR). It uses 30-min time block, 34 blocks (from 7:00 am to midnight) each day to capture physical activity characteristic of adolescents over a three-day period. Each day is also grouped into three time periods--morning, afternoon and evening. The participants are asked to recall their activity type from a checklist of 59 common activities which are divided into the following groups: sleep/bathing, eating, work, after-school/spare time/hobbies, transportation, and physical activities/sport. They are also required to assess the intensity of activity among light, moderate, hard, or very hard. Because it records three days physical activity, it may provide evidence for researchers to assess participant's physical activity pattern. It might be an appropriate school-based physical activity data collection instrument since it can be completed in a short session (30 to 40 min).

A validation study was conducted by Pate et al. (2003) to test the validity of total, moderate-to-vigorous, and vigorous physical activity estimated from the 3DPAR compared with the CSA 7164 accelerometer. A total of 70 eighth and ninth females aged from 13 to 16 were recruited from four schools and a soccer team. The CSA results were expressed by individual days as well as average of 3 and 7 days, respectively. The correlations between self-reported total METs and CSA total counts were high for both 7days of monitoring ($r=0.51$) and for 3 days of monitoring ($r=0.46$). Correlations between the 3DPAR blocks of MVPA and CSA minutes of MVPA were 0.35 ($p<0.01$) for 7 days of monitoring and 0.27 ($p<0.05$) for 3 days of monitoring. The correlations of VPA were 0.45 ($p<0.001$) for 7 days of monitoring and 0.41 ($p<0.001$) for 3 days of monitoring. The range of correlations between total MET from 3DPAR and total counts from CSA was from 0.29 ($p<0.05$) on Monday to 0.64 ($p<0.001$) on Tuesday. The estimated levels of MVPA and VPA minutes from the two instruments were significantly correlated on Sunday, Monday and Tuesday. The 3DPAR yielded valid estimates and was sensitive in assessing vigorous, moderate to vigorous (and overall) physical activity in this sample of eighth and ninth grade girls. The researchers also compared the correlation between 3DPAR and accelerometer with two previous studies using PDPAR. Validity correlation in the 3DPAR study was somewhat higher than some previous PDPAR studies (McMurray, 1998; Sallis et al., 1996; Trost et al., 1999; Weston et al., 1997). The present 3DPAR study also yielded comparable or slightly stronger validity evidence than other similar study: 3-day sweat recall (Janz et al., 2008) 3-day aerobic recall (Janz, Witt, & Mahoney, 1995) and some other 7-day recalls (Sallis, Buono, Roby, Micale, & Nelson, 1993) which also used accelerometer as comparison. However, there were some weaknesses of this study. One is the limited diversity of the sample and also the fact that only eighth and ninth grade girls participated in the study. Another limitation is that only a single criterion (an accelerometer) was used as comparison.

ACTIVITYGRAM

The ACTIVITYGRAM assessment is a computerized physical activity self-report instrument which is a part of the FITNESSGRAM software program developed by the Cooper Institute. It is conceptually derived from another valid self-report instrument known as the Previous Day Physical Activity Recall (PDPAR). ACTIVITYGRAM adopts a comparable time-based grid structure (every 30 minutes) and uses four similar categories of intensity (rest, light, medium and hard) while introducing its own unique characteristics. It provides an activity pyramid listing six categories of activity (rest, flexibility, muscular activity, aerobic sports, aerobic activity and lifestyle), among which the students can choose one specific activity from five representative ones. Another difference between the PDPAR and the ACTIVITYGRAM is that the ACTIVITYGRAM allows users to indicate whether the activity was done "some of the time" or "all of the time". The ACTIVITYGRAM is also designed to assess the whole day (7:00 am to 11:00 pm) while the PDPAR is focused only on the time after school.

Welk et al. (2004) performed a convergent and criterion validation study of both the ACTIVITYGRAM and the PDPAR. Data were collected on elementary students from 2 schools on 3 consecutive days using the ACTIVITYGRAM, PDPAR and the Biotrainer monitor. It is notable that two scoring version of PDPAR (PDPAR1 for MET bouts and PDPAR2 for PA bouts) were used to compare different outcome measures. The results revealed non-significant differences in the reported number of bouts between the two instruments which provided evidence for the convergent validity of ACTIVITYGRAM. The Biotrainer monitor provided a way to evaluate the relative validity of the two self-report formats (ACTIVITYGRAM and PDPAR) in this study. Both the ACTIVITYGRAM and PDPAR had a moderate mean correlation with Biotrainer for the 3 separate days, r=0.50 and r=0.65, respectively. The discrepancy might be explained by the different recall time for the two instruments, ACTIVITYGRAM was done by the end of 3 days and PDPAR was finished at the end of each day. The authors also mentioned the importance of careful administrating of the ACTIVITYGRAM because of the relatively high variability in correlations between ACTIVITYGRAM and Biotrainer for two schools (r=.80 vs. R=0.20). In addition, correlations were computed between the PDPAR and ACTIVITYGRAM to examine their relationship. The correlations for both schools between the two self-report instruments for three periods (afternoon, evening, and afternoon/evening) were acceptably high (range: r=0.35 to r=0.43 for PDPAR1 (MET bouts) and from r=0.41 to r=0.53 for PDPAR 2 (PA bouts)). This finding indicates that the instruments provided similar information about physical activity patterns. Another specific finding in this study is that correlations were computed across certain time periods between the two instruments and the Biotrainer. The afternoon period showed a higher correlation than evening for all 3 days. Data distribution, process and variability might be the reasons to explain the consistent correlation variability in different recall periods. Overall, this study provided convergent and criterion evidence for the validity of using ACTIVITYGRAM to assess children's physical activity patterns.

The ACTIVITYGRAM provides some significant advantages for school based assessments. The computerized version self-report instrument offers convenience on data collection since the data is entered into the software and does not require manual data entry. The ACTIVITYGRAM also provides built in feedback (on screen and with printed reports) to enable teachers to help teach children (and parents) about appropriate levels of physical activity. A disadvantage of the ACTIVITYGRAM format is that it requires 20-30 minutes to complete and some preparation time to teach children how to complete it. Another disadvantage is that some younger students might have trouble in accurately recalling the characteristic of their physical activity in certain time frame.

Summary of Self-Report Instruments

Self-report instruments provide good utility for large-scale research applications and for use in school-based or population surveillance. However, additional research is needed to address some of the fundamental measurement challenges. One innovative approach is to develop calibration equations that can equate or link self-report data to objective estimates of physical activity. Tucker et al. (2011) conducted a study to develop and validate a prediction equation for the PDPAR. A total of 121 participants wore a Biotrainer (objective measure) and completed the PDPAR for 3 consecutive days (subjective measure). The goal of the study was to develop a calibration that could be used to estimate minutes of physical activity for each 30-min time block coded as ≥ 4 METS. Calibration sample data (n=91) were used to develop the regression model. Multi-terms and combinations of models were tested to ensure an accurate equation. Predictors included PDPAR (blocks/day), $PDPAR^2$, BMI, gender, gender×PDPAR, gender × $PDPAR^2$. 31 participants' data were used to evaluate the validation of the regression equation. A high correlation (r=0.81) was detected between the Biotrainer and predicted MVPA min from the validation sample with the new equation. This study demonstrated the potential of developing and applying a calibration approach to improve the utility of self-report measures. While the 3DPAR is widely used in research (and is the basis for the ACTIVITYGRAM assessment) it has proven cumbersome to use in schools. It necessitates detailed logging over multiple days or sufficient time to complete 3 days of recall. The present review demonstrated that the PAQ meets established psychometric characteristics needed to establish validity. It has been widely used in school based research and may provide a more effective PA screening tool for school-based applications. The PAQ can be administered in short amounts of time (~5 minutes) and it provides useful insights into levels of activity at different times or in different settings. These attributes make it well suited for use in schools where education is the key goal.

Preliminary calibration research has been done by our research group to improve the utility of the PAQ but additional research is needed to test the overall utility of the PAQ. Detailed descriptive analyses of large samples of youth are needed to more completely evaluate age and gender patterns in physical activity. The reported estimates of activity from the PAQ also need to be cross validated with other indicators to provide further convergent validity. A review of activity patterns is provided in the subsequent section.

