PERCEIVED NEIGHBORHOOD CONTENTEDNESS AND ITS IMPACT ON PHYSICAL AND SEDENTARY ACTIVITY IN ADOLESCENTS

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Adolescent health is an important part of public health. Activity patterns, such as physical activity and screen time can have direct effects on this. It is important to understand what barriers to healthy activity choices exist and understand why they exist.

In the following study a measure of perceived neighborhood contentedness was developed utilizing aspects of perceived neighborhood safety, familiarity and comfort. This measure was then measured in a large, nationally representative population of adolescents and evaluated for its appropriateness. The association between perceived neighborhood contentedness and physical activity as well as sedentary activity was then evaluated. Perceived neighborhood contentedness did have a significant association with an increased level of physical activity in the population. This relationship was consistent across both genders and study waves. It had a smaller but still significant relationship with sedentary activity, as measured by screen time duration.

Adolescent health is an important aspect of public health and interventions to increase healthy lifestyle decisions are key in promoting this. Perceived neighborhood contentedness is important to consider when developing public health plans to promote

physical activity and reduce sedentary activity in the community. Neighborhood factors should be considered when developing these interventions.

TABLE OF CONTENTS

LIST OF TABLES

PREFACE

First and foremost, I would like to thank my committee members for all of their support, help and especially encouragement during this process. They have always been there to help and support me throughout this process.

In addition, I would like to thank my family for all of their love and emotional support through an up and down few years. It was never easy but they were always there to help. My mother and father are the best and without them I would not have been able to accomplish this.

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1.0 BACKGROUND

Obesity is a major public health issue in the United States and worldwide. In a recent CDC report, 27% of Americans were obese (CDC, 2010b). This is more than twice the rate of obesity that was targeted in the *Healthy People 2010* goals. In addition, the rate of obesity in adolescents is high. In an analysis of data from the most recent Youth Risk Behavior Survey (YRBS) an estimated 12-13% of youths were considered obese. These rates have been steadily increasing over the past two decades(CDC, 2010b). Aside from the direct health impact on adolescents, a lack of physical activity may lead to obesity related health problems in adulthood. Obesity has been linked with high blood pressure and high LDL cholesterol as well (E. S. Ford, Giles, & Dietz, 2002).

Physical activity has become one of the most common interventions to reduce obesity, especially in adolescents (Pereira et al., 2009). Because of this, it is important for public health professionals to understand potential barriers to physical activity. With a better understanding of these barriers, development and implementation of interventions are more likely to be successful. One potential barriers of interest is perceived neighborhood factors, such as safety, familiarity and comfort. An adolescent may well choose other activities during their leisure time if they do not feel safe or comfortable in their neighborhood. It is important to better understand this relationship, as it may become an area for potential future interventions.

In addition to the potential long-term health effects of a lack of physical activity, some data have shown that activity patterns developed in adolescence may well predict activity patterns in adulthood. Studies have shown this relationship to be significant

(Gordon-Larsen, Nelson, & Popkin, 2004) (Tammelin, Nayha, Hills, & Jarvelin, 2003). This means that encouraging physical activity during adolescence may be even more important for obesity or other chronic disease prevention.

All of this shows that an understanding of adolescent physical activity and any potential barriers for it is an important area of research in public health. The National Longitudinal Survey of Adolescent Health (Add Health) provides a unique, multi-wave opportunity to study some of these relationships in a large, nationally representative sample of adolescents as they transition into early adulthood.

In addition to physical activity, adolescent sedentary activity patterns are also important to understand. Sedentary activity is not simply the lack of physical activity but instead incorporates time spent in activities such as television viewing, video games and non-school related computer use (Li, Treuth, & Wang, 2009). An example of an activity that would not classify as either physical or sedentary would be homework, or studying. Sedentary activity options have increased greatly in recent times. Because of this, sedentary activity has also increased. Another potential reason for this is perceived neighborhood safety. Combined with the increasing sedentary activity options, an element of fear of the neighborhood could be pushing adolescents toward more time spent in these activities. It is easier for a person who feels unsafe to stay inside and watch television or play video games. It is important to understand if this relationship does exist as it would be another optimal point of intervention for public health officials.

Overall, perceived neighborhood safety is still not a well understood indicator of activity patterns, and potential long term health effects. As stated earlier, the Add Health

survey provides a very good opportunity to evaluate these relationships in a large cohort of adolescents as they progress into adulthood. In this study we looked at the following:

1. We developed a measure of neighborhood contentedness that included aspects of neighborhood safety, comfort and familiarity
2. The relationship between perceived neighborhood contentedness and physical activity patterns in adolescents.
3. The relationship between perceived neighborhood contentedness and sedentary activity in adolescents.

These evaluations help to better describe the link between perceived neighborhood contentedness and activity patterns in adolescents. The findings help to strengthen the base of knowledge on these relationships. They also help to provide more insight on opportunities for potential public health interventions. The social factors that go into perceived neighborhood contentedness are also explored, and a new measure has been developed for use in future research.

1.1 PHYSICAL ACTIVITY IN ADOLESCENTS

Physical activity patterns in children are an area of concern in public health because of their potential long term effects. Aside from the adverse outcomes directly associated with a lack of physical activity, patterns of activity established in childhood can potentially affect later ability and willingness to participate in physical activity as part of leisure time

(Gordon-Larsen et al., 2004). Physical activity is an important healthy lifestyle choice and has been established as an important factor in helping to prevent long term as well as short term adverse health outcomes in adults (Mei et al., 2002).

1.1.1 PHYSICAL ACTIVITY IN CHILDREN AS A PREDICTOR OF LATER ACTIVITY PATTERNS

Research has been done looking at whether or not activity patterns in adolescence may be associated with activity choices later in life. Although the literature is a bit sparse in this area, it appears that an overall lack of physical activity in adolescence is a strong predictor of a lack of physical activity in early adulthood(Gordon-Larsen et al., 2004).

In a study by Gordon-Larsen et al., a population of over 20,000 subjects enrolled as part of the National Longitudinal Study of Adolescent Health (Add Health Project) were evaluated during adolescence (ages 11-21) and then followed up in early adulthood (18-26) to see if individuals who had achieved physical fitness goals in adolescence maintained these achievements into early adulthood(Gordon-Larsen et al., 2004). The study did not look simply at physical activity goals, but also at a sedentary activity goal. This allowed them to assess an overall view of leisure time activity trends and how they are related to health. The physical activity cutoff used for evaluation at both time points was whether or not the subjects took part in moderate or vigorous physical activity in 5 of the previous 7 days (Gordon-Larsen et al., 2004). The analysis looked at the longitudinal trend for individuals with data for both time points. They were classified as achieving these goals in both, one or neither of the time points. The rate of individuals who achieved goals at each

time point were compared based on whether or not they achieved the same goals in adolescence. The findings of this study showed that those who failed to achieve the goals in adolescence continued that trend into adulthood at a 61% rate. Only 3.6% who were not active in adolescence met activity goals in adulthood. In addition, 31% of the population who did achieve these goals in adolescence, did not in later life (Gordon-Larsen et al., 2004). This relationship was significantly more pronounced in males. This shows that physical activity, and overall leisure time activity choices during adolescence may be an early indicator of physical activity patterns later in life. Even for those who are physically active in adolescence, the rate of continuing these patterns is low.

The same investigators looked further at the Add Health study population, and attempted to get a more detailed view of this relationship. This study showed that physical activity declines among subjects who take part in all types of recreational activity, but that the decline is significantly greater in subjects who play video games and skateboard(Nelson, Gordon-Larsen, Adair, & Popkin, 2005). They looked at three waves of the study and specified groups that evaluated the study subjects at different time points. Within the study population, they grouped the subjects into activity pattern based clusters in order to study their activity patterns. The same measures described in the article above were used as indicators of activity patterns and a Euclidian cluster development procedure was used to determine 7 unique clusters among the participants based on these indicators (Nelson et al., 2005). These clusters took into account all of their leisure activity patterns, both physical and sedentary as well as their responses to questions concerning how involved they were in school(Nelson et al., 2005). The researchers calculated odds ratios for meeting national physical activity guidelines ($\geq$ 5 bouts of physical activity per 7 days)

for each cluster as compared to the cluster of high television viewing. They compared these odds ratios between Wave II and Wave III of the study to determine potential time trends. The odds went down significantly in all but one cluster (those reporting few activities overall). The drop off was most noticeable in the cluster identified as those who participated in skateboarding/rollerblading as well as video games. This drop was from 13.13 at Wave I to 1.77 at Wave III (Nelson et al., 2005). What was interesting about this particular group was that it was the only one that had combined high rates of physical and sedentary activities. This shows that adolescents who are very involved in sedentary activities (such as video games) as well as physical activity, may revert more to their sedentary behavior patterns as organized leisure time physical activity becomes more difficult to maintain and less accessible in early adulthood. It also shows that not only do activity patterns at adolescence have an impact on activity choices later in life, but behavior specific trends, such as a simultaneous increase in both sedentary and physical activity may also lead to later decreases in physical activity.

This relationship between adolescent activity patterns and later adulthood activity has been supported by another study, conducted by Tammellin et al. In a study of nearly 8,000 adults in Finland, participation in sports as an adolescent was predictive of physical activity patterns in adulthood(Tammelin et al., 2003). The study was part of a much larger lifestyle study and looked at variables collected when the participants were ages 14 and 31(Tammelin et al., 2003). The researchers concluded that participation in physical activity or sports at least once a week for females and twice a week for males was a statistically significant predictor of participation in leisure time physical activity in adulthood. The researchers asked about specific sports in the study, and "ball sports" were

a better predictor of later activity as well. Overall, however, the trend was evident in the correlations between all sports at adolescence and activity choices in adulthood (Tammelin et al., 2003). This supports the idea that physical activity in adolescence may be a good indicator of physical activity in adulthood.

Other interesting trends in physical activity patterns over time have been shown elsewhere. In a study conducted by Taylor et al., it was shown that being forced to participate in physical activities at a young age was negatively correlated with physical fitness and voluntary physical activity in adulthood, in men(Taylor, Blair, Cummings, Wun, & Malina, 1999). The retrospective study utilized activity questionnaires from 105 men in a clinic setting. Physical fitness was assessed using a medical examination and treadmill based stress test, while physical activity was assessed in a medical questionnaire. The goal of the study was to determine if adolescent physical activity patterns were predicative of later physical fitness. The study showed a significant negative correlation between forced physical activity in adolescence and adult physical activity participation(R= -0.20)(Taylor et al., 1999). Although there are some obvious limitations to the study design, the findings are intriguing. The results suggest that forcing activity on children, through school programs for example, may not be valuable in building up appreciation for a physically active lifestyle and may in fact have a negative impact. This further indicates the importance of understanding the importance of voluntary leisure time leisure physical activity in adolescents.

1.1.2 THE RELATIONSHIP BETWEEN GENDER, RACE AND PHYSICAL ACTIVITY IN ADOLESCENTS

When discussing physical activity patterns in youths, it is important to first understand the basic demographic differences of adolescents and how this is related to their physical activity choices.

Brodersen et al. studied the trends in physical activity within a cohort of adolescents in England. The goal of this study was to better understand demographic and school grade differences in physical activity patterns among youths(Brodersen, Steptoe, Boniface, & Wardle, 2007). The research was part of the "Health and Behaviour in Teenagers Study" conducted in South London, England and had a sample size of 4320 respondents. The students were selected from 36 randomly selected schools and answered a survey under guidance and supervision of trained researchers. Measures were collected annually from year 7 (US equivalent of 6th grade) to Year 11 (Brodersen et al., 2007). Vigorous physical activity was the only dependent variable of interest and was determined by respondents answer to a single question of "how many days they took part in some form of physical activity that made them sweat and breathe hard in the past week." Across the entire longitudinal study, boys had consistently higher rates of physical activity than girls. Race was also a significant predictor of physical activity, but the differences were not as defined or consistent. Black girls took part in significantly less physical activity than their white counterparts but no difference was seen between black and white males (Brodersen et al., 2007). Asian students were also significantly less physically active than their white counterparts in both genders. SES was not a significant predictor of physical activity across

either race or time.(Brodersen et al., 2007) The study showed that gender and school year are significantly associated with physical activity in adolescents in England, which is consistent with findings of studies discussed here in American adolescents populations.

In the previously described study conducted by Gordon-Larsen et al., the investigators also looked at additional factors such as race and gender within the study cohorts at onset (Gordon-Larsen et al., 2004). These findings supported the findings of other studies, described above. Generally, the majority of adolescents do not meet physical activity goals at any time. In addition, minorities and females appear to be even less likely than their white and male counterparts to achieve these guidelines (Gordon-Larsen et al., 2004).

Kahn et al also looked at the patterns and characteristics of physical activity in U.S. Adolescents (Kahn et al., 2008). Their study was part of the "Growing Up Today Study (GUTS)" and consisted of three waves of self-report data collected between 1997 and 1999. The study population varied between 16,882 participants at inception to 12,812 subjects at the third wave (Kahn et al., 2008). Physical activity data were collected for both moderate and vigorous activity levels. Consistent with the other studies described, boys were significantly more physically active than girls across the majority of early adolescence. The range for boys went from 9.36 to 10.52 hours of physical activity per week in boys aged 9-11, compared to 8-10.23 hours in girls(Kahn et al., 2008). Although boys were more active, an interesting trend was seen in how the rates changed over time. This will be discussed in the next section.

Generally speaking, the data suggests that gender, age and race may play a role in physical activity rates in adolescents. It appears that girls report less physical activity than

boys in this age group as do certain minority groups. In addition, physical activity decreases with age in adolescence.

1.1.3 HOW DOES PHYSICAL ACTIVITY IN ADOLESCENTS CHANGED AS THEY AGE?

Many investigators have tried to better describe the patterns and characteristics of physical activity in adolescents over time. They have attempted to better understand and describe the changes in activity patterns in adolescents as they age. An age effect may be evident as they progress from a time of organized physical activity, more leisure time and more access to physical activities, such as childhood and early adolescence into early adulthood, where it can be assumed these physical activity opportunities may be more limited.

Another study by Brodersen et al. investigated the trends in physical activity within a cohort of adolescents in England (Brodersen et al., 2007). The study, described earlier, showed a statistically significant trend in decreasing activity as time progressed and this was consistent across genders (Brodersen et al., 2007). There was also evidence of an interaction between gender and school year as a significantly steeper decline in physical activity time was evident in the girls as they aged (Brodersen et al., 2007). This may indicate that the decline in physical activity and subsequent results may be more appreciable in females.

In a study described previously, conducted by Kahn et al., the decline in physical activity was much less steep for girls and by age 18, girls were more physically active (Kahn et al., 2008). Age was the only significant predictor of the time trends in physical

activity (Kahn et al., 2008). This is consistent with the findings of the other studies described here and further indicates that physical activity rates decrease as adolescence progresses (Kahn et al., 2008). Physical activity data was collected for both moderate and vigorous activity levels. These findings were in direct contrast to those of Brodersen, but the populations were from different countries (Brodersen, Steptoe et al. 2007).

A study by Nelson et al. also looked to investigate longitudinal and secular trends in physical activity in adolescents (Nelson, Neumark-Sztainer, Hannan, Sirard, & Story, 2006). As part of the "Eating Among Teens (EAT) I and II" projects, they followed a large cohort of junior and senior level high school students during the 1998-99 school year and a subsequent follow up study of changes in 2003-04. Of the original cohort of subjects, 53% gave full response to the follow up analysis. Two cohorts were followed. One was followed as it transitioned from early adolescence (junior high) to middle adolescence (high school) and the other was followed as it transitioned from middle adolescence to late adolescence (post high-school) (Nelson et al., 2006). Self-reported physical activity was evaluated using a series of questions adapted from a validated questionnaire, the Godin Leisure-Time Exercise Questionnaire. These questions asked how much time the respondents spent in vigorous physical activity (where the heart beats rapidly) and moderate physical activity (where it does not) per week. Responses ranged from 0 to 6 or more hours total. Moderate and vigorous physical activity was combined for analysis (Nelson et al., 2006). Additional socio-demographic data was collected. As seen in other studies described, the amount of physical activity did decline, longitudinally within each cohort (Nelson et al., 2006). The only exception was males in the early to middle adolescence transition, where the level of physical activity remained constant (Nelson et al., 2006). This supports the notion that as

the adolescents age, their level of physical activity decreases and that this decrease is more delayed in males than females.

Overall, there are mixed results when looking at the longitudinal trends in physical activity in adolescents. Although the results do show different findings, more analyses show a trend of declining activity, as adolescents get older.

1.2 SEDENTARY ACTIVITY IN ADOLESCENTS

Along with physical activity patterns, researchers have also tried to better understand the characteristics and trends of sedentary activity in adolescents and children. Sedentary activity is not just the absence of physical activity as it can be independent of physical activity. For example, television viewing and non-school related computer and video game time have been used as indicators of sedentary activities. The justification for this is that sedentary activity is more than just a lack of physical activity but also the choice to take part in activities that are indicative of being unproductive.

1.2.1 SEDENTARY ACTIVITY CHARACTERISTICS IN ADOLESCENTS

Li et al., evaluated time trends in sedentary activity as well as physical activity (Li et al., 2009). Gender, ethnicity and grade differences in sedentary activity were evident. Girls,

African Americans and respondents in later grades spent significantly more time in sedentary activity than their comparison groups (Li et al., 2009). The investigators looked at sedentary activity characteristics within each wave of the study. They utilized data collected as part of the Youth Risk Behavior Surveillance Surveys from 1991-2007. They defined sedentary activity in two ways. First, they looked at an overall lack of physical activity as a sole indicator. Second, they evaluated screen time in children. Screen time was defined as time spent watching TV, using a computer for gaming or non-school related activities and video game playing. The cut offs for this variable also came from the "Healthy People 2010" initiative and included whether or not the respondents watched television for greater than or equal to 3 hours a day and whether or not the respondents did non-school related activities on the computer for greater than or equal to 3 hours a day on an average school day(Li et al., 2009). The rates of television viewership were highest among males and African Americans and decreased with increased grade level (Li et al., 2009). When judging computer screen time, the rates were highest among boys and African American respondents as well (Li et al., 2009). As seen in the physical activity literature, this study shows a definite gender and race component with regards to sedentary activity.

