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# Analysis of the Association between Availability of School Facilities Available for Physical Activity and MET Scores among Adolescents aged 12-15: NHANES National Youth Fitness Survey 2012

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Analysis of the Association between Availability of School Facilities Available for Physical  
Activity and MET Scores among Adolescents aged 12-15: NHANES National Youth Fitness

Survey 2012

Alana Cilwick

Thesis Chair: Dr. Rodney Lyn

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## **Abstract**

### Background:

Physical activity (PA) is a means to improve the overall health and well-being of adolescents. Daily PA helps decrease the risk of obesity, chronic diseases, and mental health disorders. However, adolescents are not participating in sufficient amounts of daily PA and negative health related conditions are becoming more prevalent. Youth spend the majority of their days at school. PA in the school environment is influenced by a number of factors including, break/free times, access to PA facilities, and allotted time for physical education (PE). Improving the factors that contribute to school-based PA levels may facilitate an increase in adolescent's overall PA level. The purpose of this study is to determine if there is a relationship between access to school facilities for PA during free/lunch periods and MET scores of adolescents aged 12-15 years. A secondary purpose of this study is to determine if access to school facilities for PA during free/lunch periods is associated with body mass index (BMI).

### Methods:

Data for this study were obtained from the 2012 National Health and Nutrition Examination Survey (NHANES) National Youth Fitness Survey (NYFS). MET scores were computed by combining data for moderate and vigorous PA variables by assigning a MET score of 4.0 to moderate recreational activities, and an 8.0 to vigorous recreational activities. METS per week were computed by multiplying MET scores by minutes per week. To determine if mean MET scores or BMI differ significantly between those with and without access to PA, t-tests were conducted on the overall sample and were also stratified by gender.

### Results:

Of the 1,640 participants included in the survey, 478 (242 Male, 236 Female) participants met inclusion criteria to be in the analysis of MET scores and BMI. Students with access to PA facilities had a mean MET score 124.71 lower than students without access to PA facilities ( $p=0.64$ ). Students with access to PA facilities had a mean BMI 0.49 lower than students without access to PA facilities ( $p=0.31$ ). Neither result is statistically significant.

### Conclusion:

The findings of this analysis did not yield a statistically significant relationship between access to school PA facilities during lunch/free periods and MET scores or BMI. This was true of the overall analysis as well as gender stratified analyses. Boys engaged in more PA than females. Future studies should investigate how to increase PA in girls. Also, further investigation on the effect of the school environment on adolescents' PA should be conducted. More data should be collected related to free/lunch period PA and whether adolescents have access to PA facilities.

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## **Background**

Physical activity (PA) is regarded by the Centers for Disease Control and Prevention (CDC, 2011) as one of the most important things one can do for one's health. The World Health Organization (WHO) estimates that 1.9 million deaths throughout the world are attributable to physical inactivity and more than 2.6 million deaths result from being overweight or obese (Dobbins, Husson, DeCorby, & La Rocca, 2013). The many health benefits associated with PA include: weight control, reduced risk of chronic diseases (e.g. cardiovascular disease, type 2 diabetes, and some cancers), strengthening of bones and muscles, improved mental health and mood, improved agility, and increased chances of longer living (Centers for Disease Control and Prevention, 2011). Apart from these benefits, PA behavior in adolescence is also shown to be carried over into adulthood (Kobel, Kettner, Erkelenz, Kesztyus, & Steinacker, 2015).

In 2013, the Youth Risk Behavior Survey (YRBS) found that 15.2% of high school students had not participated in at least 60 minutes of any kind of PA on at least one out of seven days. A 2011 CDC study found that only three out of ten high school students reported participating in 60 minutes of PA every day. The USDHHS (2008) guidelines recommend that children and adolescents should participate in at least 60 minutes of PA daily. Adolescents are likely to reach these goals by participating in unstructured play, such as recess time, or structured play, such as organized games and sports. However, as stated, many adolescents are not reaching the PA levels suggested by the USDHHS guidelines.

Results of decreased PA levels can be seen in the increasing childhood and adolescent obesity rates from 10.6% in 1999 to 13.7% in 2013 (Youth Risk Behavior Survey, 2013). In 2012, the CDC reported that over one third of children and adolescents were either overweight or obese. Also, the prevalence of type 2 diabetes in adolescents is rising. Type 2 diabetes in youth

increased 30.5% between 2001 and 2009 (Dabelea et al., 2014). As noted above, weight control and reduced risk of type 2 diabetes are two health benefits of increased PA. In 2013, the YRBS reported that only 27.1% of students reported being physically active for at least 60 minutes per day for seven days. The increase of these two diseases may be associated with decreased levels of PA in adolescents.

