ENVIRONMENTAL CORRELATES OF PHYSICAL ACTIVITY IN YOUNG ADULTS

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The purpose of this study was to examine the association between environmental correlates and physical activity (PA) levels in young adults. The sample consisted of 369 females and 315 males, aged 24-30 years (84% white; 14% black). Physical activity (hrs/wk) averaged over the past year and number of days of vigorous PA was assessed by questionnaire. Proximity to recreational facilities, home exercise equipment, neighborhood characteristics, and barriers to physical activity were also assessed by questionnaire. Gender-specific analyses were conducted to compare mean scores for each environmental correlate across quartiles of total physical activity and across level of vigorous physical activity. Gender-specific analyses were conducted to examine the odds of a barrier being reported across quartiles of total physical activity and across level of vigorous physical activity. After adjusting for all potential covariates, in females, home exercise equipment was significantly related to vigorous physical activity (OR=1.26, 95% CI=1.10-1.42), and in both genders, proximity to recreational facilities ($p=0.005$ in males; $p=0.012$ in females) and home exercise equipment ($p<0.001$ in males; $p<0.001$ in females) were significantly associated with total physical activity. In males, a lack of good weather (OR=2.88, 95%CI=1.12-7.42) and a lack of facilities (OR=4.43, 95%CI=1.47-13.37) were significantly associated with an insufficient amount of vigorous physical activity, and a lack of equipment and facilities were negatively related to total physical activity. In conclusion, environmental correlates and barriers significantly influence leisure-time physical activity in young adults.

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PREFACE

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1. Introduction

1.1 Introduction

The purpose of this study was to examine the association between environmental correlates and physical activity levels in young adults. This chapter is composed of the following sections: (1) Rationale, (2) Purpose, (3) Significance, (4) Specific Aims, and (5) Research Hypotheses.

1.2 Rationale

Regular physical activity is strongly related to better physical and psychological health outcomes (93). On the other hand, physical inactivity is one of the most prevalent chronic disease risk factors in the United States. Due to physical inactivity and poor diet, approximately 400,000 premature deaths occur every year (53). Although the health benefits of physical activity are known, more than one quarter of the U.S. population remains sedentary (7). Therefore, encouraging people to initiate and maintain a regular program of physical activity is a public health priority in the U.S. and other industrialized nations.

A number of factors are associated with physical activity including demographic factors, psychological factors, skills, social factors and physical environment factors. Investigating these factors is necessary to the development of appropriate intervention programs. Environmental interventions are generally designed to target large groups or communities, thus identifying environmental factors is currently a topic of increasing research interest.

1.3 Purpose

The purpose of this study was to examine the association between environmental correlates and physical activity levels in young adults.

1.4 Significance

It is a public health priority to encourage people of all ages to habitually participate in physical activity on most days of the week. It is recommended that physical activity should be done for at least 30 minutes or more at a level of moderate intensity in order to achieve both physical and psychological health benefits (57, 93). Through the development of relevant policies and interventions, it is predicted that there is a potential to influence individual behavior and health by changing the attributes of a person's environment (67). Most importantly, there is a significant benefit to identifying the components that facilitate or hamper physical activity on the part of the individual.

Investigating environmental factors as correlates of physical activity is a relatively new area of research for policymakers and intervention program developers. Identifying the association of environmental factors with adherence to a physically active lifestyle, as this study endeavors to do, could increase the awareness of researchers in the public health field that relevant policies or interventions may encourage physical active lifestyles.

1.5 Specific Aims

The specific aims of this study were:

1. To identify the environmental correlates that are associated with physical activity.

2. To identify environmental barriers that are associated with low levels of participation in leisure time physical activity.

1.6 Research Hypotheses

The research hypotheses of this study were:

1. Convenient recreational facilities are associated with levels of leisure-time physical activity.
2. Physical activity equipment at home is associated with levels of leisure-time physical activity.
3. Neighborhood characteristics are associated with levels of leisure-time physical activity.
4. Perceived barriers to participation in physical activity are associated with levels of leisure-time physical activity.

2. Review of Related Literature

2.1 Introduction

The purpose of this study was to examine the association between environmental correlates and physical activity levels in young adults. This chapter will review the literature related to the topic of this investigation, and is composed of the following sections: (1) Physical Activity in Adults, (2) Environmental Correlates of Physical Activity (3) Other Correlates of Physical Activity, and (4) Summary of Review of Literature.

2.2 Physical Activity in Adults

2.2.1 Definition of Physical Activity and Physical Activity Assessment

Physical activity is one of the most important leading health indicators in adults. Physical activity (PA) is defined as "any body movement by skeletal muscles that substantially increase energy expenditure" (16). PA can be classified in various ways, such as type and intensity. Exercise, a subcategory of PA, is planned, structured, repetitive, and purposive PA for the improvement or maintenance in physical fitness.

Many methods have been developed in the last decades and used in research or clinical settings to assess physical activity. These methods include self-reporting, accelerometers, pedometers, heart rate monitoring, direct observation and doubly labeled water. Each instrument has specific advantages and disadvantages which the researcher or user needs to consider (Table 1).

Table 1: Advantages and disadvantages of physical activity assessment methods

Measure	Advantages	Disadvantages
Self-report	-Low financial Cost & low participant burden -Large sample size -Multi-dimensions measured (frequency, type, intensity, and duration) -Quantitative and qualitative information	-Recall bias -Misinterpretation of questions
Accelerometry	-Free-living setting -Intensity, frequency, and duration reported -Ease to collect, analyze, and transfer data -Long term possible	-Financial cost -Inaccurate in particular motions or activities
Heart rate (HR) monitor	-Free-living setting -Ease to collect, analyze, and transfer data - Ease to calculate energy expenditure -Low participant burden -Intensity, frequency, and duration reported	-Financial cost -Discomfort for long term -Aerobic activities only -Influenced by a ambient temperature, humidity, hydration, emotional state, age, gender, and training status
Pedometer	-Free-living setting -Low financial cost & low participant burden -Large sample size -Ease to collect, analyze, and transfer data	-Accuracy in walking only -Less accuracy in jogging or running -Inability to measure the rate or intensity of movement
Direct observation	-Free-living setting -Both quantitative and qualitative information in detailed -Suitability in children	-Time and labor to collect data -Training and practice required for observer -Interruption of observer presence to participant's activities
Indirect calorimetry & doubly labeled water	-High accuracy to assess energy expenditure "Gold Standard"	-High relative cost

The table was adapted and modified from Dale et al., 2002 (96).

Self-Report Technique: Self-report is the most common method to measure physical activity due to its low cost, low participant burden, and its feasibility for use with large sample. This technique includes physical activity diaries, interviewer-administered questionnaires, self-administered questionnaires, and reports by proxy. Reliability and validity problems involving accuracy in recalling of physical activity and participants' misinterpretation of questions are limitations of this method.

Several studies have published the information of reliability and validity for a number of the published instruments. In general, reliability measures of the instruments were reasonably high ranged 0.70 to 0.95 (59, 72). Sallis and Saelens (72) also evaluated the validity of several instruments against accelerometers and doubly labeled water. Sallis and Saelens found that the validity coefficients of the most measures were relatively low ranging from 0.14 to 0.36, but the 7-days Physical Activity Recall was relatively high (r = 0.50 to 0.56). The reproducibility and validity of the past-year questionnaire used in the current study were determined in a sample of 100 adolescents (1). The Spearman correlations between the past-year questionnaire and 7-day recalls ranged from 0.55-0.67 in males and 0.73-0.83 in females.

Accelerometry: Accelerometry is an appropriate method for assessing physical activity in free-living conditions. This device assesses the acceleration of the body in a specific dimension or in multiple dimensions. Because it provides the intensity, frequency, and duration of physical activity, and it is easy to transfer data collected into a computer, the accelerometer is useful in laboratory and field setting. However, it is expensive and inaccurate in a large range of activities. Several researches have studied the validity and reliability of accelermetry under both laboratory and field conditions.

Correlations between the raw counts from accelerometer and the metabolic variables measured, such as metabolic equivalents (METS), volume of oxygen uptake (VO_2), and energy expenditure (EE) ranged from 0.62 to 0.91 (97). Welk and Blair et al. (98) also evaluated the ability of various accelerometers to estimate the energy costs of indoor activities including sweeping, stacking, and vacuuming and outdoor activities including shoveling, mowing, and raking. Welk and Blair concluded that monitors consistently underestimated the EE measured by 38 to 48%, and the high correlation among those monitors was r=0.78. Jakicic et al. (40)

reported reliability coefficients ranging from 0.44 to 0.92 for two selected accelerometers across a variety of activities. The reliability was higher for walking and running ranging from 0.76 to 0.92 than for the stepping, sliding, or cycling raging from 0.54 to 0.88.

Heart Rate Monitor: Heart rate monitoring has been widely used to detect physical activity in the laboratory, as well as in clinical settings due to its good physiological response related to the participant's energy expenditure on physical activities. Mostly, the watch type of heart rate monitor is used. The advantages of this device are the low participant's burden and ease of collecting and analyzing data. However, the cost for a large number of participants and its usefulness only for aerobic activity are limitations of this device. Furthermore, the heart rate can be affected by other conditions, such as the ambient temperature, the humidity, hydration, the emotional state, age, gender or training state.

The flex heart rate procedure (Flex HR) which is defined as the mean of the highest heart rate at rest and the lowest during exercise has been shown to provide highly accurate estimates of energy expenditure in adults. Correlation coefficients between Flex HR method and energy expenditure measured using doubly labeled water or whole body calorimetry were moderate to high ranging from 0.54 to 0.98 (17, 77). Strath et al. (84) examined the validity of the % heart rate reserve (%HRR) method for predicting energy expenditure during moderate intensity activity in adults. Strath et al. (84) reported a strong association (r=0.87) between estimates of oxygen consumption from heart rate data and oxygen consumption measured using indirect calorimetry. Wareham et al. (95) reported a 0.69 reliability correlation coefficient for four days, using Flex HR methods.

Pedometer: This device estimates walking distance by recoding steps based on participant's stride length. It is relatively inexpensive and easy to utilize even for large

populations. However, this device is not only less accurate in assessing jogging or running, but it is also incapable of examining the intensity of movement, such as walking on flat versus hilly terrain.

Nelson et al. (54) reported that the pedometer underestimate the gross energy expenditure by 27% at 2mph and by 7% at speeds ≥ 3.5mph. Thus, the pedometer has good validity for measuring energy expenditure for treadmill walking speeds from 3 to 4 mph, but it underestimates energy expenditure at speeds ≤ 2mph. In order to improve the reliability of pedometer data and obtain data representative of usual physical activity, sampling periods longer than one day must be used (34, 76, 92). It is recommended that both weekdays and weekend days are included.

Direct Observation Technique: The direct observation method can assess the specific targeting behavioral aspects of physical activity, and both quantitative and qualitative data can be collected. Software programs are available to improve data collection and recording. However, this technique is labor-intensive, as well as time-intensive. In order to insure accurate coding, observer training and practice is necessary.

McKenzie et al. (49) reported that the interval by interval reliabilities of System for Observing Fitness Instruction Time (SOFIT) designed to measure student physical activity, lesson context, and teacher behavior during physical activity classes ranged 92%. McKenzie and et al. (50) also found that the intra-class correlations of System for Observing Play and Leisure Activity in Youth (SOPLAY) created to assess the physical activity of groups of people ranged 0.76 to 0.99.

Indirect Calorimetry: Indirect calorimetry is respiratory gas analysis which involves the measurement of oxygen consumption and carbon dioxide production in order to estimate energy

expenditure on physical activity. For short periods, the participant wears a mouthpiece, noseclip and head gear connected to a metabolic analyzer, including a metabolic cart and portable backpack system. For long periods, the participant occupies a metabolic chamber. Although the advantage of this method is its ability to accurately measure energy expenditure, it is limited to simulating true free-living situation, and it is also costly.

Doubly Labeled Water: This technique is a biochemical procedure to measure energy expenditure. The participant takes the water that includes two stable isotopes. After a certain time period (1 or 2 weeks), the difference between these two isotopes in the body is examined by measurement of urine, sweat or evaporation. Accuracy is the major advantage of this approach, but the water used is prohibitively expensive ($800 per bottle).

Doubly labeled water (DLW) and indirect calorimetry has traditionally been gold standard for assessing physical activity. Studies have attempted to validate other physical activity assessment methods against DLW/indirect calorimetry.

2.2.2 Relation between Physical Activity and Health

Regular physical activity is a significant component in improving and maintaining health. People who do not engage in regular physical activity have a high risk of death and disability (25). Epidemiology studies of physical activity have consistently documented that physical activity reduces incidence of coronary artery disease and stroke (9, 32, 46). Even modest physical activity prevents the risk of cardiovascular events (26). Physical activity also reduces the risk of breast and colon cancers and may reduce the risk of several types of cancer(20, 28, 29). In addition, physical activity helps to prevent type 2 diabetes, which has been associated with increased risk of cancers of the colon, pancreas, and other sites (14, 48, 100, 105). Regular physical activity decreases the risk of developing type 2 diabetes (42, 44),

depression (81, 99), and obesity (19, 22, 27). Physical activity may be associated with reduced symptoms of depression (15), clinical depression (99), and symptoms of anxiety (62).

2.2.3 Physical Activity Recommendations

The Centers for Disease Controls and Prevention (CDC) and the American College of Sports Medicine (ACSM) have released guidelines recommending that all adults perform at least 30 minutes of moderate intense exercise, such as brisk walking 3-5 days a week (57). These guidelines also suggest that additional health benefits of physical activity can be obtained by adding more time to the exercise session or by working at a higher intensity. Those who have a risk of cardiovascular disease, diabetes, or other chronic disease and want to increase the intensity or duration of physical activity should be advised to do so in consultation with or supervision by a physician (93).

2.2.4 Prevalence of Physical Activity in Adults

Despite evidence on the physical and mental health benefits of physical activity, a majority of the U.S. population still choose not to exercise (7). Only 19% of adults (18 years or older) in the U.S. reported engaging in a high level of overall physical activity, and 23.5% engaged in a medium-high level of overall physical activity (7).

Disparities in levels of physical activity exist between population groups. Men (21.3%) were more likely to engage in a high level of overall physical activity than women (16.9%), but men (23.3%) and women (23.8%) were about equally likely to engage in a medium-high level of overall physical activity. However, women (11.6%) were more likely than men (7.3%) to never engage in any physical activity. The proportion engaging in a high or medium-high level of overall physical activity was lower for Hispanics (34.6%) and African American (33.1%) than White (45.5%), decreased with age, and increased with education and income (7).

2.3 Correlates of Physical Activity

The term "correlate" as proposed by Bauman (8) was utilized, instead of "determinant" in reporting statistical relationships between environmental factors and physical activity. In contrast, the term "determinant" is defined as causal factor and use to indicate a causal-and-effect relationship.

In this study, there are five broad categories of factors correlated with physical activity adapted from Sallis' classification in his 1999 study (65). The categories of correlates consist of (1) demographic and biological factors, (2) psychological, cognitive, and emotional factors, (3) behavioral attributes and skills, (4) social and cultural factors, and (5) physical environment factors and are presented in Table 2.

2.4 Environmental Correlates of Physical Activity

Over the last decade, a number of studies have explored the environmental correlates of physical activity because these components are favorable to modification, and environmental interventions are well suited for targeting large group or community changes. Therefore, identifying the environmental correlates that may facilitate or hinder a physically active lifestyle is currently a topic of increasing research interest in the field of public health. These environmental correlates are classified into four subgroups, consisting of the convenience of recreational facilities, home exercise equipment, weather, and neighborhood environment.