A study by Brodersen et al. described above, which investigated the trends in physical and sedentary activity within a cohort of adolescents in England showed demographic differences across race and gender (Brodersen et al., 2007). Sedentary activity data was collected as a question concerning the amount of time (in hours) that the respondents spent watching TV, playing video games or playing computer games on school days as well as weekends.(Brodersen et al., 2007) The findings of the study showed that boys took part in statistically significantly more sedentary activity than girls. In addition, a

racial component was also evident as black boys and girls both took part in more sedentary activities across all of the time periods and both sexes (Brodersen et al., 2007). These findings were consistent with the study described above (Li et al., 2009).

Overall, it appears that African Americans have an increased rate of sedentary activity and that males take part in more sedentary activity than girls.

1.2.2 OVERALL TRENDS IN ADOLESCENT SEDENTARY ACTIVITY

Now that we have a better understanding of the demographic characteristics of sedentary behavior patterns in youths, we can look at the trends in these activities over time.

In the study conducted by Li et al., they found significant time trends in the types of sedentary activity that the subjects participated in. They also found differing trends based on the type of sedentary activity (Li et al., 2009). They used data collected as part of the Youth Risk Behavior Surveillance Surveys from 1991-2007. They chose to use two variables to define sedentary activity. One of these variables was a lack of sufficient vigorous physical activity or sufficient moderate physical activity during the 7 days prior to the assessment. The other one was "screen time", which was defined as time spent watching TV, using a computer for gaming or non-school related activities and video game playing. The cut offs for this variable also came from the "Healthy People 2010" initiative and were defined by whether or not the respondents watched television for greater than or equal to 3 hours a day and whether or not the respondents did non-school related activities on the computer for greater than or equal to 3 hours a day on an average school day. An additional variable was included for only the 2007 survey and it considered which

respondents had not participated in 60 or more minutes of vigorous (cause to sweat, breathe hard and have increased hear rate) activity at least once during the previous 7 days (Li et al., 2009). When using lack of physical activity as the sole indicator, no significant time trend was noted (Li et al., 2009). However, when looking at television viewing time, the time trends were significant and showed a decreasing rate of viewership, down from 43% to 35% from 1999 to 2007 (Li et al., 2009). The researchers hypothesized that the decrease in television viewership may have been a result of increased use of computers, but did not provide data to support this claim other than the prevalence data from the 2007 survey (Li et al., 2009). The findings indicate that overall sedentary activity fluctuates little over time, but the type of sedentary activity that makes up the major portion of this total time may be shifting from television viewing to recreational computer use.

The study by Brodersen et al. (2007) described above, investigated the trends in physical and sedentary activity over four years, within a cohort of adolescents in England. The investigators found that sedentary activity time was generally increasing throughout the study. Sedentary activity data was collected as a question concerning the amount of time (in hours) that the respondents spent watching TV, playing video games or playing computer games on school days as well as weekends (Brodersen et al., 2007). As described above, the findings of the study showed that boys took part in statistically significantly more sedentary activity than girls and that the hours of sedentary activity increased consistently as time went on (Brodersen et al., 2007). Additionally, a racial component was also seen as black boys and girls both took part in more sedentary activities across all of the time periods and both sexes, and Asian girls increased in their sedentary activities at a

steeper rate than their white counterparts (Brodersen et al., 2007). These findings are similar to the others discussed in this review for American adolescents.

In the study by Nelson et al., (2006), they also looked to investigate longitudinal trends in sedentary activity in adolescents. Sedentary activity was evaluated using self-report data collected from questions taken from the "Planet Health" survey. A large cohort of junior and senior level high school students were surveyed during the 1998-99 school year and a subsequent follow up survey in 2003-04. Of the original cohort of subjects, 53% gave full response to the follow up analysis. The aim of the questions was to evaluate the duration of time spent both watching TV or videos and using a computer for non-homework related activities. The responses ranged from 0 to 5 or more hours per weekday or weekend day (Nelson et al., 2006). The results were less consistent than those for physical activity patterns in the same study (Nelson et al., 2006). Girls showed a statistically significant decline in television viewing in the early to mid-adolescence transition with no concurrent statistically significant increase in computer use (Nelson et al., 2006). In contrast, girls showed a sharp and statistically significant increase in computer use from middle adolescence to late adolescence without a concurrent decrease in television viewing as may have been expected (Nelson et al., 2006). Over the same period, boys showed a sharp and statistically significant increase in computer use in both transition periods but their TV watching rates remained constant (Nelson et al., 2006). The mixed results here do not support that sedentary activity patterns involving computer use and television use may be independent (Nelson et al., 2006). Even so, there did appear to be significant increases in computer use in three of the four transition periods. This may be

due to an increased availability of computer and computer based entertainment over that time period (Nelson et al., 2006).

Overall, the literature suggests that a trend towards more sedentary activity over time exists in youths. This may be due to many factors, including the increasing variety of sedentary activities available and the reduced cost of them. Computers and computer games, for example, used to be a rarity in homes, and as costs have come down and usefulness has gone up, it is more common for a single household to have more than one computer, even in lower income environments. In addition, the various offerings on television have increased with time. Cable and satellite television now provide most homes with hundreds of options at any point in time. This increase of options and availability may be a big factor in the increase in sedentary activity patterns in children.

However, increasing community violence and perceived fear may also play an important role in this movement. The study proposed hopes to look at this potential relationship.

1.3. OBESITY AND RELATED HEALTH INDICATORS

The CDC defines obesity using many measures but one of the most common measurements used is Body Mass Index or BMI (CDC, 2009a). BMI is especially useful in population assessment of obesity rates because of its ease of collection. BMI is a mathematical

equation that takes into account the height and weight of an individual to create an index and estimate his/her body composition (CDC, 2009a). This measure is easy to collect, and has been shown to be relatively consistent with other direct measurements of body fatness, such as underwater weighing and dual energy x-ray absorptiometry (DXA), in independent research (CDC, 2009a; Mei et al., 2002). In adults, a BMI level below 18.5 indicates an underweight individual, a BMI level between 18.5 and 24.9 indicates a healthy individual, a BMI level between 25 and 29.9 indicates an overweight individual and a BMI over 30 indicates obesity (CDC, 2009a). These ranges are determined based on the association between body weight and adverse health outcomes including death (CDC, 2009a). Although this measure is used quite often as an indicator for obesity and overweight status, it does have some limitations. For one, equivalent BMI levels indicate higher body fat percentages in women than in men (CDC, 2009a; Prentice & Jebb, 2001). This is consistent throughout adult ages. Also, equal BMI levels indicate higher body fat percentages as adults age (CDC, 2009a; Prentice & Jebb, 2001). Another common criticism of the BMI measurement is that many athletes will have a higher BMI because of large amounts of muscle that weighs more than fat. Their BMI measurements may indicate that they are obese, when in fact they are in good physical shape (CDC, 2009a; Prentice & Jebb, 2001).

Obesity has been evaluated using other measures as well. These include underwater weighting and DXA as listed above. BMI has been positively compared with these two methods in the past, supporting its validity as an accurate population measure (CDC, 2009a; Mei et al., 2002). Additional measurements include skinfold thickness and isotope dilution (CDC, 2009a). Although these measurements do directly measure body fatness, which BMI does not, they are time consuming and require trained people to

conduct the procedures (CDC, 2009a). In a study as large as the Add Health Study, measurements like this were not practical or economical. In addition, although the measurements may be more precise, they have been shown to vary widely across time and observers which make them less useful for repeated measures studies, such as this (CDC, 2009a).

1.3.1 OBESITY IN THE UNITED STATES

The most recent data available on obesity in the United States comes from the CDC and utilizes information collected as part of the 2009 Behavioral Risk Factor Surveillance System (BRFSS) (CDC, 2010b). The data from this report relies on self reported height and weight information that is used to calculate BMI. The report showed that 26.7% of Americans were obese (CDC, 2010b). This is almost twice the rate that was proposed as a goal of the *Healthy People 2010* report. In fact, no state reached this level (CDC, 2010b).

Obesity rates are not consistent across all subgroups. The highest rate of obesity is seen in Non-Hispanic blacks and Hispanics (36.8% and 30.7% respectively) (CDC, 2010b). This compares to 25.2% of Non Hispanic Whites and 16.7% of other races (CDC, 2010b). Women were significantly more obese than males (41.9% v 30.9%) in Non-Hispanic blacks (CDC, 2010b). The opposite was true in non-Hispanic whites, where men were significantly more obese than women (27.1% v 23.3%) (CDC, 2010b). There was not a significant difference among genders in Hispanics or other races. Education level was also significantly associated with obesity. People who did not graduate from high school were significantly more likely to be obese than all other education levels. This relationship

appeared to be driven mostly by a difference in women. Women without a high school degree were much more likely than women with a high school degree, some college or a college degree (36.4% v 29.5%, 27.9% and 18.6% respectively) to be obese (CDC, 2010b). In addition, college graduates were significantly less likely to be obese than others and this was true in both genders. Only 20.8% of college graduates were obese compared to 32.9 % of people without a college degree, 29.5% of people with only a high school degree and 29.1% of people with only some college work (CDC, 2010b).

Additionally, there was geographic variance in the obesity levels in the United States. The southern and Midwest regions had significantly higher rates of obesity then the west and northeast. This was true across all genders. The state with the lowest rate of obesity was Colorado, with a rate of 18.6% (CDC, 2010b). This is still almost 4% higher than the goal set out in *Healthy People 2010*. The only other place with a level below 20% was the District of Columbia. In fact, only 17 states had a rate below 25% (CDC, 2010b). The state with the highest rate of obesity was Mississippi, with a rate of 34.4%, more than twice the goal. An additional eight states had rates above 30% or at least twice the goal (CDC, 2010b).

Of most concern to public health officials, however, is the fact that obesity levels are increasing. In the past decade, education on diet and exercise has increased, as have programs to fight the increasing obesity problem. In 2000, no states had rates above 25%, and 28 had rates below 20% (CDC, 2010b). However, in 2005, three states had an obesity level above 30% but the majority still had a level below 25%. In 2009, the most recent data shows that 9 states have an obesity level over 30% and only 16 states remain below 25%.

This increase in obesity levels is drastic and striking considering the emphasis placed on it as a public health issue.

1.3.2 CHILD AND ADOLESCENT OBESITY

Also of concern is an increasing rate of childhood obesity in the United States. A recent report by the CDC discussed an upward trend in childhood obesity (BMI > 95th percentile) from 1991-2009 (CDC, 2010a). This data comes from the Youth Risk Behavior Survey (YRBS), a bi-annual survey conducted by the CDC. The increase leveled off some in the last 3 years of the analysis, but still has reached a constant between 12 and 13 percent of youth being obese (CDC, 2010a). The geographical distribution of this is stunning as well. The geographic variation in adolescents follow similar patterns to those in adults, with the Midwest and south having the highest rates.

Rates are also increasing over time. In 2003, only three states had obesity rates over 15%, but that number has risen to six in the 2005 and 2007 surveys (CDC, 2008) and has risen to 5 in 2009 (CDC, 2010a). In addition, in 2003, only 23 states had rates between 10-14% obese in the population while in the 2009 survey, that number had risen to a staggering 31 states (CDC, 2010a). This means that in 2009, 36 of the 50 states in the United States had at least 10% of their childhood population qualifying as obese, compared to 26 in 2003 (CDC, 2008).

Obesity is clearly a major concern in the United States. The numbers show that it is a highly prevalent health issue and that the rates are increasing over time, even while the health outcomes and long term risks are being better understood and addressed. This is a

disturbing trend and emphasizes the importance of understanding the causes and progression of obesity.

1.3.3 METABOLIC SYNDROME

The American Heart Association defines the Metabolic Syndrome as having any three of the following indicators present at the same time (AHA, 2004): elevated waist circumference, elevated serum triglycerides, low HDL, increased blood pressure and increased fasting glucose. The first indicator is intended to estimate obesity or overweight status and utilizes waist circumference as a measure (AHA, 2004). For males the cutoff is 40 inches and for females it is 35 inches (AHA, 2004). Any person with a waist circumference at or above this level is considered to have the risk indicator present. The second measure is an elevated serum triglyceride level, specifically greater than 150 mg/dL (AHA, 2004). The third measure is an indicator of lower high density lipoproteins. A cutoff measure of less than 40 mg/dL in men or 50 mg/dL in women specifically for HDL cholesterol (AHA, 2004). Hypertension is also considered. A blood pressure greater than 130/85 Hg is the cutoff for this indicator. Also, a fasting glucose level of 110 mg/dL or higher is a cutoff for indication of this biomarker (AHA, 2004). These determinants were set by the national Cholesterol Education Program Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (AHA, 2004).

An understanding of the prevalence of the metabolic syndrome within the United States must also be examined to get an appreciation of how great and widespread the problem is. Because the measure was recently defined, differences in prevalence over time

are harder to evaluate than those for obesity. According to a study conducted in 2002, around 47 million U.S. residents were believed to have the metabolic syndrome (E. S. Ford et al., 2002). The age-adjusted prevalence was around 24% in adults (E. S. Ford et al., 2002). The prevalence increased with increased age from around 7% in 20-29 year olds to a almost 44% in 60-69 year olds (E. S. Ford et al., 2002). There were no statistically significant gender differences noted in the overall numbers. However there was a statistically significant difference among genders within the African American community. In African American women, the rate of metabolic syndrome was 57% higher than in men (E. S. Ford et al., 2002). Within Mexican-Americans, women had a 26% higher rate than men (E. S. Ford et al., 2002).

1.3.4 METABOLIC SYNDROME IN CHILDREN AND ADOLESCENTS

Since we are looking at adolescents in this study it is also important to understand the prevalence of metabolic syndrome in adolescents. A modification to the above definition of metabolic syndrome was used in estimating the prevalence from the NHANES II data set. A person was considered to have the syndrome if they had three or more of the following indicators: elevated serum triglycerides, low HDL cholesterol, elevated fasting glucose, high blood pressure and an elevated waist circumference. First, the cutoff for serum triglyceride level was 110 mg/dL. An HDL cholesterol level below 40 mg/dL was considered an indicator. An elevated fasting glucose level above 110 mg/dL was also considered an indicator. Additionally, a blood pressure or waist circumference at or above the sex/age specific 90^{th} percentile was an indicator as well. This is basically a modified

version of the adult metabolic syndrome checklist. Cook et al. looked at the rates of metabolic syndrome in adolescents (Cook, Weitzman, Auinger, Nguyen, & Dietz, 2003). They used data from the NHANES study and the cutoffs described above to evaluate the prevalence of within adolescents between ages 12-19 years. They showed that 4.2% of the adolescents had at least three indicators for the metabolic syndrome (Cook et al., 2003). Fourteen percent had at least two indicators and 40.9% had at least one indicator (Cook et al., 2003). The prevalence rate appeared to mostly be driven by overweight and obese status in these adolescents. For overweight adolescents, 28.7% had three or more indicators, 54.4% had two or more indicators and 88.5% had one or more (Cook et al., 2003). In another study, using the same population but also including children(4-20 years of age), Weiss et al. showed that the prevalence of metabolic syndrome (at least three present indicators) was 38.7% in moderately obese subjects and 49.7% in severely obese subjects (Weiss et al., 2004). Another study conducted by de Ferranti et al., looked at the NHANES III study population and determined that not only is metabolic syndrome prevalent in adolescents (12-19 years of age) but it follows the same racial and gender patterns as it does in adults (de Ferranti, Gauvreau et al. 2004). They conclude that this indicates that childhood metabolic syndrome likely does lead to adulthood metabolic syndrome (de Ferranti et al., 2004).

As the data above suggests, metabolic syndrome is a public health concern and the prevalence of the disorder is high in the general population. In addition, there appears to be some link between metabolic syndrome in childhood and then later in adulthood. This indicates that understanding potential contributors to the indicators that are a part of the metabolic syndrome is necessary.

1.4 PERCEIVED NEIGHBORHOOD SAFETY AND CONTENTEDNESS

Perceived neighborhood safety is a complex and hard issue to define. It is, however, an important indicator of how neighborhood factors relate to individual level health outcomes. Aggregated neighborhood level measures, such as crime victimization rates, poverty rates and neighborhood mobility are also very important and can give a general understanding of potential indicators on the aggregate level. Individual level views of the neighborhood can provide additional clues about how personal experiences and perspectives may lead to fear or uncertainty, independent of the objective neighborhood views themselves. These two levels (aggregate and individual) of understanding are both equally important to assess the potential public health implications of neighborhood safety.

Individual perceptions of neighborhood safety are the focus of the following investigation. The Add Health Dataset gives individual level data that allows us to look into this. This is important, because when a child does not feel safe, it may have a major impact on his/her choice in leisure time activities and may have a significant impact on his/her health, independent of the actual objective neighborhood characteristics. These personal feelings and perceptions are important when trying to understand their relationship with activity choices and adverse health outcomes. It is also important when considering how to translate the findings to interventions or policies to try and minimize adverse effects.

1.4.1 FACTORS AFFECTING NEIGHBORHOOD PERCEPTIONS

Neighborhood safety or contentedness and individual perception of it is a complex issue. The internal feelings and beliefs that lead to these perceptions come from various experiences as well as some physical environment factors. In addition, deciding how best to gauge perceived neighborhood safety is equally complex, especially in youth. In the literature it has been evaluated and quantified in multiple ways. Some of these ways are direct questioning of individuals, while others utilize a parent or care taker. Some use one global question, while others use a series of questions. For some a simple global question asking, "how safe do you feel in your environment/neighborhood" is used (Adkins, Sherwood, Story, & Davis, 2004; Boslaugh, Luke, Brownson, Naleid, & Kreuter, 2004; Tucker-Seeley, Subramanian, Li, & Sorensen, 2009; Velasquez, Holahan, & You, 2009). For others, adding a more practical question about how safe an individual feels when doing "X" in the environment is used (Bennett et al., 2007; Kerr, Norman, Sallis, & Patrick, 2008; Piro, Noss, & Claussen, 2006). For adolescents, the perception of neighborhood safety by the parents or caretakers can be evaluated. This is likely because they are influential in determining the boundaries of a child's leisure time activities. In addition, they may have a more heightened sense of the neighborhood and more developed perceptions. This may be especially important in younger children (Bringolf-Isler et al., 2010).