Nationally, the school setting has been a central focus in efforts to increase youth PA. Schools represent a key environment to promote PA in adolescents (Sutherland et al., 2014). Schools have been recognized as being an ideal environment for increased PA as they enable all children to avail themselves of the opportunity for PA (Kobel et al., 2015). Most PA at school is completed during physical education (PE) classes with break times being the only other time adolescents can partake in PA (Kobel et al., 2015). While PE classes are required in approximately 75% of all states in elementary through high schools, adolescents spend less than half the time period participating in moderate to vigorous PA (MVPA) (Babey, Wu, & Cohen, 2014). Other times for PA include free/elective periods, breaks, or lunchtime. Previous research is limited on the amount of PA adolescents participate in during these times and if schools provide access to PA facilities during these free times. However, one study did find that when children had breaks/free time during school, they only spent 25% of the break participating in MVPA (Kobel et al., 2015). Opportunities to improve PA at school can improve students' knowledge and awareness of PA benefits, as well as influence a greater percentage of youth adopting healthy lifestyle behaviors (Tompkins, Zizzi, Zedosky, Wight, & Vitullo, 2004). The potential for schools to positively affect adolescent's PA make it crucial to further investigate factors that influence PA in the school environment.



## **Purpose of Study**

The purpose of this study is to determine if there is a relationship between access to school facilities for PA during free/lunch periods and MET (Metabolic Equivalents of Task) scores of adolescents aged 12-15 years. Body mass index (BMI) will also be tested as a dependent variable. This study also aims to determine if these relationships differ between boys and girls.

## **Literature Review**

### *Benefits of PA*

The WHO (2015) reports that regular and adequate levels of PA improve muscular and cardiorespiratory fitness, as well as bone and functional health. Moreover, school-based interventions have been found to positively impact MVPA, television viewing, blood cholesterol and maximal oxygen uptake (VO<sub>2</sub>max) (Dobbins et al., 2013). The list of benefits of PA is well established and continuously growing.

A systematic review of health benefits of PA in school-aged adolescents examined the following health outcomes: cholesterol and blood lipids, high blood pressure, metabolic syndrome, overweight and obesity, bone mineral density, depression, and injuries (Janssen & Leblanc, 2010). Results yielded a positive effect of PA on cholesterol, high blood pressure, overweight and obesity, bone mineral density, and depression (Janssen & Leblanc, 2010). These health benefits coincide with the impact that PA has been shown to decrease psychological stress indices such as anxiety, tension, depression and anger (Sothorn, Loftin, Suskind, Udall, & Blecker, 1998). Reducing stress may enhance the immune system, contributing to the overall health of adolescents (Sothorn et al., 1998).

Other benefits of school PA include cognitive and behavioral benefits in the classroom. The Physical Activity Across the Curriculum (PAAC) project found that physically active academic lessons of moderate intensity improved overall performance on a standardized test of academic achievement by 6% (Donnelly & Lambourne, 2011). These academic lessons incorporate PA, such as hopping and skipping, into the traditional classroom setting. Lessons like this provide students with additional opportunities for PA while still adhering to the necessary academic requirements of the classroom. Similar results from a meta-analysis also concluded

that PA has a significantly positive impact on children's cognitive outcome and academic achievement, especially aerobic exercise (Fedewa & Ahn, 2011). A cross-sectional and longitudinal study of 11 year olds objectively measured data collected from the Avon Longitudinal Study of Parents and Children in the U.K. to determine if academic attainment and PA are related in adolescents (Booth et al., 2013). Higher MVPA was found to be associated with higher subsequent academic attainment (Booth et al., 2013). Therefore, increasing PA in and out of the school environment may help improve performance in the classroom.

### *Causes of Decreased PA*

The causes for low levels of PA in adolescents include environmental, motivational, and other factors. The WHO (2015) relates decreasing PA levels with high or rising gross national product. Also adding to the problem is declining leisure time PA and increasing sedentary behaviors at school and at home. Altogether, both time spent at school and at home influence PA behaviors in adolescents are causing the decline in PA levels.

### *Built Environment*

The growing trend in lower levels of PA in youth may be influenced by built environment and neighborhood design. Greater access to outdoor play/sports areas/parks and availability of PA-related facilities have been associated with higher levels of PA in youth (Slater et al., 2010). A cross-sectional study of 8<sup>th</sup> and 10<sup>th</sup> graders found that increased local area PA outlets were associated with higher levels of PA (Slater et al., 2010). The same study concluded that lower levels of neighborhood safety were associated with decreased PA, higher prevalence of obesity and higher BMI (Slater et al., 2010). The results demonstrate how youth are more likely to have increased PA if they live in a safe neighborhood with local PA outlets.

Urban settings can greatly affect the PA levels of youth. Typically, urban environments are more compact and have fewer green spaces than rural environments, making those who live further from green spaces less likely to visit them (Coombes, Jones, & Hillsdon, 2010). Adolescents with exposure to greener neighborhoods and spaces are more likely to have a lower BMI and higher MVPA (Edwards, Hooper, Knuiiman, Foster, & Giles-Corti, 2015). These green spaces and parks not only need to be in close proximity, but also need to include safety and other specific features. Edwards et al. (2015) found that higher park use by adolescents was associated with the presence of lighting around park, a skate park, walking paths, BBQs, picnic tables, public access toilets, and a high number of trees. Improving the features of parks increases the odds that adolescents will use them for PA.