2.4.1 Recreational Facilities

The components of recreational facilities include the availability of recreational facilities, the perception of the convenience and accessibility of recreational facilities, the cost of exercise

Table 2: Correlates of physical activity

Demographic and Biological Factors
• Age • Occupation • Gender • Hereditary factor • Socioeconomic status, ethnicity, education, and income • Marital status and having a kid • Obesity and overweight
Psychological, Cognitive and Emotional Factors
• Attitudes to, barriers to, enjoyment of, expectation of, and intention to exercise • Bad Mood and Stress • Perceived health or fitness • Personality • Psychological health • Self-efficacy • Locus of control • Motivation • Susceptibility to illness
Behavioral Attributes and Skills Factors
• History of activity during childhood/youth • Alcohol use and smoking • Exercise programs • Dietary habits • Skills for coping with barriers • Type A behavior patterns • Knowledge
Social and Cultural Factors
• Class size • Exercise models • Family, peer and physician influences • Social isolation • Social support
Physical Environment Factors
• Access to facilities(actual/perceived) • Exercise program • Cost • Unattended dog • Traffic • Observation of others exercising • Street light • Sidewalks • Crime rate • Safety for walking and exercise • Weather and season • Home exercise equipment

Adapted from Sallis (65)

programs and membership in sports clubs. Table 3 presents the findings and characteristics of the studies conducted to date.

The presence of recreational facilities/places was strongly associated with an increased likelihood of subjects participating in leisure-time physical activity (10, 21, 30, 38, 69, 71). Humpel and colleagues found that women living in a costal location were 3.32 times more likely to do neighborhood walking (38), and men living in a costal area were 1.66 times more likely to walk in their neighborhood (39). De Bourdeaudhuij et al. (21) reported that the presence of facilities for physical activity within a 5-minute drive from home was positively correlated with vigorous physical activity for both females and males, but exercise facilities at work were positively associated only for women. Giles-Gorti and Donovan (30) also concluded that people reporting less availability of facilities were less likely to exercise. Moreover, a study among older Australian adults (10) also found a positive association between physically active behavior and convenient facilities. Physically active people were more likely to report a higher level of access to facilities, including local exercise halls, recreation centers, cycle paths, golf courses, gyms, parks, swimming pools, tennis courts and bowling greens (40.8% vs. 32.9%). Sallis et al. (69, 71) showed that those who engaged in recommended exercise reported a greater number of facilities around their homes.

On the other hand, several studies reported no association between the presence of recreational facilities and levels of physical activity. In a study of rural white women, the findings indicated that there was no association between having a physically active lifestyle and having exercise facilities within walking distance (23). Brownson et al. (12) indicated that there was no statistical difference between the distance to walking trails and walking behavior. In addition, Wilcox and colleagues (104) revealed that urban females, in comparison with rural

Table 3: Characteristics and main findings of studies examining recreation facilities

Reference	Subject	Environmental Correlates	Physical Activity behavior	Findings
Humpel et al. 2004a	N=399 (57% Females) aged >40	Location & Perceived environment accessibility	Walking (Survey)	People perceiving moderate accessibility did more walking for pleasure
Humpel et al. 2004b	N=800 (50.3% males) mean age= 43	Location & Perceived convenience & access to exercise or walking places	Walking & total physical activity (PA) (Survey)	Men perceiving high access & convenience to places did more neighborhood walking. Women perceiving high convenience walk more; those with high access walk less
Salmon et al. 2003	N=1332 (55% females) mean age=45.4	Cost & no access to facilities	One week leisure time PA (Survey)	People reporting cost as a barrier walk more, moderate PA more and total PA more, however vigorous PA less
De Bourdeaudhuij et al. 2003	N=521 (48.2%females) mean age = 41	Presence of physical activity facilities	PA in the last 7 days (Survey)	For vigorous PA, among males, convenient facilities were significant while among females, convenient facilities and worksite environment were significant.
Eyler 2003	N=1000 women aged 20 to 50	Presence of place to exercise	Recommended PA (Survey)	No significant findings
Giles-Corti & Donovan 2002	N=1803 aged 18-59	Presence of facilities	Recommended PA (Survey)	People with less access to facilities did less exercise
Ball et al. 2001	N=3392 (54.2%females) age ≥ 18	Perception of recreational facili ties	Past two weeks walking (Survey)	People reporting less convenient facilities did less walking for exercise
Wilcox et al. 2000	N=2912 wome n age ≥ 40	Perception of recreational facili ties	Past two weeks PA (Survey)	Urban women have more facilities. No association between access to facilities and sedentary behavior
Booth et al. 2000	N=449 (55.2%females) age ≥ 60	Presence of recreational facili ties	Past two weeks PA (Survey)	Physically active people had more access to recreational facilities
Brownson et al. 2000	N=1269 (65.3%females) age ≥ 18	Presence of walki ng trail and indoor	Walking behavior (Survey)	No differences
Sternfeld et al. 1999	N=2636 wome n aged 20-65	Perceived lack of facilities	Occupational and r ecreational PA (Survey)	Lack of facilities negatively associa ted with sport and exercise

Table 3 **Continued**

Reference	Subject	Environmental Correlates	Physical Activity behavior	Findings
Leslie et al. 1999	N=2729 (57.2%females) median age=20	Membership & perceived facilities	Moderate and vig orous PA (Survey)	People with awareness of camp us facilities and gym members hip were more active
Sallis et al. 1997	N=110 (83 females) mean age=20.6	Presence of facilities	Strength & vigorous PA and walking (Survey)	No significant association
Sallis et al. 1992	1719 (41.9%females) mean age=50.3	Presence of facilities	For 24 months change in vigorous PA (Survey)	No association
Sallis et al. 1990	N=2053 (42% females) mean age=47.8	Presence of pay/free facilities	Vigorous PA (Survey)	Active people had a greater nu mber of facilities near home

females, were more likely to report a greater accessibility of recreational facilities (84.4% vs. 64.2%), but this had no effect on overall physical activity.

Most studies used a questionnaire to assess the presence of recreational facilities/sites; however, others used a variety of alternate assessment methods. These include the use of ZIP codes to identify costal and non-costal locations (38, 39), MapInfo to determine the spatial location of destinations (30), Arc Info GIS software to determine the distance between individuals' home and destinations (30), and a list of exercise facilities to classify as either free or having user fees.

The perception that facilities were convenient was also positively related to participation in leisure time physical activity (6, 21, 38, 39, 47, 82). For both men and women, those reporting a greater convenience of facilities were more likely to walk or be physically active (6, 21, 38, 39). Sternfeld et al. (82) also concluded that physical activity was negatively associated

with a lack of recreational facilities. Leslie et al. (47) reported that college students' awareness of facilities was positively associated with being physically active.

Physically active people were more likely to have memberships in recreational groups or sports clubs (30). Giles-Gorti and Donovan (30) identified that individuals who engaged in vigorous exercise reported using at least one recreational facility around their homes, and participants who had a sports or recreation club membership were more likely to be active (OR=2.56, 95%CI=1.86-3.22). Sallis et al. (69) also reported that vigorous exercise behavior was positively ($p<0.05$) associated with the density of pay facilities, but interestingly no significant association was found with free facilities. Salmon et al. (74) determined that people reporting "cost" as a barrier to physical activity were less likely to do vigorous activity (OR=0.7, 95%CI=0.5-0.9), but more likely to do walking (OR=1.4, 95%CI=1.1-1.8), moderate exercise (OR=1.5, 95%CI=1.2-2.0), and total physical activity (OR=1.5, 95%CI=1.1-2.1).

In a longitudinal study (68) measuring factors affecting vigorous activity in 1719 adults (mean age of 50.3years), the results indicated that there was no association between the adoption or maintenance of vigorous exercise and the components of recreational facilities over a period of 24 months.

In conclusion, ten studies (6, 10, 21, 30, 38, 39, 47, 69, 74, 82) reported a statistically positive association between recreational facilities and levels of physical activity. However, no association was found in five other studies. People who reported more recreational facilities or walking trails around their homes were more likely to do vigorous activity or to walk. In addition, older adults who reported having shopping malls or parks within walking distance or within easy access were more likely to be physically active. Overall, recreational facilities or programs are strongly associated with the level of physical activity in an individual's lifestyle.

2.4.2 Weather

The perception of bad weather is considered as a barrier to physical activity. Table 4 presents the findings and characteristics of studies conducted to date.

Table 4: Characteristics and main findings of studies examining weather

Reference	Subject	Environmental correlates	Physical Activity Behavior	Findings
Humpel et al. 2004	N=399 (57% females) aged > 40	Perceived weather as a barrier	Walking for any purpose (survey)	People perceiving no influence did more neighborhood & exercise walking
Salmon et al. 2003	N=1332 (55% females) mean age=45.4	Perceived weather as a barrier	One week physical activity (PA) (survey)	People perceiving weather as a barrier did more TV watching & sedentary behavior
Wilcox et al. 2000	N=2912 women age ≥ 40	Perceived weather as a barrier	Past two weeks PA (survey)	Bad weather positively associated with sedentary behavior
King et al. 2000	N=2912 Women age ≥ 40	Perceived weather as a barrier	Past two weeks PA (survey)	No association

One study reported a positive association between bad weather and sedentary behavior (74). Salmon et al. (74) found that among Australian adults, people who reported weather as a barrier to physical activity were 50% more likely to do TV watching and have a higher total of sedentary behavior.

In addition, one study reported that people who perceived the weather as having no influence on their walking were more likely to walk (38). Humpel et al. reported that participants who perceived the weather as having no influence on their walking for any purpose were more likely to do neighborhood walking (OR=4.71, 95%CI=1.60-13.91 in men; OR=3.84, 95%CI=1.68-8.77 in women) and exercise walking (OR=5.48, 95%CI=1.83-16.38 in men; OR=7.68, 95%CI=3.03-19.46 in women).

Wilcox et al. (104) in a U.S. women's determinants' study, found that women with a high score on ten perceived barriers were more likely to have a sedentary lifestyle (OR=0.86, 95%CI=0.79-0.94 in urban women; OR=0.84, 95%CI=0.78-0.91 in rural women). However, among the same female participants, King et al. (41) reported that there was no association between individual's perceptions of bad weather and sedentary behavior.

In conclusion, all studies assessed adult's perceptions of weather as being a barrier to physical activity or a correlate of sedentary behavior. No study found any negative association between bad weather and sedentary behavior.

2.4.3 Home Exercise Equipment

The components of home exercise equipment are the number of pieces of equipment and the availability of equipment. Home exercise equipment includes things such as stationary aerobic equipment, bicycles, dogs, running shoes, weight lifting equipment, and aerobic workout videotapes. Table 5 presents the findings and characteristics of the studies conducted to date.

Three studies of adults reported that physical activity equipment at home was positively associated with subjects' physical activity (21, 70, 71). De Bourdeaudhij et al. (21) found that physical activity equipment at home was a significantly positive correlate of moderate and vigorous physical activity among men ($p<.01$) and a significantly positive correlate of vigorous physical activity among women ($p<.05$). Sallis et al. (71) indicated that after adjusting for neighborhood socioeconomic status, 7% of the variance in strength exercise was explained by home exercise equipment variables. However, there were no significant association between the amount of home exercise equipment and vigorous physical activity or walking in the young adult population. In 1989, Sallis and colleagues (70) also reported that for older adults ($\geq$ 50 years)

Table 5: Characteristics and main findings of studies examining home exercise equipment

Reference	Subject	Environmental correlates	Physical Activity Behavior	Findings
De Bourdeaudhuij et al. 2003	N=521 (48.2% females) mean age = 41	Number of physical activity (PA) equipment at home	Last 7 days physical activity (PA) (survey)	Home physical activity equipment positively related to vigorous physical activity
Booth et al. 2000	N=449 (55.2% females) aged ≥ 60	Presence of PA equipment at home	Past two weeks PA (survey)	No association
Trost et al. 1999	N=198 (52% females) mean age = 11.4	Number of PA equipment at home	Moderate & vigorous PA (survey & activity monitor)	In females, home exercise equipment positively associated with MPA.
Pate et al. 1997	N=361 (51% females) mean age =10.7	Number of PA equipment at home	Moderate & vigorous PA (survey)	In terms of moderate physical activity, active people had more home exercise equipment
Trost et al. 1997	N=202 (110 females, 64% Blacks) Fifth grade	Number of PA equipment at home	Moderate & vigorous PA (survey)	No association
Sallis et al. 1997	N=110 (83 females) mean age = 20.6	Number of PA equipment at home	Past 7 days PA & past two week walking (survey)	Home equipment positively associated with strength exercise
Stucky-Ropp et al. 1993	N=242 (50% females) mean age = 11.2	Number of PA equipment at home	PA reported by child & parent (survey)	Among girls, home equipment positively related to PA
Sallis et al. 1992	N=1719 (42%female) aged 18-90	Number of PA equipment at home	Over 24 months changes in PA (survey)	No association
McKenzie et al. 1992	N=351 (48% girls) 4 year old	Number of toys facilitating PA	Child's physical activity level (survey)	Mexican children were less active and had fewer toys
Hovell et al. 1991	N=127 Hispanics (38%females), mean age= 43.3	Number of PA equipment at home	Past week PA & two weeks walking (survey)	No association
Sallis et al. 1989	N=1789 (43% females) mean age = 47	Number of PA equipment at home	Vigorous PA (survey)	In men ≥ 50 years, home equipment positively related to vigorous PA
Hovell et al. 1989	N=1789 (43%females) mean age = 47	Number of PA equipment at home	Walking for exercise (survey)	No association

there was a positive association between home exercise equipment and vigorous physical activity ($p<.02$).

Additional studies with children also found a positive association between home exercise equipment and levels of physical activity (51, 58, 85, 91). Trost et al. (91) reported that among children at sixth grade girls, the presence of exercise equipment emerged as a significant correlate of moderate physical activity. Pate et al. (58) also found that among children, those who were moderately active were more likely to have home exercise equipment than those who were less active. In the Stucky-Ropp and et al. study (85), 242 children and their mothers were interviewed to assess the children's habits with regard to physical activity and the amount of exercise equipment in their homes as a social learning variable. For girls only, home exercise equipment was a significant predictor of physically active behavior ($p=.008$). In a study comparing the activity patterns and environmental influences on Anglo and Mexican American children, McKenzie et al. (51) found that Anglo children were more active than Mexican children at home ($p<.002$) and during recess ($p<.03$), while Mexican children had access to fewer active toys (home, $p<.001$; recess, $p<.05$).

On the other hand, several studies reported no association between home exercise equipment and physical activity (10, 36, 37, 90). Booth et al. (10) found that there was no significant difference in the amount of equipment between the active (energy expenditure $\geq$ 800 kcal/kg/week) and inactive groups (energy expenditure <800 kcal/kg/week) in adults aged 60 years or older. In the Trost et al. study (90) involving fifth grade children, the findings indicated that there were no differences in the quantity of home exercise equipment between girls and boys. There was no association between home equipment and either vigorous physical activity or moderate & vigorous physical activity. Hovell et al. (36) reported that among middle class

and well educated Latinos, there was no significant association of vigorous activity and exercise walking with the amount of exercise equipment in the home. In 1989, Hovell et al. (37) also found no significant association between home exercise equipment and walking for exercise.

In the Sallis et al. longitudinal study (68) examining predictors for the adoption of vigorous activity among 1719 adults (mean age of 50.3years), no association was found between initiating or continuing vigorous exercise and home exercise equipment.

All studies asked about the amount of exercise equipment at a participant's home, while some studies offered a list of exercise devices (10-15 items), and used the questionnaire to measure levels of physical activity. One study (91) additionally employed an activity monitor to assess participants' time spent in moderate (3-5.9 METs), vigorous (6-8.9 METs), and extremely vigorous (> 9METs) physical activity during each 60 minute segment of the 7-day monitoring period. No study found any negative association between the home equipment and physical activity.

2.4.4 Neighborhood Characteristics

The components of neighborhood characteristics include the presence of a sidewalk, street lights, heavy traffic, unattended dogs, hills, enjoyable scenery, high crime rates, aesthetics, safety for exercise, and a frequent observation of people exercising. Table 6 presents the findings and characteristics of the studies conducted to date.