Epidemiology of Physical Activity Levels in Children and Adolescents

There are several general conclusions from epidemiology studies of physical activity in young people. The clear and well documented one is an age-related decline in PA in both boys and girls (Caspersen, Pereira, & Curran, 2000; Jago, Andersen, Baranowski, & Watson, 2005; Nader, 1999; Sallis, 1993; Telama & Yang, 2000; Thompson, Baxter-Jones, Mirwald, & Bailey, 2003), especially during the adolescent years. Both cross-sectional and longitudinal studies have shown similar results – regardless of whether assessed with objective approaches such as accelerometer or with subjective method such as self-report assessment. For example, a longitudinal study with a short self-report questionnaire was conducted in Finland and the results showed a remarkable decline in frequency of physical activity and sport participation when both boys and girls at the age of 12 (Telama & Yang, 2000). Additionally, Mechelen et al (2000) completed a longitudinal study to describe the natural development of habitual physical activity behavior of young Dutch male and female subjects between the age of 13 and 27. The data showed a significant decrease in habitual physical activity over a 15-yr period of time for both male and female subjects, especially the time spent on vigorous activities. Similarly, the data from 1992 National Health Interview Survey-Youth Risk Behavior Survey, of 10,645 male and female subjects ages 12-21 yr documented the physical activity patterns among those adolescents generally eroded most from age 15 through 18 and the “regular, vigorous activity” and muscular strength decreased from age 12 through 21 (Caspersen et al., 2000). Other studies have reported similar results, such as the a 3-yr follow-up study of Child and Adolescent Trial for Cardiovascular Health (CATCH) (Nader, 1999) and a detailed study using objective measures of activity in a population-based sample of public school students in grade 1 through 12 (Trost et al., 2002). The numerous studies have confirmed that physical activity levels decline considerably with age in both boys and girls. The decline of physical activity levels during the adolescence period is a major concern since this is a critical period of development with large changes in physical, psychosocial, cognitive, and emotional development. These changes have led to the strong public health interest in promoting physical activity in this age group (Caspersen et al., 2000).

Another significant and well established finding about the epidemiology of physical activity is that the boys tend to be more active than girls at a given age. For example, in a review article, Sallis compared nine studies in 1980s and early 1990s to evaluate physical activity patterns in children and adolescents. Despite the use of different PA measures (various self-report and objective tools), the same overall patterns were found. Males were more active than females, although the difference was greater with objective measures.

Specifically, males appeared to be around 15 to 25% more physically active than females between the age of 6 and 17 (Sallis, 1993). A study using objective monitors in 81 8^{th} grade students provides a more detailed review of activity levels. The data has shown that boys spend more time engaging in TV/electronics and sports, while girls spend more time in personal care. Except on Sunday, consistent gender differences were found in activity levels even though boys spend more time on TV/electronics (Jago et al., 2005). Lastly, both self-report and accelerometer studies indicated that boys and girls did not differ remarkably with respect to daily participation in moderate physical activity and the majority of the gender gap in overall physical activity was accounted for girls' low participation in vigorous physical activity (Trost et al., 2002). The results from the 1992 Youth Risk Behavior Survey showed that boys participated in 5.4% more regular, sustained activity than girls; for regular, vigorous activity, the variation by activity pattern is + 11.3% and for strengthening activity, the number is +18.2% (Caspersen et al., 2000). Trost et al. (2002) used objective monitors to provide additional and perhaps more accurate views of physical activity patterns. The boys participated in only 11% more MVPA than girls but the gender differences for daily VPA was substantial at about 45%.

A number of other studies have examined the influences of physical maturity differences on observed gender gap in objectively measured PA in children (Sherar, Esliger, Baxter-Jones, & Tremblay, 2007; Thompson et al., 2003). For example, Thompson and colleagues (2003) conducted a study to demonstrate that the gender differences in PA disappeared when physical maturity was controlled. On average, girls mature approximately

2 yr earlier than boys. Other studies using objectively measured PA have also reached the same conclusion. The data from an accelerometer measured study (Sherar et al., 2007) of 194 boys and 207 girls who ages 8-13 yr documented significantly decreased levels of PA with increasing chronological age in both boys and girls. However, when aligned on biological age, PA still declined with increasing maturity but gender differences between biological age groups disappeared. These studies highlight the importance of maturation in evaluating activity patterns. The different patterns and preferences suggest that interventions should be gender specific (Cumming, 2008; Davison, 2007; Niven, Fawkner, Knowles, & Stephenson, 2007). Interventions may also need to target girls at an earlier chronological age than boys, considering girls mature around 2 years before boys, on average. Also, boys and girls in adolescent's period prefer different activities with various reasons, and may face dissimilar barriers (Vu, Murrie, Gonzalez, & Jobe, 2006).

Chapter Ⅲ: METHODS

The study was part of the NFL PLAY 60 FITNESSGRAM Partnership project with the Cooper Institute. One goal of the project was to help schools make effective use of the FITNESSGRAM software and help the students be more fit and active. Each of the 32 NFL franchises was provided with 35 FITNESSGRAM site licenses to distribute to local schools in their area. Once identified, the participating schools were provided with training on how to collect fitness data and how to use the software to track and monitor fitness data. The participating schools were asked to submit fitness testing scores every semester. In Spring of 2012, fitness data were compiled from over 5339 youth.

A focus of the broader NFL Play 60 initiative is to encourage youth to be physically active at least 60 minutes per day. To provide insight about physical activity, a subsample of participating schools was invited to complete the recently developed Youth Activity Profile (YAP). The schools were provided with a customized login for the YAP along with cards, flyers and communications to help promote effective use of the tool in their school. Additional information including frequently asked questions for NFL PLAY 60 FITNESSGRAM site leaders, teachers and parents were posted on the NFL PLAY 60 FITNESSGRAM website http://www.nflplay60fitnessgram.com/youhactivityprofile.cfm.

The university Institutional Review Board (IRB) status classified this research as exempt from human subjects review since the data contained no personal identifiers and were obtained through previously-established agreements.

Instruments

Physical Activity Assessment

Physical activity was assessed with the Youth Activity Profile (YAP). The YAP is an online physical activity assessment tool that was designed to assess children and adolescent's PA and sedentary habits both in school and at home. After logging in to the webpage, students were asked to type in a participation code, which was assigned as the NFL franchise mascot name such as BEARS, REDSKINS and so forth. Students were able to select their school by clicking their school name in a dropdown list. They were asked to provide some basic information about their gender, school level (elementary, middle or high school), and grade (from 3rd to 12th). Before they moved forward to the actual questions, they were provided with information and descriptions explaining differences between types and intensities of physical activities and sedentary activities. The YAP is made up of 15 total items each scored on a 5-point scale. The first five items assess physical activity at school by asking about behavior in different school time periods (transportation to school, PE, recess, lunch and transportation back from school). Questions included items such as "*During lunch break, how often were you moving around, walking or playing?*" The next five questions asked about physical activity levels at home. Three questions asked how many days they were active before school, after school, and weeknights. Answers were chosen from 0 days at the minimal and 4 to 5 days at the most. Two additional questions asked more specifically about the length of time they spend on physical activity on Saturday and Sunday. The last five items asked about time spent in different sedentary behaviors (TV time, video games, computer time, Phone/Text time and overall).

Separate behavioral indices were computed from the three subscales of the YAP. The three indices are Physical Activity at School Index (PASI), Physical Activity at Home Index (PAHI), and Sedentary Behavior Index (SBI). The score for each index was calculated by averaging the responses from the five equally weighted items in each category. A higher overall activity score is reflective of a higher level of physical activity (or a greater amount of sedentary behavior in the case of the SBI). At the end of the online survey, the students were able to access the summary report and view their score in each of the three activity components.

The YAP has not been previously used in youth activity research but studies have demonstrated that similar items from the PAQ provide a valid assessment of physical activity in youth (Crocker, 1997; Janz et al., 2008). Past research tested the reliability of PAQ-C and results suggested acceptable test-retest reliability for both males (r=0.75) and females (r=0.82)(Crocker, 1997). The study also supported concurrent validity against objective measurement tools (accelerometry-based activity monitor). The PAQ score was shown to be moderately correlated with both total PA and percent of minutes spent in MVPA (r= 0.56 and 0.63, respectively). The YAP is conceptually similar to the PAQ as it captures the same basic periods captured in the PAQ and uses a similar 5 point scale. Therefore, similar validity is expected.