Built environment also plays a role in active school commuting. Studies have found that adolescents who participate in active modes of transport (walking or cycling) are more likely to have overall increased PA. A study on built environment as a factor to active school commuting found that differences in built environment along school routes were significantly associated with frequency of active commuting to school and overall daily MVPA (Oreskovic et al., 2014). The study found that even though higher traffic volume occurred among high connectivity routes, these high connectivity routes were associated with 18 more minutes of daily MVPA than routes with low connectivity (Oreskovic et al., 2014). Improving the connectivity and walkability of routes to school can help increase PA in adolescents.

Passive transportation may prohibit adolescents from reaching daily PA recommendations. In a systematic review of active school transport related to physical fitness, the majority of studies examined found that active school travelers were more active than those who took passive transportation (Larouche, Saunders, Faulkner, Colley, & Tremblay, 2014). The

same review found that active school transport interventions lead to increases in PA (Larouche et al., 2014). A yearlong cross-sectional study of modes of transportation to school found that adolescents in Norway who cycled to school had better cardiorespiratory fitness compared to passive transport to school (Ostergaard, Kolle, Steene-Johannessen, Anderssen, & Andersen, 2013).

### Sedentary Behavior

Sedentary behavior consists of any activities that use an energy expenditure of less than or equal to 1.5 METs while in a sitting or reclining posture (Herman, Hopman, & Sabiston, 2015). Watching television and using a computer are sedentary behaviors that youth are likely to participate in. Sedentary behaviors are associated with negative health outcomes that are typical of physical inactivity. Findings of a systematic review on health outcomes related to sedentary behavior found that sedentary behavior is associated with all-cause cardiovascular mortality, regardless of PA level or BMI (Rezende, Lopes, Rey-Lopez, Matsudo, & Luiz, 2014). The same review found that sedentary behavior is associated with increased risk of colorectal, breast, endometrial, ovary, and prostate cancer (Rezende et al., 2014). Other adolescent health outcomes associated with sedentary discovered in the review include risk of obesity, increased blood pressure and total cholesterol, self-esteem and behavior problems, and physical fitness and academic achievement (Rezende et al., 2014). Another systematic review reinforces the health outcomes stated above but also reports that increased sedentary time in adolescents is associated with increased risk for metabolic syndrome and risk for cardiovascular disease (Tremblay et al., 2011).

While at home, adolescents participate in greater amounts of screen time (e.g. computer and television activities). A study of diet and PA behaviors in Mexican school aged children 8-10 years, found through questionnaire data that participants exceeded the two-hour limit of “screen time” per day recommended by the American Academy of Pediatrics (Perez-Rodriguez, Melendez, Nieto, Aranda, & Pfeffer, 2012). Mental health may also be affected by sedentary behavior such as high screen-time use as reported by Kremer et al. (2014). Results of the study found that young adolescents who participated in PA and who had low levels of screen-time were less likely to report depressive symptoms than those with higher amounts of screen-time (Kremer et al., 2014). Screen-time is also associated with cardiorespiratory fitness. A study of Australian adolescents found a significant inverse relationship between screen-time and cardiorespiratory fitness (Sandercock & Ogunleye, 2013). Results from both of these studies illustrate that increased screen-time leads to decreases PA, which affects fitness level and mental health status in adolescents.

### *Physical Education (PE)*

PE has been associated with increased PA among adolescents (Drake et al., 2012). The impact that PE classes can have on adolescents has led to policy creation that requires a certain amount of PE in schools. The current PE requirement in California requires 200 minutes of PE every ten school day for students grades one through six and 400 minutes of PE every ten school days for students in grades seven through twelve (Consiglieri, Leon-Chi, & Newfield, 2013). Results of a study on the observance of the California PE policy discovered that there is low adherence to the requirements in San Diego schools (Consiglieri et al., 2013). The low adherence

to PE requirements indicates that while adolescents attend PE classes, they are still not participating in enough PA during these classes.

As of 2013, the number of states that required PE was 43 for elementary schools, 40 for middle schools, and 46 for high school (Carlson et al., 2013). However, the number of states that require the recommended 150 minutes/week of PE for elementary schools was three, one state required the recommended 225 minutes/week of PE for middle schools, and no states met the recommended 225 minutes/week of PE for high schools (Carlson et al., 2013). The problem seems not to be the policies but the adherence to the PE policies.

#### *Break-Time PA*

The literature on the use of school PA facilities during lunch, free, or elective periods is limited. However, a few studies have discussed the impact that break times at school have on PA. A German study examining the incidence of break times related to PA discusses the advantages of this time over formal PE classes; one main advantage being that adolescents have the chance to engage in daily PA through play (Kobel et al., 2015). Similarly, a study examining adolescents' PA during recess and lunchtime, discusses how these periods are prevalent for almost all adolescents every school day and increasing PA during these periods could make a significant contribution to their overall PA levels (Yildirim et al., 2014). Other researchers note taking advantage of these informal situations to increase PA as an opportunity to encourage active play in children (Hyndman, Benson, Ullah, & Telford, 2014a). However, an obstacle to enhancing PA levels in adolescents has to do with the limited play spaces and equipment available to adolescents during these break times or lunch periods (Hyndman et al., 2014a). Researchers agree that unstructured active play at school can be a great opportunity to address PA levels in adolescents.