Low perceived safety and the crime rate negatively influenced physical activity (10, 33, 37, 38, 52). Booth et al. (10) reported that footpath safety for walking was significantly associated with participation in physical activity among the older population. In a study examining the determinants of adolescent physical activity or inactivity, Gordon-Larsen et al. (33) found that high levels of neighborhood crime were associated with a decreased likelihood of

Table 6: Characteristics and main findings of studies examining neighborhood characteristics

Reference	Subject	Environmental correlates	Physical Activity Behavior	Findings
Humpel et al. 2004a	N=399 (57% Females) aged > 40	Neighborhood safety & aesthetics	Walking (survey)	Males perceiving positive neighborhood aesthetics did more neighborhood walking, but males perceiving high safety did less social walking
Humpel et al. 2004b	N=800 (50.3% males) mean age=43	Neighborhood aesthetics & traffic	Walking and physical activity (PA) (survey)	Males perceiving positive aesthetics did more neighborhood walk, but perceiving no traffic did less neighborhood walk
De Bourdeaudhuij et al. 2003	N=521 (48.3%females) mean age=41	Neighborhood sidewalks, aesthetics, crime, & traffic	Last seven days PA (survey)	Sidewalks had positively effect on males' walking Among females, ease of walking to bus stop had a positively effect on walking
Eyler 2003	N=1000 women aged 20-50	Other exercising, traffic, sidewalks, street lights, unattended dogs, & safety	Recommended PA (survey)	People with fair street lighting were less active compared to those with poor street lighting
Voorhees & Young 2003	N=285 Hispanic women aged 20-50	Other exercising, traffic, sidewalks, street lights, unattended dogs, & safety	Recommended PA (survey)	Participants with others exercising in neighborhood were less active Those with very good street lighting were less active compared to poor lighting
Thompson et al. 2003	N=350 Native American women aged 20-50	Other exercising, traffic, sidewalks, street lights, unattended dogs, & safety	Recommended PA (survey)	Participants with others exercising in neighborhood were more active
Wilcox et al. 2003	N=102 women aged ≥ 50	Safety, traffic, street lighting, & unattended dogs	Past seven days PA (survey)	Safety & traffic positively associated with PA, but sidewalks negatively associated with PA
Saelens et al. 2003	N=107 aged 18-65	Sidewalks, pedestrians, bike trails, aesthetics, & crime rate	Seven days PA (activity monitor & survey)	People in highly walkable neighborhoods did more moderately intensive activity and more total PA
Wilbur et al. 2003	N=399 African American women aged 20-50	Other exercising, traffic, sidewalks, street lights, unattended dogs, & safety	Recommended PA (survey)	Women in extremely/somewhat safe neighborhoods were more active
Ball et al. 2001	N=3392 (54.2%females) aged ≥ 18	Neighborhood Aesthetics	Past two weeks walking (survey)	People with low aesthetics in neighborhood did less walking

Table 6 **Continued**

Reference	Subject	Environmental correlates	Physical Activity Behavior	Findings
Troped et al. 2001	N=413 aged ≥ 18	Steep hills & busy streets by self-reported & geographic information system	Bikeway use (survey)	Absence of busy streets barrier by self-report had effect on bikeway use Absence of steep hills by GIS had effect on bikeway use
Brownson et al. 2001	N=1818 (67.1%females) aged ≥ 18	Sidewalks, enjoyable scenery, traffic, hills, streetlights, unattended dogs & foul air	PA behavior (survey)	Sidewalks, enjoyable scenery, traffic & hills positively associated with PA behavior
Booth et al. 2000	N=449 (55.2%females) aged ≥ 60	Safety for walking in the neighborhood	Past two weeks PA (survey)	Safety for walking on footpaths positively associated with physical activity
Wilcox et al. 2000	N=2912 urban & rural women aged ≥ 40	Sidewalk, traffic, hills, streetlight, unattended dog, safety, other exercising & enjoyable scene	Leisure time physical activity (survey)	Rural women with others exercising or enjoyable scenery were more sedentary
King et al. 2000	N=2912 Women aged ≥ 40	Sidewalk, traffic, hill, streetlights, unattended dog, safety, other exercising & enjoyable scene	Past two weeks PA for leisure time & household (survey)	Participants with hills, enjoyable scenery, unattended dogs, others exercising, a high crime rate associated with sedentary behavior
Gordon-Larsen et al. 2000	N=17766 (49.2%females) mean age=15.5	Crime rate in neighborhood	Past seven day moderate to vigorous PA and inactivity (survey)	Participants in high crime areas were less active
MMWR 1999	N=12767 (58% females) aged ≥18	Neighborhood safety	Past seven day PA (survey)	People in “not at all” safe neighborhood were more inactive
Sallis et al. 1999	N=732 (51% females) fifth grade at baseline	Neighborhood safety	PA by child, parent, with activity monitor over 20 months	No change
Sallis et al. 1997	N=110 (83 females) mean age=20.6	Number of neighborhood environmental factors	Past seven days PA & Past two weeks walking (survey)	No association

Table 6 **Continued**

Reference	Subject	Environmental correlates	Physical Activity Behavior	Findings
Sallis et al. 1992	N=1719 (42%female) aged 18-90	Safety, ease to exercise, & other exercising	Over 24 months, changes in PA (survey)	Initiation of vigorous exercise in sedentary men inversely related to neighborhood environment.
Hovell et al. 1991	N=127 Hispanics (38% females), mean age=43.3	Safety, ease of exercise, & others exercising	Past week PA & two weeks walking (survey)	No association
Sallis et al. 1989	N=1789 (43% females) mean age = 47	Safety, ease of exercise, & others exercising	Vigorous PA (survey)	No association
Hovell et al. 1989	N=1789 (43% females) mean age = 47	Safety, ease of exercise, & others exercising	Walking for exercise (survey)	People with positive perceptions of the neighborhood walked more

being physical active (OR=0.77, 95%CI=0.66-0.91). Among U.S. adults aged 18 years or older, the Centers for Disease Control and Prevention (CDC) reported that people who described their neighborhood as "not at all safe" were more likely to be inactive (52). The CDC also indicated that females and less educated people who reported their neighborhoods as "not at all safe" were likely to be inactive. Hovell et al. (37) found that individuals who reported a positive perception of the neighborhood environment were more likely to do walking for exercise.

Additional studies with female participants reported a positive association between either safety and the crime rate and physical activity (41, 102, 103). Wilcox et al. (103) found that among rural and older African American and White women, neighborhood safety was positively associated with physical activity. Wilbur et al. (102) found that among African-American urban women, those who reported their neighborhoods to be "extremely or somewhat safe" were more likely to be active (OR=2.43, 95%CI=1.19-4.99). King et al. (41) found that those who perceived a high crime rate in their neighborhood were more likely to be inactive.

However, several studies reported no association between neighborhood safety or the crime rate and levels of physical activity (21, 23, 36, 64, 66, 68, 70, 88, 94, 104). In addition, Humpel et al. (38) reported that men who perceived their neighborhood as highly safe for walking were less likely to walk for socializing (OR=0.22, 95%CI=0.06-0.78).

The presence of sidewalks, street lightings, and the frequent observation of other people exercising were positively related to physical activity (11, 21, 64, 88). De Bourdeaudhij et al. (21) found that among Belgian adults 4% of the variance in males' walking was explained by the greater availability of sidewalks. In an investigation of the environmental correlates of physical activity among Native American women aged 20-50 years, the results indicated that those who reported seeing others exercising in their neighborhood were more likely to be active (OR=3.81, 95%CI=1.66-8.75) (88). Saelens et al. (64) found that people who reported living in high walkability neighborhoods were more likely to have higher levels of both moderate-intensity activity (194.8 minute vs. 130.7 minute, $p<.01$) and total physical activity (210.5 vs. 139.9, $p<.01$).

Interestingly, several studies found a negative association between the presence of sidewalks, street lightings, and the frequent observation of others exercising (23, 41, 94, 103, 104). Eyler (23) and Voorhees and Young (94) found that people who reported a positive perception of street lighting were also less likely to be active. Voorhees and Young (94), Wilcox et al. (104), King et al. (41) reported that participants who saw frequently others exercising in their neighborhood were more likely to be inactive. In addition, Wilcox et al. (103) revealed that the presence of sidewalks was negatively associated with physical activity.

The presence of traffic, hills, and unattended dogs were barriers to physical activity (41, 89). The absence of steep hills was positively associated with the use of bikeways (89), and the presence of hills and unattended dogs were positively associated with a sedentary lifestyle (41).

However, no association was found between these barriers and physical activity (23, 94, 102, 103). In addition, Brownson et al. (11) reported that the presence of heavy traffic and hills were positively associated with physical activity (OR=1.28, 95%CI=1.04-1.58; OR=1.28, 95%CI=1.04-1.58 respectively).

Neighborhood aesthetics and enjoyable scenery facilitated individuals' physical activity (11), especially walking (6, 38, 39). However, two studies of women (41, 104) found that people reporting enjoyable scenery in their neighborhood were more likely to be inactive (OR=1.42, 95%CI=1.12-1.79; OR=1.71, 95%CI=1.16-2.63 respectively).

Sallis et al. (66, 68) conducted two longitudinal studies investigating the association between the neighborhood environment and changes in physical activity. In a childhood longitudinal study, Sallis et al. (66) examined the influence of neighborhood safety on changes in physical activity change over 20 months. The researchers employed children's one-day recall, accelerometers, and parents' reports to determine a physical activity change index and levels of neighborhood safety in this population. The study concluded that there was no association between changes in neighborhood safety and changes in physical activity over the 20 month period. In another study, Sallis et al. (68) examined predictors of the adoption and maintenance of a lifestyle characterized by vigorous physical activity for a period of over 24 months. The individual's perceptions of the neighborhood environment, including safety and the frequent observation of others exercising were assessed. Interestingly, the findings indicated that the

initiation of vigorous physical activity in sedentary men was inversely correlated with the neighborhood environment.

In conclusion, investigators have examined the association between physically active behavior such as walking, moderate physical activity, vigorous physical activity, moderate to vigorous physical activity, physical activity as recommended by the ACSM, or the use of bikeway and neighborhood characteristics, including neighborhood aesthetics, the presence of sidewalks, traffic, the crime rate, the frequency of seeing others exercising, unattended dogs, street lighting, and enjoyable scenery as neighborhood environmental factors. The findings of many studies have indicated that neighborhood aesthetics, the presence of sidewalks, frequent observation of other people exercising, neighborhood safety and the absence of hills were positively associated with individuals' activity. However, some studies have indicated that there were negative correlations between lack of traffic, others exercising in the neighborhood, street lighting, or the presence of sidewalks and participants' physically active behavior.

2.5 Other Correlates of Physical activity

2.5.1 Demographic and Biological Factors

In several studies, gender and age were the most consistent correlates of physical activity behavior in both children and adults. In general, participation in physical activity was consistently higher in men than in women (10, 11, 35, 38, 47, 68, 73, 78, 86, 94). In a large sample (n=12,120) of Canada youth, aged 12-24 years (35), females were less likely to be active and more likely to be overweight. In a U.S. study (5) of young adults, aged 18 - 30 years, the mean metabolic equivalent frequency in females was significantly lower than in males.

Participation in physical activity was consistently inversely related to age (10, 18, 23, 38, 47, 78, 82, 103, 104). Even in the investigation of adolescents' participation in physical activity programs, the findings showed that 12 year olds (25%) had a higher frequency of physical education as compared to 17 year olds (8%) (33).

Ethnicity, income, education and employment were also predictors of physical activity. Whites usually had a higher level of physical activity than Blacks, Native Americans and Hispanics (33, 41, 55, 73, 78, 82, 102, 104, 108). People who reported higher income levels were more likely to be physically active than those who reported having less income (23, 33, 73, 101). In several studies, not only the level of their education (5, 18, 41, 68, 83, 101-104) but also level of their mothers' education (33) was positively associated with an active lifestyle.

In Eyler (23), employment was a significantly positive factor when individuals who performed habitual physical activity according to the American College of Sports Medicine recommendations were compared with those who did not. However, Ainsworth et al. (5) found that young adult females who were not employed or who had small families were more likely to be active while males who were currently involved in school were more likely to be active.

Studies investigating the relationship between marital status and physical activity presented mixed findings. Studies of young adults reported that people who had a spouse or partner were more likely to be inactive compared to those who had no spouse or partner (5, 88). However, in a study involving older adults, individuals who had a partner were more likely to be physically active (103).

Good current health is a strong positive correlate of physical activity (5, 13, 23, 35, 63, 88). Shumway-Cook et al. (79) concluded that disabled older adults tended to use motor vehicles, as well as to avoid physically challenging situations, as compared to nondisabled older

adults. In addition, being overweight or obese had a negative effect on participation in physical activity (5, 31, 55, 64, 82). Giles-Corti and Donovan (31) found that overweight people were more likely to live along a highway or on streets with no sidewalks or only one sidewalk. Furthermore, the researchers found that obese people tended to use motor vehicles all the time, and they reported watching TV 3 or more hours per day.

Interestingly, McKenzie et al. (51) found that in children aged 4 years, boys were likely to be more active, as well as to watch more of hours TV than girls.

2.5.2 Psychological, Cognitive and Emotional Factors and Physical Activity

Self-efficacy was the most consistent positive variables correlated with physically active behavior (10, 55, 66, 68, 73, 82, 86, 88, 102, 103, 106). Women who reported a high level of confidence were 1.77 to 3.11 times more likely to be active, as compared to those who were not confident (88).

Stutts et al. (86) found that a person with a high body mass index (BMI) was more likely to have lower levels of self efficacy than one with a low BMI. This finding suggested that BMI was a significant predictor of self-efficacy. In older adults, individuals who were active were more likely to have higher levels of self-efficacy (48% vs. 27%) than those who were inactive (10). Sallis et al. (66) found in the intervention study that self-efficacy was a strong factor in resisting relapses away from vigorous activity among college female students and away from strength exercises in male students.

Wilbur et al. (102) and Thompson et al. (88) both emphasized that the perception of an individual's good health and one's belief in the health benefits of physical activity were strong predictors of being physically active. Women who rated their general health as good were 3

times (102) and 1.74 times (88) more likely to be active than those who rated their health as poor.

Barriers to physical activity are also strongly related to physically active behavior. Barriers to physical activity include lack of motivation, lack of time, family duties, dissatisfaction with one's body weight or appearance, felling too tired or too weak, lack of energy, lack of knowledge, and lack of exercise partners. In previous researches, family responsibility including caregiving duty emerged as the dominant barrier to habitual physical activity among women (24, 41, 78, 82, 87, 101, 104, 107). Sternfeld et al. (82) found that women with the highest level of caregiving activity were more likely to be older, be an ethnic minority or not be employed. Moreover, they tended to perceive themselves to have little time to exercise. King and colleague (41) also found that caregiving duty, lack of time, lack of energy and feeling too tired to do exercise were top four barriers to being active among women over 40 years of age. Wilcox et al. (104) determined that in the study of the differences in determinants of physical activity among rural and urban, ethnically diverse older women in the U.S., rural women were more likely to be inactive; moreover, rural women reported a higher number of barriers to leisure time physical activity, including lack of time, lack of energy, feeling too tired feeling and caregiving duty.

The perception of stress (103) tended to increase individual's participation of physical activity program, but depressive symptoms tended to increase the tendency toward a sedentary lifestyle. Especially, in older individuals, the cost, an awareness of the risk of falls, injuries, and heart attacks were strong barriers to being physically active.

2.5.3 Behavioral Attributes and Skills

A study of participants from six different Europe countries suggested knowledge of exercise programs as a correlate of physical activity (80). It was found that those who were less educated about programs or options for activity and exercise were 77% more likely to be inactive than those who were well educated on these matters.

Some studies suggested that a preference for sedentary behavior might also influence the decreased likelihood of being physically active; however, enjoyment of physical activity clearly correlated to a significant degree with participation in physical activity (47, 74). In addition, Oman et al. (56) indicated that past exercise habits taken together constituted a predictor of the level of current activity.

Several studies (12, 61, 74) emphasized that smoking was a forceful barrier to physical activity. In the study of Canadian youth, smoking and consuming alcohol were negative correlates of a physically active lifestyle (35).