Physical Fitness Assessment

Physical fitness was assessed with established items from the FITNESSGRAM health-related fitness battery with a subsample. It includes a variety of field-based assessments in three main areas of health-related fitness: aerobic capacity, body composition, and muscular strength, endurance and flexibility. The battery provides several assessment choices in each area but in the present study only items assessing aerobic capacity and body composition were included since researchers have established more robust links between health risk factor with these two dimensions of fitness. Besides, they satisfy the public health interest (Welk, 2011). For aerobic capacity, teachers chose from the PACER test, one-mile run/walk and walk test (ages 13 or older) to assess aerobic capacity. Two options are available for body composition assessment. One is percent body fat (calculated from triceps and calf skin folds or entered from an alternative measuring device- bioelectrical impedance analysis) and the other is body mass index (calculated from height and weight). Different test methods for aerobic capacity and body composition are equivalent tests.

Procedures

Due to the distributed nature of the project, communication with the schools was primarily through emails and phone calls. A series of emails were sent out to provide suggestions on how to effectively and accurately collect fitness testing data. Various resources were also offered to sites, such as free webinars, online course, videos, CDs, manuals. The program was launched in Fall 2010 and fitness data have been compiled through the FITNESSGRAM software each semester since then. In Spring 2012, the YAP was introduced to sites that had successfully completed and reported the spring fitness testing. Schools were provided with general information about the YAP and access to the website of YAP that provided specific information. The sites were also provided with suggestions for how the YAP could be used to collect data in school settings. Site-specific flyers and instruction cards were prepared for each site to give teacher flexibility in how to administer and use the YAP in their school. The survey asked respondents to provide their school, grade and gender but no personal identifiers were obtained.

Data Processing

One of the unique features of the YAP website is that it provides easy access to the survey results to facilitate analyses. No additional manual entry data is needed since all the data were saved and could be exported into a CSV file. In addition to the individual items, the tool also computes averages for each of the three outcome measures (PASI, PAHI and SBI). Variables including gender, school name, school type, and grade were also recorded. The fitness data were processed and exported using the FITNESSGRAM 9.0 software. The export procedure provided individual (de-identified) data along with information about school, grade and gender. For the second purpose, due to the anonymous attribute of YAP it was not possible to match the physical activity data with the physical fitness data individually. Data from PA and fitness were then merged and averaged by school by grade and by gender to create a composite dataset.

Data Analyses

Primary analyses were focused on descriptive comparisons of physical activity and sedentary levels by grade and gender. Separate descriptive statistics were computed for each of the YAP subscales and the two main fitness assessments (aerobic VO_2 max and BMI) by school, gender and grade. Gender and grade differences were computed using percent change scores to facilitate interpretation. Gender differences were computed as follows: [(boys' scores - girls' scores) / girls' scores]. Grade differences were computed as follows: [(higher grade scores – lower grade scores) / lower grade scores]. Three two-way (grade x gender) mixed model analyses of variance was used to examine the differences in different YAP indices. School was included as a random factor to control for any clustering of physical activity within each school. Separate analyses were performed for each of the three indices (PASI PAHI and SBI). Cohen's d effect sizes were reported to indicate the magnitude of the differences in PASI, PAHI and SBI between boys and girls (small ES= 0.1, moderate ES=0.25, and large ES=0.50 for social sciences). The least square means procedure was used to detect significant subgroup differences. Partial pearson correlations were computed between the three matched YAP indices and the key FITNESSGRAM outcomes (aerobic capacity and body composition). Partial correlations were used to control for any effect due to school level clustering.

Chapter Ⅳ: RESULTS

Summary of Participation Rates Distribution

A total of 3415 participants (1726 males, 1689 females) completed the online YAP from late April to middle June. The participants were from 31 schools recruited by 14 franchises enrolled in the FITNESSGRAM NFL PLAY60 Partnership project. Participation rates were computed by gender, grade, school and franchise (See Table1). Due to the limited sample sizes in certain grades, the analyses were restricted to a sample of 3165 participants in grades 5 to 8 (1600 boys, 1565 girls). The sections below report on the three separate sections of the YAP.

Evaluation of Physical Activity Level at School

A mixed model ANOVA was conducted to test for mean differences in PASI construct. The interaction effect was not statistically significant [F (3, 3122) = 1.26, p =0.2858]. The main effect was significant for gender (F = 66.20, p <0.0001) and grade (F = 4.4, p<0.01). The mean differences between measures of PASI are graphed in Figure 1. The gender difference ranged from 4.5% in grade 5 to 12.9% in grade 8. The average gender difference for PASI was 9.8%. For both boys and girls, PASI values in grade 6 and grade 8 were significantly lower than previous grade level. Among boys, the average grade difference (relative to the previous grade level) for PASI was 5.4%, with the largest difference (9.3%) detected between grade 7 and 8. Among girls, the average grade difference for PASI was 7.6%, with the largest difference (13.0%) detected between grade 5 and 6. The Cohen's d effect size for PASI between boys and girls was 0.24.

To further assess the gender and grade PA difference at school, descriptive statistics representing means, standard deviation and 95% confidence intervals were computed for the five individual questions (Q1 to Q5). The statistics by gender and grade level are displayed in Table 2. With the exception of girls at 5th grade, both boys and girls adopted more active transportation (walk or bike) on the way home from school compared to going to school, even though the scores were relatively low for both items (Q1 and Q5). The PE class was the most active period during school time since the scores ranged from 3.75 to 4.22. Recess was the period that showed the biggest age differences but this is largely because middle school youth do not have recess. In the lunch time period, with the exception of grade 5, boys were more active than girls. Both genders tended to be less active at higher grades.

Evaluation of Physical Activity Level at Home

A similar mixed model ANOVA was conducted to test for mean differences in PAHI estimates. The interaction effect was statistically significant [$F (3, 3120) = 5.85$, $p <0.01$]. The main effect was also significant for gender ($F = 31.41$, $p <0.0001$) and grade ($F = 8.28$, $p<0.0001$). The mean differences between measures of PAHI are graphed in Figure 2. For PAHI, the mean values of girls tended to be lower in older students. In contrast, the mean values of boys tended to be fairly consistent across grade. The 7th and 8th grade boys exhibited significantly higher physical activity levels than same aged girls. The gender difference ranged from 0.6% in grade 6 to 12.3% in grade 8 (average = 6.8%). Among boys, the average grade difference for PAHI was only 0.8%, with the largest difference (4.0%) detected between grade 5 and 6. Among girls, the average grade difference for PAHI was

3.3%, with the largest difference (5.6%) detected between grade 6 and 7. The Cohen's d effect size for PAHI between boys and girls was 0.15.

Detailed descriptive statistics for individual items (Q6-Q10) in this home component of the YAP are shown in Table 3 by gender and grade level. The activity level before school (6:00am to 8:00am) was the least active period while the activity level after school (between 3:00 to 6:00) was the most active period. The scores for the after school period ranged from 4.08 to 4.28 for boys and from 3.92 to 4.26 for girls. Weeknights were another active period for both genders with values ranging from 3.67 to 3.84 for boys and from 3.42 to 3.69 for girls. Interestingly, there were not many differences across the grades. Both genders have higher scores on Saturday than Sunday.

Evaluation of Sedentary Behavior

A similar mixed model ANOVA was done to examine grade and gender differences in the SBI. The grade by gender interaction effect was not statistically significant [$F(3, 3108) = 1.4$, $p = 0.3755$]. A significant main effect was evident for grade ($F = 13.39$, $p < 0.0001$) but not gender ($F = 0.05$, $p = 0.8238$). The mean differences between measures of SBI are graphed in Figure 3. For SBI, mean values tended to be higher for older boys and girls. Among boys, the average grade difference was 5.1 %, with the largest difference (8.4%) detected between grade 7 and 8. Among girls, the average grade difference was 4 %, with the largest difference (6.4%) detected between grade 7 and 8. Both boys and girls in grade 8 had significantly higher values for SBI than gender-matched peers in grade 7. As mentioned, the gender main effect was non-significant but boys tended to have slightly lower mean values except for grade 8. The gender difference ranged from -2.4% in grade 5 to 0.7% in grade 5 (with an average of -0.5%). The Cohen's d effect size for PASI between boys and girls was 0.13.