Understanding the amount of time available for adolescents to engage in PA during school is crucial to understanding if break times, lunch periods, and free periods are feasible times to encourage adolescents to increase their PA. Results of a study conducted in Vancouver found that while most participants were meeting overall school PA guidelines, opportunities to engage adolescents more effectively during lunch and PA periods were being missed (Nettlefold et al., 2011). These results are similar to studies concluding that children who have a greater amount of break times have higher amounts of MVPA during the day (Kobel et al., 2015). This is consistent with findings of a study that found longer morning breaks plays a role in increasing MVPA behaviors in 9-11 year olds (Mantjes et al., 2012). Other results have shown that students are more likely to participate in break time MVPA if allowed to bring in sports equipment to school, or have access to school-owned sports equipment (Ridgers, Timperio, Crawford, & Salmon, 2013). Results of a break time intervention that incorporated the use of games during 15-minute school breaks found that children were more active during the games program than during standard playtime (Loprinzi, Cardinal, Loprinzi, & Lee, 2012). The studies suggest that increasing break times, as well as increasing access to PA equipment, may help increase daily MVPA in school adolescents.

Literature on the topic has also addressed the enjoyment levels and age groups that are participating in break and lunch time PA. A study on rural school PA found that adolescents older than 11 years participated in less playground PA during break times than children aged 8-9 years (Escalante, Backx, & Saavedra, 2014). As adolescents grow older, it is important to target school interventions towards them to increase their break time PA. When further examining how to increase break and lunch time PA, a study on adolescents' enjoyment discusses the importance of lunchtime PA enjoyment as a contributing factor to increased PA (Hyndman, Benson, Ullah,



Finch, & Telford, 2014b). Results of the study identified high levels of children's enjoyment of lunchtime play among elementary children (Hyndman et al., 2014b). However, the study did not conduct further research on whether or not adolescents participating had high levels of PA during lunchtime.

### *School PA and BMI*

School environment may also have the ability to affect body mass index (BMI) in adolescents. Some studies have found that requiring PE in school is associated with lower BMI, and while results can be inconsistent, the school food and PA environments play at least some role in student's weight status (Vericker, 2014). However, BMI and school environment has mostly been researched in terms of school lunch offerings, not PA.

Previous research has concluded that a combination of diet and PA are important factors for maintaining a healthy BMI range (Dobbins et al., 2013). Elgar et al. (2005) also found that PA in early adolescence reduced BMI increases during adolescence. The association between PA and BMI also affects the mental health status of adolescents. A study on Chinese adolescents discovered that low PA level and high BMI increase the risk for depression (Wang, Fu, Lu, Tao, & Hao, 2014). These results demonstrate the impact that PA has on BMI, and BMI on mental health status in adolescents.

Some studies suggest that increased PA can reduce BMI. A study aiming to better understand the relationship between PA and BMI found that a decrease in MVPA among boys was associated with an increase in BMI scores (Basterfield et al., 2014). Another study also reported that increased MVPA predicted reduced BMI score over a three-year follow-up in obese/overweight children (Trinh, Campbell, Ukoumunne, Gerner, & Wake, 2013). Similar results were found in a longitudinal study of adolescents PA, sedentary behavior, and BMI where

participants were clustered into either low PA, high sedentary behavior (LPAHSB) and high PA, low sedentary behavior (HPALSB) groups (Lee, 2014). Participants in the LPAHSB had the greatest BMI while participants in the HPALSB cluster had the lowest BMI (Lee, 2014). The studies above suggest that increasing the amount of PA adolescents participate in while at school may help decrease their BMI.

Other studies have found in general no significant relationship between PA and BMI (Aires et al., 2010) and that school lunch may have a larger impact on BMI compared to PA (Vericker, 2014). There has not been research done on BMI in relation to use of school facilities available to adolescents during free periods for PA.

Results from school-based interventions have found that increased PA during school may help reduce BMI. A Chinese intervention study placed children and adolescents aged 7 to 15 years into either a control group or an intervention group that consisted of a multi-component PA intervention (PE improvement, extracurricular PA, PA at home, and health education lectures) for 12 weeks (Li et al., 2014). Results of the intervention showed that those who participated in the intervention had significantly decreased levels of BMI, skinfold thickness and fasting glucose, and increased duration of MVPA (Li et al., 2014). A systematic review of obesity treatment in adolescents found that throughout the majority of the trials that assessed BMI change, intervention participants had a significantly greater reduction in BMI compared with participants in the control groups (Peirson et al., 2015).

Other school-based interventions have found no significant effects related to BMI. The SPARK (Sports, Play, and Recreation for Youth) was developed to increase PA, improve cardiorespiratory fitness, and weight status among elementary students after school (Herrick, Thompson, Kinder, & Madsen, 2012). The five-month intervention study divided students into

intervention or control groups. Results showed there was no difference between groups in mean change of MVPA, BMI z-score, or cardiorespiratory fitness (Herrick et al., 2012).