The components of perceived neighborhood safety come from various areas. Some of these are basic demographic indicators such as gender. Others are factors that have more to do with the financial well being of the individual (income level, homeownership, quality of housing); however, these may be confounded by the neighborhood in which

these individuals reside. Prior victimization has been shown to be a predictor of reduced perceptions of safety.

A study by Austin et al. (2002) investigated which factors are included in the perception of neighborhood safety. The investigators asked a series of four questions to the study subjects. These questions concerned whether or not people needed to lock their doors, were worried about break-ins, feared being attacked or feared leaving property outside of their house unattended. A Likert scale was used to gauge the responses. A combined victimization variable was constructed using the response to two questions concerning whether or not the respondent or anyone that he/she knew had ever been the victim of a property crime or an attack (Austin, Furr, & Spine, 2002). In addition, six items, combined into two variables, were used to gauge the respondents overall view on the neighborhood environment. These items included prevalence of litter, amount of open spaces, neighborhood pride and peace and quiet in the neighborhood (used to describe the physical environment), as well as the trustworthiness of neighbors and how much neighbors look out for each other (used to describe the people, environment factors) . An additional set of information was collected when investigators visited the dwellings of respondents and rated them based on a number of physical characteristics (Austin et al., 2002). In the final model, women and victims expressed significantly lower levels of perceived safety than men and non-victims. In addition respondents that were more happy with the physical characteristics of their neighborhood rated the perceived safety of the neighborhood significantly higher (Austin et al., 2002). Essentially, both personal experiences and the experiences of people close to a subject were impactful in their grading of "perceived neighborhood safety". Additionally, certain physical factors also played a

role. This study helped illustrate the complexity of demographic, neighborhood and victimization factors and how they are all part of personal perception of neighborhood safety.

In a study conducted by DeJesus et al. (2010), the social aspects of perceived neighborhood safety were investigated. Social cohesion was the only universal predictor of perceived neighborhood safety levels, however some gender specific factors were also investigated. The investigators examined a population of 1352 residents in Boston and utilized data gathered at the baseline step of the Open Doors to Health study in 2004-05 (DeJesus, Puleo, Shelton, & Emmons, 2010). The independent measures collected included basic demographic characteristics, household income and poverty levels. The predictors of interest (social ties) were collected using the Berkman-Syme Social Networks Index (BSSNI). This index collects data to develop a composite measure that includes marital status, sociability, church group membership, and membership in community organizations. Data on social support was collected using the Inventory of Socially Supported Behaviors which assessed the ability of a subject to depend or rely on those around them for help when in need(DeJesus et al., 2010). Social cohesion was assessed using an index that looked at how much trust and value sharing a respondent has with his/her neighbors (DeJesus et al., 2010). Perceived neighborhood safety was collected using two global questions asking the respondents how safe they felt during the day and at night in their neighborhood. The index for this was determined based on the responses for both questions. Feelings of safety in one of the times, but not the other was considered “a little unsafe”, whereas identical responses to both times were coded as “safe” or “unsafe” respectively (DeJesus et al., 2010). Social cohesion was a significant predictor of perceived

neighborhood safety in both males and females (DeJesus et al., 2010). For males, specifically, a smaller social network was also shown be a significant predictor of neighborhood safety which seems to contradict this. No other findings were significant. This shows that there is a social aspect to perceived neighborhood safety that extends beyond basic demographics, financial and housing components.

Boslaugh et al. (2004) looked at neighborhood as well as individual level characteristics and their influence on whether or not an individual believed that their neighborhood was a good place for outdoor physical activity. Some of this relates directly to perceived neighborhood safety. They conducted a cross-sectional study of 1,104 adults living in the metropolitan St. Louis area. The population was about 50% African-American and 50% Caucasian and averaged 33.1 years of age, with around 13 years of education. Individual level data was collected by utilizing a written survey for study participants (Boslaugh et al., 2004). The survey asked questions concerning the subject's perception of their neighborhood in terms of its pleasantness and the availability of physical activity opportunities. One of the "pleasantness" questions asked how safe the neighborhood was for activities such as running, walking and biking. Additional, basic demographic characteristics were collected such as race, gender and SES. The study indicated that neighborhood level factors accounted more to perceived pleasantness variability concerning crime (Boslaugh et al., 2004). In addition, demographic data and neighborhood level data had a significant impact on the overall perception of pleasantness in the neighborhood (Boslaugh et al., 2004). The percent of African-Americans in the neighborhood and percent of people utilizing public transportation negatively impacted the perception, while median household value, percent of people who walk or bike to work

and residential stability positively impacted this. These factors held when testing for interaction of neighborhood and individual level variability (Boslaugh et al., 2004). The study shows that both neighborhood and individual level factors can influence neighborhood perception and need to be considered in evaluating the impacts of neighborhood perception on other factors, such as physical activity.

1.4.2 PERCEIVED NEIGHBORHOOD SAFETY AND PHYSICAL ACTIVITY

Studies have been conducted that aim to better evaluate the potential relationship between perceived neighborhood safety and physical activity. Many of these studies focused on children in different settings and of different ages. The findings of the studies are mixed in their results, however general trends are apparent. In addition, these trends point to the fact that more studies are needed in this area and these studies should use more advanced techniques.

A study conducted by Romero et al. (2001) aimed to investigate the potential association between perceived neighborhood safety and physical activity in children. The study showed a positive relationship between perceived neighborhood hazards and physical activities, but only in high SES subjects. The population included around 800 fourth grade students from Northern California who were selected from 8 separate schools in the area. Self reported variables for physical activity, height and weight and neighborhood safety were collected. In addition, basic demographic information was collected. A lack of perceived neighborhood safety, defined as hazardous neighborhood context, was assessed using an eight-question portion of the survey with a Likert scale

response range (Romero et al., 2001). The questions asked "how much of a problem" particular factors, such as crime, gangs and prejudice were in their neighborhood. The researchers utilized a 20 meter shuttle run, and height/weight data to define physical fitness. After analysis, it was shown that those subjects with a higher SES and increased perception of neighborhood hazards were associated with an increase in physical activity and decrease in BMI. There were no gender differences in perceived neighborhood hazards; self reported physical activity or height, weight and BMI (Romero et al., 2001). The findings suggest a positive relationship between perceived neighborhood safety and physical activity, at least in the group of subjects with a high SES.

A study by Kerr et al. (2008) looked at the relationship between exercise aids available at home, physical activity and perceived neighborhood safety. The study utilized a cross-sectional design and 878 participants were included, from 45 primary care providers in San Diego County, California. The subjects ranged in age from 11-15 years. The study included an assessment of the adolescent and an accompanying survey of the parent or guardian. Physical activity data was collected using a 7-day physical activity recall interview. Adolescents were categorized as being moderately or vigorously and not physically active on 5 or more days a week. The parents using portions of the Neighborhood Environment Walkability Scale evaluated neighborhood safety. Fifteen questions were asked, including some that asked about the effect that crime has on the ability to walk in the neighborhood. In the study, no statistically significant relationship was shown in boy's perceived neighborhood safety and physical activity (Kerr et al., 2008).

In a study conducted by Adkins et al. (2004), the association between perceived neighborhood safety and physical activity in adolescent African-American girls was

studied. It showed no significant relationship between perceived neighborhood safety and physical activity. The data for the study came from Phase I of the University of Minnesota GEMS study. The participants were from the Minneapolis/St. Paul area of Minnesota. The physical activity data was collected using a Computer Science Application (CSA) monitor. The participants wore the monitor for 3 consecutive days and the number of minutes of moderate or vigorous activity between 12pm and 6pm each day was summed and averaged for an average daily value. In addition, BMI was evaluated using height and weight measurements for each participant. A question in the evaluation assessed both the parent's and the adolescent's perception of neighborhood safety (Adkins et al., 2004). No significant relationship was shown between physical activity and perceived safety in the population. This study supported the idea that perceived neighborhood safety does not have a detrimental effect on physical activity in African-American girls.

In another study that evaluated which relationship in adolescent girls, Motl et al. (2007) used a cross-sectional study design to evaluate both the direct and indirect effects of perceived neighborhood safety on self reported physical activity. No significant relationship was shown between perceived neighborhood safety and physical activity. The study involved the evaluation of 12th grade girls (n=1,655) from 22 public schools in South Carolina (Motl, Dishman, Saunders, Dowda, & Pate, 2007). To evaluate perceived neighborhood safety, two questions were asked, and responses were evaluated on a 5 point scale. Self reported physical activity data was collected using the "3 Day Physical Activity Recall". The evaluators assigned each block a MET (basal metabolic rate) value. The findings were consistent with the findings of the Adkins study described above (Adkins et al., 2004).

While the studies above indicate that perceived neighborhood safety may not be a significant contributor to reductions in physical activities in children, many other studies have found a relationship.

Bennett et al. (2007) evaluated this relationship in public housing residents in a study in an urban environment. The findings of the study showed that there was a significant positive association between perceived neighborhood safety and self reported physical activity across both genders. This was supported by objective measures of safety in women at night. The study included 1,180 adults coming from predominantly minority populations living in low-income housing complexes in the Boston area. To analyze perceived neighborhood safety, the study subjects were asked "how safe they felt walking alone both at night and during the day". The responses were "safe", "a little unsafe", or "unsafe" (Bennett et al., 2007). To evaluate physical activity, the study subjects were asked to wear a pedometer for 5 days, starting on the day of the initial survey. The study found that most participants felt safe in their neighborhood during the day (80.2%) but only a third (37.2%) felt safe at night (Bennett et al., 2007). There was no statistically significant relationship between daytime safety and actual physical activity (based on pedometer data) (Bennett et al., 2007). In women, however, there was a significant relationship between perceived safety and physical activity at night. They took 20% fewer steps at night than during the day (4,302 compared to 5,178) (Bennett et al., 2007). However, for self reported physical activity, perceived feelings of neighborhood safety was statistically significantly associated with physical activity for both men and women (OR for men 0.40, for women 0.68) (Bennett et al., 2007). This showed that living in a neighborhood that is

perceived as unsafe can be a barrier to regular physical activity as well as hinder motivation or confidence in taking part in physical activity in adult populations.

Humbert et al. (2006) took a slightly different approach to evaluating this relationship. In their study, children reported perceived neighborhood safety as a significant barrier to leisure time activity. They used focus groups of students as a way of understanding how they perceived physical activity opportunities in their neighborhoods and what neighborhood factors were barriers to taking part in these activities. They then asked the youths involved in the study how they would make these opportunities more accessible. Four total schools were used in the study, two from low SES neighborhoods and two of which came from high SES neighborhoods. The simple goal of the focus groups was to answer the question: "If you could be the one in charge of increasing the physical activity levels of kids your age, what would you do?" They focused on interpersonal, social and environmental barriers to participation. Physical activity of the participants was evaluated using the MAQ-A (Humbert et al., 2006). The findings of the study indicated that low SES groups were less physically active than high SES groups. Members of the low SES group indicated that perceived safety was a key barrier to participation in outdoor physical activity but this was not found in the high SES groups (Humbert et al., 2006). What was interesting about this study was that children themselves reported that safety was, in some instances, a barrier to overcome with regards to their leisure time physical activity.

The relationship is not always an inverse one. A study of adolescent girls, conducted by Kuo et al. (2007) aimed to determine the dimensions of the family environment, intimacy and physical activity and how they were related to perceived and real neighborhood violence. The authors showed that there is a strong and significant

correlation between perceived safety and actual crime levels within a neighborhood but showed that other family determinants were the true predictors of physical activity levels (Kuo, Voorhees, Haythornthwaite, & Young, 2007). The analysis was cross-sectional and included adolescent girls (n=221) who resided in urban Baltimore and were evaluated for self reported physical activity. They found a high correlation between perceived neighborhood violence and the actual violent crime rate for the neighborhoods. The researchers found that although family support (p=.03), family intimacy (p=.004) and family involvement (p=.04) were significantly associated with physical activity in the adolescent girls, perceived and actual neighborhood violence were not (Kuo et al., 2007). The study shows that the family structure may be more important in determining the physical activity level in adolescent girls than perceived neighborhood safety. In addition, the study showed that perceived neighborhood safety in this population was highly correlated with the actual level of safety in the community when looking at violent crime rates.

1.4.3 STUDIES OF PARENTS PERCEPTIONS OF PERCEIVED NEIGHBORHOOD FACTORS AND ADOLESCENT ACTIVITY

In some cases, parents' perceptions of neighborhood safety are the focus of research in these areas. Parents exert a lot of control over their children's activity choices, especially at a young age, so their feelings are important to understand as well.

Bringolf-Isler et al. (2010) looked to better understand the relationship between parents perceptions about the neighborhood built environment and their children's'

participation in vigorous outdoor activity in Switzerland. The study showed a significant relationship between parental perceptions of neighborhood safety and their willingness to allow their children to play outside. The study was conducted as part of the Study on Childhood Allergy and Respiratory Symptoms with Respect to Air Pollution, Climate and Pollen (SCARPOL) study and involved a cross sectional analysis of three Swiss communities. The children in the study ranged from 6-14 years of age, divided among children and adolescents (6-10 and 13-14 respectively) and the final sample size for the study was 1,081 (Bringolf-Isler et al., 2010). The dependent measure in the study, vigorous outdoor activity, was collected using a questionnaire given to the parents. The validity of the questionnaire was verified with accelerometer data collected a sample of 167 children from the study, and the results showed an acceptable correlation (r=0.52). The questionnaire asked simply how much time the child spent, on average, engaged in vigorous physical activity outdoors. Perceived neighborhood safety was measured by whether parent perception of crime influenced their willingness to allow the children to play outside. The results showed that children played almost 20 minutes less per day in areas where the perception of crime as a deterrent to outdoor activity but this relationship was not significant (p=0.1) (Bringolf-Isler et al., 2010).

1.4.4 GENDER FACOTRS IS THE RELATIONSHIP BETWEEN PERCEIVED NEIGHBORHOOD SAFETY AND PHYSICAL ACTIVITY

When considering the possible barriers between neighborhood factors and leisure time physical activity, it is important to consider gender differences as well. Gender can

play a part in both the perception of the neighborhood and the choice of physical activity as a leisure time activity.

In a study of adults in Texas, conducted by Velasquez et al. (2009) which looked at the relationship between perceived safety factors and leisure time physical activity and major gender differences were evident. Perceived neighborhood safety was only a significant predictor of activity in women. Using data from the 2004 Behavioral Risk Factor Surveillance System (BRFSS) for Texas from 2004, the investigators attempted to assess this relationship. The predictor of interest concerning the perceptions of the neighborhood included questions concerning the neighbors (their physical activity levels, trustworthiness) and questions concerning the physical environment of the neighborhood (perceived pleasantness, street lighting, and safety) (Velasquez et al., 2009). Additionally some questions about the physical facilities in the area were asked, including access and utilization to parks, sidewalks, walking trails, recreation centers and schools. The outcome was defined in the BRFSS as a yes/no question concerning participation in activity outside of work related activity. An additional set of questions collected data on moderate and vigorous physical activity (Velasquez et al., 2009). These questions determined the time that respondents spent doing each of these and categorized them with based on whether or not they met recommended daily levels of physical activity. The data were then stratified by gender and analyzed. The results varied greatly. For women, leisure time physical activity was significantly related to several perceived neighborhood safety factors. These include their perception of the neighborhood being very or somewhat pleasant and whether they considered their neighborhood to be extremely safe or quite safe. In addition, women who felt that their neighbors could be trusted were more likely to be

involved with leisure time physical activity (Velasquez et al., 2009). The only physical feature of the neighborhood significantly associated with physical activity was lighting, but only when comparing the two extremes of the scale (very good lighting to very poor lighting) or poor lighting to very poor lighting. All of these factors, except lighting were also found to be predictors of "meeting recommended physical activity levels" in women as well (Velasquez et al., 2009). Perception of the physical activity of the neighbors also significantly predicted meeting these levels in women. Interestingly, no factors were found to be significant in men (Velasquez et al., 2009). Therefore, it was shown that neighborhood characteristics were much better predictors of physical activity in women than men in this population.

1.4.5 SUMMARY OF FINDINGS OF PAPERS CONCERNING THE RELATIONSHIP BETWEEN PERCEIVED NEIGHBORHOOD SAFETY AND ACTIVITY PATTERNS

A summary of the above findings are shown in Table 1:

Table 1.1: Findings of Studies Concerning PNS and Activity Patterns

Authors	Year	Study Population	Results
Romero et al.	2001	4th graders in California	An increase in PA was significantly related to a decrease in PNS
Kerr et al.	2008	878 subjects in San Diego, CA	No relationship between PNS and PA
Adkins et al.	2004	African American adolescent girls in Minnesota	No relationship between PNS and PA
Motl et al.	2007	12th grade girls in South Carolina	No relationship between PNS and PA
Bennett et al.	2007	Urban low income, minority adults	No relationship between PNS and PA during the day but a significant decrease in PA with with decreased PNS at night in men and women
Humbert et al.	2006	Focus groups of children questioned about barriers to physical activity	Lower PNS was a significant barrier to leisure time PA
Bringolf-Isler et al.	2010	Parents of children in Switzerland	Parental perception of PNS was significantly associated with their willingness to allow their children to play outside, as well as the duration in which the children actually did play outside

The studies described above show that major differences exist within the literature on the impact of perceived neighborhood safety and physical activity. Some show that there is a significant association between perceived neighborhood safety and participation in physical activity, while others show no difference in the outcome. Differences in measures could be one of the reasons for this range of results. In addition, the different populations that were studied could have different attitudes toward safety, perceptions of safety and attitudes towards physical activity.