Detailed descriptive statistics for individual items (Q11-Q15) in this SBI component of the YAP are shown in Table 4.There were no significant difference across grades for both boys and girls for any of the items. Significant gender differences ($p<0.05$) in video, computer and phone/text time were observed from 5th grade to 8th grade. Boys spent more time in video time, whereas girls spent more time engaged in computer and phone/text.

Correlation between Physical Activity and Physical Fitness

The means and standard deviation of height, weight, BMI and aerobic capacity by gender and grade were displayed in Table 5. To investigate relationships between physical activity and physical fitness, it was necessary to aggregate the data by school, grade and gender. The outcome response for each gender, at each grade from one school served as one aggregated mean data unit. The means and standard deviations for the key outcome measures (PASI, PAHI, SBI, aerobic capacity and BMI) are displayed in table 6. A total of 77 mean units were matched between YAP and aerobic capacity and 87 mean units for YAP and BMI. The correlations between physical activity and fitness measurements are displayed in Table 7. The PAHI had a significant, positive correlation with aerobic capacity ($r=0.42$, $P<0.01$) and a significant negative correlation with BMI ($r=-0.34$, $P<0.05$). The SBI had a significant negative correlation with aerobic capacity ($r=-0.29$, $P<0.05$) and a significant positive correlation with BMI ($r=0.66$, $P<0.01$). No statistically significant relations were found among PASI with both aerobic capacity ($r=0.16$) and BMI ($r=-0.06$).

Chapter Ⅴ: DISCUSSION

In this cross-sectional study of adolescents in 5th grade to 8th grade, we found that boys engaged in more PA than girls did in both school and after school across different grades. The gender disparity in PA levels was greater in the PASI than PAHI. We also observed a decline in PA level from 5th grade to 8th grade for both genders at school. At home, boys at all four grades maintained relatively stable PA levels, whereas their female counterparts decreased their PA levels since 7th grade.

One of the unique aspects of this study was that it piloted the use of the YAP in a large sample of schools. This easily administered and understood survey carry minimal burden for students to complete as well as teachers to administer. With access to internet, students can finish it in 15 to 30 minutes depending on the cognitive ability in various ages. The ability to export data in CSV format saved time and made it easily to manage the data. It is also more environmentally friendly since no paper is used which is also saved the money for schools. Accelerometers are viewed as feasible alternatives to self-report in moderately sized population-level surveillance (Trost et al., 2002), but the YAP has great potential to facilitate evaluation in large school tracking studies or population-level surveillance studies.

Our finding that boys were more active than their female counterparts is consistent with previous research results. Andre` (Teixeira e Seabra et al., 2008) reported significant gender differences across a range of ages (from age 10 to 18) in three different indices (physical activity index, sport index, and leisure time index) using a questionnaire. Boys had higher scores than girls in all four indices including work/school index besides the three listed above. Though different questionnaires and analytic approaches were used in the present study, similar gender differences patterns were observed. Various studies reported at different ages that girls have been found to have lower physical activity levels. One the major reason caused the gender difference is that girls have an early rapid PA decline than boys. Some researchers have claimed that the gender difference starts from early adolescence at age 10 (Teixeira e Seabra et al., 2008), while other studies report gender differences showing up from ages 12 through 16 (Caspersen et al., 2000). In our study, the gender differences were observed as early as in 5th grade.

The actual age where gender differences begin is not consistently reported so factors contributing to the inconsistent results need to be explored. Mechelen et al. (2000) have studied the sports preferences in the cohort of Amsterdam longitudinal growth and health study. They concluded that boys tended to select very vigorous intensity team sports, whereas girls had a preference for moderate and vigorous intensity individual sport and expressive forms sport like dance and gymnastics. Similarly, School Physical Activity and Nutrition Questionnaire illustrated girls' higher participation in organized physical activity and lessons, such as martial arts, dance, gymnastics and tennis than boys (Springer, Hoelscher, Castrucci, Perez, & Kelder, 2009). Megan and colleagues found that boys participated in more free-time PA while girls were more likely to participate in organized PA (Wall, Carlson, Stein, Lee, & Fulton, 2011). We found a similar pattern in our study, as significant gender differences were exhibited during recess (Q3) and lunch time (Q4) in all grades except for 5th grade in lunch time (See Table 2). Boys had a higher PA levels also in PE class (Q2), transportation to school (Q1), before school (Q6), weeknights (Q8), Saturday (Q9) and Sunday (Q10). There are no specific questions investigating the choice for activity among genders so we do not have information of gender preferences in PA. Further research is needed to investigate the sex differences in choice for type and intensity for PA.

Interestingly, no gender differences were observed across grades in the sedentary behavior index (SBI). However, noticeable results are found in some specific subcategories questions. For questions based on time spent on video game, computer time, and phone/text (Q12, Q13 and Q14), there were statistically significant gender differences across four grades (the only exception was for 7th grade youth on computer time – Q13). Boys spent more time than girls on video game (gender differences were from 35.6% to 68.8% across 5^{th} to 8^{th} grade) (Q12). Girls, on the other hand, spent more time on phone/text (Q14) than boys (gender differences were from 18.7% to 28.7% across 5^{th} to 8^{th} grade). Girls also reported more computer time (Q13) with gender differences ranging from 7.5% to 13.3% across 5^{th} to 8^{th} grade. These disparate effects tended to cancel out and cause the overall gender difference to be non-significant when averaged together. These findings are in accordance with other research results. For example, Vandewater et al. (2004), found that boys at age 9-12 spent 56.91 minutes per day on video games compared with their counterpart girls who spent only 17.65 minutes per day. Similarly, Mathers et al. (2009), who studied a sample of 925 adolescents (ages from 13.6 to 19.4 years old) using recalled diary data, reported that boys spent 50.5 minutes on video games and girls spent 19.8 per day, respectively. They also reported girls spent 18.1 minutes and boys spent 8.8 minutes on telephone use. The question as to why boys and girls differ in their sedentary behavior patterns was not explained and it was not examined in this study either. However, the disparity of sedentary patterns provides public health researcher with valuable insights about how to target these differences in media usage to reduce sedentary behavior. For example, a study conducted by Maddison et al. (2007) evaluated energy expended when playing video console games. They reported that children expended moderate to high energy when they were playing the new generation of active electronic games. Maloney et al. (2008) also found that the active video games facilitate slight increases in vigorous PA and decreases in sedentary screen time. Except for active video, phone/text can also be used as a PA promotion tool. Like active video games, there is potential to use mobile phones for PA promotion. The public health field has already started to use mobile phone in monitoring /tracking PA changes (Mathers et al., 2009) as well as PA promotion intervention delivery (Hurling, 2007; Mehta, 2011; Wei, Hollin, & Kachnowski, 2011). Moreover, mobile phones can used as the PA measurement tool (Bexelius, 2011). In addition, numerous smart phone platforms have an integrated accelerometer which could enable them to measure PA objectively (Chinmay, Shelly, Yuichi, Loannis, & James, 2010). Activity recognition using a mobile phone with an integrated accelerometer has also been studied by researchers (Choudhury, 2008). With the information we obtained from the YAP, the active electronic games can be more effectively used among boys to reduce their sedentary time. On the other hand, phone/text could be adopted among girls either to monitor their PA or help them to promote health and wellness.

There was evidence of declining PA with increasing age for PASI at grade 6 and grade

8 for both genders, statistically significant difference is only observed between grades 7 with 8 for both genders. For PAHI, there is no apparent decline pattern as statistically difference is only observed between grades 7 with 8. Girls' PAHI scores dropped from grade 7 and statistically significant differences are detected between 6^{th} grade with 7^{th} grade, and 7^{th} with 8^{th}, respectively. When trying to explain the difference in PA patterns, it is important to consider the specific items included in each subcategory. The biggest contributor to the decline in PASI is the decline in PA levels during recess. Significant differences from previous grade group (e.g., 5^{th} grade compared with 6^{th} grade) are observed in all grades for both genders except for 7^{th} and 8^{th} grade boys. Other than the large decreases in recess, no significant difference are shown in other questions, such as active transportation to school and back home, PE class and lunch time. Within elementary school, recess has been identified as a period that could be targeted to help youth to be more active (Erwin et al., 2012; Ridgers, Stratton, Fairclough, & Twisk, 2007; Stratton, 2000). In Ridgers' review of children's PA levels during school playtime, they found that the contribution of recess to daily recommended moderate and vigorous PA (MVPA) ranges from 4.7% to 40% for boys and 4.5–30.7% for girls (Ridgers, Stratton, & Fairclough, 2006). In the present study, significant gender differences during recess were found across all four grades, consistent with numerous studies indicating that boys participated in more MVPA during recess than girls (McKenzie, 1997; Sarkin, 1997; Verstraete, Cardon, De Clercq, & De Bourdeaudhuij, 2006; Zask, van Beurden, Barnett, Brooks, & Dietrich, 2001). A decline in PA during recess across 5^{th} to 8^{th} grade was also found in our study. McKenzie et al. (1997) reported higher PA

participation among elementary students than preschoolers. Additional investigations are needed to track the PA levels changes during recess with increasing age.