### *Socioeconomic Status (SES)*

Socioeconomic status (SES) may be another predictor to PA level in adolescents. The physical fitness of an adolescent with a low SES may be affected due to lack of health education, low-quality food, and lack of recreation facilities (Bohr, Brown, Laurson, Smith, & Bass, 2013). The physical fitness status of low SES youth can be seen in their overall level of PA. A study of high school girls found significant differences between high and low SES groups for body composition, mile run, and physical activity, with girls from lower SES having lower levels of overall fitness (Bohr et al., 2013). The differences between the groups may be another factor to consider when attempting to understand youth PA at school. School-based PA offers opportunities to combat factors like SES, as all youth should have equal access to school facilities.

### *Summary of Literature*

Results of the literature review reflect the increasing trend in decreased PA in adolescents. The causes of lower PA include built environment, increased screen-time, and low participation in PE classes. The school environment is both a cause of decreasing PA and a possible solution. Increasing PE classes and allowing adolescents to take part in PA during break times may improve PA levels. The benefits to increased PA make it crucial to explore how schools can make changes to improve the overall health of adolescents.

## **Methods**

This study aims to determine if there is a relationship between access to school facilities for PA during free/lunch periods and recreational MVPA and BMI in adolescents aged 12-15.

### *Data and IRB Approval*

Data for this study were obtained from the 2012 National Health and Nutrition Examination Survey (NHANES) National Youth Fitness Survey (NYFS), conducted by the National Center for Health Statistics (NCHS), a division of the Centers for Disease Control and Prevention (CDC). The NYFS was administered in congruence with the 2012 NHANES. The NCHS Research ERB approved the NYFS and informed signed consent was obtained from all participants. Approval for this study came from the Georgia State University IRB. IRB approval was based on Designation of Not Human Subjects Research due to the nature of the secondary data in this study.

### *Participants*

The NYFS collected data on PA and fitness levels of children and adolescents aged 3-15 through both questionnaires and physical examination. Of the 2,065 children and adolescents selected to participate in the survey, 1,640 were interviewed, and 1,576 were examined. Of the 1,640 participants, 823 (50.2%) were male and 817 (49.8%) were female. The PA questionnaire was administered to participants' aged 12-15, who answered the questionnaire themselves. This study will only be looking at participants aged 12-15 because of the age limitation of the PA questionnaire.

### *Independent Variable*

The independent variable for this study is access to school facilities. The PA questionnaire asked if students were allowed to use school facilities such as the gymnasium, tennis courts, weight room, or track during lunch or a free/elective period during school time. Participants either answered “yes”, “no”, or “don’t know”. Those who did not answer or that answered, “don’t know” were recorded as “missing”.

### *Metabolic Equivalents of Task (METs)*

Metabolic equivalents of task (METs) are defined by the U.S. Department of Health and Human Services (2008) as the ratio of the rate of energy expended during an activity to the rate of energy expended at rest. METs are a simple way to express the energy cost of physical activities as a multiple of the resting metabolic rate (Jette, Sidney, & Blumchen, 1990). For example, 1 MET is the rate of energy expenditure while at rest, 4 METs relate to moderate PA, and 8 METs are associated with vigorous PA. MET-minutes refer to the amount of minutes an individual partakes in a task times the MET. For example, an individual that participates in 30 minutes of 4 METs receives 120 MET-minutes (US, Department of Health and Human Services, 2008). Assigning a MET to all types of physical activities helps provide a general system to understand energy expenditure. However, there are some limitations to using the METs system. One limitation is a person's size. A larger individual can be expected to have a larger resting oxygen uptake compared to a smaller person (Jette et al., 1990). An individual's percentage of body fat also affects their metabolic rate. For example, two individuals that weigh the same but have a differing in body fat percentage will have different resting metabolic rates (Jette et al.,

1990). However, even with these limitations, METs represent an effective and simple method to understand energy expenditure.

The use of METs in PA studies has been used to produce a general scale for understanding PA levels. A study assessing PA behavior and peer influence in young children attached accelerometers to the hips of children to record their PA and then converted the accelerometer data into METs (Barkley et al., 2014). Similar, a study using the ActiGraph GT1M, a PA recording device attached to a child's hip, was used to record PA and calculated METs in children with attention deficit hyperactivity disorder (ADHD) (Lin, Yang, & Su, 2013). METs have also been converted based on self-report of PA. An intervention study of overweight children aimed at improving BMI and PA asked children weekly to recall their PA and then a MET was assigned to each activity (Siwik et al., 2013). Whether being used objectively or subjectively, METs are useful to get a general level of PA in adolescents.

### *Dependent Variables*

The main dependent variable for this study is MET scores for moderate and vigorous recreational activities. To calculate the MET scores, six different variables were examined including: participation in vigorous recreational activities, days per week participating in vigorous activities, minutes per day vigorous recreational activities, participation in moderate recreational activities, days per week participating in moderate recreational activities, and minutes per day moderate recreational activities. According to the survey, vigorous recreational activities included sports or fitness activities that cause large increases in breathing or heart rate, like running or basketball, for at least 10 minutes continuously. Moderate recreational activities included sports or fitness activities that cause a small increase in breathing or heart rate, such as

brisk walking, bicycling, or swimming, for at least 10 minutes continuously. Data for the six variables were collected by first asking participants if they participated in vigorous or moderate recreational PA for at least 10 minutes (Centers for Disease Control and Prevention, Division of Health and Nutrition Examination Surveys, 2012). If yes, participants are then asked on average how many days per week do they participate in moderate or vigorous PA. Finally, participants answered how many minutes per day they participated in moderate or vigorous PA on average.