2.5.4 Social and Cultural Factors

Low income urban black females reported needing financial support in terms of recreational facilities, exercise programs, and child care centers in order to initiate and maintain physically active behavior (102).

Social support for physical activity from friends, family, program staff, physicians or the community was a very strong predictor of physical activity level among interpersonal relation variables. Numerous studies found that the social support from friends or family were positively associated with an individual's level of, initiation of, or maintenance of a physically active lifestyle (5, 10, 24, 35, 47, 60, 65, 68, 73, 75, 78, 80, 82, 86, 87, 94, 103, 104, 108).

Seefeldt et al. (78) determined that social support from family, peers, communities, and healthcare providers resulted in moderate improvements in being physically active across

cultures, ages, social economic status (SES), and genders. On the other hand, among women, family responsibilities, obligations or expectations about family duties as a barrier to active behavior might have negative effects on participation in physical activity or the maintenance of an active lifestyle (88).

Individuals who attended religious services or socialized were more likely to be physically active (23, 35, 88, 94). However, interestingly, in a study urban Latino women (94), individuals who reported knowing friends who exercised, seeing people who exercise in neighborhood, belonging to community groups, or attending religious services were significantly less likely to be active (OR =0.42; 0.19; 0.32; 0.41, respectively 95%CI). Culturally inappropriate activities may also have negative effects on healthful lifestyle (78).

In a study of Taiwanese adolescents study (106), there was no association between interpersonal relations such as parental influences and physical activity, but these parental influences had indirectly effects on physical activity through perceived benefits and perceived self-efficacy.

2.6 Summary of Review of Literature

Numerous studies have been conducted to identify the environmental correlates of physical activity among children, adolescents, and adults. All studies used a questionnaire to measure physical activity such as moderate physical activity, vigorous physical activity, and walking, and environmental correlates such as the presence of recreational facilities, the presence of home exercise physical equipment, and neighborhood characteristics. Few studies used an activity monitor to assess physical activity level, and used zip codes or geographic information system to identify neighborhood characteristics.

The findings of the strength and direction of the studies examining the association between environmental correlates and physical activity were various. A great number of studies found a positive association between the presence recreational facilities, the presence of home exercise equipment, and physical activity. However, in few studies, no association was found, but no study reported any negative association. Positive or no association was found between the perception of bad weather and sedentary behavior in few studies. Interestingly, the findings of the direction of studies examining neighborhood characteristics varied. In most studies, positive association was found between perceived neighborhood safety for walking or exercise, the presence of sidewalks, the presence of street lights, and the frequent observation of others exercising, but in few studies, no association or negative association was found. In addition, several studies reported that heavy traffic, hills, unattended dogs, and high crime rate negatively influenced physical activity participation, but few studies found a positive association. Overall, environmental correlates were significantly related to physical activity participation.

3. Methods

3.1 Introduction

The purpose of this study was to examine the association between environmental correlates and physical activity levels in young adults. This chapter is composed of the following sections: (1) Adolescent Injury Control Study, (2) Physical Activity in Young Adults Study, (3) Study Design and Participants, (4) Data Collection, and (5) Statistical Analysis.

3.2 Adolescent Injury Control Study (AICS)

3.2.1 Overview of AICS

The Adolescent Injury Control Study (AICS) was a 4-year NIH funded prospective study of the incidence and determinants of physician-treated injuries in adolescents. It was initiated in August, 1989 in a metropolitan school district near Pittsburgh, PA. The objectives of the study were to 1) determine the incidence of and risk factors for all physician-treated injuries in a cohort of adolescents and 2) assess the relative contribution of sports and recreational activities to total injury morbidity and mortality in adolescents.

A total number of 1245 participants, aged 12-16 years at baseline were recruited for AICS, and the cohort was comprised of similar numbers of males (n=641) and females (n=604). The racial composition of the cohort was White (73%), African-American (24%) and Hispanic or Asian (3%).

3.2.2 Physical Activity in the AICS

A past year recall physical activity questionnaire (3, 4, 45) was administered four times to the AICS participants in order to determine leisure-time physical activity (1990, 1991, 1992,

and 1993). At baseline (1990), males reported significantly more physical activity (hrs/wk) than females, and white students reported being more active than non-white students of both genders (3). While a cross-sectional association between age and activity was observed in females, this was not evident in males. No association was found between socioeconomic status and activity level.

The 3-year longitudinal follow-up of this cohort provided information regarding changing patterns of leisure time physical activity during adolescence (2). Physical activity (hrs/wk) was seen to decline in both males (41%) and females (29%) over the four years of the study.

3.3 Physical Activity in Young Adults Study

This subsequent study was the follow-up to the Adolescent Injury Control Study (AICS) and investigated the association between physical activity (PA) during adolescence and PA during young adulthood in the AICS cohort. The age of the participants at the beginning of this project was 21-25 years. The objectives of the study were to 1) determine the degree of change in PA from adolescence to young adulthood, 2) evaluate the degree of tracking of PA from adolescence to young adulthood, and 3) investigate the adolescent determinants of PA in young adulthood.

All of the data collected in this study were obtained through telephone or mail surveys, completed twice (Rounds 1 and 2) over a 5-year period, with at least a 1-year interval between Round 1 and Round 2 for each participant. Leisure-time physical activity was assessed using a past-year questionnaire identical to that used in the AICS. Participants were asked to indicate all leisure-time activities that they had participated in at least 10 times during the previous year along with frequency and duration estimates for each activity. They also responded to three

multiple choice questions that assessed vigorous activity over the previous two weeks, daily television viewing, and participation in competitive activities (43). Occupational and household activity was assessed using the questionnaire developed by Kriska (44, 45).

In addition, a number of sociodemographic, lifestyle, psychosocial, and environmental factors were assessed to determine predictors of physical activity in young adulthood and to provide follow-up data to describe changes in physical activity from adolescence to young adulthood.

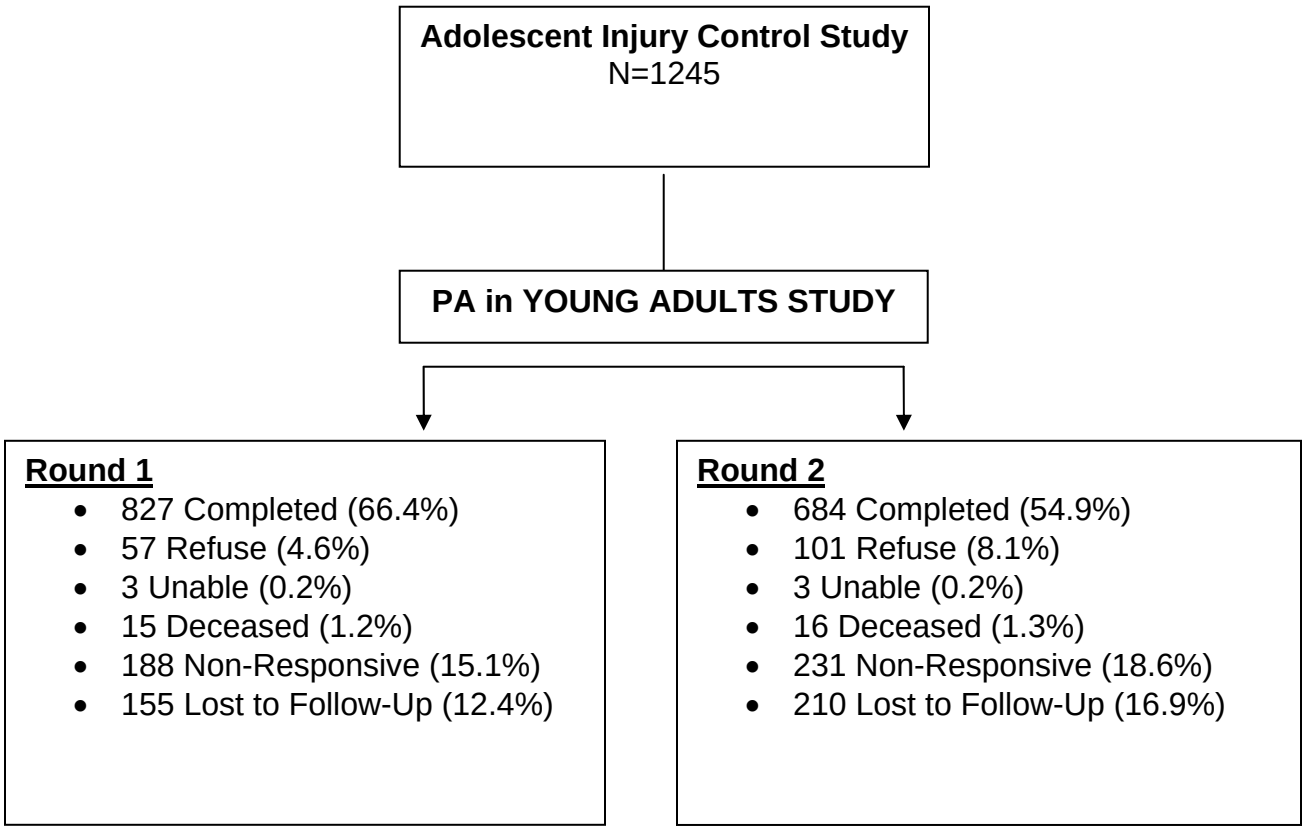
3.3.1 Tracking and Recruiting Participants

The initial attempt to locate the participants was made using the names, addresses, and telephone numbers obtained from the AICS (parents, guardians etc.). The Pittsburgh Metropolitan telephone directory, Allegheny County, PA "Coles" directory, web data bases, and commercial searching company were also used to identify the current telephone numbers of participants, parents/guardians, or the other contacts.

When the current address and telephone number of each potential subject had been verified, a letter of introduction was mailed to explain the purpose of the current study and to outline the requirements for participation. One week after the letter was mailed; a telephone call was made by a trained interviewer in order to conduct the survey. The interviewer attempted to make phone contact 20 times and/or mail contact with each participant. If the participant could not be reached or did not respond to these attempts, the questionnaire was mailed to him or her. If the questionnaire was not received after 30 days, an additional 10 phone calls were made. After this second round of phone calls, if attempts to contact the participants were still unsuccessful, a second questionnaire was mailed. If participants did not send the second mail back, they were classified as non-respondents.

If participants could not be reached or their current phone number was not known, phone books, the 411-service, nation-wide databases of telephone directories such as whitepages.com and superpages.com on the World Wide Web, and commercial tracking services were used in an attempt to obtain accurate contact information. If a mailed survey came back with a bad address, commercial tracking services attempted another search for that participant. If the tracking services could not find new information, the person was considered lost to follow-up.

Figure 1 Follow-up Rate



3.4 Sample for Current Analysis

The data for the current analysis were obtained from the Round 2 survey completed between November 2001 and October 2004. The parent study was approved by the University of Pittsburgh Institutional Review Board, and informed consent was obtained from all participants.

Participants were identified from the individuals who participated in the Adolescent Injury Control Study (AICS) and completed the Round 2 survey of the PA young adult study. As presented in Figure 1, 684 (54.9%) of the AICS participants completed the Round 2 survey; 101 (8.1%) refused; 3 (0.2%) were unable to participate; 16 (1.3%) were deceased; 231 (18.6%) were non-responsive; 210 (16.9%) were lost to follow-up.

Using AICS baseline data, a comparison was made between those who completed the Round 2 survey and those who did not (Table 7). There were no differences in age or leisure time physical activity at baseline between those who completed Round 2 and those who did not. However, those who did not complete Round 2 were more likely to be male, minority and have a lower adolescent socioeconomic status (SES) ($p<0.001$).

The characteristics of the sample for the current analysis are presented in Table 8. A total of 369 females and 315 males completed the Round 2 survey (mean age 27 years). The racial composition was 84% White and 14% African American. Sixty three percent reported some past high school education, and 75% had full time job. Males were more likely to be white (88% vs. 81%), full time workers (85% vs. 66%), binge drink (60% vs. 30%), live with parents (26% vs. 16%), and have a higher BMI (26.7 ± 4.4 vs. 24.9 ± 5.2) than females. However,

Table 7: Comparisons of participants who Completed the Round 2 survey and participants who did not complete the survey

At Baseline (1990)	Participants who completed (N = 684)	Participants who did not complete (N = 561)	P-value
Age (yrs)			
Mean ± SD	13.6 ± 1.0	13.7 ± 1.1	0.228
Median	14.0	14.0	
Minimum	11.0	12.0	
Maximum	17.0	17.0	
Gender (%)			
Male	46	59	**<0.001**
Female	54	41	
SES (%)			
High	36	16	**<0.001**
Middle	50	57	
Low	14	27	
Race (%)			
White	84	59	**<0.001**
Black	14	37	
Other	2	4	
PA (hrs/wk)			
Median	13.1	12.6	0.218

SES, Socioeconomic Status; PA, Physical Activity

Table 8: Participants* characteristics for current analysis

	Overall (N = 684)	Males (N = 315)	Females (N = 369)	P-value **
Age (yrs)				
Mean ± SD	27.0 ± 1.0	27.0 ± 1.0	26.9 ± 1.0	**0.036**
Median	27.0	27.1	26.9	
Minimum	23.7	24.2	23.7	
Maximum	29.9	29.4	29.9	
BMI				
Mean ± SD	25.7 ± 4.9	26.7 ± 4.4	24.9 ± 5.2	**<0.001**
Education (%)				
12 yrs ≤	36	39	34	0.176
12 yrs >	64	61	66	
Race (%)				
White	84	88	81	**0.016**
Other	16	12	19	
Relationship Status (%)				
Married/Unmarried Partner	48	40	56	**<0.001**
Other	51	60	44	
Children (%)				
Yes	34	26	40	**<0.001**
No	66	74	60	
Employment (%)				
Full Time/Military	75	85	66	**<0.001**
Other	25	15	34	
Residence (%)				
Live with Parents/relatives	21	26	16	**0.001**
Rent/Own House	79	74	84	
Smoking Status (%)				
Yes	34	27	32	0.169
No	66	73	68	
Binge Drinking (5 or more drinks in a row)				
Yes	44	60	30	**<0.001**
No	56	40	70	

BMI, Body mass index

* Participated in AICS and completed Round 2 of PA in young adults

** P value is comparison of males and females

females were more likely to be married or have an unmarried partner (56% vs. 40%) and have a child/children than males (40% vs. 26%).

3.5 Data Collection

Trained research assistants conducted telephone interviews or mailed the survey to obtain data on physical activity habits, environmental factors, and barriers to physical activity.

Completed forms were forwarded to the data manager who logged them in; visually scanned them for completeness and obvious errors. In the event of missing or confusing data, a follow-up phone call or email was made to the participant to clarify his/her responses. A frequency distribution was generated for each variable to perform a final check for potential errors and outliers. Finally, 10% of all the records were randomly selected and verified by comparing electronic data to the actual survey to ensure that the data were entered correctly.

Several questionnaires were administered to measure each participant's physical activity level, sociodemographic background & lifestyle, characteristics of his or her environment, and barriers to participation in physical activity.

3.5.1 Physical Activity Questionnaire

Leisure-time physical activity was assessed using the identical questionnaire used in the Adolescent Injury Control Study (AICS) and presented in the Appendix A. This questionnaire has been shown to be both reliable and valid (1, 44). One of the strengths of this questionnaire is that it can easily be modified to reflect the typical leisure-time physical activities of the population under investigation. For the adult follow-up study, the list of activities was modified to more accurately reflect those that are commonly reported in young adults.

Participants were asked to indicate all leisure-time activities that they had participated in at least 10 times during the past year. For activities to which the participants respond "yes", further information was collected regarding the frequency and duration of participation in the activity. An estimate of the average number of hours per week spent each activity was calculated, and the hours from all activities was summed to derive an overall estimate (hrs/wk) averaged over the past year. The distribution of physical activity hours per week were divided into gender-specific quartiles.