However, researchers have noticed the tremendous potential of using recess to promote PA (Scruggs, Beveridge, & Watson, 2003; Stratton, 2000). In Stratton's intervention (2000) that applied playground markings to promote PA during recess, 4-11 years old students on average increased 18 minutes a day in MVPA. His study also showed 36.7% to 50.3% increase in MVPA among experiment group with playground markings strategy (Stratton, 2000). Additionally, fitness breaks with a 400m obstacle course is also indicated to be an effective PA promotion strategy during recess (Scruggs et al., 2003). Due to the dramatic decline in PA during recess, interventions that target on increasing PA levels among early adolescence during recess might be helpful to counter the overall MVPA decrease.

The age at which PA decline starts varies from study to study. Some researchers have claimed that the greatest decline takes place during adolescence (van Mechelen et al., 2000), but other researchers report greater declines after age 16 (Teixeira e Seabra et al., 2008). Caspersen (2000) concluded that PA generally eroded most from ages 15 through 18. With objective measurements, Trost et al. (2002) observed the largest differences occurring roughly in late elementary school. Inconsistent results might due to the different measurement (objective vs. subjective), as well as the data aggregation of boys and girls. A recent review by Samuel et al. concluded that the decline of PA during adolescence is a consistent finding in 26 studies assessed PA with questionnaire (Dumith, 2011). Though early or late adolescence tends to be the period with the greatest decline it hasn't been accurately clarified yet. The consistent decline supports the importance of this age period for behavioral interventions. Without a reasonable sample size for each grade, it is impossible to accurately characterize the changes in the whole adolescent period in our study.

The secondary aim of his study was to test the correlation between physical activity levels and physical fitness. It is assumed that physical activity should be related to fitness but genetic factors (Blair, Cheng, & Holder, 2001) and measurement issues have contributed to generally low correlations between these variables – particularly for children. Previous studies have reported positive correlations between physical fitness and physical activity and negative associations between physical activity and BMI (Dencker et al., 2006; Katzmarzyk, Malina, Song, & Bouchard, 1998; Kimm et al., 2005). However, the magnitude of correlations in the present study was considerably larger than is typically observed. The high values in our study might be due to the statistical process we adopted. Instead of computing the correlation on individual levels, we aggregated the results by grade and gender in each school first and the correlations were computed with matched means of those variables. It increased the accuracy of capturing real physical fitness and physical activity levels. In addition, it is interesting to notice that aerobic capacity and BMI were significantly correlated with physical activity levels at home and sedentary behavior patterns in our study, but not with activity levels at school. The reason is probably due to the variation of activity levels at different settings. At school, the PE classes and recess are scheduled and students do not have many additional choices to be more active. However, children could either spend time on various after-school physical activity programs or choose being sedentary at home. Variations of after school physical activity and sedentary behavior might have contributed to the significant correlation among activity (sedentary) with fitness and BMI.

There are several limitations that should be considered when interpreting the results of the study. First, the YAP has not been directly validated. The YAP was developed based on the frame of the established PAQ-A (or PAQ-C), but several changes have been made. Studies evaluating the validity and reliability of the YAP are currently in process in our lab but data are not available at present. Second, similar to other questionnaires, the results of the YAP are difficult to interpret. The 1 to 5 scales is not meaningful for public health applications where variables such as duration, frequency, intensity and type of PA are needed. The inherent differences in the various subjective instruments also make it difficult to compare findings with other research results. However, we were at least able to compute the percentage changes by different genders and grades. A calibration study on the YAP is currently underway in our lab and this will help to increase the utility of the tool. With a validated regression equation, weekly PA and sedentary minutes can be estimated based on students' responses. By converting the PASI and the PAHI into estimated minutes of MVPA it will make it possible to compare PA levels with established U.S. physical activity guidelines for physical activity. Whether children and adolescents accumulate 60 minutes or more of physical activity daily as recommended by guidelines could be determined. Third, our study only covered four grades (5^{th} to 8^{th}) using a cross-sectional design, which may not give us as powerful analysis as longitudinal data. However, the program is still going on and we are hoping to obtain YAP data on a larger and more representative sample in a future follow-up evaluation. The easy manageable database enables us to track the PA and sedentary pattern longitudinally by schools. Lastly, a final limitation is that there was little control over how the instrument was administered. Instructions were provided to the teachers but it is possible that there could be bias introduced depending on how the instrument was described or interpreted by the children. The potential differences due to method of administration require further study.

In conclusion, the findings from this study suggest that the YAP provides consistent PA levels among 5th grade to 8th grade children and adolescents with previous studies. The YAP is able to capture the gender discrepancy at different settings and periods as well as the trend of declining PA levels with increasing age. The relatively high correlation between physical fitness and physical activity support the validity of the YAP and support the potential incorporation of combined physical activity assessment and physical fitness testing in the PE curriculum. The web-based features and easily data management provide YAP promising usage in a large scale population and longitudinal surveillance study.

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TABLES AND FIGURES

Figure 1.Physical activity in school index

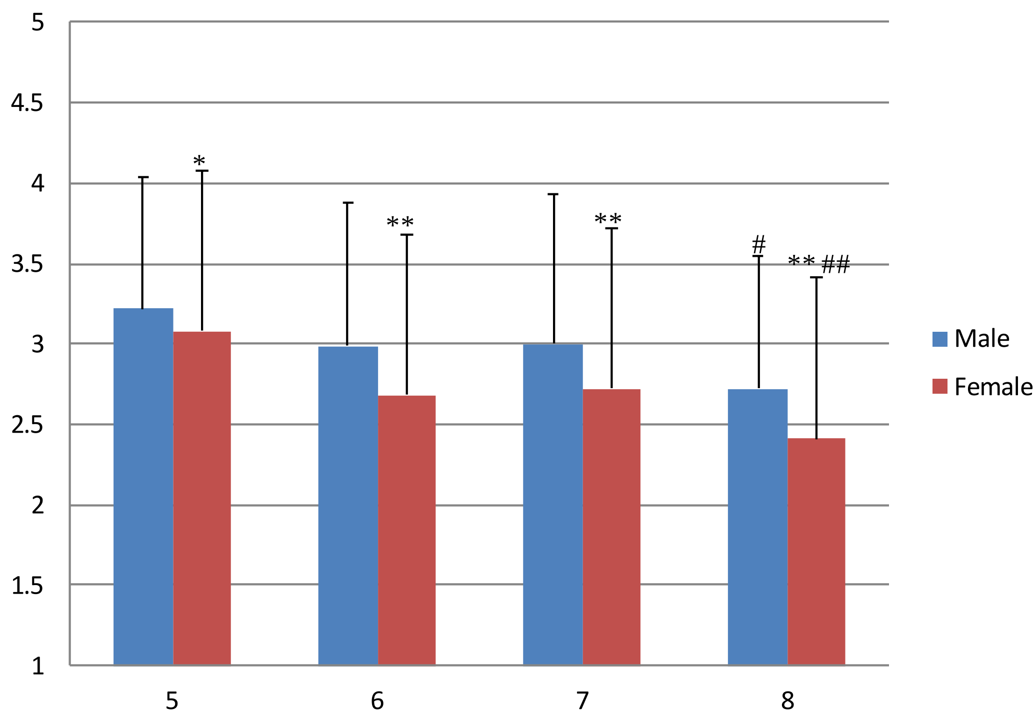

Figure 1 Physical Activity in School Index: Means and standard deviations of physical activity in school index by gender and grade

* *significant gender difference within grade group, P < 0.01; # # denotes significantly different from previous grade group within gender, P < 0.01. * significant gender difference within grade group, P < 0.05; # denotes significantly different from previous grade group within gender, P < 0.05.