1.5 ADD HEALTH SURVEY

The National Longitudinal Study of Adolescent Health (Add health) dataset is a nationally representative, longitudinal survey of adolescents as they transition into adulthood. This data was collected at multiple time points in a repeated measure format (Harris et al., 2009). The first two waves evaluated the study participants during adolescence while the latter waves followed them as they transitioned through adulthood. This study is currently being conducted by the University of North Carolina's Carolina Population Center (Harris et al., 2009). At its inception in 1994, high schools across the country were evaluated for inclusion. Wave I included survey results from 20,745 respondents. Wave II data was collected for 14,738 of these same students.

The in-home survey that makes up the backbone of the study is a comprehensive interview that covers multiple areas (Harris et al., 2009). These areas include but are not limited to general demographic information, feelings, health, school issues, daily activities and relationships at each subsequent wave of the study. Changes are made to the survey to better target the parameters of the population at that time in their lives (Harris et al., 2009).

1.5.1 WAVE I OF ADD HEALTH

The first wave of the Add Health Dataset was collected between 1994 and 1995 (Harris et al., 2009). The investigators used a clustered sampling design and school based sample collection (Harris et al., 2009). This was done to help optimize the collection of respondents of interest and it allowed the investigators better access to the peers of the study sample which was important to the investigators at the inception of the study. The data collection technique was designed to ensure a nationally representative sample of schools for the analysis (Harris et al., 2009). In-home interviews were conducted

The goal of the data collection plan was to identify representative high schools for study inclusion. All high schools in the United States with at least an 11th grade and an an enrollment of at least 30 students were considered for inclusion. From this evaluation, they selected a representative sample of high schools (n=80) for inclusion. In order to capture target students who were not yet in the high schools, they also conducted interviews at intermediate schools that fed directly into the high schools in the study (Harris et al., 2009).. These feeder schools were junior-high or secondary schools. The

sampling frame for the study came from the Quality Education Data Inc. (QED) (Harris et al., 2009).

Data was collected both through an in school questionnairre as well as in home interviews conducted by trained interviewers. The school questionairre was given to all students in the target schools and produced response sets from around 90,000 students. It was self administered over the course of a class period lasting between 45 and 60 minutes. These questionnaires were administered in 1994 and 1995 (Harris et al., 2009).

More in depth in home interviews were also conducted. These data are what was used for these analyses. They were conducted on a nationally representative sample that included adolescents in grads 7-12 (Harris et al., 2009). All students who took the in-school survery were eligibile for the in–home interview as well. Around 200 students were selected from each of the 80 schools. These interviews were conducted during 1995 and all of the respondents received the same interview which took between 1 and 2 hours (Harris et al., 2009). Questions were asked concerning: health status, health facility utilization, and nutrition among other things. Specific questions were asked concerning daily activities, witnessing violence and neighborhood feelings that were used in this study.

1.5.2 WAVE II OF ADD HEALTH

Wave II interviews were conducted in 1996 and included the same students who were interviewed in Wave I. Almost 15,000 of the students who were interviewed in Wave I were interviewed in Wave II (71%) (Harris et al., 2009). Among those who were not interviewed at Wave II were students who graduated between the interview times (12th

graders at Wave I) and students who were parts of selected subsamples (disabled sample, genetic sample) in Wave I (Harris et al., 2009). The questionnaire used in this wave was virtually identical to the Wave I questionnaire. One significant difference, however, respondednt height and weight were measured at Wave II, as opposed to Wave I when they were self reported.

1.6 OVERALL SUMMARY

Adverse health outcomes associated with inactivity are an increasing problem in the United States. As described above, obesity and metabolic syndrome rates are increasing at an alarming rate (CDC, 2010a, 2010b). One of the many factors that may be leading to these outcomes is leisure time activity patterns. In many cases these activity patterns may be developed in adolescence (Nelson et al., 2005).

A relationship between adolescent activity patterns and activity patterns in adulthood is shown in the literature. Although there is not a lot of research on this relationship, what has been done indicates that childhood decision patterns do predict these patterns at a later time (Nelson et al., 2005). In addition, adolescents who are forced into physical activity, do not maintain these activity choices later so leisure time physical activity, specifically, is even more impactful (Taylor et al., 1999). It also appears that

adolescents who take part in both physical and sedentary activity, revert to sedentary activity as they grow older (Nelson et al., 2005).

The relationship between perceived neighborhood safety and activity patterns has been researched. The studies have mixed results, as described in the review above. It is unclear, at this time, how much of an impact PNS actually has on an adolescent's decision making during leisure time. With new and more abundant sources of sedentary activity, adolescents may be more inclined to avoid physical activity if they do not feel safe.

Although it has been established that activity patterns are an important factor influencing the health of children, an understanding of the impact of the adolescent's perceived safety has not been as clear. The studies that have been done in this area have had conflicting results. Some indicate that there is no relationship, while others indicate the relationship is strong. These studies, thus far, have been limited to smaller sub-populations. The Add Health dataset, however, allowed for an analysis of this relationship on a large national scale. This allowed for a more thorough view of the impact of PNS on adolescents in the United States as a whole and minimized the impact of regional bias.

In addition, the sample size allowed for an increased ability to detect smaller or more subtle effect sizes than other studies. We were able to detect changes in the proportion of adolescents taking part in these activity goals as small as 5% with this study population, with substantial power (see Appendix 1).

The ultimate goal of this study was to fill some of the holes and answer some of the questions that still exist on this topic. Specifically, this research would like to evaluate the trends and relationships between perceived neighborhood contentedness and activity patterns in a large, nationally representative sample of adolescents. The dataset used

provided this opportunity. This research added to the understanding of the relationship between perceived neighborhood contentedness and leisure time activity in adolescents. In addition, it helped develop a new measure of perceived neighborhood contentedness that encapsulates feelings of safety, comfort and familiarity for use in an adolescent population.

2.0 DEVELOPMENT OF A MEASURE OF "NEIGHBORHOOD CONTENTEDNESS" IN THE ADD HEALTH DATASET

2.1 INTRODUCTION

Perception of neighborhood factors has recently become a focal point of researchers in the social and health sciences. Many measures have been developed to try and gauge personal feelings in the neighborhood environment (Sampson, Raudenbush, & Earls, 1997). These have included measures of safety, neighborly actions and familiarity (Bennett et al., 2007; Forrester & Tashchian, 2004; Lumeng, Appugliese, Cabral, Bradley, & Zuckerman, 2006; Widome, Sieving, Harpin, & Hearst, 2008).

While aggregated neighborhood measures, such as crime victimization rates, poverty rates and neighborhood mobility are important for general understanding of indicators on the aggregate level, individual level views of the neighborhood can provide additional clues about how personal experiences and perspectives may lead to fear or uncertainty, independent of the objective neighborhood views themselves. A robust measure of personal feelings of comfort in the neighborhood is important because it can be

used as a predictor for various social and health related outcomes. Researchers have attempted to capture this information by developing indices of neighborhood feelings, most notably Sampson with his measure of "collective efficacy"(Sampson et al., 1997). This measure can also be used to evaluate the impact of new intervention strategies aimed at increasing neighborhood safety or cohesion.

Before one can look at the association between neighborhood comfort and health outcomes, reliable ways of assessing comfort must be developed. To do this, several studies have tried to capture what factors lead to feelings of "neighborhood safety" or "neighborhood comfort". In a study conducted by DeJesus et al., the social aspects of perceived neighborhood safety were investigated and social cohesion was the only universal predictor of perceived neighborhood safety (DeJesus et al., 2010). This was assessed using an index that looked at how much trust and value sharing a respondent had with his/her neighbors (DeJesus et al., 2010).

Another study by Boslaugh et al. (2004) looked at neighborhood as well as individual level characteristics and their influence on whether or not an individual believed that his or her neighborhood was a good place for outdoor physical activity, as this can be a good indicator of feelings of neighborhood comfort. It showed that neighborhood level data, as well as demographic data, had a significant impact on the overall perception of pleasantness in the neighborhood (Boslaugh et al., 2004). This supports the assertion that individual perception as well as objective measures are important to evaluate in assessing neighborhood feelings.

One of the more notable measures of individualized feelings of the neighborhood, collective efficacy, was developed by Sampson in the 1990s. His measure was defined as

"social cohesion among neighbors combined with their willingness to intervene on behalf of the common good" (Sampson et al., 1997). This measure included two basic domains. The first was informal social control, which, as defined by Conklin, involved the "reactions of individuals and groups that bring about conformity to norms and laws, (and) includes peer and community pressure, bystander intervention in a crime, and collective responses such as citizen patrol groups" (Conklin, 2007). This measure included questions specific to neighborhood intervention in the event of a range of perceived injustices from witnessing a fight, to the shutting down of a community fire hall. The second factor was an evaluation of "social cohesion" which incorporated questions concerning the overall shared values of the community (Sampson et al., 1997).

Although these measures capture specific aspects of neighborhood perceptions, they are limited in the breadth of this evaluation. The social cohesion and collective efficacy measures assess the expected response of the members of a community and the overall community feeling (Conklin, 2007; Sampson et al., 1997). They do not however address the individual perception of the neighborhood, including individual perceptions of safety and happiness. Using the Add Health dataset, we have an opportunity to capture aspects of safety, familiarity and comfort in a shorter set of questions that have been asked. These questions capture feelings about the neighborhood.

We plan to look at four major domains in our analysis. We aim to capture an overall feeling of neighborhood contentedness by incorporating questions concerning neighborhood safety, neighborhood familiarity, neighborhood comfort and witnessing/experiencing violence in the neighborhood. These four domains may have a

significant impact on the overall perceived neighborhood contentedness and will be the starting point for our development of the index.

Our goal is to fill some of the gaps that exist in evaluating neighborhood contentedness. We aim to develop a measure that includes comfort, familiarity and safety in the neighborhood and utilizes questions aimed at individual adolescents. To achieve this, we will use data from the National Longitudinal Study of Adolescent Health (Add Health) survey to create a new index of perceived neighborhood contentedness (PNC) that will include feelings of neighborhood safety, comfort and familiarity.

The Add Health dataset is comprised of information on adolescent physical and mental health, and the factors that impact these outcomes. We will use exploratory factor analysis on Wave I data to develop our index and then confirmatory factor analysis will be used on Wave II data. We will then validate the measure in a separate sample collected for the Casino & Arena Study – Impact on Neighborhood Outcomes (CASINO), to validate this index in a different population.

2.2 METHODS

2.2.1 ADD HEALTH DATASET

The National Longitudinal Study of Adolescent Health (Add health) dataset is a nationally representative, longitudinal survey of adolescents as they transition into adulthood. Data were collected at multiple time points in a repeated measure format (Harris et al., 2009). The first two waves evaluated the study participants during adolescence while later waves followed them as they transitioned through adulthood. This is an ongoing study and is currently being conducted by the University of North Carolina's Carolina Population Center (Harris et al., 2009). At its inception in 1994, high schools across the country were evaluated for inclusion. Wave I included survey results from 20,745 respondents. Wave II data was collected for 14,738 of these same students.

The first wave of the Add Health Dataset was collected between 1994 and 1995 (Harris et al., 2009). A clustered sampling design and school based sample collection was used for collection (Harris et al., 2009). The data collection technique was designed to ensure a nationally representative sample of schools for the analysis (Harris et al., 2009).

The basis of the data collection plan was to identify representative high schools for study inclusion. All high schools in the United States with at least an 11th grade and enrollment of at least 30 students were considered for inclusion. From this evaluation,

they selected a representative sample of high schools (n=80) for inclusion in the study. In order to capture target students who were not yet in the high schools, they also conducted interviews as intermediate schools that fed directly into the high schools in the study (Harris et al., 2009). These feeder schools were junior-high or secondary schools. The sampling frame for the study came from the Quality Education Data Inc. (QED) (Harris et al., 2009). This method achieved goals on representation and weighting.

Data was collected through an in-school questionnairre as well as in home interviews conducted by trained interviewers. The school questionnaire was given to all students in the target schools and produced response sets from around 90,000 students. The questionnaire was self administered over the course of a class period lasting between 45 and 60 minutes. These questionnaires were administered in 1994 and 1995 (Harris et al., 2009).

More in depth in-home interviews were also conducted. on a nationally representative sample that included adolescents in grads 7-12 (Harris et al., 2009). All students who took the in-school survery were also eligibile for the in–home interview. Around 200 students were selected from each of the 80 schools. These interviews were conducted during 1995 and all of the respondents received the same interview which took between 1 and 2 hours (Harris et al., 2009). Questions were asked concerning: health status, health facility utilization, and nutrition among other things. These three sections were the most prominently used in the current study. These data are what will be used in this analysis.

The in-home survey that makes up the backbone of the study is a comprehensive interview that covers multiple areas (Harris et al., 2009). These areas include but are not

limited to general demographic information, feelings, health, school issues, daily activities and relationships at each subsequent wave of the study. Regular changes were made to the survey to better target the parameters of the population at particular times in their lives (Harris et al., 2009).

Wave II interviews were conducted in 1996 and included the same students who were interviewed in Wave I. Almost 15,000 of the students who were interviewed in Wave I were interviewed in Wave II (71%) (Harris et al., 2009). Among those who were not interviewed at Wave II were students who graduated between the interview times (12^{th} graders at Wave I) and students who were parts of selected subsamples (disabled sample, genetic sample) in Wave I (Harris et al., 2009). The questionnaire used in this wave was virtually identical to the Wave I questionnaire. Specifically, the questions evaluated in the current study were identical.

2.2.2 CASINO DATASET

The Casino & Arena Study - Impact on Neighborhood Outcomes (CASINO) is a study being conducted by the University of Pittsburgh Consortium for Injury Research and Community Action (CIRCA). This phone survey targeted adults living in one of four neighborhoods in Pittsburgh that recently had a large community business project open in their neighborhood. In one neighborhood, a new casino was built, and in another, a new arena was built. Four additional neighborhoods were also surveyed. Four of the neighborhoods surveyed were in lower income areas of the city with higher crime rates, while two others were in more affluent neighborhoods with lower crime rates. The goal of the study is to

evaluate the impact of these two projects on the community as a whole. The five questions that were used in developing our "perceived neighborhood contentedness" variable were included in the CASINO survey. The survey collected data from over 1,200 participants, with over 600 giving valid answers to the questions of interest.

2.2.3 EXPLORATORY FACTOR ANALYSIS

Exploratory factor analysis was used on Wave I of the study. Factor analysis was chosen over principal components analysis because we are evaluating a set of questions that we anticipate as indicators of the latent variables. While PCA is a good method for reducing the number of variables in a model, factor analysis most often gives the same results but uses shared variances which is important when considering factors that may have some level of covariance (Costello & Osborne, 2005).

As stated, four domains were chosen to consider in this analysis. Questions that fit into these domains came from two sections of the Add health survey. Thirteen questions were initially considered for the index development. Five of these questions came from the "Neighborhood" section of the survey and ask about perceptions of the neighborhood itself, comfort and familiarity. They consider the safety and familiarity of the neighborhood, as well as the happiness of the respondent in their neighborhood. Eight other questions came from the "crime and delinquency" section of the survey and evaluate the level of violence experienced in the neighborhood. We included these because we felt that they may be influential in the perception of the neighborhood. The variables are listed below:

1. Do you know the people in your neighborhood?

2. In the past 12 months have you stopped to talk to people in your neighborhood?
3. Do people in your neighborhood stick up for each other?
4. Do you feel safe in your neighborhood?
5. Are you happy living in your neighborhood?
6. During the past 12 months how often did you see someone shoot or stab another person?
7. During the past 12 months how often did someone pull a knife or gun on you?
8. During the past 12 months how often did someone shoot you?
9. During the past 12 months how often did someone cut or stab you?
10. During the past 12 months how often did you get into a physical fight?
11. During the past 12 months how often did you get jumped?
12. During the past 12 months how often did you pull a knife or gun on someone?
13. During the past 12 months how often did you shoot or stab someone?

Questions 1 through 4 were all asked in a true/false fashion and gave dichotomous data. Question 5 was collected with a five level scale with that had values ranging from "not at all" to "very much". The responses to this question were collapsed for analysis. The responses "very much" and "quite a bit" were condensed to "happy" and the responses "somewhat", "very little" and "not at all" condensed to "unhappy" for ease of interpretation. Questions 6-13 asked for the number of times the event had occurred (once, more than once, never). Due to the relative infrequency of the answers "once" and "more than once" categories were collapsed for data analysis, resulting in a dichotomous outcome.

Exploratory factor analysis was done using these 13 variables. Because we assume that there will be at least some level of correlation between the factors that will be the

product of this reduction, we chose to use an oblique rotation method (Costello & Osborne, 2005). Even if there is no correlation between the factors, this method would not give significantly different results from those of orthogonal rotation methods(Costello & Osborne, 2005). We used maximum likelihood estimates to extract the factors that were included in our final PNC index.

2.2.4 CONFIRMATORY FACTOR ANALYSES

Confirmatory factor analysis was used to validate our PNC index. This was done on two populations: Wave II of the Add health population and data from the CASINO study, This confirmatory analysis was done looking at the same 13 questions that were considered in the exploratory factor analysis of the Wave I data. This analysis was done using the PROC CALIS command in SAS 9.2 (SAS Institute, Cary, NC, U.S.A.).

2.3 RESULTS

2.3.1 DEMOGRAPHIC CHARACTERISTICS

The two populations differed significantly in their demographic makeup, as seen in table 4. The Add Health dataset was aimed at adolescents therefore the population was young. In

Wave I, the mean age was 15.7 $\pm$ 1.7 years. In Wave II, the mean age was 16.2 $\pm$ 1.6 years. In contrast, the CASINO study captured older individuals, 64±15 years of age. The racial makeup of the two populations differed as well. Although the percent of white individuals was similar (59.9% in Add Health Wave I, 62.1% in CASINO), there was a higher percentage of African Americans in the CASINO Study (22.7% in Add Health Wave I, 34.5% in CASINO). Additionally, there was a much higher percentage of females in in CASINO than Add Health (50.5% in Add Health Wave I, 69.8% in CASINO). There was a much higher percentage of Hispanics in the Add health dataset (17% compared to 0.8%) as well.