These six variables were converted by assigning MET scores to the moderate and vigorous activities. For moderate activities, a MET score of 4.0 was assigned, while a MET score of 8.0 was assigned to vigorous activities. To find the MET minutes of PA per week, reported minutes of moderate or vigorous PA was multiplied by the moderate (4.0) or vigorous (8.0) MET scores. MET scores for this study were determined by the suggestions of the NYFS as given in the appendix (Centers for Disease Control and Prevention, Division of Health and Nutrition Examination Surveys, 2012). The final MET score variable used for this analysis is the METs per week, which combines the moderate and vigorous categories into a single MET score. The secondary dependent variable for this study is BMI. BMI in the NYFS (2012) was taken as part of the examination section. BMI is calculated based on height and weight of an individual. BMI values of the survey ranged from 11.9 to 48.3 (Centers for Disease Control and Prevention, Division of Health and Nutrition Examination Surveys, 2012).

### *Gender*

A possible contributing factor to PA level in adolescents is gender. Socio-demographics and lifestyle factors have been noted as important determinants of PA among adolescents (Seo et al., 2013). It has been previously established that among youth, boys tend to be more physically active while also being high users of television or video games, compared to girls (Lam, Sit, &

Cerin, 2010). The difference in PA among girls and boys remains true at school, with boys engaging in more PA than girls. A study on PA gender differences found that boys engaged in greater amounts of MVPA than girls and boys were more likely to meet daily PA guidelines (Crespo et al., 2013). The difference between boys and girls engagement in PA is well established in the literature however it must be taken into account when discussing the participation of adolescents in PA during break times at school.

### *Data Analysis*

First, recreational PA data from the survey was transformed into MET scores as explained above. A number of t-tests were conducted for the analysis. An independent samples t-test was conducted to determine if there was a significant relationship between the means of those who do and do not have access to school PA facilities. Weights were accounted for in the procedure with the weight variable provided in the NYFS data. A weight from the questionnaire data was used for the MET analysis and examination weights were used for the BMI analysis. Another t-test was performed to determine if there was a relationship between the secondary dependent variable (BMI) and school facilities. After the overall t-test was completed, two other independent sample t-tests were conducted among male and female participants separately to determine if the association differed between the genders.  $P < .05$  and 95% CI were used to determine statistical significance for all procedures. All statistical analyses were performed in SAS 9.3 (SAS Institute, Cary NC).



## Results

### *Demographics*

**Table 1: Demographics**

	N	%	Mean	SD
Age			13.39	1.09
METS/WK			2758.03	3030.19
BMXBMI			22.79	5.45
Sex				
Male	242	50.63		
Female	236	49.37		
Race				
Mexican American	60	12.55		
Other Hispanic	70	14.64		
Non-Hispanic White	212	44.35		
Non-Hispanic Black	100	20.92		
Other Race - Including Multi-Racial	36	7.53		
Annual Household Income				
\$ 0 to \$ 4,999	9	1.89		
\$ 5,000 to \$ 9,999	10	2.10		
\$10,000 to \$14,999	29	6.09		
\$15,000 to \$19,999	27	5.67		
\$20,000 to \$24,999	44	9.24		
\$25,000 to \$34,999	57	11.97		
\$35,000 to \$44,999	32	6.72		
\$45,000 to \$54,999	29	6.09		
\$55,000 to \$64,999	31	6.51		
\$65,000 to \$74,999	32	6.72		
\$20,000 and Over	14	2.94		
Under \$20,000	3	0.63		
\$75,000 to \$99,999	41	8.61		
\$100,000 and Over	108	22.69		
Access				
Yes	276	57.74		
No	202	42.26		

Table 1 illustrates the demographics of the participants that were included in the analysis. Demographics were not weighted. Of the 1,640 participants included in the survey, 478 were within the age range (12-15) and had complete data. The overall mean weighted METS per week for females in this study is 2239.50 and 3247.70 for males. The overall mean weighted BMI for females in this study is 23.01 and 22.62 for males.

*MET Scores Results*

The overall mean weighted METS per week for participants in this study with and without access to facilities at school is 2728.10. The MET score t-test results shows a -124.71 difference between no access ( $\mu=2780.71$ ) and access ( $\mu=2656.00$ ), but this difference is not a statistically significant difference from 0 ( $p= 0.64$ ). Table 2 shows results of the MET score and facilities t-test.

**Table 2: MET Scores and Facilities**

	Mean	SE	t	df	p
No Access	2780.71	275.85	-	-	-
Access	2656.00	218.62	0.48	14	0.64

The effect of availability of school facilities on MET scores was also tested separately for boys and girls. The results of the female MET score t-test showed a -325.87 difference between no access ( $\mu=2325.63$ ) and access ( $\mu=1999.76$ ) to facilities, which is not a statistically significant difference ( $p= 0.21$ ). Table 3 shows results of the MET analysis with the facilities variable for females. The results of the MET score t-test among males showed a 47.42 difference between no

access ( $\mu=3227.51$ ) and access ( $\mu=3274.93$ ) to facilities, which is not a statistically significant difference ( $p= 0.91$ ). Table 4 shows the results of the MET analysis with the facilities variable for males.