Participants also responded to a multiple-choice (0, 1-2 days, 3-5 days, 6-8 days, and 9 or more days) question that assessed vigorous activity over the past two weeks. Vigorous activity was assessed as follows: "How many of the past 14 days have you done at least 20 minutes of exercise hard enough to make you breath heavily and make your heart beat fast, for example, playing basketball, jogging, fast dancing, or bicycling?" The number of reported days of vigorous physical activity (VPA) was classified into two groups: "insufficient VPA ($\leq$5 days/2weeks)" and "sufficient VPA ($\geq$6 days/2weeks)."

3.5.2 Sociodemographic and Lifestyle Factors

A number of sociodemographic and lifestyle factors were assessed, using the questionnaire presented in Appendix B. These factors included marital status, number of children, employment status, education, cigarette use, alcohol use and self-reported height and weight. Body mass index (BMI) was calculated (kg/m^2).

3.5.3 Environmental Characteristics

Forty-three self-report items were used to assess environmental variables that may influence physical activity; these items were classified according to three scales including

(1)Recreational Facilities, (2)Home Exercise Equipment, and (3)Neighborhood Characteristics as presented in Appendix C (71).

Recreational Facilities was the sum of the presence of 17 recreation or exercise facilities within a 5 minute drive from work or home. These facilities included for example beaches or lakes, bike lanes or trails, golf courses, public parks, public recreation centers, and tennis courts. The total number of recreational facilities reported was summed to obtain a total score that ranged from 0 to 17.

The Home Environment scale consisted of a list of 14 pieces of recreation or exercise equipment in the home including things such as stationary aerobic equipment, weight lifting equipment, running shoes, and aerobic workout videotapes or audiotapes. The total number of home exercise equipment reported was summed to obtain a total score that ranged from 0 to 17.

The Neighborhood Characteristic scale included three separate items, neighborhood features, perceived safety, and neighborhood character. Neighborhood features was the sum of eight items such as existence of sidewalks, hills, enjoyable scenery, and high crime rates. Perceived safety employed a rating of 1 to 5 for participants' perception of safety for neighborhood walking. Neighborhood character was an assessment of participants' perceptions of their neighborhoods as "residential, mixed commercial and residential, or mainly commercial." The Neighborhood Characteristic score was the total of Neighborhood Features, Perceived Safety, and Neighborhood Character, with a high score reflecting advantages in terms of physical activity, and the total score ranged from 2 to 16.

3.5.4 Barriers to Physical Activity

Participants were asked to rate each barrier to physical activity using a 5-point Likert scale ranging from 1 (never a barrier) to 5 (very often a barrier) as presented in Appendix C.

Barriers included for example “lack of interest in exercise,” “lack of self-discipline,” “lack of time,” lack of equipment,” and “lack of knowledge on how to exercise.” Each barrier was categorized as a low barrier (never, rarely, and sometimes) or a high barrier (often and very often).

3.6 Statistical Analysis

To determine if there was any follow-up bias associated with nonparticipation, the baseline characteristics of participants (age, gender, race, socioeconomic status, and physical activity) who completed the Round 2 survey and participants who did not were compared.

Each environmental factor was summed to provide three total scores: recreational facilities (0-17), home exercise equipment (0-14), and neighborhood characteristics (2-16). Each barrier was dichotomized as either yes (often or very often a barrier) or no (sometimes, rarely or never a barrier). The distribution of physical activity hours per week was divided into gender-specific quartiles. Vigorous physical activity (VPA) was classified into two groups: insufficient VPA ($\leq$5 days/2weeks) and sufficient VPA ($\geq$ 6 days/2weeks).

Descriptive statistics for all variables were calculated. Measures of central tendency (means, medians and percentiles) and dispersion (standard deviations and ranges) were computed for continuous variables, and frequency distributions were examined for categorical variables. Graphical displays including histograms and box plots were produced. Statistical analysis for gender differences in the hrs/week of PA (Kruskal-Wallis), vigorous PA (Chi-Square), environmental correlates (t-tests), and barriers (Chi-Square) were conducted.

To identify potential covariates, statistical comparisons were employed using appropriate parametric (e.g., t-test and ANOVA) and nonparametric (e.g., Kruskal-Wallis and Wilcoxon) tests for continuous variables and chi-square test for categorical variables.

Specific Aim #1

This analysis examined the association between environmental factors (neighborhood characteristics, recreational facilities, and home exercise equipment) and leisure-time physical activity (number of hrs/wk of total PA, and VPA).

Gender-specific ANOVA were conducted to compare mean values of neighborhood characteristics, recreational facilities, and home exercise equipment across quartiles of total PA hour and across categories of vigorous PA. Significant covariates identified in the preceding analysis were entered into an ANCOVA to examine the relationship between environmental correlates and PA (hrs/week and vigorous PA) after adjusting for appropriate covariates. If overall p-value was significant, in order to identify which groups were significantly different, Post Hoc comparisons were conducted.

Specific Aim #2

This analysis examined the association between barriers to physical activity and leisure-time physical activity (number of hrs/wk of total PA, and VPA).

Gender-specific univariate logistic regression models were run using each barrier as a separate dependent variable (yes/no). For each model, quartile of PA and categories of vigorous PA were entered to examine the odds of the barrier being reported by the different levels of PA participation. Significant covariates identified in the preceding analysis were entered into multiple logistic regression models to examine the relationship between barriers and PA after adjusting for appropriate covariates.

Covariates were entered into the multivariate models if they have a p-value $\leq .10$ in the univariate analyses. Results were considered statistically significant at a p-value $< .05$. Data were analyzed using the Statistical Package for the Social Science (SPSS, version 13.0).

4. Results

4.1 Introduction

The purpose of this study was to examine the association between environmental correlates and physical activity levels in young adults. This chapter is composed of the following sections: (1) Prevalence of Physical Activity, (2) Environmental Correlates and Barriers, (3) Results of Specific Aims, and (4) Summary of the Results

4.2 Prevalence of Physical Activity

The sample for this study included 315 male and 369 female young adults. Table 9 presents the gender-specific median number of overall hours of leisure-time physical activity, the cutoff points for the gender-specific quartiles in ranking participants' overall hours of leisure-time physical activity, and the percentages of participants engaging in vigorous physical activity (VPA) by race. Among males, the median number of hours of overall leisure-time physical activity was 5.89 per week with 41% of participants engaging in a sufficient amount of VPA. Among females, the median number of hours of overall leisure-time physical activity was 3.75 per week, with only 29% engaging in sufficient amount of VPA.

There were no race related differences found in both median number of hours of leisure-time physical activity and the percentages of participants engaging in sufficient vigorous physical activity (VPA), either for males or females.

Table 9: Median (hrs/wk) of total physical activity (PA), cut points for quartiles (hrs/wk), and percentage of participants engaging in sufficient VPA

	Overall (N=684)	Whites (N=574)	Minorities (N=110)	P-values*
Males (N)	(315)	(276)	(39)	
Median(hrs/wk)	5.89	6.04	5.24	0.151
Cut points				
25%	2.91			
50%	5.89			
75%	10.25			
Sufficient VPA (%)	41	41	41	0.992
Females (N)	(369)	(298)	(71)	
Median(hrs/wk)	3.75	3.87	2.98	0.091
Cut points				
25%	1.84			
50%	3.75			
75%	6.59			
Sufficient VPA (%)	29	31	21	0.093

*Compares white to minority

4.3 Environmental Correlates and Barriers

Statistical analyses were conducted to examine the gender-specific associations between various environmental factors (i.e., recreational facilities, home exercise equipment, neighborhood characteristics, and environmental barriers to physical activity participation) and leisure-time physical activity, as measured by the number of hours per week of total physical activity (PA) and level of VPA.

4.3.1 Recreational Facilities

This analysis was conducted to compare the percentage of participants reporting the perceived proximity of individual types of recreational facilities and the total number of all facilities by level of leisure-time physical activity. Table 10 shows the total number of recreational facilities and the percentages reporting each recreational facility by gender and race. White participants of both genders had a higher score for the total number of recreational facilities ($p=0.040$ in males; 0.037 in females) than minority participants. Public parks, playing fields (i.e., soccer, football, softball, etc.), and basketball courts were the three facilities most frequently reported by both genders. White males were significantly more likely to report proximity to a golf course (67% vs. 44%), a martial arts studio (54% vs. 23%), a sporting goods store (64% vs. 46%), and a swimming pool (68% vs. 49%) than minority males. White females were more likely to report proximity to bike lanes (58% vs. 39%), running tracks (65% vs. 48%), swimming pools (61% vs. 42%), walking trails (60% vs. 44%), and tennis courts (63% vs. 41%) than minority females; in contrast, minority females were more likely to report proximity to a public recreation center (58% vs. 43%) and a skating rink (45% vs. 33%) than white females. No differences were found in the proximity to an aerobic studio, a beach/lake, bike lanes, a health spa/gym, a playing field, a public park, a public recreation center, racquetball courts,

Table 10: Total number of recreational facilities and percentages of participants reporting recreational facilities by gender and race

	White Males (N=276)	Minority Males (N=39)	P-value*	White Females (N=298)	Minority Females (N=71)	P-value*
Overall Score Mean (SD)	10.55 (3.83)	9.21 (3.60)	**0.040**	9.33 (4.17)	8.19 (3.98)	**0.037**
Percent Reporting	%	%		%	%	
Aerobic Studio	55	49	0.468	61	59	0.868
Basketball courts	87	97	0.069	74	72	0.823
Beach or lake	7	8	0.925	12	11	0.941
Bike trails	61	62	0.992	58	39	**0.005**
Golf course	67	44	**0.004**	49	39	0.160
Health spa/gym	73	62	0.121	68	65	0.739
Martial arts studio	54	23	**<0.001**	41	30	0.101
Playing field	89	92	0.582	82	70	0.059
Public park	90	90	0.932	85	83	0.841
Recreation center	51	54	0.763	43	58	**0.016**
Racquetball court	38	31	0.393	30	18	0.051
Running track	70	62	0.274	65	48	**0.009**
Skating rink	36	33	0.712	33	45	**0.038**
Sporting goods	64	46	**0.028**	48	42	0.439
Swimming pool	68	49	**0.015**	61	42	**0.005**
Walking trails	66	56	0.213	60	44	**0.016**
Tennis court	73	64	0.222	63	41	**0.001**

*Compares white to minority

running tracks, a skate rink, walking trails, and tennis courts between white and minority males, and the proximity to an aerobic studio, basketball courts, a beach/lake, a golf course, a health spa/gym, a martial arts studio, a public park, and sporting goods store between white and minority females.

Table 11 shows the total number of recreational facilities and the percentages of participants reporting proximity to each type of recreational facility by level of VPA. Among female participants only, those who engaged in a sufficient amount of VPA were significantly more likely to report a higher number of proximal recreational facility (10.15 ± 4.03 vs. 8.68 ± 4.13, p=0.002) than females who engaged in an insufficient amount of VPA. Males who engaged in a sufficient amount of VPA were more likely to report proximity to a health spa/gym (80% vs. 67%), and a running track (78% vs. 63%) than males who engaged in insufficient VPA. Females who engaged in sufficient VPA were more likely to report proximity to an aerobic studio (69% vs. 57%), basketball courts (82% vs. 71%), a playing field (90% vs. 75%), racquetball/squash courts (37% vs. 24%), a running track (79% vs. 56%), a swimming pool (69% vs. 53%), and tennis courts (71% vs. 54%) than females who engaged in insufficient VPA. No differences were found in the proximity to an aerobic studio, basketball courts, a beach/lake, bike lanes, a golf course, a martial arts studio, a public park, a public recreation center, racquetball courts, running tracks, a skating rink, a sporting goods store, walking trails, and tennis courts among males, and the proximity to a beach/lake, bike lanes, a golf course, a health spa/gym, a martial arts studio, a public park, a skating rink, sporting goods store, and walking trails among females.

Table 11: Total number of recreational facilities and percentages of participants reporting recreational facilities by gender and level of VPA

	Males (N=315)			Females (N=369)		
	Insufficient (N=186)	**Sufficient (N=129)**	**P-value***	**Insufficient (N=261)**	**Sufficient (N=108)**	**P-value***
Overall Score Mean (SD)	10.08 (3.92)	10.82 (3.63)	0.089	8.68 (4.13)	10.15 (4.03)	**0.002**
Percent Reporting	%	%		%	%	
Aerobic Studio	51	59	0.123	57	69	**0.030**
Basketball courts	88	91	0.408	71	82	**0.033**
Beach or lake	8	7	0.868	11	13	0.623
Bike trails	59	65	0.307	54	57	0.693
Golf course	64	65	0.875	45	53	0.196
Health spa/gym	67	80	**0.012**	65	72	0.203
Martial arts studio	50	52	0.616	38	40	0.755
Playing field	87	94	0.055	75	90	**0.002**
Public park	90	90	0.889	85	85	0.964
Recreation center	51	52	0.825	43	53	0.077
Racquetball court	36	39	0.519	24	37	0.013
Running track	63	78	**0.004**	56	78	**<0.001**
Skating rink	34	39	0.346	34	39	0.320
Sporting goods	61	63	0.721	46	49	0.609
Swimming pool	65	68	0.526	53	69	**0.004**
Walking trails	63	68	0.408	57	58	0.751
Tennis court	73	72	0.891	54	71	**0.002**

*Compares insufficient to sufficient VPA

Tables 12 and 13 show the total number of recreational facilities across quartiles of total leisure-time physical activity calculated in terms of hours per week and the percentages of participants reporting the proximity to each type of recreational facility. Male participants in the highest quartile of total PA were more likely to report a higher number of recreational facilities (11.37 ± 3.64 vs. 9.15 ± 4.09) than males in the lowest. Female participants in the highest and 3rd quartile of total PA were more likely to report a higher number of recreational facilities (10.22 ± 3.91 or 9.63 ± 4.08 vs. 7.89 ± 4.27) than females in the lowest quartile. Significant differences were found in proximity to bike trails (p=0.001), a running track (p=0.002), and walking trails (p=0.005) across the quartiles of total PA among males, and in proximity to basketball courts (p=0.048), a golf course (p=0.005), a playing field (p=0.047), a running track (p=0.012), a swimming pool (p=0.024), and a tennis court (p=0.010) across the quartiles of total PA among females. No differences were found in the proximity to an aerobic studio, basketball courts, a beach/lake, a golf course, a health spa/gym, a martial arts studio, a playing field, a public park, a public recreation center, racquetball courts, a skating rink, a sporting goods store, and a swimming pool among males, and the proximity to an aerobic studio, a beach/lake, bike lanes, a health spa/gym, a martial arts studio, a public park, a public recreation center, a skating rink, and a sporting goods store among females across quartiles of total PA.