Figure 2.Physical activity at home index

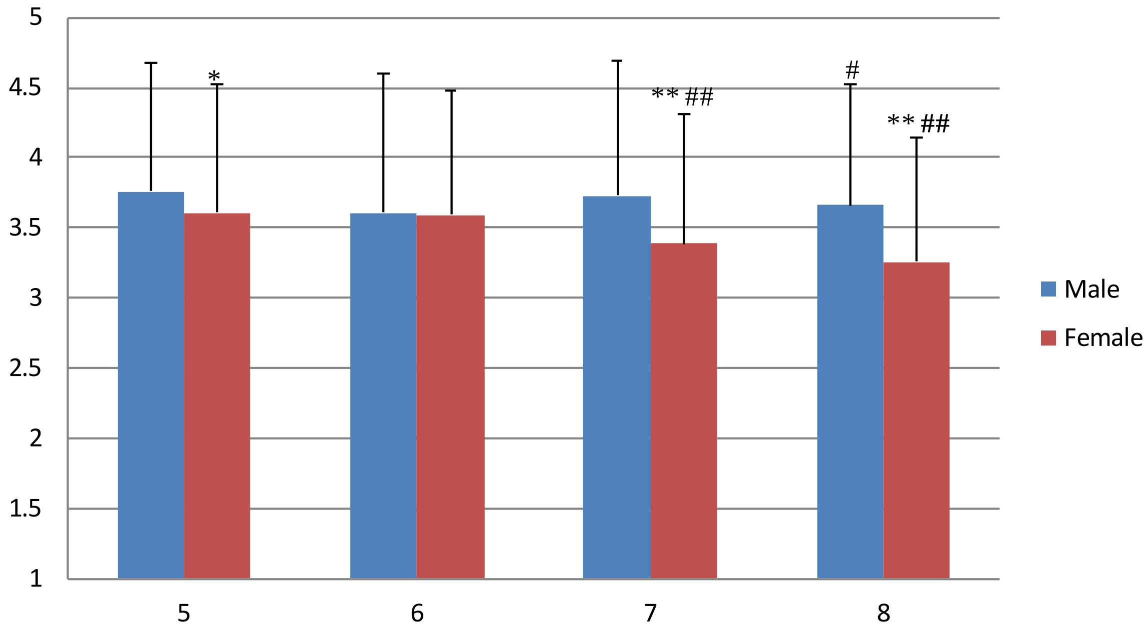

Figure 2 Physical Activity at Home Index: Means and standard deviations of physical activity at home index by gender and grade

* *significant gender difference within grade group, $P < 0.01$; # # denotes significantly different from previous grade group within gender, $P < 0.01$. * significant gender difference within grade group, $P < 0.05$; # denotes significantly different from previous grade group within gender, $P < 0.05$.

Figure 3. Sedentary behavior index

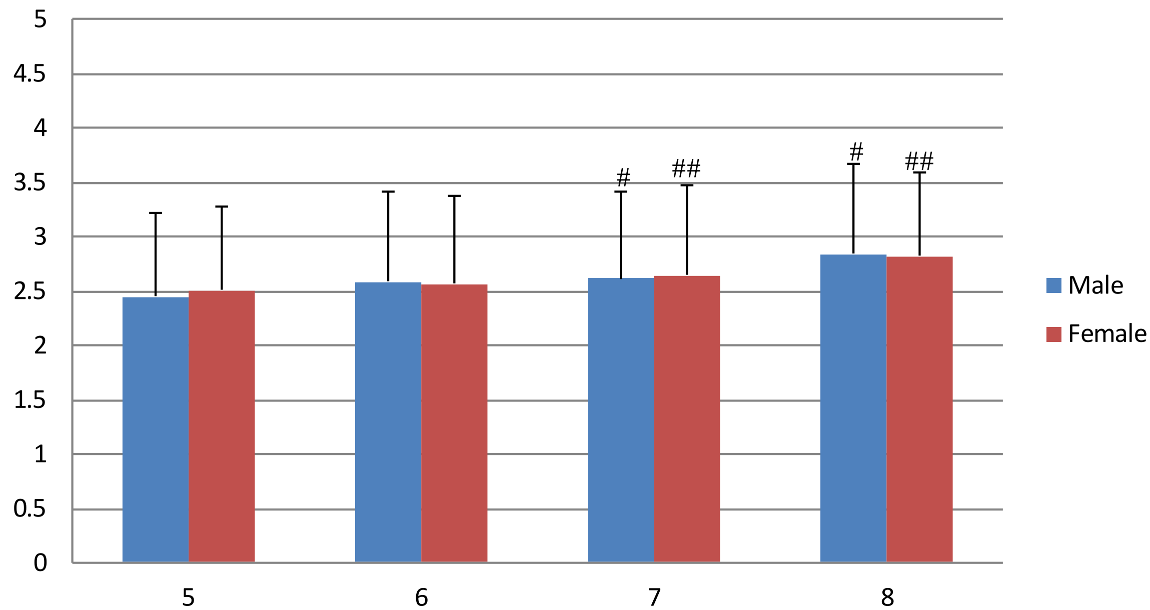

Figure 3 Sedentary Behavior Index: Means and standard deviations of sedentary behavior index by gender and grade

* *significant gender difference within grade group, P < 0.01; # # denotes significantly different from previous grade group within gender, P < 0.01. * significant gender difference within grade group, P < 0.05; # denotes significantly different from previous grade group within gender, P < 0.05.

Table 1 Response frequency by school, gender and grade

FranchiseName	School Name	Male										Female										Total
		3	4	5	6	7	8	9	10	11	12	3	4	5	6	7	8	9	10	11	12	
Arizona Cardinals	Chandler Traditional Academy - Goodman	12	10	21	20	.	.	.	.	.	.	12	17	22	19	.	.	.	.	.	.	133
Carolina Panthers	York Intermediate School	.	.	17	34	.	.	.	.	.	.	.	.	18	53	.	.	.	.	.	.	122
	York Middle School	.	.	.	.	13	.	.	.	.	.	.	.	.	.	13	.	.	.	.	.	26
Chicago Bears	Apollo School	.	29	26	34	.	.	.	.	.	.	.	24	23	35	.	.	.	.	.	.	171
Dallas Cowboys	Harmony Science Academy Dallas	.	.	19	.	.	.	.	.	.	.	.	.	23	.	.	.	.	.	.	.	42
	Rosemont Elementary	.	.	46	.	.	.	.	.	.	.	.	.	36	.	.	.	.	.	.	.	82
Detroit Lions	Waverly East Intermediate	.	.	36	32	.	.	.	.	.	.	.	.	28	14	.	.	.	.	.	.	110
Green Bay Packers	Colfax Middle School	.	.	.	29	17	37	22	11	9	10	.	.	.	27	19	29	28	5	5	6	254
	St. Paul Lutheran	.	.	7	6	7	8	.	.	.	.	.	.	10	5	7	8	.	.	.	.	58
Indianapolis Colts	Rosa Parks-Edison Elementary	.	.	20	.	.	.	.	.	.	.	.	.	18	.	.	.	.	.	.	.	38
	Stonybrook Middle School	.	.	.	.	65	122	.	.	.	.	.	.	.	.	.	.	.	.	.	.	187
Jacksonville Jaguars	Joseph Stilwell Middle	.	.	.	69	.	.	.	.	.	.	.	.	.	78	.	.	.	.	.	.	147
	Timberlane Middle School	.	.	.	.	.	21	.	.	.	.	.	.	.	.	.	16	.	.	.	.	37
New York Giants	Whitney M. Young Jr. Elementary School	.	.	28	.	.	.	.	.	.	.	.	.	41	.	.	.	.	.	.	.	69
New York Jets	Saint James Catholic School	.	.	14	10	3	.	.	.	.	.	.	.	8	11	8	2	.	.	.	.	56
San Diego Chargers	Audubon	.	.	.	.	21	.	.	.	.	.	.	.	.	.	18	.	.	.	.	.	39
	Bethune	.	.	.	.	33	.	.	.	.	.	.	.	.	.	33	.	.	.	.	.	66
	Correia	.	.	.	.	48	.	.	.	.	.	.	.	.	.	47	.	.	.	.	.	95