Notable differences in the social makeup of the two studies were also observed. Since the Add Health survey targeted adolescents, their parents or caretakers were surveyed at Wave I. These results are also presented in table 4. The Add Health population had a higher percentage of married couples in the household (70% compared to 40%). Though the Add Health respondents had around 10% more high school graduates as caretakers or parents, the CASINO study had twice as many college graduates. The income distribution skewed higher in the CASINO study as well.

2.3.2 EXPLORATORY FACTOR ANALYSIS

Two domains emerged from the exploratory factor analysis in Wave I of the Add Health survey. These factors represented two domains that were labeled as: neighborhood contentedness and violent experience. Table 1 shows the fators and associated variables. Five of the variables loaded into the neighborhood contentedness factor. These included; how safe do you feel in your neighborhood, how happy are you living in your

neighborhood, do you know the people in your neighborhood, do you stop and talk to the people in your neighborhood and whether or not people in the neighborhood looked out for each other. They loaded into this factor with an Eigenvalue of 1.68. All eight of the items that involved witnessing or experiencing violence loaded separately from the variables in the neighborhood contentedness domain. This factor included witnessing an attack, being attacked, or being part of an attack. They did load strongly together and were labeled as a separate factor; violent experience domain with an Eigenvalue of 3.28. The factor loading matrix for the two domains is shown in Table 2.

2.3.3 RELABILITY

Confirmatory factor analysis indicated that the two domain breakdown that was extracted from the exploratory factor analysis in Wave I was validated in Wave II. Because of the large sample size in this model, the Root Mean Square Error of Approximation (RMSEA) was used to assess the fit of the two domains (Shevlin, Miles, & Lewis, 2000). In addition, the Bentler and Bonnet non-normed fit index (NNFI) and normed fit index (NFI) were used for confirmation (Shevlin et al., 2000). The RMSEA value was 0.07 indicating an acceptable discrepancy in the model and the incremental fit models, Bentler Bonnett NFI and NNFI, were both 087. These values indicate that the two-factor model was an adequate improvement over a null model.

Confirmatory factor analysis in the CASINO dataset, however, did not validate this index. The RMSEA was 0.14 and the NFI was 0.76 while the NNFI was 0.55. These indicate that one factor did not adequately account for the variance of the five variables. When further analyzing the results, it is revealed that, specifically, the "do you know the people in your neighborhood" variable did not fit well into the single factor "neighborhood contentedness" in our analysis. The other four variables did load sufficiently into the factor.

2.4 DISCUSSION/TABLES

The aim of this study was to design and validate a measure of "neighborhood contentedness" that was robust and would be useful in future research. We wished to bridge some of the gaps in current measures by including aspects of safety, familiarity and comfort. Aspects of this measure have been evaluated in previous research (Bennett et al., 2007; Sampson et al., 1997; Widome et al., 2008). In order to do this, we evaluated a series of questions in one survey and validated this index in a different population. Although the neighborhood contentedness index was robust within the study population for which it was designed, it was not validated in the outside population.

One reason that the index was not applicable in the CASINO study was the difference in the two populations. The Add Health study was a targeted study that recruited adolescents to follow into young adulthood and had a population that reflected that. Another goal of the study was to get a representative population, so the gender and racial breakdown mirror that of the US population at that time. The CASINO study was done using random digit dialing and was aimed at adults in the target households. Children and adults perceptions of fear have been shown to be different (Backett-Milburn & Harden, 2004).

There were very noticeable differences in the population aside from just their age, however. The CASINO study had a larger proportion of women, and only a few Hispanics. Women perceive safety and neighborhood factors differently than men (Smith & Tortensson, 1997; Velasquez et al., 2009). A population that is made up mostly of older women is much different than one made up of adolescents with equal gender distribution, and this must be considered.

The neighborhood contentedness domain included some aspects of neighborhood familiarity and comfort that have been shown to cluster in other studies of adolescent perception (Widome et al., 2008). They clustered in our study as well, but only in adolescents. The measure also contained variables that captured the adolescents' perception of neighborhood safety. This was assessed with one question, asking how safe the individual felt in their neighborhood. This is a common way to address this issue (Adkins et al., 2004; Boslaugh et al., 2004; Tucker-Seeley et al., 2009; Velasquez et al., 2009).

The distribution of the responses differed between the two populations as well. As shown in Table 3, generally the CASINO study respondents had more positive responses to questions concerning all aspects of neighborhood contentedness with the exception of their familiarity with their neighbors. The Add health respondents were much more familiar. That particular variable was not highly correlated in the index, when CFA was done on the CASINO data.

This study suggests that an assessment of neighborhood contentedness needs to be catered to its target population. Not only must the questions be asked differently, but creating an index should be done differently as well. The domains that emerge from analysis of survey questions may differ and therefore, must be used and analyzed differently.

When assessing the adolescent perception of the neighborhood environment, in the Add Health dataset, however, the proposed perceived neighborhood contentedness index is valid. It remained consistent through the first two waves of the study, which were the waves that captured the subjects at their adolescent stage. The index can be used for research studies that aim to better understand the relationship between adolescent attitudes and other outcomes, such as activity patterns, delinquent behavior or health. Past studies have indicated that perceived neighborhood safety, an aspect of our index is related to depression in children (Aneshensel & Sucoff, 1996). In addition, neighborhood constructs have been associated with increased rates of delinquency, such as illicit drug use (Lambert, Brown, Phillips, & Ialongo, 2004).

This analysis has limitations. First, the Add Health data is from 1994-1996, so it is possible that attitudes have changed. Adolescents today may be more or less active in their

neighborhood and therefore their perceptions may differ. In addition, the scope of the index, and its usefulness is narrow. As shown by the confirmatory factor analysis using the CASINO study, the index is not applicable to other age groups. More comparisons should be done with similar measures that have been proposed by others to better develop a global index. Aspects of our measure are used in other indexes that are commonly used, such as "collective efficacy and social cohesion(Conklin, 2007; Sampson et al., 1997). These indices are still the best ways of assessing similar information in adult populations.

The index that has been assessed in this paper has usefulness, albeit in a smaller targeted age group. Future research should consider perceptions of neighborhood contentedness as a potential measure in population surveys. Incorporating neighborhood level safety, comfort and familiarity into surveys can be useful and provide good information. This may be especially true in children and adolescents since they spend a lot of their leisure time in these neighborhoods. Further refining these measures for all age groups should be considered as well.

Table 2.1: Domain Names and Associated Variables

Domain	Questions
Violent Experience	Have you seen someone shot or stabbed
	Have you had a knife pulled on you
	Have you been shot at
	Have you been stabbed
	Have you gotten into a fight
	Have you gotten jumped
	Have you pulled a knife on someone else
	Have you shot or stabbed someone else
Neighborhood Contentedness	Do you know most of the people living in your neighborhood
	Have you stopped on the street to talk with someone who lives in your neighborhood
	People in this neighborhood look out for each other
	Do you usually feel safe in your neighborhood
	How happy are you living in your neighborhood

Table 2.2: Exploratory Factor Analysis Results or Reduced Maximum Likelihood Analysis for Wave I of the Add Health Survey (n=20,132)

	Add Health Wave I	**Violent Experience**	**Neighborhood Contentedness**
1	Have you seen someone shot or stabbed	0.54	0.01
2	Have you had a knife pulled on you	0.61	0.01
3	Have you been shot at	0.31	0.01
4	Have you been stabbed	0.54	0.02
5	Have you gotten into a fight	0.48	0.03
6	Have you gotten jumped	0.54	-0.01
7	Have you pulled a knife on someone else	0.61	0.01
8	Have you shot or stabbed someone else	0.52	0.02
9	Do you know most of the people living in your neighborhood	0.05	0.57
10	Have you stopped on the street to talk with someone who lives in your neighborhood	0.09	0.49
11	People in this neighborhood look out for each other	-0.06	0.60
12	Do you usually feel safe in your neighborhood	-0.15	0.29
13	How happy are you living in your neighborhood	-0.16	0.40
	Eigenvalue	*3.28*	*1.68*

Underlined values indicate factor with greatest loading value. Exploratory Factor Analysis done using oblique rotation method

Table 2.3: Positive Response Percentages to Perceived Neighborhood Contentedness Questions in Study Populations

(percent positive response)	Add Health Wave I	Add Health Wave II	CASINO Study
Do you know most of the people living in your neighborhood	70.2%	69.9%	50%
Have you stopped on the street to talk with someone who lives in your neighborhood	78.3%	77.1%	85.3%
People in this neighborhood look out for each other	71.4%	71.0%	81.8%
Do you usually feel safe in your neighborhood	88.2%	88.1%	89.5%
How happy are you living in your neighborhood	68.9%	66.5%	76.7%

Table 2.4: Demographic Characteristics of Study Populations

	Add Health Wave I	Add Health Wave II	CASINO
GENDER			
Male	49.5%	48.7%	30.2%
Female	50.5%	51.3%	69.8%
RACE			
White	60.0%	60.9%	62.1%
African American	22.7%	22.3%	34.6%
Asian/Pacific Islander	7.0%	6.8%	0.8%
American Indian	1.6%	1.7%	1.3%
HISPANIC	17.0%	16.9%	0.8%
MARITAL STATUS			
Married	70.0%#	70.4%#	40.7%
Unmarried	30.0%#	29.6%#	58.9%
EDUCATION LEVEL			
Did not graduate High School	17.2%#	17.1%#	4.1%
High School Graduate	59.8%#	59.2%#	50.8%
College Graduate	23.0%#	23.7%#	44.9%
ANNUAL HOUSEHOLD INCOME			
< $20,000	39.1%#	36.6%#	20.5%
$20,001-40,000	25.0%#	26.2%#	17.2%*
$40,001-60,000	18.9%#	19.7%#	12.8%**
$60,001-80,000	9.2%#	9.6%#	12.3%***
>$80,001	7.8%#	8.0%#	23.0%****

This data was collected from the respondents parent for the Add Health survey
* income was evaluated with different cutoffs in the CASINO study, * indicates $20,000-35,000, ** indicates $35,000-50,000, *** indicates $50,000-75,000, **** indicates >$75,000

3.0 THE ASSOCIATION BETWEEN PHYSICAL ACTIVITY AND PERECIVED NEIGHBORHOOD CONTENTEDNESS IN THE ADD HEALTH SURVEY

3.1 INTRODUCTION

An active lifestyle is an important behavioral factor that can help to reduce many adverse health outcomes and promote healthy functioning(Stewart et al., 1994). This is not only true in adults, but also in adolescents(Penedo & Dahn, 2005). A lack of physical activity may lead to obesity related health problems in adulthood. These diseases include heart disease, diabetes, respiratory illness and some forms of cancer(Berlin & Colditz, 1990; Garcia-Aymerich, Lange, Benet, Schnohr, & Anto, 2006; Jeon, Lokken, Hu, & van Dam, 2007; Laaksonen et al., 2005; Maruti, Willett, Feskanich, Rosner, & Colditz, 2008; Wolin, Yan, Colditz, & Lee, 2009). In addition, obesity has been linked with risk factors for cardiovascular disease and diabetes, such as high blood pressure and high LDL cholesterol (E. S. Ford et al., 2002). Physical activity is also important in reducing the outcomes and diseases later in life.

In addition to the potential long term health effects several studies have shown that activity patterns developed in adolescence are a significant predictor of activity patterns in adulthood. A study by Gordon-Larsen et al. showed that physical activity, and overall leisure time activity choices during adolescence may be an early indicator of physical activity patterns later in life. This relationship is also supported by a study, conducted by Tammellin et al. which looked at playing sports as an adolescent and adult physical activity (Tammelin et al., 2003). It is important to note, however that these studies look at adolescent physical activity as a choice. A study by Taylor et al., showed that being pushed to participate in physical activities at a young age was negatively correlated with physical fitness and voluntary physical activity in adulthood, in men(Taylor et al., 1999). These data suggest that encouraging, but not pushing, physical activity during adolescence is important for maintaining a healthy lifestyle to decrease the risk of obesity or other chronic disease prevention later in life as well.

It is important for public health professionals to understand and consider potential barriers to physical activity in adolescents and adults (Pereira et al., 2009). One potential barrier of interest is perceived neighborhood contentedness. Perceived neighborhood contentedness is an overall comfort level that the adolescent has and incorporates their feelings of safety, familiarity and comfort. An adolescent may choose to participate in other activities during their leisure time if they do not feel safe or content in their neighborhood. If we can better understand this relationship, it may become an area for potential future interventions.

Perceived neighborhood contentedness is a complex issue to define. It may, however, be an important indicator of how neighborhood factors relate to individual level health outcomes. Aggregated neighborhood level measures, such as crime victimization rates, poverty rates and neighborhood mobility are often studied (Burdette & Whitaker, 2004; Gomez, Johnson, Selva, & Sallis, 2004). These factors give a general understanding of potential indicators on the community level. However, individual level views of the neighborhood may provide additional clues about how personal experiences and perspectives may lead to fear or uncertainty, independent of these objective neighborhood views themselves(Lopez & Hynes, 2006).

Multi-factor measures of neighborhood feelings have been established in the previously. One of the more notable measures was collective efficacy, which was developed by Sampson in the 1990s. It was defined as "social cohesion among neighbors combined with their willingness to intervene on behalf of the common good" (Sampson et al., 1997). Another measure, proposed by Conklin, involved the "reactions of individuals and groups that bring about conformity to norms and laws, (and) includes peer and community pressure, bystander intervention in a crime, and collective responses such as citizen patrol groups" (Conklin, 2007). This was referred to as "social cohesion". In our study, we will look at perceived neighborhood contentedness (PNC), which incorporates aspects from both of these measures, in the Add Health dataset. This index will capture feelings of familiarity, safety and comfort in the neighborhood. It was developed and validated for use in this particular dataset (Bazaco et al.). Neighborhood factors have been shown to affect the health of adolescents in other studies (Aneshensel & Sucoff, 1996;

Bennett et al., 2007; Lambert et al., 2004). For this reason, an assessment of the relationship in this population, using neighborhood contentedness is important.

Studies have, however, been conducted that aim to better evaluate the potential barrier between perceived neighborhood safety, (one aspect of neighborhood contentedness) and physical activity. These studies focused on children in different settings and of different ages. A study conducted by Romero et al. showed a positive relationship between perceived neighborhood hazards and physical activities, but only in high SES subjects. (Romero et al., 2001). Three other studies conducted in various subgroups, however, showed no significant relationship between perceived neighborhood safety and physical activity (Motl et al., 2007) (Adkins et al., 2004) (Kerr et al., 2008).

While the studies above indicate that perceived neighborhood safety may not be a significant barrier to physical activities in children, other studies have shown that it is. Although the measures used in these studies are mixed, and the findings differ somewhat (different subgroup results), a general trend emerges that perceptions of safety are a barrier to physical activity. A study by Bennett et al. showed a relationship between perceived neighborhood safety and self reported physical activity in both genders, though activity was only lower in males at night (Bennett et al., 2007). A study conducted by Velasquez et al. evaluated the relationship between perceived safety factors and leisure time physical activity and showed that neighborhood safety was a significant predictor of activity, but only in women (Velasquez et al., 2009). Humbert et al. used student focus groups and the children reported neighborhood safety as a significant barrier to their physical activity (Humbert et al., 2006). This relationship has been shown in parent's perceptions as well. Bringolf-Isler et al. found a significant relationship between parental

perceptions of neighborhood safety and their willingness to allow their children to play outside (Bringolf-Isler et al., 2010). Although these studies indicate that perceived neighborhood factors are a barrier to physical activity, they are not uniform. In addition, they come from smaller subsets of the population. More research needs to be done on this barrier, and a study looking at the relationship between perceived neighborhood contentedness and physical activity in a large, nationally representative survey of adolescents would fill this gap.

The aim of this study is to examine the relationship between perceived neighborhood contentedness and physical activity in adolescents. We choose to evaluate contentedness, as opposed to safety alone because it incorporates other aspects of neighborhood perception. We have chosen the Add Health dataset because of its large and diverse sample as well as its relevant survey questions.

3.2 METHODS

3.2.1 SAMPLE

The National Longitudinal Study of Adolescent Health (Add health) dataset is a nationally representative, longitudinal survey of adolescents as they transition into adulthood. These data were collected at multiple time points format (Harris et al., 2009). The first two waves

evaluated the study participants during adolescence (1 year apart) while the latter waves followed them as they transitioned through adulthood. At its inception in 1994, high schools across the country were evaluated for inclusion. Wave I included survey results from 20,745 respondents. Wave II data was collected for 14,738 (71%) of these same students.

The in-home survey that makes up the backbone of the study is a comprehensive interview that covers multiple areas which include neighborhood perception and leisure time activities. These areas include but are not limited to; general demographic information, feelings, health, school issues, daily activities and relationships at each subsequent wave of the study (Harris et al., 2009).

The study population is described in Table 1. It is roughly 50% male with the mean age of of 15.7 years at Wave I. At Wave II, the average age was 16.2. The population was ~60% white, 22% black, 7% Asian, 1% Native American and 8% of other races. Seventeen percent of the population was of Hispanic origin and 88% spoke English primarily at home. Nearly 70% of the respondent's parents were married. The mean BMI was 22.6$\pm$4.5 in Wave I and 23$\pm$4.7 in Wave II. Around 40% of the respondents parents reported an annual income of less than $20,000 annually, while 25% reported their income as between $20-40,000 annually, 19% reported an annual income of $40,000 – 60,000, 9% reported $60,000 – 80,000 and ~8% reported greater than $80,000. The parental education breakdown as shown was unremarkable. A high rate (22%) of subjects had repeated a grade.

3.2.2 STUDY DESIGN

A cross-sectional study design was used to evaluate the relationship between perceived neighborhood contentedness and physical activity patterns in the study population. Analysis of both Wave I and Wave II of the Add health Study were done separately.