**Table 3: Female MET Scores and Facilities**

	Mean	SE	t	df	p
No Access	2325.63	260.97	-	-	-
Access	1999.76	264.37	1.32	14	0.21

**Table 4: Male MET Scores and Facilities**

	Mean	SE	t	df	p
No Access	3227.51	340.99	-	-	-
Access	3274.93	329.03	-0.11	14	0.91

**BMI Results:**

The overall mean weighted BMI of adolescents with and without access to facilities for this study is 22.81. The results of the BMI t-test show a -0.49 difference between no access ( $\mu= 23.02$ ) and access ( $\mu=22.53$ ) to facilities, which is not a statistically significant difference ( $p= 0.31$ ). Table 5 shows results of the BMI analysis.

**Table 5: BMI and Facilities**

	Mean	SE	t	df	p
No Access	23.02	0.32	-	-	-
Access	22.53	0.38	1.05	14	0.31

The effect of availability of school facilities on BMI was also tested separately for boys and girls. The results of the female BMI score t-test showed a -1.02 difference between no access ( $\mu=23.44$ ) and access ( $\mu=22.42$ ) to facilities, which is not a statistically significant difference ( $p=0.08$ ). Table 6 shows results of the BMI analysis with the facilities variable for females. The results of the male BMI score t-test showed a 0.02 difference between no access ( $\mu=22.61$ ) and access ( $\mu=22.63$ ) to facilities, which is not a statistically significant difference ( $p=0.98$ ). Table 7 shows the results of the BMI analysis with the facilities variable for males.

**Table 6: Female BMI and Facilities**

	Mean	SE	t	df	p
No Access	23.44	0.61	-	-	-
Access	22.42	0.44	1.87	14	0.08

***Table 7: Male BMI and Facilities***

	Mean	SE	t	df	p
No Access	22.61	0.47	-	-	-
Access	22.63	0.52	-0.03	14	0.98

## Discussion

The purpose of this study was to examine the association of access to school PA facilities during free/elective periods and MET scores. The secondary purpose of this study was to examine the relationship between school facilities and BMI. Neither MET scores nor BMI were significantly associated with access to school PA facilities during free/elective periods. The effect of access to school PA facilities on MET scores was also shown to not be statistically significant among males or females separately.

Results of this study showed that adolescents aged 12-15 with access to school PA facilities during free, elective, or lunch periods had MET scores per week 124.71 less than those who said they did not have access, but this difference was not significantly different from zero. This study also found that the BMI of those with access was 0.49 less than those without access. Both results were not statistically different to say that access to school facilities had either a positive or negative effect on MET scores or BMI.

Overall, males showed to have higher average MET scores ( $\mu= 3247.70$ ) than females ( $\mu= 2239.50$ ). Males also had a lower average BMI ( $\mu= 22.62$ ) than females ( $\mu= 23.01$ ). These results coincide with previous literature, which reports that males engage in more PA than females and have a lower BMI. The results of this study suggest that female and male adolescents need specially tailored PA interventions. Specifically targeting female and male adolescents separately through tailored PA interventions may help improve their MET scores and possibly their BMI. However, before creating these tailored interventions, a better understanding for the reasons females and males are not participating in PA would be needed. Crespo et al. (2013) reports that males and females have different correlates for PA, which may partly explain the gender differences in PA. Young females are also strongly affected by social influences, peer

pressure, and perceived norms (Peykari et al., 2015). Considering these factors when creating female targeted PA interventions may help make interventions more effective. An example of this has to do with female body image. Adolescent girls may prefer being in classes with their same-sex peers as they may be sensitive to issues of body image and self-presentation while being active in mixed-sex environments (Pearson, Braithwaite, & Biddle, 2015). Results of a meta-analysis investigating adolescent girls PA interventions found that out of the 45 studies included in the analysis, the average treatment effect for adolescent girls involved in PA interventions was significant but small (Pearson et al., 2015). The meta-analysis concluded that interventions to increase PA in adolescent girls may be a challenging task as it requires behavior change. To improve effectiveness of similar interventions, evidence based practices, longer follow-ups, use of objective measures, and assessment of potential mediators of behavior change should be implemented (Pearson et al., 2015).

While the results from this study suggest that males participate in more PA than females, there are still ways to improve the health of adolescent boys. A 16-month randomized, controlled school-based study compared the effects of a daily PA program among boys and girls (Macdonald, Kontulainen, Khan, & McKay, 2007). Findings suggest that daily PA enhances bone strength at the distal tibia in prepubertal boys, but not in girls the same age (Macdonald et al., 2007). Another intervention aimed to increase cardiovascular fitness and body composition in adolescent black boys (Howe, Harris, & Gutin, 2011). Results of this intervention found that after 10-months of an after-school PA intervention, boys who attended the intervention at least 3-days/ week had significant reduction in body fat, BMI, and fat mass compared to those in a control group (Howe et al., 2011). Adolescent boys may still benefit from specifically tailored

PA interventions. It is recommended that future studies and interventions, target adolescent boys and girls separately to improve their PA levels.