Table 12: Total number of recreational facilities and percentages of male participants reporting recreational facilities across quartiles* of total PA

	Males (N=315)				
	1st (N=78)	**2nd (N=79)**	**3rd (N=79)**	**4th (N=79)**	**P-value****
Overall Score Mean (SD)	9.15 (4.09)	10.53 (3.85)	10.46 (3.40)	11.37 (3.64)	**0.003**
Percent Reporting	%	%	%	%	
Aerobic Studio	50	51	53	62	0.423
Basketball courts	83	91	89	92	0.286
Beach or lake	6	8	8	7	0.988
Bike trails	47	59	70	70	**0.011**
Golf course	58	67	60	73	0.149
Health spa/gym	63	72	73	80	0.128
Martial arts studio	42	51	52	57	0.322
Playing field	85	90	91	94	0.291
Public park	86	91	92	91	0.534
Recreation center	47	54	49	56	0.708
Racquetball court	32	37	34	44	0.407
Running track	54	73	68	81	**0.002**
Skating rink	32	36	37	39	0.824
Sporting goods	55	60	61	72	0.159
Swimming pool	64	63	66	71	0.725
Walking trails	49	71	70	72	**0.005**
Tennis court	62	80	73	75	0.079

*1st Q=Low and 4th Q=High Post Hoc significant findings: Q4>Q1

**Overall P-value across groups

Table 13: Total number of recreational facilities and percentages of female participants reporting recreational facilities across quartiles* of total PA

	Females (N=369)				
	1st (N=92)	**2nd (N=93)**	**3rd (N=92)**	**4th (N=92)**	**P-value****
Overall Score Mean (SD)	7.89 (4.27)	8.71 (4.03)	9.63 (4.08)	10.22 (3.91)	**0.001**
Percent Reporting	%	%	%	%	
Aerobic Studio	56	54	64	70	0.103
Basketball courts	66	70	77	83	**0.048**
Beach or lake	9	13	9	16	0.312
Bike trails	45	57	57	61	0.161
Golf course	33	46	58	53	**0.005**
Health spa/gym	66	59	70	75	0.133
Martial arts studio	40	34	35	46	0.359
Playing field	70	79	85	85	**0.047**
Public park	85	82	85	89	0.565
Recreation center	40	45	46	52	0.400
Racquetball court	32	37	34	44	0.407
Running track	51	58	69	72	**0.012**
Skating rink	32	34	37	37	0.870
Sporting goods	39	42	55	52	0.065
Swimming pool	50	51	65	66	**0.024**
Walking trails	45	62	60	61	0.064
Tennis court	44	63	64	64	**0.010**

*1st Q=Low and 4th Q=High Post Hoc significant findings: Q3 and 4 >Q1

** Overall P-value across groups

4.3.2 Home Exercise Equipment

This analysis was conducted to compare the percentages of participants reporting the availability of various types of home exercise equipment and the total number of home exercise equipment by level of leisure-time physical activity. Table 14 shows the percentages for each type of home exercise equipment along with the total number of home exercise equipment by race. White participants of both genders were more likely to report a higher total number of the home exercise equipment (p=0.024 in males; 0.038 in females) than minorities. Among males, running shoes, sports equipment (i.e., balls and racquets), and weight lifting equipment were reported as the three most common forms of exercise equipment at home, while among females, running shoes, aerobic workout videotapes or audiotapes, and sports equipment were most common. White males were significantly more likely to report having bicycles (51% vs. 33%), dogs (34% vs. 10%), a swimming pool (19% vs. 5%), skates (40% vs. 15%), a canoe (10% vs. 0%), and skis (22% vs. 8%) than minority males. White females were more likely to report having dogs (37% vs. 20%), sports equipment (61% vs. 48%), and a canoe (6% vs. 1%) than minority females. However, no differences were found in having stationary aerobic equipment, a trampoline, running shoes, weight lifting equipment, toning devices, aerobic workout video tapes, a step aerobic, and sporting equipment between white and minority males, and stationary aerobic equipment, a bicycle, a trampoline, running shoes, a swimming pool, weight lifting equipment, toning devices, aerobic workout video tapes, a step aerobic, skates, and skis between white and minority females.

Table 14: Total number of home exercise equipment and percentages of participants reporting home exercise equipment by gender and race

	White Males (N=276)	Minority Males (N=39)	P-value*	White Females (N=298)	Minority Females (N=71)	P-value*
Overall Score Mean (SD)	4.24 (2.31)	3.36 (2.05)	**0.024**	4.52 (2.06)	3.96 (2.23)	**0.038**
Percent Reporting	%	%		%	%	
Stationary aerobic	35	26	0.258	37	32	0.559
Bicycle	51	33	**0.042**	45	38	0.307
Dog	34	10	**0.002**	37	20	**0.006**
Trampoline	5	0	0.166	4	4	0.815
Running shoes	89	95	0.244	92	86	0.206
Swimming pool	19	5	**0.033**	20	14	0.262
Weight lifting	59	54	0.508	47	44	0.684
Toning devices	31	39	0.336	36	34	0.840
Workout video	29	41	0.114	68	65	0.739
Step aerobic	12	10	0.806	19	17	0.702
Skates	40	15	**0.003**	37	31	0.418
Sports equipment	80	74	0.442	61	48	0.056
Canoe	10	0	**0.037**	6	1	**0.030**
Skis	22	7	**0.036**	11	6	0.159

*Compares white to minority

Table 15 shows the total number of home exercise equipment and the percentages of home exercise equipment by level of VPA. Among females only, participants who engaged in sufficient VPA were significantly more likely to report a higher total number of home exercise equipment (5.16 ± 1.85 vs. 4.11 ± 2.07, $p<0.001$) than participants who engaged in insufficient vigorous physical activity, but no significant differences were found in males. Males who engaged in sufficient VPA were more likely to report having weight lifting equipment (68% vs. 52%), toning devices (38% vs. 27%), and sports equipment (85% vs. 75%) than males who engaged in insufficient VPA. Females who engaged in sufficient VPA were more likely to report having stationary aerobic equipment (47% vs. 31%), bicycles (54% vs. 40%), running shoes (96% vs. 89%), weight lifting equipment (59% vs. 41%), toning devices (46% vs. 31%), and aerobic workout videotapes or audiotapes (75% vs. 64%) than females who engaged in insufficient VPA. No differences were found in having stationary aerobic equipment, a bicycle, a dog, a trampoline, running shoes, a swimming pool, aerobic workout video tapes, a step aerobic, skates, a canoe, and skis in males, and having a dog, a trampoline, a swimming pool, a step aerobic, skates, sports equipment, a canoe, and skis in females.

Tables 16 and 17 show the total number of home exercise equipment and the percentages of participants indicating the presence of specific types of home exercise equipment across quartiles of overall leisure-time physical activity calculated in terms of hours per week. Male participants in the highest quartile were more likely to report having a higher number of home exercise equipment than males in 1st, 2nd or 3rd quartile (5.18 ± 2.31 vs. 3.67 ± 2.37, 4.03 ± 2.25 and 3.66 ± 1.93). On the other hand, females in the 2nd, 3rd, or 4th quartile were more likely to report having a higher number of home exercise equipment than females in the 1st quartile (5.22 ± 2.09, 4.93 ±1.85, and 4.24 ± 1.87 vs. 3.26 ± 1.89), and females in the 4th quartile

Table 15: Total number of home exercise equipment and percentages of participants reporting home exercise equipment by gender and level of VPA

	Males (N=315)			Females (N=369)		
	Insufficient (N=186)	**Sufficient (N=129)**	**P-value***	**Insufficient (N=261)**	**Sufficient (N=108)**	**P-value***
Overall Score Mean (SD)	3.96 (2.32)	4.38 (2.25)	0.113	4.11 (2.07)	5.16 (1.85)	**<0.001**
Percent Reporting	%	%		%	%	
Stationary aerobic	33	34	0.886	31	47	**0.003**
Bicycle	47	51	0.443	40	54	**0.016**
Dog	28	36	0.111	34	35	0.751
Trampoline	3	5	0.334	4	3	0.507
Running shoes	89	90	0.847	89	96	**0.023**
Swimming pool	19	15	0.344	18	22	0.313
Weight lifting	52	68	**0.004**	41	59	**0.002**
Toning Devices	27	38	**0.048**	31	46	**0.005**
Workout video	31	30	0.821	64	75	**0.045**
Step aerobic	11	12	0.651	17	23	0.164
Skates	36	37	0.830	34	41	0.184
Sports Equipment	75	85	**0.048**	57	62	0.401
Canoe	7	12	0.155	5	5	0.766
Skis	20	21	0.822	9	14	0.148

*Compares insufficient to sufficient VPA

Table 16: Total number of home exercise equipment and percentages of male participants reporting home exercise equipment across quartiles* of total PA

	Males (N=315)				
	1st (N=78)	**2nd (N=79)**	**3rd (N=79)**	**4th (N=79)**	**P-value****
Overall Score Mean (SD)	3.67 (2.37)	4.03 (2.25)	3.66 (1.93)	5.18 (2.31)	**<0.001**
Percent Reporting	%	%	%	%	
Stationary aerobic	37	29	24	44	**0.038**
Bicycle	47	49	38	60	0.061
Dog	22	29	29	46	**0.011**
Trampoline	1	3	1	11	**0.003**
Running shoes	87	89	89	94	0.563
Swimming pool	19	13	18	19	0.667
Weight lifting	46	60	52	77	**<0.001**
Toning Devices	21	30	29	47	**0.004**
workout video	32	29	25	34	0.646
Step aerobic	13	14	4	15	0.099
Skates	24	39	34	48	**0.019**
Sports Equipment	62	81	82	91	**<0.001**
Canoe	5	8	6	17	0.051
Skis	17	19	23	23	0.724

*1st Q=Low and 4th Q=High Post Hoc significant findings: Q4>Q1, 2, and 3
**Overall P-value across groups

Table 17: Total number of home exercise equipment and percentages of female participants reporting home exercise equipment across quartiles* of total PA

	Females (N=369)				
	1st (N=92)	**2nd (N=93)**	**3rd (N=92)**	**4th (N=92)**	**P-value****
Overall Score Mean (SD)	3.26 (1.89)	4.24 (1.87)	4.93 (1.85)	5.22 (2.09)	**<0.001**
Percent Reporting	%	%	%	%	
Stationary aerobic	24	42	39	38	0.057
Bicycle	26	39	51	60	**<0.001**
Dog	23	37	33	44	**0.031**
Trampoline	3	4	2	5	0.691
Running shoes	84	89	96	96	**0.009**
Swimming pool	11	19	32	14	**0.002**
Weight lifting	30	41	57	59	**<0.001**
Toning Devices	22	30	37	52	**<0.001**
Workout video	63	62	78	66	0.072
Step aerobic	17	15	20	24	0.425
Skates	22	37	38	46	**0.008**
Sports Equipment	37	61	65	71	**<0.001**
Canoe	4	1	4	11	**0.023**
Skis	2	9	12	19	**0.003**

*1st Q=Low and 4th Q=High
** Overall P-value across groups
Post Hoc significant findings: Q2, 3, and 4>Q1
Q4>Q2

were more likely to report having a higher number of home exercise equipment than females in the 2nd quartile (5.22 ± 2.09 vs. 4.24 ± 1.87). Significant differences were found in having a stationary aerobic (p=0.038), a dog (p=0.011), a trampoline (p=0.003), a weight lifting (p<0.001), toning devices (p=0.004), skates (p=0.019), and sports equipment (p<0.001) across quartiles of total PA among males, and bicycle (p<0.001), a dog (p=0.031), running shoes (p=0.009), a swimming pool (p=0.002), a weight lifting (p<0.001), toning devices (p<0.001), skates (p=0.008), sport equipment (p<0.001), a canoe (p<0.023), and skis (p=0.003) across quartiles of total PA among females. However, there were no differences in having running shoes, a swimming pool, aerobic workout video tapes, and skis across quartiles of total PA among males, and a trampoline and a step aerobic across quartiles of total PA among females.

4.3.3 Neighborhood Characteristics

This analysis was conducted to compare the percentages of participants reporting specific neighborhood characteristics, along with the total score of neighborhood characteristic by level of leisure-time physical activity. Table 18 shows the total score of neighborhood characteristics and the percentages of participants reporting each neighborhood characteristic by race. There were no race related differences in total score of neighborhood characteristics in both genders. Minority males were more likely to report a higher safety score for walking (p=0.042) than white males, but white females were more likely to report a higher safety score for walking (p=0.049) than minority females. Among male participants, there were no race differences in the total score of neighborhood characteristics. Minority males were significantly more likely to report sidewalks (92% vs. 74%) than white males. White females were more likely to report frequent observation of others walking or exercising in neighborhood (79% vs.

Table 18: Total number of neighborhood characteristics, safety score for walking, and percentages of participants reporting neighborhood characteristic by gender and race

	White Males (N=276)	Minority Males (N=39)	P-value*	White Females (N=298)	Minority Females (N=71)	P-value*
Overall score Mean (SD)	12.91 (1.84)	12.74 (2.13)	0.596	12.93 (1.85)	12.47 (1.82)	0.060
Safety score for walking Mean (SD)	1.91 (0.76)	2.18 (0.79)	**0.042**	4.58 (0.81)	4.31 (1.03)	**0.049**
Percent Reporting	%	%		%	%	
Sidewalks	74	92	**0.012**	72	83	**0.032**
Heavy traffic	37	36	0.933	33	45	0.072
Hills	82	79	0.675	77	76	0.840
Street lights	86	90	0.546	80	89	0.054
Unattended dogs	22	23	0.850	21	22	0.908
Enjoyable scenery	70	62	0.268	76	66	0.152
Others exercising	76	64	0.096	79	66	**0.031**
High crime	12	20	0.159	11	27	**0.002**
Neighborhood type						
Residential	73	64	0.296	71	74	0.562
Mixed	25	31		29	26	
Commercial	2	5		0	0	

*Compares white to minority

66%) than minority females, but minority females were more likely to report sidewalks (83% vs. 72%) and a high crime rate (27% vs. 11%) than white females. There were no significant differences of percentages between white and minority males in reporting heavy traffic, hills, street lights, unattended dogs, enjoyable scenery, a high crime rate, and type of neighborhood while no difference was found among females in reporting hills, unattended dogs, enjoyable scenery, and type of neighborhood.

Table 19 shows the total score of neighborhood characteristic and the percentages of participants reporting specific neighborhood characteristics by level of VPA. No significant differences of safety score for walking and total neighborhood score were found in males; however, females who engaged in sufficient VPA were more likely to report a higher safety score for walking (4.68 ± 0.62 vs. 4.47 ± 0.94) and a higher total score of neighborhood characteristics (13.12 ± 1.58 vs. 12.73 ± 1.94) than females who engaged in insufficient amount of VPA. Males who engaged in sufficient amount of VPA were more likely to report enjoyable scenery (77% vs. 64%) and the frequent observation of others walking or exercising in the neighborhood (83% vs. 69%) than males with insufficient amount of VPA. However, no significant differences were found in neighborhood characteristics among females.