3.2.3 INDEPENDENT MEASURES (PERCEIVED NEIGHBORHOOD CONTENTEDNESS)

In previous research conducted by Bazaco et al., factor analysis was used to evaluate the relationship between a set of variables taken from the Add health Survey concerning neighborhood contentedness. Exploratory factor analysis defined the neighborhood contentedness domain, from a collection of potential variables in Wave I. Confirmatory factor analysis was done on these questions in Wave II of the study and validated this index. The factor analysis is described in greater detail here (Bazaco et al.).

In order to assess perceived neighborhood contentedness, five questions from the Add health survey were used. These questions are as follows:

1. Do you know the people in your neighborhood?
2. In the past 12 months have you stopped to talk to people in your neighborhood?
3. Do people in your neighborhood stick up for each other?
4. Do you feel safe in your neighborhood?
5. Are you happy living in your neighborhood?

These questions were used to create a PNC index. This measure incorporates aspects of neighborhood safety (question 4), social cohesion (questions 1 and 2) and collective efficacy (question 3), as described above(Conklin, 2007; Sampson et al., 1997). The responses for these five questions were summed using the dichotomous outcomes. The higher the sum, the more content the subject feels in his/her neighborhood. The lower the sum, the lower the contentedness. This sum was used as the PNC measure and treated as such throughout the study.

3.2.4 DEPENDENT MEASURES (PHYSICAL ACTIVITY)

To assess physical activity in this study, we utilized multiple variables assessed in the Add Health dataset. These variables have been used to assess physical activity in other studies conducted using this data set (Boone, Gordon-Larsen, Adair, & Popkin, 2007; Heinonen & Gordon-Larsen, In Press; Kim, Liu, Colabianchi, & Pate, 2010). The survey asked how often an individual took part in the following activities:

-rollerblading, skating, skateboarding, bicycling

-active sports such as baseball, football, basketball and soccer

-outdoor exercise, jogging, walking, jumping rope, dancing or karate

The responses to the question ranged from not at all to five or more times.

These responses were scored as such:

Not at all = 0

1 or 2 times = 1.5

3 or 4 times = 3.5

5 or more times = 5

An overall variable was calculated to assess the total number of times an individual participated in physical activity over the course of the prior week and this was used in the analysis. We summed the values for each of the three measures of physical activity for each respondent. This has been done in previous literature using this dataset (C. A. Ford, Nonnemaker, & Wirth, 2008; Gordon-Larsen, McMurray, & Popkin, 1999, 2000). Since the survey question asks for the frequency of physical activity and not duration, categorical cutoffs were used as the independent measure.

We looked at the combined variable as a three level dependent variable. The cutoffs for this variable are as follows:

High Physical Activity $\geq$ 5 bouts in past 7 days

Moderate Physical Activity 3-4 bouts in past 7 days

Low Physical Activity < 3 bouts in past 7 days

This value was used as the independent measure or physical activity measure in this study.

3.2.5 POTENTIAL COVARIATES

Potential covariates, such as age, gender, race, Hispanic status, parental education, household income, parental marital status, and whether or not English was spoken at home

were also assessed. These variables have all been shown to be associated with physical activity patterns (Brodersen et al., 2007; Gordon-Larsen et al., 2004; Kahn et al., 2008). Self-reported health, how frequent the subject felt fearful or cried, how often the subject repeated a grade in school, how often the students had missed a social event because of illness or self-reported physical limitations were also considered as potential covariates and evaluated as such.

Interaction terms for gender and neighborhood contentedness and violent experience and neighborhood contentedness were included in the models. This was done because the literature suggested that an interaction may exist.

We also assessed an individual's experience with violent activities. Experiencing violence or being the victim of violence could potentially affect both an adolescent's perception of their neighborhood as well as their activity patterns and therefore be a confounder. The survey asked how often each subject had witnessed a shooting or stabbing, had a knife pulled on them, shot or stabbed someone, been shot at, been stabbed, gotten in a fight, gotten jumped or pulled a knife on someone. These variables were dichotomized by whether or not the subject had at least one experience. They were then added together to form an index. These variables were included in a previously described factor analysis to validate their use as a measure (Bazaco et al., paper 1 above). The index was labeled "Violent Experience" (VE) and included as a potential covariate for this analysis. The values ranged from 0-7 with the higher the value for VE, the more experience with violence the subject had.

3.2.6 STATISTICAL ANALYSIS

Multinomial logistic regression was used for multivariate analysis. Gender was shown to have a significant interaction with the independent variable of interest (PNS) in the full model ($p<0.001$), so separate models were made for males and females. In addition, models were built for each wave of the study to determine if there was any difference as the cohort aged.

Bivariate analysis was used to determine what variables should be included in the initial model. Variables were included if they were related to the outcome variable at a significance of 0.20 or less. Dummy variables were used when adding non-dichotomous, non-ordinal, categorical variables to the model. These included race, household income and parental education.

After each model was run, the variable with the highest global *p*-value was removed and the model was run again. The final model consisted of variables with a *p*-value of 0.10 or lower for any outcome level. If a variable had been retained in at least one model, it was included in the final models for all comparisons in that Wave and gender.

Interaction between VE and PNC was also evaluated and was not significant in any of the models. SAS 9.2 (SAS Institute, Cary, NC, U.S.A.) was used for all data analysis.

3.3 RESULTS

3.3.1 STUDY SAMPLE

Nineteen percent of the study population was classified as having low levels of neighborhood contentedness in both Wave I and Wave II. The remaining 80% were evenly distributed between moderately and highly content with their neighborhood. Forty-two percent of the study population had at least one violent experience within the past year in Wave I of the study, but dropped to 28% at the time of Wave II.

3.3.2 WAVE I FEMALES

The results for Wave I females can be seen in table 2. A significant positive relationship is evident between the level of neighborhood contentedness and physical activity. This is consistent in all three models, when controlling for other factors. The odds of girls being in the moderately active group when compared to the low group was 1.07 (1.02-1.12). This is consistent, OR = 1.11 (1.06-1.16) when comparing those in the highly physically active group to the moderate one. When comparing the highly physically active group to the low group, the OR was 1.18 (1.14-1.24). The increase in odds at in each comparison, with higher neighborhood contentedness shows PNC is significantly associated with increased likelihood of higher physical activity.

Other variables remained significantly associated with physical activity at all levels in the model. Age was negatively associated with increases physical activity in each comparison. In addition, an increase in self-reported health was significantly associated with increased odds of being in the higher physical activity group at each level of the comparison. African-American girls were significantly less likely to be in the moderate or high activity group than the low group.

3.3.3 WAVE I MALES

In males, the results for Wave I can be seen in table 3. A significant positive relationship is evident between the level of neighborhood contentedness and physical activity level. This is consistent in all three comparisons, when controlling for other factors. Boys had an OR of 1.08 (1.01-1.16) for being in the moderately physically active group when compared to the low. The OR was larger, 1.19 (1.13-1.25) when comparing the moderate physically active group to the high group. When comparing the low group to the high group, boys had an OR of 1.29 (1.22-1.36) for being in the high group when they were more content. The significant increase in odds at each level, with higher neighborhood contentedness shows that PNC is associated with increased likelihood of higher physical activity.

Other specific variables remained significantly associated with physical activity at all levels in the model. Age was negatively associated with increases physical activity in each comparison. In addition, an increase in self-reported health was significantly associated with increased odds of being in the higher physical activity group at each level of the comparison.

3.3.4 WAVE II FEMALES

The results for Wave II females can be seen in table 4. A significant positive relationship is evident between the level of neighborhood contentedness and physical activity. This is consistent in all three comparisons, when controlling for various external factors. The odds of girls being in the moderately physically active group when compared to the low group was 1.11 (1.05-1.17). This was similar when comparing those in the highly physically active group to the moderate one at 1.11 (1.06-1.17). When comparing the low physically active group to the high group, the OR was 1.22 (1.03-1.44). The significant increase in odds at each level, with higher neighborhood contentedness shows that PNC is significantly associated with increased likelihood of higher physical activity.

Other specific variables remained significantly associated with physical activity at all levels in the model. Age was negatively associated with increased physical activity in each comparison. In addition, an increase in self-reported health was significantly associated with increased odds of being in the higher physical activity group at each level of the comparison. Similar to Wave I, African American girls were significantly less likely to be in higher physical activity groups in all comparisons.

3.3.5 WAVE II MALES

In males, the results for Wave II can be seen in table 5. A significant positive relationship is evident between the level of neighborhood contentedness and physical activity level. This is consistent in all three comparisons, when controlling for various external factors. Boys had an OR of 1.15 (1.07-1.23) for being in the moderately physically active group when compared to the low. The OR was lower, 1.09 (1.04-1.16) when comparing the highly physically active group to the moderate group. When comparing the low group to the high group, boys had an OR of 1.25 (1.18-1.33) for being in the high group when they were more content. The significant increase in odds at each level, with higher neighborhood contentedness shows that self-reported neighborhood feelings are associated with increased likelihood of higher physical activity.

Other specific variables remained significantly associated with physical activity at all levels in the model. Age was negatively associated with increases physical activity in each comparison. In addition, an increase in self-reported health was significantly associated with increased odds of being in the higher physical activity group at each level of the comparison.

3.4 DISCUSSION/TABLES

In this study, we evaluated the potential relationship between perceived neighborhood contentedness and physical activity in adolescents from the Add Health data set. To do this we used a scale of contentedness previously validated (XXXX). Overall, the results of the study indicate that there is a relationship between perception of neighborhood contentedness and physical activity in adolescents. This relationship is evident in both males and females but differs in magnitude. There are also differences in the magnitude of the OR between different levels of physical activity.

For girls, the relationship was slightly more pronounced when looking at the transition from moderate physical activity to high physical activity (Wave I OR = 1.07, Wave II OR = 1.12) than it was from low to moderate (Wave I OR =1.11, Wave II OR = 1.11). This is important to note, because it allows us to see where the impact of discontent may reduce physical activity levels, which is important for adolescent health. The magnitude of the relationship was consistent between Wave I and Wave II of the study. Although the differences are slight we can infer that neighborhood contentedness may be more impactful on the ability of the girls to move from a moderate level of physical activity to the optimal level.

In boys, the relationship was also significant. The magnitude of this relationship was higher in boys than girls as well. In fact, this was close to a 30% increased odds of being highly physically active, compared to having low activity with each 1 point increase in neighborhood contentedness in Wave I of the study (OR = 1.30). The odds were 25% higher in Wave II (OR = 1.25). This significant difference shows how much of a barrier to

physical activity, uneasy neighborhood perception truly is. There is a possibility that some of these adolescents would choose to be more physically active, if they felt more content in their neighborhood. This is an important barrier to physical activity and should be considered when promoting it to adolescents. Neighborhood level interventions that may make a community more open and familiar could promote this.

As noted, this is the first examination of the relationship between neighborhood contentedness and physical activity that we are aware of. However, many studies have been conducted looking at other measures of neighborhood social processes, and can be looked at for comparison.

As discussed earlier, the literature on the relationship between perceived neighborhood safety and physical activity is mixed. Some studies have shown that neighborhood safety has a negative effect on the rate of physical activity in adolescents of both genders. Others have shown no significant relationship. Although this literature only assessed the "safety" of the neighborhood, we use safety as one part of our contentedness index and it is important to consider these findings in relationship to ours.

One study by Bennett et al. looked at perceived neighborhood safety and self reported physical activity. When individuals reported their neighborhood as unsafe, they were less likely to report high levels of physical activity (OR for men 0.40, for women 0.68) (Bennett et al., 2007). An additional study by Velasquez et al. showed that leisure time physical activity was significantly related to several perceived neighborhood safety factors in women. These include their perception of the neighborhood being very or somewhat pleasant and whether they considered their neighborhood to be extremely safe (OR=1.70) or quite safe (OR=1.75) (Velasquez et al., 2009). The effect of the magnitude in this study

was larger than ours, but similar in its direction. This could be due to the fact that we used a 5 point scale for evaluation, while they used a dichotomous outcome. In addition, women who felt that their neighbors could be trusted (OR = 1.35) were more likely to be involved with leisure time physical activity (Velasquez et al., 2009). These gender differences are consistent with differences noted in our study as well. Gender should be considered when looking at this relationship. Boys and girls respond differently to neighborhood perceptions and participate in physical activity at different levels(Gordon-Larsen et al., 2004) (Kahn et al., 2008) (Brodersen et al., 2007).

In a study by Humbert et al. focus groups conducted among high and low SES students were used to determine what they identified as barriers to physical activity. Safety was one cited by the authors, especially in low-income youths. Adult participation was linked to this as well (Humbert et al., 2006). This shows that safety is of concern to adolescents, but that it may be more complex than just "safety" itself. Our results agree with this assertion. Additionally, the measure of neighborhood contentedness was collected from adolescents themselves, similar to our measure. We feel that our measure of "contentedness" may be more representative and incorporate some of the other, related factors that were not considered in the Humbert study, such as familiarity and comfort.

Additional studies in children utilized parental attitudes as a measure of safety perception. Bringolf-Isler, for example, showed that children played almost 20 minutes less per day in areas where the perception of crime as a deterrent to outdoor activity but this relationship was not significant (p=0.1) (Bringolf-Isler et al., 2010). Although the findings of this study are similar to ours, parents attitudes were assessed in this study, and they may differ from that of adolescents (Backett-Milburn & Harden, 2004). In addition,

this study only assessed safety, and we looked at contentedness, which has other attributes, as described above.

Although many studies have been conducted looking at aspects of perceived neighborhood contentedness and physical activity in adolescents, our study looked at this measure as a whole in a large nationally representative cohort of adolescents. We found that it may be a significant barrier to both boy and girls. The findings suggest that neighborhood contentedness should be considered when assessing barriers to physical activities in adolescents, and that these barriers may be personalized.

This barrier is important because physical activity is a very good way for adolescents to maintain a healthy lifestyle and has been linked to reduced rates of adverse health indicators and disease. In addition, activity patterns in adolescents have been shown to predict patterns in adults, so a healthy lifestyle is important to long term health. It is important to understand all barriers to physical activity, if we want to develop effective interventions to reduce them. This study has shown that neighborhood factors, and contentedness are one of those. It has also shown that it is important to talk to adolescents to understand their personal feelings about the neighborhood, and not rely solely on objective neighborhood level statistics.

One limitation of this study is it's time frame. The data was collected in the mid 1990's and adolescent attitudes and perceptions have likely changed somewhat. Although this may be the case, the results of this study are robust and the relationship is significant. The research lays out a benchmark against which other generations of acolescents can be compared. Another limitation of the study that may be cited is its cross-sectional design. The relationship between PNC and physical activity should be evaluated simultaneously

however, as it is the best way to evaluate the effect. We are concerned with how an adolescent feels at the present, and what activity level is at that time. Still, temporality must be considered when evaluating the results. It is possible that adolescents who participate in more physical activity, may have a more favorable view on their neighborhood and score higher in neighborhood contentedness.

The PNC measure that was used in this study should be implemented into other adolescent health studies. It incorporates more than just neighborhood safety or built neighborhood environment. It captures familiarity, safety and comfort level. In addition, it may be used for future prospective studies as the Add Health study population ages. We can look to see if PNC had any long term effects on health indicators in early adulthood. Presently, Add Health has collected two more waves of data and included common diseases such as diabetes and hypertension in the survey. Investigating the downstream health impacts of lowered PNC would be interesting and very informative to public health officials.

Table 3.1 – Individual Level Characteristics of Add Health Population at Waves I and II

	Wave I N(%)	Wave II N(%)
Neighborhood Contentedness		
Low	3,684 (18.2%)	2,761 (19.1%)
Moderate	8,458 (40.8%)	6,159 (42.6%)
High	8,114 (40.1%)	5,553 (38.4%)
Violent Experience	8,594 (41.9%)	4,132 (28.5%)
Gender		
Male	10,263 (49.5%)	7,182 (48.7%)
Female	10,480 (50.5%)	7,556 (51.3%)
Age (SD)	15.66 (1.8%)	16.22 (1.6%)
Race		
White	12,379 (59.9%)	8936 (60.9%)
African American	4,696 (22.7%)	3267 (22.2%)
Asian	1,463 (7.1%)	245 (1.7%)
Native American	331 (1.6%)	1003 (6.8%)
Other	1,801 (8.7%)	1231 (8.4%)
Hispanic	3,525 (17.0%)	
English Spoken at Home		
Yes	18,364 (88.6%)	
No	2,371 (11.4%)	
Parents Married	12,310 (69.9%)	
BMI (SD)	22.58 (4.5%)	22.97 (4.7%)
Parental Income		
<20,000	7,397 (39.2%)	
20-40,000	4,722 (25.0%)	
40-60,000	3,551 (18.8%)	
60-80,000	1,733 (9.2%)	
>80,000	1,455 (7.7%)	
Parental Education Level		
Did not Graduate High School	3,040 (17.3%)	
High School or Equivalent	5,270 (30.1%)	
Some College or Equivalent	5,190 (29.6%)	
College Graduate	2,463 (14.0%)	
Post-graduate Professional	1,564 (8.9%)	
Generally Healthy (Self Report)	13,931 (67.2%)	10,101 (68.6%)
Frequently Cries	1,378 (6.6%)	1,091 (7.4%)
Frequently Feels Fearful	1,363 (6.6%)	837 (5.7%)
Repeated a Grade in School	4,655 (22.5%)	
Difficulty Using Hands and Feet (Self Report)	579 (2.8%)	

Table 3.2 Effect of Neighborhood Contentedness on Physical Activity Goals in Girls at Wave I of the Add Health Population