Table 1. (continued)

	Fulton	.	.	29	7	9	21	.	.	.	.	.	.	19	17	23	9	.	.	.	.	134
	Grant K-8	.	.	.	.	20	30	.	.	.	.	.	.	.	.	22	37	.	.	.	.	109
	John Muir	.	.	.	.	14	6	10	12	1	.	.	.	.	.	12	18	15	9	3	.	100
	Marshall	.	.	.	.	65	36	.	.	.	.	.	.	.	.	61	33	.	.	.	.	195
	Memorial Preparatory for Scholars and Athletes	.	.	.	.	17	.	.	.	.	.	.	.	.	.	43	.	.	.	.	.	60
	Muirlands	.	.	.	23	52	.	.	.	.	.	.	.	.	17	38	.	.	.	.	.	130
	Pacific Beach	.	.	.	.	15	.	.	.	.	.	.	.	.	.	15	.	.	.	.	.	30
	Roosevelt	.	.	.	117	.	.	.	.	.	.	.	.	.	99	.	.	.	.	.	.	216
	Standley	.	.	.	.	22	.	.	.	.	.	.	.	.	.	19	.	.	.	.	.	41
	Taft Middle	.	.	.	93	52	.	.	.	.	.	.	.	.	70	55	.	.	.	.	.	270
Seattle Seahawks	Smith Elementary	.	.	20	.	.	.	.	.	.	.	.	.	15	.	.	.	.	.	.	.	35
St. Louis Rams	Valley Park Middle School	.	.	.	29	29	31	.	.	.	.	.	.	.	30	25	40	.	.	.	.	184
Tampa Bay Buccaneers	McLaughlin Middle School and Fine Arts Academy	.	.	.	.	.	.	.	.	.	.	.	.	.	73	74	32	.	.	.	.	179
Total		12	39	283	503	502	312	32	23	10	10	12	41	261	548	532	224	43	14	8	6	3415

Table2 Descriptive statistics of physical activity scores in school

	Q1(to School)		Q2(PE class)		Q3(Recess)		Q4(Lunch)		Q5(from School)	
	Mean(SD)	95% CI	Mean(SD)	95% CI	Mean(SD)	95% CI	Mean(SD)	95% CI	Mean(SD)	95% CI
Boys										
5	2.59(1.79)	(2.38,2.80)	4.07(1.03)	(3.95,4.19)	4.17(1.16)	(4.03,4.30)	2.61(1.39)	(2.45,2.78)	2.63(1.78)	(2.43,2.84)
6	2.25(1.68)	(2.11,2.40)	4.05(0.97)	(3.96,4.13)	3.15(1.50)	(3.02,3.28)	3.17(1.38)	(3.05,3.29)	2.31(1.71)	(2.16,2.46)
7	2.36(1.73)	(2.2,2.51)	4.22(0.93)	(4.14,4.3)	2.87(1.47)	(2.74,3.00)	3.07(1.33)	(2.96,3.19)	2.49(1.73)	(2.34,2.64)
8	1.90(1.50)	(1.73,2.07)	4.15(0.96)	(4.04,4.25)	2.86(1.41)	(2.70,3.02)	2.82(1.31)	(2.62,2.84)	1.90(1.44)	(1.74,2.06)
Girls										
5	2.49(1.80)	(2.27,2.71)	4.01(1.06)	(3.88,4.14)	3.67(1.20)	(3.53,3.82)	2.75(1.37)	(2.58,2.91)	2.46(1.79)	(2.25,2.68)
6	2.02(1.58)	(1.88,2.15)	3.88(1.05)	(3.80,3.97)	2.71(1.41)	(2.59,2.83)	2.75(1.41)	(2.63,2.86)	2.02(1.56)	(1.89,2.15)
7	2.17(1.68)	(2.02,2.31)	3.83(1.05)	(3.74,3.92)	2.46(1.32)	(2.35,2.57)	2.73(1.31)	(2.62,2.84)	2.41(1.70)	(2.27,2.56)
8	1.71(1.38)	(1.53,1.89)	3.75(1.07)	(3.61,3.89)	2.19(1.25)	(2.02,2.35)	2.47(1.24)	(2.31,2.63)	1.95(1.49)	(1.75,2.14)

Table 3 Descriptive statistics of physical activity scores at home

	Q6(before School)		Q7(after School)		Q8(Weeknights)		Q9(Saturday)		Q10(Sunday)	
	Mean(SD)	95% CI	Mean(SD)	95% CI	Mean(SD)	95% CI	Mean(SD)	95% CI	Mean(SD)	95% CI
Boys										
5	3.14(1.68)	(2.95,3.34)	4.16(1.25)	(4.02,4.31)	3.84(1.32)	(3.69,4.00)	3.98(1.14)	(3.85,4.11)	3.65(1.25)	(3.50,3.80)
6	2.93(1.65)	(2.78,3.07)	4.08(1.28)	(3.97,4.20)	3.67(1.36)	(3.55,3.79)	3.88(1.30)	(3.76,3.99)	3.48(1.28)	(3.37,3.59)
7	2.84(1.72)	(2.69,2.99)	4.28(1.15)	(4.18,4.39)	3.79(1.40)	(3.67,3.92)	4.04(1.14)	(3.94,4.14)	3.70(1.27)	(3.59,3.81)
8	2.56(1.64)	(2.38,2.74)	4.22(1.20)	(4.09,4.36)	3.83(1.29)	(3.69,3.98)	4.07(1.16)	(3.94,4.20)	3.60(1.21)	(3.47,3.74)
Girls										
5	2.94(1.59)	(2.74,3.13)	4.26(1.13)	(4.12,4.39)	3.63(1.34)	(3.47,3.79)	3.77(1.23)	(3.62,3.92)	3.44(1.30)	(3.28,3.60)
6	2.83(1.72)	(2.69,2.99)	4.13(1.21)	(4.02,4.23)	3.69(1.29)	(3.59,3.80)	3.90(1.18)	(3.80,4.00)	3.40(1.29)	(3.29,3.51)
7	2.34(1.50)	(2.21,2.47)	3.92(1.31)	(3.81,4.03)	3.56(1.39)	(3.44,3.68)	3.76(1.17)	(3.66,3.86)	3.37(1.25)	(3.26,3.47)
8	2.02(1.39)	(1.84,2.21)	3.94(1.26)	(3.78,4.11)	3.42(1.37)	(3.24,3.60)	3.63(1.22)	(3.47,3.79)	3.28(1.29)	(3.11,3.45)

Table 4 Descriptive statistics of sedentary behavior scores

	Q11(TV time)		Q12(Video Game)		Q13(Computer)		Q14(Phone/Text)		Q15(Overall)	
	Mean(SD)	95% CI	Mean(SD)	95% CI	Mean(SD)	95% CI	Mean(SD)	95% CI	Mean(SD)	95% CI
Boys										
5	2.96(1.27)	(2.82,3.11)	2.93(1.43)	(2.77,3.10)	2.36(1.22)	(2.22,2.50)	1.86(1.27)	(1.71,2.01)	2.11(1.00)	(1.99,2.23)
6	2.97(1.27)	(2.86,3.09)	2.91(1.45)	(2.79,3.04)	2.40(1.30)	(2.29,2.51)	2.16(1.40)	(2.03,2.28)	2.50(1.15)	(2.40,2.60)
7	2.95(1.28)	(2.84,3.06)	2.76(1.41)	(2.64,2.89)	2.52(1.24)	(2.41,2.63)	2.29(1.39)	(2.17,2.42)	2.58(1.06)	(2.48,2.67)
8	3.07(1.33)	(2.93,3.22)	3.14(1.48)	(2.97,3.30)	2.69(1.35)	(2.54,2.84)	2.78(1.58)	(2.61,2.96)	2.57(1.09)	(2.45,2.69)
Girls										
5	3.18(1.30)	(3.02,3.33)	2.16(1.20)	(2.02,2.31)	2.62(1.29)	(2.46,2.77)	2.30(1.44)	(2.12,2.47)	2.29(1.07)	(2.16,2.42)
6	2.94(1.30)	(2.83,3.05)	2.02(1.26)	(1.92,2.13)	2.72(1.35)	(2.61,2.84)	2.78(1.57)	(2.65,2.91)	2.39(1.05)	(2.30,2.47)
7	3.08(1.34)	(2.93,3.22)	1.92(1.22)	(1.81,2.02)	2.71(1.38)	(2.59,2.82)	2.89(1.60)	(2.83,3.82)	2.64(1.11)	(2.55,2.73)
8	3.08(1.27)	(2.91,3.24)	1.86(1.21)	(1.70,2.02)	2.96(1.40)	(2.78,3.14)	3.30(1.61)	(3.09,3.52)	2.91(1.08)	(2.77,3.05)