Tables 20 and 21 show the total score of neighborhood characteristics and the percentages of participants reporting each neighborhood characteristic across quartiles of total PA. Females in the 2nd and 4th quartiles had a significantly higher total score for neighborhood characteristics than females in the lowest quartile (13.11 ± 1.58 and 13.08 ± 1.85 vs. 12.31 ± 2.17), and females in the 2nd, 3rd, and 4th quartile reported a significantly higher safety score for walking than females in the lowest quartile (4.63 ± 0.78, 4.63 ± 0.64 and 4.59 ± 0.85 vs. 4.25 ±

Table 19: Total score of neighborhood characteristic, safety score for walking, and percentages of participants reporting neighborhood characteristics by gender and level of VPA

	Males (N=315)			Females (N=369)		
	Insufficient (N=186)	**Sufficient (N=129)**	**P-value***	**Insufficient (N=261)**	**Sufficient (N=108)**	**P-value***
Overall score Mean (SD)	12.83 (2.03)	12.97 (1.63)	0.511	12.73 (1.94)	13.12 (1.58)	**0.046**
Safety score for walking Mean (SD)	4.64 (0.82)	4.70 (0.75)	0.547	4.47 (0.94)	4.68 (0.62)	**0.012**
Percent Reporting	%	%		%	%	
Sidewalks	80	71	0.091	73	77	0.451
Heavy traffic	39	33	0.330	35	35	0.973
Hills	80	85	0.196	75	80	0.251
Street lights	88	85	0.345	81	84	0.480
Unattended dogs	20	26	0.189	20	22	0.693
Enjoyable scenery	64	77	**0.016**	71	81	0.061
Others exercising	69	83	**0.006**	74	83	0.059
High crime	13	14	0.787	16	20	0.161
Neighborhood type						
Residential	72	71	0.759	73	68	0.289
Mixed	25	27		27	32	
Commercial	3	2		0	0	

*Compares insufficient to sufficient VPA

Table 20: Total score of neighborhood characteristics, safety score for walking, and percentages of male participants reporting neighborhood characteristics across quartiles* of total PA

	Males (N=315)				
	1st (N=78)	**2nd (N=79)**	**3rd (N=79)**	**4th (N=79)**	**P-value****
Overall score Mean (SD)	12.48 (1.91)	12.87 (2.01)	12.94 (1.79)	13.25 (1.75)	0.082
Safety score for walking Mean (SD)	4.65 (0.72)	4.70 (0.76)	4.59 (0.91)	4.72 (0.75)	0.758
Percent Reporting	%	%	%	%	
Sidewalks	76	80	82	67	0.123
Heavy traffic	41	35	44	25	0.070
Hills	78	85	85	80	0.600
Street lights	82	85	95	85	0.086
Unattended dogs	23	21	20	23	0.972
Enjoyable scenery	58	67	77	75	**0.037**
Others exercising	63	72	82	82	**0.012**
High crime	17	15	13	9	0.497
Neighborhood type					
Residential	68	72	65	82	0.133
Mixed	31	27	30	17	
Commercial	1	1	5	1	

*1st Q=Low and 4th Q=High
**Overall P-value across groups

Table 21: Total score of neighborhood characteristics, safety score for walking, and percentages of female participants reporting neighborhood characteristics across quartiles* of total PA

	Females (N=369)				
	1st (N=92)	**2nd (N=93)**	**3rd (N=92)**	**4th (N=92)**	**P-value****
Overall score Mean (SD)	12.31 (2.17)	13.11 (1.58)	12.88 (1.66)	13.08 (1.85)	**0.011**
Safety score for walking Mean (SD)	4.25 (1.08)	4.63 (0.78)	4.63 (0.64)	4.59 (0.85)	**0.006**
Percent Reporting	%	%	%	%	
Sidewalks	68	77	72	79	0.282
Heavy traffic	32	38	35	36	0.871
Hills	72	77	79	77	0.733
Street lights	77	88	79	84	0.202
Unattended dogs	22	21	28	22	0.930
Enjoyable scenery	66	73	75	82	0.119
Others exercising	67	81	77	83	0.060
High crime	20	10	12	15	0.225
Neighborhood type					
Residential	74	74	66	72	0.625
Mixed	26	26	34	28	
Commercial	0	0	0	0	

*1st Q=Low and 4th Q=High
**Overall P-value across groups

Post Hoc significant findings: Q2 and 4>Q1 in total score
Q2, 3 and 4>Q1 in safety score for walking

1.08). However, among males, no significant differences were found in safety score for walking and the total score of neighborhood characteristics across quartiles of total PA. Significant differences were found in reporting enjoyable scenery (p=0.037) and a frequent observation of others walking/exercising (p=0.037) across quartiles of total PA among males, but no differences were found in neighborhood characteristics across quartiles of total PA among females.

4.3.4 Environmental Barriers to Physical Activity

This analysis was conducted to compare the percentages of participants reporting environmental barriers to physical activity by level of leisure-time physical activity. Table 22 shows the percentages of participants indicating each barrier by race. Minority males were significantly more likely to report a lack of facilities (18% vs. 8%) than white males. There were no significant differences in a lack of equipment and a lack of good weather among males, and no significant differences in a lack of equipment, a lack of good weather, and a lack of facilities among females.

Table 22: Percentages of participants reporting environmental barriers by gender and race

Percent reporting (%)	**White Males (N=276)**	**Minority Males (N=39)**	**P-value***	**White Females (N=298)**	**Minority Females (N=71)**	**P-value***
Lack of Equipment	11	13	0.776	10	15	0.331
Lack of Good weather	10	8	0.708	14	9	0.257
Lack of Facilities	8	18	**0.035**	9	10	0.716

*Compares white to minority

Table 23 shows the percentages of participants reporting environmental barriers by level of VPA. Males who engaged in insufficient amounts of VPA were more likely to report a lack of equipment (15% vs. 7%), a lack of good weather (12% vs. 5%), and a lack of facilities or space (13% vs. 3%) than males who engaged in sufficient VPA. However, among females no significant differences were found in environmental barriers by level of VPA.

Table 24 shows the percentages of participants reporting environmental barriers across quartiles of total PA. Among males, significant differences were found in reporting a lack of equipment (p=0.033) and a lack of facilities or space (p=0.001) across quartiles of total PA. Among females, no differences were found in reporting environmental barriers across quartiles of total PA. Other barriers are presented in Appendix D.

Table 23: Percentages of participants reporting environmental barriers by gender and level of VPA

	Males (N=315)			**Females (N=369)**		
Percent reporting (%)	**Insufficient (N=186)**	**Sufficient (N=129)**	**P-value**	**Insufficient (N=261)**	**Sufficient (N=108)**	**P-value**
Lack of Equipment	15	7	**0.037**	13	7	0.065
Lack of Good weather	12	5	**0.017**	12	15	0.457
Lack of Facilities	13	3	**0.002**	11	5	0.058

*Compares insufficient to sufficient VPA

Table 24: Percentages of participants reporting environmental barriers across quartiles* of total PA by gender

	Males (N=315)					Females (N=369)				
Percent reporting (%)	**1st**	**2nd**	**3rd**	**4th**	**P-value****	**1st**	**2nd**	**3rd**	**4th**	**P-value****
Lack of Equipment	21	10	8	8	**0.033**	19	11	8	8	0.058
Lack of Good Weather	11	14	8	5	0.243	14	12	12	13	0.954
Lack of Facilities	21	6	5	4	**0.001**	15	9	5	7	0.087

*1st Q=Low and 4th Q=High

**Overall P-value across groups

4.4 Specific Aims

4.4.1 Identification of Covariates

This analysis was conducted to identify potential covariates of the relationship between environmental correlates and physical activity (Table 25). Among females, age, level of education, having a child/children, current employment status, and smoking habits were significantly related to VPA, while body mass index, level of education, and having child/children were significantly related to total PA. Among males, smoking was significantly related to VPA, while level of education, having a child/children, and smoking were significantly related to total PA. Covariates with a p-value $\leq$ 0.10, including age, BMI, race, level of education, having a child/children, current employment status, and smoking habits were included in all multivariate analyses.

Table 25: Association of potential covariates with leisure-time PA

	VPA		Quartiles of Total PA	
	Females	**Males**	**Females**	**Males**
Age*	**0.008**	0.661	0.281	0.704
BMI*	0.774	0.166	**0.085**	**0.090**
Education**	**0.009**	0.514	**0.026**	0.148
Relation Status**	0.818	0.543	0.606	0.200
Child**	**<0.001**	0.680	**0.004**	**0.012**
Employment**	**0.067**	0.669	0.102	0.982
Residence**	0.933	0.420	0.626	0.998
Smoking**	**0.005**	**0.069**	0.370	**0.022**
Binge Drinking**	0.633	0.608	0.714	0.998

*t-test for VPA and ANOVA for quartiles of total PA
**Chi-square analysis

4.4.2 Specific Aim #1

This analysis was conducted to examine the association between environmental correlates (i.e., recreational facilities, home exercise equipment, and neighborhood characteristics) and physical activity (i.e., VPA and total PA). Among females, participants who reported a greater number of proximal recreational facilities and a greater number of home exercise equipment were significantly more likely to participate in sufficient amounts of VPA (OR=1.09, 95%CI=1.03-1.16; OR=1.29, 95%CI=1.15-1.45, respectively), but there was no significant finding between VPA and recreational facilities, home exercise equipment, and neighborhood characteristics in males (Table 26).

After adjusting for appropriate covariates, females who reported a greater number of home exercise equipment were more likely to be vigorously active (OR=1.26, 95%CI=1.11-1.44),

Table 26: Environmental correlates of VPA: Odds ratio (OR) and 95% confidence interval (95% CI)

	Vigorous Physical Activity			
	Females		Males	
	OR	95% CI	OR	95% CI
Recreation Facilities	**1.09**	1.03-1.16	1.05	0.99-1.12
Home Exercise Equipment	**1.29**	1.15-1.45	1.08	0.98-1.20
Neighborhood Characteristics	1.13	0.99-1.28	1.04	0.92-1.17

Table 27: Environmental correlates of VPA after adjusting for covariates: Odds ratio (OR) and 95% confidence interval (95% CI)

	Vigorous Physical Activity			
	Females		Males	
	OR	95% CI	OR	95% CI
Recreation Facilities	1.06	0.99-1.13	1.04	0.98-1.11
Home Exercise Equipment	**1.26**	1.10-1.42	1.06	0.96-1.18
Neighborhood Characteristics	1.04	0.90-1.20	0.98	0.86-1.12

Covariates: age, BMI, race, having a child/children, level of education, current employment status, and smoking

but the relationship between VPA and recreational facilities was no longer significant. There was no significant finding in males after adjusting for appropriate covariates (Table 27).

Table 28 shows the adjusted mean value of the environmental correlates scores across quartiles of participants' total PA. Males in the 2nd, 3rd, and 4th quartiles were more likely to report a higher number of proximal recreational facilities than males in the 1st quartile (10.61, 10.49, and 11.42 vs. 9.21), and females in the 3rd and 4th quartiles were more likely to report a higher number of proximal recreational facilities than females in the 1st quartile (9.65 and 10.02

vs. 8.13). Males in the highest quartile were more likely to report a higher number of home exercise equipment than males in the 1st, 2nd, and 3rd quartiles (5.17 vs. 3.67, 4.06, and 3.70). Females in the 2nd, 3rd, and 4th quartiles were more likely to report a higher number of home exercise equipment than females in the lowest quartile (4.33, 4.93, and 5.17 vs. 3.29), and females in the 3rd and 4th quartiles were more likely to report a higher number of home exercise equipment than females in the 2nd quartile (4.93 and 5.17 vs. 4.33). However, in both genders, there were no significant differences in the score of neighborhood characteristics across quartiles of total PA.

Table 28: Total number/score of environmental correlate across quartiles of total PA after adjusting for covariates: analysis of covariance (ANCOVA)

	Quartiles of Total PA				
Adjusted Mean (Std. Error)	**1st**	**2nd**	**3rd**	**4th**	**P-value***
RF					
Males	9.21 (0.44)	10.61 (0.44)	10.49 (0.44)	11.42 (0.43)	**0.005**
Females	8.13(0.44)	8.83(0.43)	9.65(0.44)	10.02(0.43)	**0.012**
HEE					
Males	3.67 (0.25)	4.06 (0.25)	3.70 (0.26)	5.17 (0.25)	**0.000**
Females	3.29 (0.21)	4.33 (0.21)	4.93 (0.21)	5.17 (0.21)	**0.000**
NC					
Males	12.42 (0.21)	12.98(0.21)	13.00 (0.21)	13.20 (0.21)	0.062
Females	12.42 (0.20)	13.12(0.19)	12.83 (0.20)	13.01 (0.20)	0.065

RF, Recreational facilities; HEE, Home exercise equipment; NC, Neighborhood characteristics
*Overall P-value across groups
Covariates: age, BMI, race, having a child/children, level of education, current employment status, and smoking

Post Hoc significant findings
Males: RF Q2, 3, and 4>Q1; HEE Q4>Q1, 2, and 3
Females: RF Q3 and 4>Q1; HEE Q2, 3, and 4>Q1 and Q3 and 4>Q2

4.4.3 Specific Aim #2

This analysis was conducted to examine the association between environmental barriers and leisure-time physical activity. The odds for each specific barrier by VPA are presented in Table 29. Males who engaged in insufficient amounts of VPA were significantly more likely to report a lack of equipment (OR=2.28, 95% CI=1.03-5.03), a lack of good weather (OR=2.96, 95% CI=1.17-7.51), and a lack of facilities (OR=4.69, 95% CI=1.59-13.86) than males who engaged in sufficient VPA; however, there were no significant associations in females.

After adjusting for appropriate covariates, males who engaged in insufficient amounts of VPA were more likely to report a lack of good weather (OR=2.88, 95% CI=1.12-7.42) and a lack of facilities (OR=4.43, 95% CI=1.47-13.37) than males who engaged in sufficient VPA; however, there were no significant associations in females (Table 30).

Table 29: Environmental barriers to VPA: Odds ratio (OR) and 95% confidence interval (95% CI)

	Lack of equipment		**Lack of good weather**		**Lack of facilities**	
VPA	**OR**	**95%CI**	**OR**	**95%CI**	**OR**	**95%CI**
Males						
Sufficient	1.00		1.00		1.00	
Insufficient	**2.28**	1.03-5.03	**2.96**	1.17-7.51	**4.69**	1.59-13.86
Females						
Sufficient	1.00		1.00		1.00	
Insufficient	2.18	0.94-5.08	0.78	0.41-1.50	2.51	0.94-6.68

Table 30: Environmental barriers to VPA after adjusting for covariates: Odds ratio (OR) and 95% confidence interval (95% CI)

	Lack of equipment		Lack of good weather		Lack of facilities	
VPA	**OR**	**95%CI**	**OR**	**95%CI**	**OR**	**95%CI**
Males						
Sufficient	1.00		1.00		1.00	
Insufficient	2.10	0.93-4.76	**2.88**	1.12-7.42	**4.43**	1.47-13.37
Females						
Sufficient	1.00		1.00		1.00	
Insufficient	1.66	0.69-3.99	0.75	0.38-1.48	1.95	0.71-5.35

Covariates: age, BMI, race, having a child/children, level of education, current employment status, and smoking

The odds of the each environmental barrier across quartile of total PA are presented in Table 31. Males in the lowest quartile of total PA were significantly more likely to report a lack of equipment (OR=3.14, 95% CI=1.16-8.51) and a lack of facilities (OR=6.54, 95% CI=1.82-23.47) than males in the highest quartile, but there were no significant findings related to a lack of good weather. Females in the lowest quartile of total PA were significantly more likely to report a lack of equipment (OR=2.76, 95% CI=1.08-7.02) than females in the highest quartile, but there were no significant findings related to a lack of good weather and a lack of facilities.

After adjusting for appropriate covariates, males in the lowest quartile were more likely to report a lack of equipment (OR=3.43, 95% CI=1.20-9.81) and a lack of facilities (OR=7.69, 95% CI=2.03-29.14) as an environmental barrier to physical activity than males in the highest quartile. However, among females, after adjusting for appropriate covariates, there were no significant associations between environmental barriers and leisure-time PA (Table 32).

Table 31: Environmental barriers to total PA: Odds ratio (OR) and 95% confidence interval (95% CI) across quartiles of total PA

	Lack of equipment		Lack of good weather		Lack of facilities	
Quartiles of PA	**OR**	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**
Males						
1st	**3.14**	1.16-8.51	2.21	0.64-7.66	**6.54**	1.82-23.47
2nd	1.39	0.46-4.21	3.08	0.94-10.13	1.74	0.40-7.52
3rd	1.00	0.31-3.25	1.56	0.42-5.77	1.37	0.30-6.33
4th	1.00		1.00		1.00	
Females						
1st	**2.76**	1.08-7.02	1.10	0.47-2.55	2.55	0.93-6.96
2nd	1.45	0.53-3.98	0.88	0.37-2.12	1.32	0.44-3.96
3rd	0.99	0.33-2.94	0.89	0.37-2.14	0.81	0.24-2.74
4th	1.00		1.00		1.00	

Table 32: Environmental barriers to total PA after adjusting for covariates: Odds ratio (OR) and 95% confidence interval (95% CI) across quartiles of total PA

	Lack of equipment		Lack of good weather		Lack of facilities	
Quartiles of PA	**OR**	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**
Males						
1st	**3.43**	1.20-9.81	2.46	0.69-8.73	**7.69**	2.03-29.14
2nd	0.99	0.31-3.16	2.88	0.84-9.87	1.36	0.30-6.18
3rd	1.02	0.30-3.47	1.74	0.46-6.55	1.57	0.33-7.54
4th	1.00		1.00		1.00	
Females						
1st	2.15	0.81-5.68	1.16	0.49-2.78	1.80	0.63-5.13
2nd	1.40	0.49-3.99	0.79	0.31-1.98	1.15	0.37-3.59
3rd	0.99	0.32-3.03	1.00	0.40-2.43	0.77	0.22-2.69
4th	1.00		1.00		1.00	

Covariates: age, BMI, race, having a child/children, level of education, current employment status, and smoking

4.5 Summary of the Results

After adjusting for all covariates, proximal recreational facilities and home exercise equipment were significantly related to total physical activity in males. In addition, home exercise equipment was significantly related to total physical activity and vigorous physical activity, and proximal recreational facilities were significantly related to total physical activity in females. Neighborhood characteristics were not significant correlates of total physical activity and vigorous physical activity in females.