	Low to Moderate Physical Activity OR (95% CI) (n=3,424)	Moderate to High Physical Activity OR (95% CI) (n=6,450)	Low to High Physical Activity OR (95%CI) (n=6,574)
Neighborhood Contentedness	1.07 (1.02-1.12)*	1.11 (1.06-1.16)*	1.18 (1.14-1.24)*
Violent Experience	1.05 (0.85-1.30)	1.24 (1.03-1.48)	1.30 (1.08-1.55)*
Age	0.83 (0.80-1.87)*	0.86 (0.83-0.88)*	0.71 (0.68-0.74)*
Race (ref. white)			
African American	0.79 (0.67-0.94)*	0.91 (0.79-1.05)	0.72 (0.63-0.83)*
Asian	1.20 (0.87-1.66)	0.97 (0.74-1.26)	1.16 (0.88-1.53)
Native American/Pacific Islander	1.04 (0.58-1.88)	1.58 (0.99-2.54)	1.65 (1.03-2.66)*
Other	0.94 (0.70-1.27)	1.11 (0.86-1.44)	1.05 (0.82-1.34)
Hispanic	0.96 (0.74-1.23)	0.83 (0.67-1.03)	0.79 (0.64-0.98)*
English Spoken at Home	1.14 (0.86-1.50)	0.92 (0.72-1.17)	1.04 (0.83-1.32)
Parents Married	---	---	---
BMI	1.11 (1.01-1.22)*	1.00 (0.92-1.10)	1.11 (1.02-1.21)*
BMI^2	0.998 (0.996-1.000)	1.00 (0.99-1.00)	0.998 (0.996-0.999)
Parental Income (ref = 20-40,000 Annual)	---	---	---
<20,000			
40-60,000			
60-80,000			
>80,000			
Parental Education Level (ref=college graduate)			
Did not Graduate High School	0.94 (0.72-1.22)	0.96 (0.77-1.20)	0.90 (0.72-1.12)
High School or Equivalent	0.96 (0.76-1.20)	0.85 (0.70-1.02)	0.81 (0.67-0.98)*
Some College or Equivalent	1.01 (0.81-1.27)	0.99 (0.82-1.19)	1.00 (0.83-1.21)
Post-graduate Professional	1.22 (0.90-1.66)	1.07 (0.84-1.37)	1.31 (1.01-1.69)
Generally Healthy (Self Report)	1.21 (1.05-1.39)*	1.43 (1.27-1.62)*	1.73 (1.53-1.95)*
Frequently Cries	---	---	---
Frequently Feels Fearful	0.72 (0.56-0.92)*	1.27 (1.02-1.57)*	0.91 (0.75-1.10)
Repeated a Grade in School	1.21 (1.01-1.45)*	0.96 (0.82-1.12)	1.16 (0.99-1.36)
Difficulty Using Hands and Feet (Self Report)	0.68 (0.44-1.04)	1.47 (0.96-2.26)	0.99 (0.71-1.38)

Note. CI = confidence interval; OR = Odds Ratio; Neighborhood Contentedness and Violent Experience interaction tested for and not significant; Physical Activity defined as: High $\geq$ 5 bouts per week, Moderate = 3-4.5 bouts per week, Low < 3 bouts per week
* = $P<0.05$

Table 3.3 Effect of Neighborhood Contentedness on Physical Activity Goals in Boys at Wave I of the Add Health Population

	Low to Moderate Physical Activity OR (95% CI) (n=2,015)	Moderate to High Physical Activity OR (95% CI) (n=6,573)	Low to High Physical Activity OR (95%CI) (n=6,454)
Neighborhood Contentedness	1.08 (1.01-1.16)*	1.19 (1.13-1.25)*	1.29 (1.22-1.36)*
Violent Experience	1.06 (0.86-1.31)	1.38 (1.18-1.61)*	1.46 (1.24-1.73)*
Age	0.86 (0.81-0.91)*	0.82 (0.78-0.85)*	0.70 (0.67-0.73)*
Race (ref. white)			
African American	1.09 (0.86-1.40)	1.09 (0.91-1.31)	1.19 (0.97-1.46)
Asian	0.89 (0.59-1.33)	1.46 (1.07-2.01)*	1.30 (0.95-1.79)
Native American/Pacific Islander	1.46 (0.67-3.19)	0.99 (0.57-1.70)	1.44 (0.75-2.80)
Other	1.23 (0.82-1.84)	0.94 (0.70-1.28)	1.16 (0.84-1.61)
Hispanic	0.78 (0.55-1.10)	1.40 (1.07-1.82)*	1.09 (0.83-1.43)
English Spoken at Home	0.64 (0.44-0.93)*	1.10 (0.83-1.45)	0.70 (0.52-0.96)*
Parents Married	0.99 (0.80-1.24)	0.83 (0.70-0.98)*	0.83 (0.69-0.99)*
BMI	1.10 (0.99-1.21)*	1.08 (0.99-1.18)	1.18 (1.08-1.29)*
BMI^2	0.99 (0.997-1.00)	0.99 (0.99-1.0)	0.99 (0.995-0.99)*
Parental Income (ref = 20-40,000 Annual)			
<20,000	0.92 (0.72-1.17)	1.06 (0.88-1.27)	0.97 (0.80-1.18)
40-60,000	0.91 (0.71-1.16)	1.25 (1.03-1.50)*	1.13 (0.93-1.38)
60-80,000	0.87 (0.63-1.20)	1.38 (1.08-1.76)*	1.20 (0.93-1.55)
>80,000	1.10 (0.78-1.57)	1.34 (1.04-1.73)*	1.48 (1.11-1.98)*
Parental Education Level (ref=college graduate)	---	---	---
Did not Graduate High School			
High School or Equivalent			
Some College or Equivalent			
Post-graduate Professional			
Generally Healthy (Self Report)	1.51 (1.25-1.82)*	1.51 (1.30-1.75)*	2.29 (1.96-2.66)*
Frequently Cries	1.25 (0.65-2.41)	0.60 (0.36-1.54)*	)0.74 (0.42-1.32)
Frequently Feels Fearful	---	---	---
Repeated a Grade in School	---	---	---
Difficulty Using Hands and Feet (Self Report)	---	---	---

Note. CI = confidence interval; OR = Odds Ratio; Neighborhood Contentedness and Violent Experience interaction tested for and not significant; Physical Activity defined as: High $\geq$ 5 bouts per week, Moderate = 3-4.5 bouts per week, Low < 3 bouts per week
* = $P<0.05$

Table 3.4 Effect of Neighborhood Contentedness on Physical Activity Goals in Girls at Wave II of the Add Health Population

	Low to Moderate Physical Activity OR (95% CI) (n=2,673)	Moderate to High Physical Activity OR (95% CI) (4,752)	Low to High Physical Activity OR (95%CI) (4,833)
Neighborhood Contentedness	1.11 (1.05-1.17)*	1.11 (1.06-1.17)*	1.23 (1.17-1.29)*
Violent Experience	1.04 (0.85-1.27)	1.17 (0.99-1.38)	1.22 (1.03-1.44)*
Age	0.82 (0.78-0.86)*	0.80 (0.77-0.84)*	0.66 (0.63-0.69)*
Race (ref. white)			
African American	0.70 (0.58-0.86)*	0.76 (0.64-0.90)*	0.54 (0.45-0.64)*
Asian	1.20 (0.84-1.71)	0.86 (0.64-1.17)	1.04 (0.76-1.42)
Native American/Pacific Islander	1.73 (0.95-3.17)	0.72 (0.45-1.16)	1.25 (0.72-2.18)
Other	1.26 (0.90-1.78)	0.79 (0.59-1.07)	1.0 (0.74-1.35)
Hispanic	0.79 (0.60-1.04)	0.99 (0.78-1.25)	0.78 (0.62-0.98)*
English Spoken at Home	---	---	---
Parents Married	1.14 (0.96-1.36)	0.89 (0.76-1.04)	1.01 (0.87-1.18)
BMI	1.25 (1.12-1.38)*	1.03 (0.94-1.13)	1.28 (1.17-1.40)*
BMI^2	0.997 (0.995-0.998)*	0.999 (0.997-1.003)	0.996 (0.994-0.997)*
Parental Income (ref = 20-40,000 Annual)	---	---	---
<20,000			
40-60,000			
60-80,000			
>80,000			
Parental Education Level (ref=college graduate)			
Did not Graduate High School	1.00 (0.75-1.34)	0.92 (0.72-1.17)	0.92 (0.72-1.18)
High School or Equivalent	0.90 (0.70-1.15)	0.87 (0.70-1.07)	0.78 (0.63-0.97)*
Some College or Equivalent	0.98 (0.76-1.27)	1.09 (0.88-1.35)	1.07 (0.86-1.33)
Post-graduate Professional	0.93 (0.66-1.30)	1.10 (0.84-1.45)	1.02 (0.77-1.36)
Generally Healthy (Self Report)	1.27 (1.08-1.50)*	1.35 (1.17-1.56)*	1.72 (1.49-1.98)*
Frequently Cries	---	---	---
Frequently Feels Fearful	0.87 (0.65-1.18)	1.29 (0.99-1.67)	1.13 (0.88-1.45)
Repeated a Grade in School	---	---	---
Difficulty Using Hands and Feet (Self Report)	0.80 (0.47-1.36)	1.55 (0.98-2.47)	1.24 (0.81-1.89)

Note. CI = confidence interval; OR = Odds Ratio; Neighborhood Contentedness and Violent Experience interaction tested for and not significant; Physical Activity defined as: High $\geq$ 5 bouts per week, Moderate = 3-4.5 bouts per week, Low < 3 bouts per week
* = $P<0.05$

Table 3.5 Effect of Neighborhood Contentedness on Physical Activity Goals in Boys at Wave II of the Add Health Population

	Low to Moderate Physical Activity OR (95% CI) (n=1,781)	Moderate to High Physical Activity OR (95% CI) (n=5,359)	Low to High Physical Activity OR (95%CI) (n=5,248)
Neighborhood Contentedness	1.15 (1.07-1.23)*	1.09 (1.04-1.16)*	1.25 (1.18-1.33)*
Violent Experience	1.21 (0.99-1.47)	1.16 (1.00-1.35)	1.40 (1.19-1.66)*
Age	0.86 (0.80-0.91)*	0.80 (0.77-0.84)*	0.69 (0.65-0.72)*
Race (ref. white)			
African American	1.46 (1.13-1.89)*	0.94 (0.78-1.13)	1.37 (1.10-1.70)*
Asian	1.64 (1.13-2.36)*	0.90 (0.69-1.18)	1.47 (1.07-2.01)*
Native American/Pacific Islander	0.76 (0.35-1.62)*	1.36 (0.72-2.57)	1.03 (0.58-1.85)
Other	1.24 (0.88-1.75)	1.03 (0.79-1.34)	1.28 (0.96-1.70)
Hispanic	---	---	---
English Spoken at Home	---	---	---
Parents Married	---	---	---
BMI	1.05 (0.95-1.17)	1.10 (0.99-1.20)	1.15 (1.05-1.27)*
BMI^2	0.999 (0.997-1.00)	0.99 (0.99-1.00)	0.997 (0.996-0.999)*
Parental Income (ref = 20-40,000 Annual)			
<20,000	1.03 (0.82-1.30)	1.28 (1.07-1.54)*	1.32 (1.09-1.61)*
40-60,000	1.02 (0.78-1.35)	1.33 (1.08-1.64)*	1.36 (1.08-1.70)*
60-80,000	0.92 (0.64-1.33)	1.54 (1.16-2.04)*	1.42 (1.06-1.90)*
>80,000	0.98 (0.66-1.46)	1.52 (1.13-2.05)*	1.49 (1.08-2.05)*
Parental Education Level (ref=college graduate)	---	---	---
Did not Graduate High School			
High School or Equivalent			
Some College or Equivalent			
Post-graduate Professional			
Generally Healthy (Self Report)	1.43 (1.67-1.74)*	1.66 (1.42-1.95)*	2.37 (2.01-2.80)*
Frequently Cries	1.34 (0.46-3.93)	2.12 (1.01-4.49)*	2.85 (1.19-6.85)*
Frequently Feels Fearful	---	---	
Repeated a Grade in School	---	---	
Difficulty Using Hands and Feet (Self Report)	---	---	

Note. CI = confidence interval; OR = Odds Ratio; Neighborhood Contentedness and Violent Experience interaction tested for and not significant; Physical Activity defined as: High ≥ 5 bouts per week, Moderate = 3-4.5 bouts per week, Low < 3 bouts per week
* = $P<0.05$

4.0 RELATIONSHIP BETWEEN PERCEIVED NEIGHBORHOOD CONTENTEDNESS AND SEDENTARY ACTIVITY PATTERNS IN A NATIONALLY REPRESENTATIVE SAMPLE OF ADOLESCENTS

4.1 INTRODUCTION

Obesity is a major public health issue in the United States and worldwide. In a recent CDC report, 27% of Americans were obese (CDC, 2010b). This is more than twice the rate of obesity that was targeted in the *Healthy People 2010* goals. In addition, the rate of obesity in adolescents is high. In an analysis of data from the most recent Youth Risk Behavior Survey (YRBS) an estimated 12-13% of youths were considered obese. These rates have been steadily increasing over the past two decades (CDC, 2010b).

This epidemic of obesity is likely to be driven, in part by sedentary activity. Sedentary activity is not simply the lack of physical activity. It instead incorporates time spent in activities such as television viewing, video games and non-school related computer use (Li et al., 2009). Several studies have evaluated the relationship between sedentary activity and adverse health indicators in adolescents. A study by Utter et al. showed that

TV/video screen time was associated with higher BMI as well as unhealthy diet choices in both boys and girls (Utter, Neumark-Sztainer, Jeffery, & Story, 2003). In addition, a meta-analysis conducted by Marshall et al. showed an overall relationship between television watching or video and computer game playing and body fatness (Marshall, Biddle, Gorely, Cameron, & Murdey, 2004). A review by Rey-Lopez has shown similar results (Rey-Lopez, Vicente-Rodriguez, Biosca, & Moreno, 2008).

Additionally, though sedentary activity is not simply a lack of physical activity, it can take up time that would be better utilized in physical activity. Physical activity has been shown to be important in reducing certain diseases later in life including heart disease, diabetes, respiratory illness and some forms of cancer (Berlin & Colditz, 1990; Garcia-Aymerich et al., 2006; Jeon et al., 2007; Laaksonen et al., 2005; Maruti et al., 2008; Wolin et al., 2009).

Sedentary activity rates have been shown to vary by several demographic characteristics. Age, gender, ethnicity and socioeconomic status (SES) are some of the variables that have been found to be associated with differences in sedentary activity rates. A study by Brodersen et al. investigated the trends in physical and sedentary activity over four years, within a cohort of adolescents in England (Brodersen et al., 2007). The investigators found that sedentary activity time increased throughout the study, with an average increase over the study course of 2.52 hours/wk in boys and 2.81hrs/wk in girls. They also found differences by race, as blacks had higher sedentary levels than whites for both sexes (2.76 hr/wk in boys, 5.4 hrs/wk in girls), and Asian girls had higher (0.41 more hrs/wk) than whites. When they looked at SES, they found that sedentary activity rates were higher in low SES neighborhoods for both sexes (2.29 hrs/wk more in boys and 4.09

hrs/wk in girls). Another study, EAT-II, by Nelson et al. also found that the average number of hours adolescents spent on the computer (not for homework) increased in males (10.4 hrs/wk to 14.2 hrs/wk) and females (8.8 hrs/wk to 12.5 hrs/wk) as they transitioned from mid-to late adolescence (high school to post high school). They hypothesize that this may be due to an increased availability of computers and computer based entertainment over that time period (Nelson et al., 2006).

Period trends in sedentary activity have also been seen. Data from the Kaiser Family Foundation show that computer use among 8 – 18 year olds more than doubled from 1999 to 2004 and that it was mostly due to increases in computer gaming and internet surfing (Roberts, Foehr, & Rideout, 2005). The CDC's Youth Risk Behavior Surveillance System (YRBSS) has also shown that the percentage of children in middle and high school that used computers 3 or more hours per day increased from 22.1% in 2003 to 24.9% in 2009 (CDC, 2009b). Television viewing time, however has decreased over time. Data from the YRBSS show that the percentage of adolescents that watch 3 or more hours of television per day has decreased from 43% in 1999 to 32.8% in 2009 (CDC, 2009b). The previously mentioned study by Broderson et al, also showed a decrease (2.2 hrs/wk) in viewing time in females over the study, while there was no significant change in males.

Another potential reason for an increase in sedentary activity may be due to how an adolescent perceives the neighborhood they live in. If a child feels fear of or detachment in the neighborhood they live in, it could push him or her toward sedentary activities. Several studies have shown that neighborhood safety can be a barrier to physical activity in adolescents and children (Bennett et al., 2007; Humbert et al., 2006; Velasquez et al., 2009).

Decreasing the likelihood of participating in physical activities may lead to more time spent in sedentary activity.

There are, however, very few studies that directly examine the relationship between neighborhood safety or contentedness and sedentary activity. A search of the literature results in only two such studies and they both looked at safety alone. Timperio et al. showed a relationship between neighborhood crime rates and increased TV viewing time (Timperio et al., 2011). Crime rates, however, are an objective measure, and may not be a good reflection of how a child actually feels about their neighborhood. A study by Carson et al. evaluated the relationship and showed no significant relationship between perceived neighborhood safety and screen time (a measure of sedentary activity (Carson, Kuhle, Spence, & Veugelers, 2010).

Multi-factor measures of neighborhood feelings have been established in the past. Collective efficacy, which was developed by Sampson in the 1990s incorporated measures of "social cohesion among neighbors combined with their willingness to intervene on behalf of the common good" (Sampson et al., 1997). Another measure, proposed by Conklin looked at the "reactions of individuals and groups that bring about conformity to norms and laws, (and) includes peer and community pressure, bystander intervention in a crime, and collective responses such as citizen patrol groups" as his measure of social cohesion (Conklin, 2007). In our study, we will look at perceived neighborhood contentedness (PNC), which incorporates aspects from both of these measures, in the Add Health dataset. The development of this measure is described in detail here (Bazaco et al.)

To address the gap in knowledge, the objective of this study is to look at the association between sedentary activity and a previously defined index of Perceived

Neighborhood Contentedness (PNC) that encapsulates neighborhood safety, comfort and familiarity (Bazaco et al, XXXX). We will use data from the National Longitudinal Study of Adolescent Health dataset to examine this relationship.