The lack of a statistically significant difference of variables in this study does not confirm the absence of a relationship between PA and school facilities. Hood et al., (2014) researched PA breaks and facilities in secondary schools. Compared to a 2006 study, Hood et al. (2014) found that the prevalence of PA breaks was much lower (27.2% lower for middle school students and 9.3% lower for high school students) than the levels of PA in the School Health Policies and Programs Study (SHPPS) four years prior. The decreasing amounts of PA breaks provide adolescents with less time to participate in PA, decreasing their overall PA level. The same study found a small but statistically significant association between facilities and PA, and PA breaks in middle schools were associated with lower rates of obesity and overweight (Hood et al., 2014). This study illustrates the influence that school breaks may have on PA and weight status and continuous research should be conducted to determine the effect of school breaks related to PA and if they serve as an opportunity to influence PA.

While there was no statistically significant relationship found in this study, according to the literature suggests a relationship between school PA interventions and adolescent's PA levels. Previous studies have specifically examined the effect of school PE interventions on adolescent's PA. A PE intervention was found to be effective in improving the PA habits and physical performance of adolescents and decreasing daily sedentary activities (Sacchetti et al., 2013). It has also been found through a study of high school students that higher school day MVPA was associated with higher overall MVPA (Long et al., 2013). These results suggest that school environments can and do affect students' PA level.



A possible explanation for the statistically insignificant differences seen in this study may have to do with time available to partake in PA during the free/lunch periods. The NYFS data did not ask participants how much time was available during free/lunch periods. While students may have access to PA facilities throughout the school day, if they do not have enough time to utilize them, their MET scores would not be affected. To better understand if access affects MET scores, further details on time available to students would need to be collected. A previous study found that very little MVPA is performed during recess at school with children spending about 73% of recess time participating in sedentary activities (Perez-Rodriguez et al., 2012). Future research on the subject should include time available to be spent on PA at school as a possible barrier to PA participation.

While the results of this study did not show a statistically significant difference in mean METS or BMI between those with and without access to PA facilities at school, other research has shown that both social and built environments can affect adolescents' PA level. Adolescents' perceptions of access to PA facilities also are proven to be more closely associated with use of facilities than proximity (Carroll-Scott et al., 2013). It is also possible that statistically insignificant difference relates to a lack of intentional effort by adolescents to use the school PA facilities provided. Adolescents need to have motivation to participate in PA in order for it to have a positive effect on them. The lack of essential motivation and the pressure of academic assignments influences adolescents to remove PA from their daily priorities (Peykari et al., 2015). Recommendations for future research would be to include built environment as a contributing factor to PA level as well as investigate the effects of motivation on PA.

The importance of increased PA at school is not just important to increase overall PA but to help improve academic achievement of adolescents. This study does not assess the impact of

access to school PA facilities and academic performance. However, more research is needed to improve our understanding of the relationship between PA and academic achievement. Donnelly and Lambourne (2011) found that a curriculum-based PA intervention improved academic achievement in participants, as well as decreased BMI.

### *Limitations*

The first limitation to this study is that the data from the PA questionnaire was self-reported. Self-reported data can be biased or false, especially self-reported data from adolescents. Adolescents may either underestimate or overestimate the amount of PA they participate in, therefore data may not accurately reflect the actual amount of PA. Also, adolescents may be unaware whether or not they have access to PA facilities at school during their lunch or free periods. The data from the examination portion of the NYFS would be based on surveyor reporting, and while this method is less likely to be biased, there is still a possibility for surveyor error.

A final limitation in this study is that potentially important confounders, like SES were not controlled for in the analysis. SES may affect the amount of PA that adolescents participate in.

### *Implications and Future Studies*

While results from this study showed no statistically significant relationship between school facility access and MET scores, time spent at school represents an opportunity to influence PA level in adolescents and should not be overlooked. Further research should investigate the effect of the school environment on adolescent's PA. More data should also be

collected related to free/lunch period PA and whether adolescents at school have access to PA facilities. Time available to engage in PA during school breaks should be researched further as well. Improving access within the school environment has vast implications for adolescent's overall wellbeing. Tailoring PA interventions differently between girls and boys would also be important in the future since barriers to PA differ among gender. As stated, adolescent females' PA participation is strongly affected by social influences compared to adolescent boys who are more influenced by their physical abilities to participate in PA (Peykari et al., 2015). Focusing programs that target these key issues may allow for more effective interventions.

It is known that increased PA in adolescents can lead to many health benefits including: weight control, mental health, cognitive achievement, and decreased risk for type 2 diabetes and other chronic diseases. Future interventions should also focus on PA promotion programs, and not just on increasing access. Results from previous literature emphasize the need for providing adolescent health programs based on specific needs (Peykari et al., 2015). Other evidence suggests that school-based PA interventions of longer duration may influence adolescents' PA level (Dobbins, Husson, DeCorby, & LaRocca, 2013). The importance of providing programs based on previous research will help create efficient PA interventions. The long list of benefits associated with increased PA illustrates the need for future research and interventions on the topic. Finally, the potential for school facilities to positively impact the benefits of PA make it crucial to further investigate PA opportunities school facilities may provide adolescents.

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