After adjusting for all covariates, a lack of equipment was significantly related to only total physical activity, a lack of good weather was related to only vigorous physical activity, and a lack of facilities was related to both total physical activity and vigorous physical activity in males. No significant association was found related to environmental barriers in females. Overall, in the current analysis, environmental correlates and barriers were significantly associated with both total physical activity and vigorous physical activity in young adults.

Table 33: Summary of univariate and multivariate analyses

	Recreational Facilities	**Home Exercise Equipment**	**Neighborhood Characteristics**	**A Lack of Equipment**	**A Lack of Good Weather**	**A Lack of Facilities**
Males						
Total PA	+ *	+ *		+ *	+	+ *
VPA				+	+ *	+ *
Females						
Total PA	+ *	+ *	+	+		
VPA	+	+ *	+			

+ Significant association - Univariate Analysis
* Significant association – Multivariate Analysis

5. Discussion, Conclusions, and Recommendations

5.1 Introduction

The purpose of this study was to examine the association between environmental correlates and physical activity levels in young adults. This chapter is composed of the following sections: (1) Discussion of Results (2) Conclusions, and (3) Recommendations for Future Research

5.2 Discussion of Results

This cross-sectional study investigated the association between environmental factors such as proximity to recreational facilities, presence of home exercise equipment, neighborhood characteristics, and barriers to physical activity participation in young adults.

The findings indicated that environmental correlates were significantly associated with the likelihood of participation in physical activity. In agreement with previous research (10, 21, 30), this study found that the number of proximal recreational facilities and home exercise equipment was positively related to total physical activity in both men and women, and related to vigorous physical activity in women. Booth et al. (10) found that those who were physically active were more likely to report access to a higher number of facilities. De Bourdeaudhuij et al. (21) also reported that the presence of recreational facilities near home or worksite and physical activity equipment at home were positively correlated with increased likelihood of vigorous physical activity in adults.

The current study found no association between neighborhood characteristics and participation in leisure-time physical activity in either men or women. In contrast with the

current research, most previous studies (6, 21, 38, 39) have reported a positive relationship between neighborhood characteristics and leisure-time physical activity. The lack of significant association in the current study might be due to several factors. The current study used a neighborhood characteristics scale that yielded a composite score for neighborhood features, perceived safety for walking, and type of neighborhood. However, previous studies examined the association between leisure-time physical activity and individual neighborhood characteristic rather than using a composite score. Additional analyses that examine the relation between physical activity and the individual components of the composite score may provide additional insight. Furthermore, neighborhood characteristics are more likely to be related to outdoor physical activities such as walking or jogging (21, 38, 39). Humple et al. (38, 39) indicated that positive perception of neighborhood aesthetics among Australian adults was positively related to their neighborhood walking. Thus, additional analyses may examine the relation of neighborhood characteristics and the number of hours of specific activities such as walking, jogging, rollerblading, etc.

We also found interesting results related to potential racial differences in the relation between environmental correlates and physical activity. White males and females reported a greater number of proximal recreational facilities and home exercise equipment than minority participants. However, total physical activity and the participation in sufficient vigorous physical activity were not statistically different between whites and minorities. Possible reasons are that minorities might participate in physical activities that are less likely to require facilities/places or equipment, and characteristics of community such as neighborhood socioeconomic status which was not assessed can strongly influence the number of proximal recreational facilities in community.

This study found that environmental barriers were significantly associated with both total physical activity and vigorous physical activity, but only among male participants. We might expect that individuals who are not physically activity would be likely to report environmental barriers (74). However, there was no association found between level of physical activity and environmental barriers in females. Additional analyses indicated that among females, other barriers, including a lack of company and discouragement of physical activity participation were significantly related to level of leisure-time rather than environmental barriers, and previous studies (41, 104) have reported that caregiving duties and family responsibilities are the most common barriers in young female adults; however, those barriers were not assessed in this study.

Sallis et al. (71) investigated the association between environmental correlates and diverse physical activity behaviors, including walking, strength exercise, and vigorous exercise in college students. Due to employing identical questionnaire to the current study to assess environmental components, scoring the degree of environmental correlates by similar calculation, and recruiting similar young adult sample, it is important to compare the findings of the current study to the findings of this previous study. Sallis et al. found a significant association between home exercise equipment and strength exercise, but no association between the number of proximal recreational facilities, neighborhood characteristics and physical activity. This lack of significant association may be due to the homogeneous environment that the participants were living as all were attending the same university.

The study had several limitations. Physical activity and environmental correlates were assessed using a self-reported questionnaire. Thus, the data may be limited by recall or other bias. Another limitation of this study is due to the cross-sectional design, as it is not possible to

determine cause-and-effect relationships. Finally, while the proportion of minorities (16%) was representative of Allegheny County, the findings related to racial comparison are not able to be generalized to diverse population.

The strength of this study includes the large population-based young adult sample of similar numbers of men and women that represent diverse socio-economic subgroups. In addition this study examined the relation between the individual environmental factors and the overall score of each environmental group by gender, race, vigorous physical activity and total physical activity. Finally, multivariate analyses were used to control for other factors that may influence physical activity such as age, BMI, education level, and smoking status.

5.3 Conclusions

The purpose of the current study was to examine the association between environmental correlates (i.e., recreational facilities, home exercise equipment, neighborhood characteristics, and environmental barriers to physical activity) and physical activity (i.e., total physical activity and vigorous physical activity) in young adults. A total of 369 females and 315 males completed the self-reported questionnaire measuring physical activity, sociodemographic and lifestyle factors, environmental characteristics and barriers to physical activity. After adjusting for all potential covariates, in females only, home exercise equipment was significantly related to vigorous physical activity; in both genders, proximity to recreational facilities and home exercise equipment were significantly associated with total physical activity; in males only, a lack of good weather and a lack of facilities were significantly associated with insufficient amount of vigorous physical activity; a lack of equipment and facilities were negatively related to total physical activity.

In conclusion, environmental correlates and barriers significantly influence physical activity behavior in this young adult sample.

5.4 Recommendations for the Future

The findings of the current study suggest several recommendations for the future.

1. A longitudinal study is recommended to identify the cause-and-effect relationship between the environmental attributes and physical activity.
2. It is necessary to examine how specific environmental correlates might be related to particular types or intensities of physical activity. For example, the current study indicated no association between neighborhood characteristics and total physical activity. Neighborhood characteristics are more likely to be related to outdoor activity in neighborhood such as walking or jogging. The significant association might be identified between the number of hours of walking or jogging and neighborhood characteristics.
3. Future investigation should employ objective methods to assess physical activity such as activity monitor or pedometer and environmental correlates including geographic information system. Some participants may live close to recreational facilities but they may be unaware that it is close.
4. In order to increase physical activity, policy makers or community planners should consider strategies to increase or develop particular environmental attributes that may impact on physical activity behaviors such as traffic patterns or constructing sidewalks.

APPENDIX

A. Physical Activity Questionnaire

A-1. PAST YEAR LEISURE-TIME PHYSICAL ACTIVITY

I want you to think back to _____ (month/year). I will be reading to you a list of activities and I will need you to indicate any that you have participated in at least ten times in the PAST YEAR. Make sure you include all sports teams that you participated in during the last year, from _____ (month/year) through _____ (month/year).

__a. Aerobics
__b. Band/Drill Team
__c. Baseball
__d. Basketball
__e. Bicycling*
__f. Bowling
__g. Cheerleading
__h. Dance Class
__i. Football
__j. Garden/Yard Work
__k. Gymnastics
__l. Hiking
__m. Ice Skating
__n. Roller Skating
__o. Running for Exercise
__p. Skateboarding
__q. Snow Skiing
__r. Soccer
__s. Softball
__t. Street Hockey
__u. Swimming (Laps)
__v. Tennis
__w. Volleyball
__x. Water Skiing
__y. Weight Training
__z. Wrestling(Competitive)
__ aa. Walking for Exercise*

Other: (Please write below any activities that you participated in that were not listed above.)
1. _____bb 2. _____cc 3. _____dd 4. _____ee 5. _____ff

(a) Beginning with _____, 2002 tell me which months of the past year you participated in each activity. (b) Approximately how many days per week did you participated in this activity? (c) On average, how many minutes per day did you participated in this activity? [Repeat for each activity.]

		(a)												**(b)**	**(c)**
Activity	# of Months	Past Year Activity												Average # Days/Week	Average # Minutes/Day
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		

*Note: Walking and/or biking to and from work should not be included in this section

A-2. Vigorous Physical Activity Question

How many of the past 14 days have you done at least 20 minutes of exercise hard enough to make you breath Heavily and make your heart beat fast? (Hard exercise includes, for example, playing basketball, jogging, fast dancing, or bicycling)

1) None
2) 1 to 2 days
3) 3 to 5 days
4) 6 to 8 days
5) 9 or more days

B. Participants Characteristics Questionnaire

B-1. Participants Characteristics Questions

1. What is your birth date? _____ month _____ day _____ year
1a. Age _____

2. Which of the following "best" describes your current relationship status?
1) Never Married
2) Living with unmarried Partner
3) Married
4) Separated
5) Divorced
6) Widowed

3. Do you have any children (biological/foster/adopted/step)?
0) No
1) Yes
↓
a. How many children do you have? _____
b. What are their ages? (List all) _____
c. How many of these children are you a primary caregiver for? _____

4. What is the highest level of education you have completed?
1) Some high school
2) High school graduate/GED
3) Trade school
4) Diploma/Associate degree
5) Bachelor's degree
6) Master's degree
7) Professional/Doctoral degree

5. Which of the following "best" describes your current employment status?
1) Working full time
2) Working part time
3) Active Military
4) Unemployed
5) Disable
6) Full-time Homemaker
7) Full-time Student

6. Which of the following "best" describes your permanent residence?

1) Live with parents
2) Live with other relatives
3) Rent apartment/house/condo
4) Own house/condo

7. How tall are you, without shoes ? _____ feet _____ inches

8. How much do you weight, without clothes and shoes? _____ pounds

9. During the past 30 days, on how many days did you smoke cigarettes?
1) 0 days
2) 1 or 2 days
3) 3 to 5 days
4) 6 to 9 days
5) 10 to 19 days
6) 20 to 29 days
7) All 30 days

10. During the past 30 days, on how many days did you have 5 or more drinks of alcohol in a row, that is, within a couple of hours?
1) 0 days
2) 1 day
3) 2 days
4) 3 to 5 days
5) 6 to 9 days
6) 10 to 19 days
7) 20 or more days

C. Barriers and Environmental Correlates Questionnaire

C-1. Barrier Question

How often do the following prevent you from getting exercise? (MARK ALL THAT APPLY)

	Never	Rarely	Sometimes	Often	Very Often
Self conscious about my looks when I exercise					
Lack of interest in exercise					
Lack of self-discipline					
Lack of time					
Lack of Energy					
Lack of company					
Lack of enjoyment from exercise					
Discouragement					
Lack of equipment					
Lack of good weather					
Lack of skills					
Lack of facilities or space					
Lack of knowledge on how to exercise					
Lack of good health					
Fear of injury					
Other _____					

C-2. Home Exercise equipment Question

Please indicate which items you in your home, yard, or apartment complex.

- Stationary aerobic equipment
- Bicycle
- Dog
- Trampoline for jumping in place
- Running Shoes
- Swimming Pool
- Weight Lifting Equipment (e.g., free weights, machines)
- Toning Devices (e.g., heavy hands, ankle weights, thighmaster)
- Aerobic workout videotapes of audiotapes
- Step aerobic of slide aerobic equipment
- Skates (roller, in line, or ice)
- Sport Equipment (balls, racquets)
- Canoes, Row Boat, Kayak
- Skis (snow or water)

C-3. Neighborhood Characteristics Questions

Please indicate which of the following apply to your neighborhood.

- Are there Sidewalks
- Is there Heavy Traffic
- Are there Hills
- Are there Street Lights
- Are there Dogs that are unattended
- Is there Enjoyable scenery
- Do you Frequently see people walking or exercising
- Is there High Crime

On a scale of 1 to 5, how safe do you feel walking in your neighborhood during the day with 1= very unsafe and 5= very safe? (Circle answer)

1 2 3 4 5

Is your neighborhood:

- Residential
- Mixed commercial and residential
- Mainly commercial

C-4. Recreational Facilities

For each of these places where you can exercise, please indicate if it is on a frequently traveled route (e.g., to and from work) or within a 5-minute drive from your work or home.

- Aerobic or dance studio
- Basketball court
- Beach or lake
- Bike lane or trails
- Golf course
- Health spa/gym
- Martial arts studio
- Playing field (soccer, football, softball, etc.)
- Public park
- Public recreation center
- Racquetball/squash court
- Running track
- Skating rink
- Sporting goods store
- Swimming pool
- Walking/hiking trails
- Tennis courts

D. Tables for Barriers To Leisure-Time Physical Activity

Table D-1: Percentages of participants reporting barriers by gender and race

Percent Report	White Males	Minority Males	P-value	White Females	Minority Females	P-value
Self-Conscious	2	5	0.279	9	10	0.779
Interest	14	10	0.526	16	11	0.359
Self-discipline	23	28	0.499	36	22	**0.024**
Time	45	36	0.271	49	41	0.276
Energy	11	13	0.783	23	26	0.606
Company	8	10	0.581	13	23	**0.034**
Enjoyment	11	8	0.536	14	16	0.694
Discouragement	4	8	0.239	7	3	0.200
Skills	3	0	0.312	3	6	0.356
Knowledge	3	8	0.130	2	10	**0.002**
Good health	3	0	0.280	4	3	0.670
Injury	2	3	0.607	4	2	0.352

*Compares White to minority

Table D-2: Percentages of participants reporting barriers by gender and level of VPA

	Males			Females		
	Insufficient	**Sufficient**	**P-value**	**Insufficient**	**Sufficient**	**P-value**
Self-Conscious	4	1	**0.017**	12	3	**0.006**
Interest	18	6	**0.002**	20	4	**0.000**
Self-discipline	33	10	**0.000**	40	17	**0.000**
Time	52	33	**0.001**	52	35	**0.003**
Energy	17	4	**0.000**	28	13	**0.002**
Company	10	5	0.158	17	11	0.179
Enjoyment	14	5	**0.014**	18	5	**0.001**
Discouragement	7	0	**0.002**	8	3	0.075
Skills	3	0	0.141	5	2	0.205
Knowledge	4	2	0.339	4	4	0.932
Good health	4	0	**0.016**	5	1	0.061
Injury	2	1	0.331	4	2	0.319

*Compares insufficient to sufficient VPA

Table D-3: Percentages of participants reporting barriers across quartiles of total PA by gender

	Males					Females				
Percent Report	**1st**	**2nd**	**3rd**	**4th**	**P-value**	**1st**	**2nd**	**3rd**	**4th**	**P-value**
Self-Conscious	5	0	3	3	0.239	11	11	7	9	0.702
Interest	26	15	8	5	**0.001**	30	13	9	8	**0.000**
Self-discipline	44	20	19	13	**0.000**	49	36	29	20	**0.000**
Time	55	47	46	29	**0.010**	67	44	42	35	**0.000**
Energy	22	13	6	5	**0.003**	39	25	16	13	**0.000**
Company	13	6	9	4	0.182	28	17	8	8	**0.000**
Enjoyment	21	10	4	8	**0.005**	25	14	10	9	**0.006**
Discouragement	10	1	3	3	**0.018**	13	8	2	2	**0.005**
Skills	7	0	1	1	**0.032**	7	3	2	3	0.448
Knowledge	4	5	4	1	0.616	21	4	2	6	0.671
Good health	4	4	1	1	0.556	6	6	1	3	0.346
Injury	3	0	3	1	0.514	6	7	0	1	**0.031**

*Compares all groups by gender

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