Table 5 Descriptive statistics of subject characteristics, BMI and aerobic capacity

	N	Height (m)		Weight (kg)		BMI		Aerobic Capacity(ml/kgmin)	
		Mean(SD)	95% CI	Mean(SD)	95% CI	Mean(SD)	95% CI	Mean(SD)	95% CI
Boys									
5	378	1.36(0.40)	(1.32,1.40)	40.48(16.84)	(38.78,42.18)	20.14(4.49)	(19.67,20.62)	42.68(11.60)	(41.40,43.96)
6	603	1.47(0.34)	(1.44,1.49)	47.96(19.15)	(46.43,49.49)	21.18(4.91)	(20.77,21.58)	44.89(8.69)	(44.15,45.63)
7	1534	1.55(0.29)	(1.53,1.56)	52.60(17.67)	(51.71,53.48)	20.95(4.69)	(20.71,21.19)	45.91(8.42)	(45.47,46.35)
8	443	1.57(0.42)	(1.53,1.61)	58.32(22.05)	(56.26,60.38)	21.89(4.80)	(21.43,22.35)	46.68(7.75)	(45.87,47.48)
Girls									
5	352	1.36(0.43)	(1.32,1.41)	41.37(17.93)	(39.49,43.25)	20.19(4.52)	(19.70,20.69)	39.34(10.34)	(38.14,40.53)
6	532	1.49(0.28)	(1.47,1.52)	50.72(16.74)	(19.229,52.15)	21.82(5.00)	(21.39,22.26)	40.51(7.56)	(39.82,41.20)
7	1346	1.52(0.28)	(1.51,1.54)	51.14(16.61)	(50.25,52.03)	21.22(4.83)	(20.95,21.48)	41.53(6.96)	(41.14,41.91)
8	329	1.56(0.28)	(1.53,1.59)	56.00(16.53)	(54.21,57.80)	22.12(4.64)	(21.61,22.64)	41.19(6.80)	(40.41,41.97)

Table 6 Descriptive statistics of aggregated data for matched YAP / FITNESSGRAM evaluation.

	YAP Match with Aerobic Capacity				YAP Match with BMI			
	PASI	PAHI	SBI	Aerobic Capacity	PASI	PAHI	SBI	BMI
N	77	77	77	77	87	87	87	87
Mean(SD)	2.88(0.44)	3.61(0.30)	2.56(0.32)	43.65(3.09)	2.87(0.43)	3.63(0.34)	2.56(0.33)	21.4(1.79)

Table7 Pearson correlation between YAP and aerobic capacity, BMI

	PASI	PAHI	SBI
Aerobic Capacity	0.16	0.42**	-0.29*
BMI	-0.06	-0.34*	0.66**

**significant difference between variabls, $P < 0.01$; * significant difference between variabls, $P < 0.05$;

APPENDIX

Youth Activity Profile

Activity Levels - at School

1. Activity To School: How many days often did you walk or bike to school? *(If you can't remember, try to estimate)*
   a. 0 days (never)
   b. 1 day
   c. 2 days
   d. 3 days
   e. 4-5 days (most every day)

2. Activity during Physical Education Class: During physical education, how often were you running and moving as part of the planned games or activities? *(If you didn't have PE, choose "Almost none of the time")*
   a. Almost none of the time
   b. A little bit of the time
   c. A moderate amount of time
   d. A lot of the time
   e. Almost all of the time

3. Activity during Recess: During recess, how often were you playing sports, walking, running, or playing active games? *(If you sat the whole time or didn't have a break at school, choose "Almost none of the time")*
   a. Almost none of the time
   b. A little bit of the time
   c. A moderate amount of time
   d. A lot of the time
   e. Almost all of the time

4. Activity during Lunch: During lunch break, how often were you moving around, walking or playing? *(If you sat the whole time at lunch, choose "Almost none of the time")*
   a. Almost none of the time
   b. A little bit of the time
   c. A moderate amount of time
   d. A lot of the time
   e. Almost all of the time

5. Activity From School: How many days often did you walk or bike from school? *(If you can't remember, try to estimate)*
   a. 0 days (never)
   b. 1 day
   c. 2 days

d. 3 days
e. 4-5 days (most every day)

Activity Levels - Outside of School

6. Activity before School: How many days before school (6:00-8:00 am) did you do some form of physical activity? (*This includes activity at home NOT walking or biking to school*)
   a. 0 days
   b. 1 day
   c. 2 days
   d. 3 days
   e. 4 to 5 days

7. Activity after School: How many days after school (between 3:00 - 6:00 pm) did you do some form of physical activity? (*This includes activity at home or in town but NOT walking or biking to school*)
   a. 0 days
   b. 1 day
   c. 2 days
   d. 3 days
   e. 4 to 5 days

8. Activity on Weeknights: How many school evenings (6:00-10:00 pm) did you do some form of physical activity? (*If you don't remember, try to estimate*)
   a. 0 days
   b. 1 day
   c. 2 days
   d. 3 days
   e. 4 to 5 days

9. Activity on Saturday: How much physical activity did you do last Saturday? (*This could be for exercise, work/chores, family outings, sports, dance, or play. If you don't remember, try to estimate)*
   a. No activity (0 minutes)
   b. Small amount of activity (1 to 30 minutes)
   c. Small to Moderate amount activity (31 to 60 minutes)
   d. Moderate to Large amount of activity (1 to 2 hours)
   e. Large amount of activity (more than 2 hours)

10. Activity on Sunday: How much physical activity did you do last Sunday? (*This could be for exercise, work/chores, family outings, sports, dance, or play. If you don't remember, try to estimate)*
   a. No activity (0 minutes)
   b. Small amount of activity (1 to 30 minutes)
   c. Small to Moderate amount activity (31 to 60 minutes)
   d. Moderate to Large amount of activity (1 to 2 hours)

e. Large amount of activity (more than 2 hours)

Sedentary Habits - Outside of School

11. TV Time: How much time did you spend watching TV outside of school time (*This includes time spent watching movies or sports but NOT time spent playing video games*).
  a. I didn't watch TV at all
  b. I watched less than 1 hour per day
  c. I watched 1 to 2 hours per day
  d. I watched 2 to 3 hours per day
  e. I watched more than 3 hours per day

12. Video Game Time: How much time did you spend playing video games outside of school time? (*This includes games on Nintendo DS, wii, Xbox, PlayStation, iTouch, iPad, or games on your phone*)
  a. I didn't really play at all
  b. I played less than 1 hour per day
  c. I played 1 to 2 hours per day
  d. I played 2 to3 hours per day
  e. I played more than 3 hours per day

13. Computer Time: How much time did you spend using computers outside of school time? (*This doesn't include home work time but includes time on Facebook as well as time spent surfing the internet, instant messaging, playing online video games or computer games*)
  a. I didn't really use the computer at all
  b. I used a computer less than 1 hour per day
  c. I used a computer 1 to 2 hours per day
  d. I used a computer 2 to3 hours per day
  e. I used a computer more than 3 hours per day

14. Phone / Text Time: How much time did you spend using your cell phone after school? (*This includes time spent talking or texting*).
  a. I didn't really use a cell phone
  b. I used a phone less than 1 hour per day
  c. I used a phone 1 to 2 hours per day
  d. I used a phone 2 to 3 hours per day
  e. I used a phone more than 3 hours per day

15. Overall Sedentary Habits: Which of the following best describes your overall sedentary habits at home last week?
  a. I spent almost none of my free time sitting
  b. I spent little time sitting during my free time
  c. I spent a moderate amount of time sitting during my free time
  d. I spent a lot of time sitting during my free time
  e. I spent almost all of my free time sitting