4.2 METHODS

4.2.1 SAMPLE

The National Longitudinal Study of Adolescent Health (Add health) dataset is a nationally representative, longitudinal survey of adolescents as they transition into adulthood. These data were collected at multiple time points in a repeated measure format (Harris et al., 2009). The first two waves evaluated the study participants during adolescence (1 year apart) while the latter waves followed them as they transitioned through adulthood. At its inception in 1994, high schools across the country were evaluated for inclusion. Wave I included survey results from 20,745 respondents. Wave II data was collected for 14,738 (71%) of these same students.

The in-home survey that makes up the backbone of the study is a comprehensive interview that covers multiple areas which include neighborhood perception and leisure time activities. These areas include but are not limited to; general demographic

information, feelings, health, school issues, daily activities and relationships at each subsequent wave of the study (Harris et al., 2009).

The study population is described in Table 1. It is roughly 50% male and the mean age of the study population at Wave I was 15.7 years. At Wave II, the average age was 16.2. The population was ~60% white, 22% black, 7% Asian, 1% Native American and 8% of other races. Seventeen percent of the population was of Hispanic origin and 88% spoke English primarily at home. Nearly 70% of the respondent's parents were married. The mean BMI did not change between Waves was between 22 and 23. Around 40% of the respondents parents reported an annual income of less than $20,000 annually, while25% reported their income as between $20-40,000 annually, 19% reported an annual income of $40,000 – 60,000, 9% reported $60,000 – 80,000 and ~8% reported greater than $80,000. The parental education breakdown as shown was unremarkable. A high rate (22%) of subjects had repeated a grade.

4.2.2 STUDY DESIGN

A cross-sectional study design was used to evaluate the relationship between perceived neighborhood contentedness and physical activity patterns in the study population. Analysis of both Wave I and Wave II of the Add health Study were done separately.

4.2.3 INDEPENDENT MEASURES (PERCEIVED NEIGHBORHOOD CONTENTEDNESS)

In order to assess perceived neighborhood contentedness, five questions from the Add health survey were used. These questions are as follows:

1. Do you know the people in your neighborhood?
2. In the past 12 months have you stopped to talk to people in your neighborhood?
3. Do people in your neighborhood stick up for each other?
4. Do you feel safe in your neighborhood?
5. Are you happy living in your neighborhood?

These questions were used to create a PNC index. This measure incorporates safety, cohesion and efficacy, as described above. The responses for these five questions were summed using the dichotomous outcomes. The higher the sum, the more content the subject feels in his/her neighborhood. The lower the sum, the lower the contentedness. This sum was used as the PNC measure and treated as such throughout the study.

A factor analysis was used to evaluate the relationship of these variables to each other and their usefulness as an index. Exploratory factor analysis defined the neighborhood contentedness domain, from a collection of potential variables in Wave I. Confirmatory factor analysis was done on these questions in Wave II of the study and validated this index. The factor analysis is described in greater detail here (Bazaco et al.).

4.2.4 DEPENDENT MEASURES (SEDENTARY ACTIVITY)

To assess sedentary activity in this study, we utilized multiple variables assessed in the Add Health dataset. The Add Health investigators asked how often each individual watched television, watched videos or played video games in the past week. The Add health data also yielded how much time (in hours) each individual spent doing the following over the course of the past week:

-watching television

-watching videos

-playing video games

The duration for each of these three variables were added into one sedentary activity variable. This variable was divided into three categories based on its distribution. This first category (low sedentary activity) included subjects in the lowest 25% of the population with regards to sedentary activity. The second category included those in the 26^{th}-74^{th} percentile of the sedentary activity. They were labeled moderately sedentary. The people in the highest 25% of sedentary activity were labeled as highly sedentary. For Wave I, the cutoff for the low sedentary group was less than 8 hours of sedentary activity per week. The cutoff for highly sedentary was 30 or more hours of combined sedentary activity per week. For Wave II, the cutoff for the lowest 25% was 8 hours or less as well, and the cutoff for the highly sedentary group was 28 or more hours per week.

4.2.5 POTENTIAL COVARIATES

Potential covariates such as age, gender, race, Hispanic status, parental education, household income, parental marital status, and whether or not English was spoken at home were also assessed. These variables have all been shown to be associated with physical activity patterns (Brodersen et al., 2007; Gordon-Larsen et al., 2004; Kahn et al., 2008). Self-reported health, how frequent the subject felt fearful or cried, how often the subject repeated a grade in school, how often the students had missed a social event because of illness or self-reported physical limitations will also be considered as potential confounders.

We also assessed an individual's experience with violent activities. Experiencing violence or being the victim of violence could potentially affect both an adolescents perception of their neighborhood as well as their activity patterns. The survey asked how often each subject had witnessed a shooting or stabbing, had a knife pulled on them, shot or stabbed someone, been shot at, been stabbed, gotten in a fight, gotten jumped or pulled a knife on someone. These variables were dichotomized by whether or not the subject had at least one experience. They were then added together to form an index. They were then included in the above described factor analysis and were retained in a single factor. This index was labeled "Violent Experience" (VE) and looked at as a potential covariate for this analysis. The higher the value for VE, the more experience with violence the subject had.

4.2.6 STATISTICAL ANALYSIS

Multinomial logistic regression was used to build appropriate models for this analysis. Models were built for each wave of the study to determine if there was any difference as the cohort aged.

Bivariate analyses was used to determine what variables should be included in the initial model. Variables were included if they were related to the outcome variable at a significance of 0.20 or less. Dummy variables were used when adding non-dichotomous, non-ordinal, categorical variables to the model. These included race, household income and parental education.

After each model was run, the variable with the highest global *p*-value was removed and the model was run again. The final model consisted of variables with a *p*-value of 0.10 or lower for any outcome level. If a variable had been retained in at least one model, it was included in the final models for all comparisons in that Wave and gender.

Interaction between VE and PNC was also evaluated and was not significant in any of the models. SAS 9.2 was used for all data analysis.

4.3 RESULTS

4.3.1 STUDY SAMPLE

Demographic characteristics as well as distribution of covariates are displayed in Table 1.

The mean age during Wave I of the study was 15.7±1.8 years. The gender breakdown was even with 50.5% being female and 49.5% being male. 60% of the adolescents were white, 22.7% were black, 7% were Asian or Pacific Islander and 1.6% were Native American. Seventeen percent of the adolescents were Hispanic. Seventy percent of the respondent's parents were married and the man BMI was 22.6±4.5.

The mean age at Wave II was 16.2±1.6 years. The gender was evenly distributed with 51.3% being female and 48.7% male. The racial breakdown remained consistent with 60.9% white, 22.3% African American, 6.8% Asian or Pacific Islander and 1.7% American Indian.

As shown in Table 2, sedentary activity levels differed by race. In Wave I, 39.4% of African Americans were in the highly sedentary group compared to 29% of American Indians, 23.3% of Asians and 22% of Whites. This was consistent in Wave II of the study where 39% of African Americans were highly sedentary compared to 27.6% of American Indains, 24.8% of Asians and 22.1% of Whites. Conversely, 27.7% of whites were low sedentary, compared with 26.8% of Asians, 23.3% of native Americans and 19.4% of African Americans This was consistent in Wave II where 29% of Whites were low sedentary, compared to 25.3% of Asians, 24.3% of American Indians and 19.7% of African Americans .

Sedentary activity levels also differed significantly by gender. In females, 30.7% were low sedentary, compared to only 20.8% of males in Wave I. This was similar in Wave II, as 32.5% of girls were low sedentary, while 20.9% of males were. In the highly sedentary level, the opposite is true as 30.7% of males were highly sedentary, compared to 22.4% of females. The distribution in Wave II was similar as 29.8% of males fell into this category compared to 21% of females.

4.3.2 WAVE I

The results from Wave I of the study are shown in Table 3. The only significant relationship between perceived neighborhood contentedness and sedentary activity was seen in the comparison between moderately and highly sedentary groups. Adolescents were 0.05 percent less likely to be highly sedentary (OR 0.95, 95%CI 0.92-0.98). The direction of the relationship was reversed when comparing low sedentary activity to moderate sedentary activity (OR = 1.03, 95%CI 1.0-1.06).

Additionally, males were significantly more sedentary across all comparisons than females when controlling for all other factors in the model. The odds of being highly sedentary was 2.16 times that of being in the low sedentary group for males when controlling for all of the other factors, including PNC. African Americans were also significantly more likely to be more sedentary across all comparisons than Whites (OR 2.47, 95%CI 2.19-2.79). Increased age was significantly related to being less likely to be sedentary across all comparisons as well.

4.3.3 WAVE II

The results for Wave II of the study are shown in Table 4. When comparing those in the low sedentary activity group to those in the high sedentary group, the relationship had a higher effect size than seen in Wave I. Those who were more content were 8% less likely to be highly sedative than low (OR = 0.92, 95%CI 0.88-0.96). Adolescents with higher contentedness were 5% less likely to be in the moderately sedentary group than the low group as well (OR = 0.95, 95%CI 0.92-0.99). There was no significant relationship when comparing the moderate and high sedentary activity groups (OR = 0.96, 95%CI 0.93-1.00). All three of the comparisons showed a relationship in the same direction, where a higher level of perceived neighborhood contentedness led to a lower level of sedentary activity.

Similar to Wave I of the study, males were much more likely to be in the highly sedentary group(OR 2.65, 95%CI 2.28-2.88, for low to highly sedentary), as were African-Americans(OR 3.05, 95%CI 2.63-3.53) compared to Whites, when controlling for all other factors. Unlike in Wave I, Asian Americans were also significantly more likely to be more sedentary than Whites as well. An increased age was associated with lower odds of being more sedentary across all comparisons, like was seen in Wave I. In addition, adolescents whose parents made $80,000 or more per year are less likely to be more sedentary across all comparisons.

4.4 DISCUSSION / TABLES

These analyses show a small negative relationship between increased Perceived Neighborhood Contentedness and sedentary activity in adolescents in the Add Health study. In Wave I, adolescents were 5% less likely to be highly sedentary (OR 0.95, 95%CI 0.92-0.98) than moderately sedentary with increased PNC. In Wave II, adolescents were 5% less likely to be moderately sedentary than low sedentary with increased PNC (OR 0.95, 95%CI 0.92-0.99), and 8% less likely to be highly sedentary than moderately (OR 0.98, 95%CI 0.95-1.02).

The percentage of highly sedentary adolescents decreased between Wave I and Wave two for all races, and for both genders. These trends differ from the results from Brodersen and Nelson, as they saw increases in overall sedentary activity over time (Brodersen et al., 2007; Nelson et al., 2005; Nelson et al., 2006). However, these studies, as well as the period studies previously mentioned did note a decrease over time in the amount of time adolescents spent watching television and videos. As our study did not look at the time spent watching television and time spent on the computer separately, it is possible that there were increases in computer time in this cohort, but that there was a bigger decrease in the amount of time watching television and videos, resulting in a net decrease in sedentary activity time.

Sedentary activity in this population varied by ethnicity. In Wave I, a higher percentage of African Americans (39.4%) were highly sedentary as compared to the other reported races. Additionally, being African-American increased the odds by 2.5 of being highly sedentary than being low sedentary. Asians/Pacific Islanders also had a higher

percentage of adolescents that were highly sedentary (23.3%) than whites (22.0). This relationship was also seen in Wave II, as 39.0% of African Americans were highly sedentary compared to 24.8% of Asians/Pacific Islanders, and 20.6% of whites. These results are constant with those of Brodersen et al, that found blacks and Asians spent the highest number of hours per week participating in sedentary activities (Brodersen et al., 2007).

Sedentary activity rates also varied significantly by gender in this population. In Wave I, a higher percentage of males (30.7%) were highly sedentary than females (22.4%). Being male increased the odds of being moderately sedentary by 1.58 (95% CI 1.46-1.72) than low sedentary and increased the odds by 1.36 (95%CI (1.26-1.48) for being highly sedentary. These results were consistent with Wave II, as 29.8% of males were highly sedentary while only 21.0% of females were highly sedentary. In Wave II, being male increased the odds of being more sedentary at each level (low to moderate OR 1.76, moderate to high 1.45 and low to high 2.56.. These results are however, differed from the Brodersen et al study, as they found that males spend more hours per week participating in sedentary activities than females (2.52 hours/wk in boys and 2.81hrs/wk in girls) (Brodersen et al., 2007). Our results would suggest the opposite. However, Nelson et al, found that males spent more time doing sedentary activities than females, which is consistent with the results of our study (Nelson et al., 2006).

Previous research using the same index, found PNC to be significantly associated with physical activity in this population (XXXX). The fact that the relationship between PNC and sedentary activity was mostly insignificant in this population while the relationship between PNC and physical activity was significant and positive in direction helps to support the idea that sedentary activity is independent from physical activity(Li et al.,

2009; Spanier, Marshall, & Faulkner, 2006). It additionally supports the idea that people can be considered both physically active and sedentary (Nelson et al., 2005).

The body of literature on sedentary activity and its relationship to perceived neighborhood safety and other aspects of contentedness is limited at this time. Carson et al. evaluated the relationship between screen time the neighborhood constructs of sidewalks and parks, satisfaction and services, safety. They showed no significant relationship between perceived neighborhood safety and screen time. (However in this study, the perceived safety of the neighborhood was determined by parents not children (Carson et al., 2010). The study by Timperio et al (2011), showed a relationship between neighborhood crime rates and increased TV viewing time (Timperio et al., 2011). Our study has added to this area of knowledge, by evaluating the relationship of PNC as felt by the adolescents themselves and the relationship with sedentary activity participation. By using a nationally representative study, our results are highly generalizable to the general adolescent population. The presence of multiple waves of data in this dataset allowed us to also examine temporal trends in sedentary activity.

While these are some of the strengths of our study, there are a few notable limitations. The study data for Waves 1 and 2 are from 1994 and 1996, respectively, and therefore, the data are a bit dated. As the availability of computers and computer based entertainment has increased over recent years (Nelson et al., 2006), it is possible that our study results are no longer as representative of current rates.

Table 4.1 – Individual Level Characteristics of Add Health Population at Waves 1 and 2

	Wave1 N(%)	Wave II N(%)
Neighborhood Contentedness		
Low	3,684 (18.2%)	2,761 (19.1%)
Moderate	8,458 (40.8%)	6,159 (42.6%)
High	8,114 (40.1%)	5,553 (38.4%)
Violent Experience	8,594 (41.9%)	4,132 (28.5%)
Gender		
Male	10,263 (49.5%)	7,182 (48.7%)
Female	10,480 (50.5%)	7,556 (51.3%)
Age (SD)	15.66 (1.8%)	16.22 (1.6%)
Race		
White	12,379 (59.9%)	
African American	4,696 (22.7%)	
Asian	1,463 (7.1%)	
Native American	331 (1.6%)	
Other	1,801 (8.7%)	
Hispanic	3,525 (17.0%)	
English Spoken at Home		
Yes	18,364 (88.6%)	
No	2,371 (11.4%)	
Parents Married	12,310 (69.9%)	
BMI (SD)	22.58 (4.5%)	22.97 (4.7%)
Parental Income		
<20,000	7,397 (39.2%)	
20-40,000	4,722 (25.0%)	
40-60,000	3,551 (18.8%)	
60-80,000	1,733 (9.2%)	
>80,000	1,455 (7.7%)	
Parental Education Level		
Did not Graduate High School	3,040 (17.3%)	
High School or Equivalent	5,270 (30.1%)	
Some College or Equivalent	5,190 (29.6%)	
College Graduate	2,463 (14.0%)	
Post-graduate Professional	1,564 (8.9%)	
Generally Healthy (Self Report)	13,931 (67.2%)	10,101 (68.6%)
Frequently Cries	1,378 (6.6%)	1,091 (7.4%)
Frequently Feels Fearful	1,363 (6.6%)	837 (5.7%)
Repeated a Grade in School	4,655 (22.5%)	
Difficulty Using Hands and Feet (Self Report)	579 (2.8%)	

Table 4.2: Distribution of Sedentary Activity by Race and Gender in Wave I and Wave

Wave I				
	Low	**Moderate**	**High**	**P-value**
Race				0.205
White	17.6 (2179)	17.5 (2164)	64.9 (8036)	
African American	18.5 (868)	17.1 (803)	64.4 (3025)	
Native American	13.9 (46)	16.9 (56)	69.2 (229)	
Asian/Pacific Islander	17.7 (259)	16.9 (247)	65.4 (957)	
Other	19.8 (356)	17.6 (316)	62.7 (1129)	
Gender				<0.001
Female	22.5 (2357)	20.5 (2145)	57.0 (5978)	
Male	13.4 (1374)	14.2 (1454)	72.4 (7435)	
Wave II				
	Low	**Moderate**	**High**	**P-value**
Race				<0.001
White	7.8 (1592)	17.5 (1564)	64.7 (5780)	
African American	20.4 (667)	18.9 (617)	60.7 (1983)	
Native American	18.8 (46)	20.8 (51)	60.4 (148)	
Asian/Pacific Islander	18.9 (190)	20.7 (208)	60.3 (605)	
Other	19.9 (245)	20.3 (250)	59.8 (736)	
Gender				<0.001
Female	23.5 (1779)	21.2 (1600)	55.3 (4177)	
Male	13.6 (978)	15.3 (1098)	71.1 (5106)	

Table 4.3: Effect of Neighborhood Contentedness on Sedentary Activity Duration in Wave I of the Add Health Population

	Low to Moderate Sedentary Activity OR (95% CI) (n=11,127)	Moderate to High Sedentary Activity OR (95% CI) (n=11,342)	Low to High Sedentary Activity OR (95%CI) (n=7,865)
Neighborhood Contentedness	1.03 (1.00-1.06)	0.95 (0.92-0.98)*	0.98 (0.95-1.02)
Violent Experience	0.94 (0.85-1.05)	1.25 (1.13-1.38)*	1.18 (1.05-1.34)*
Male Gender	1.58 (1.46-1.72)*	1.36 (1.26-1.48)*	2.16 (1.96-2.37)*
Age	0.88 (0.86-0.90)*	0.91 (0.89-0.93)*	0.80 (0.78-0.82)*
Race (ref. white)			
African American	1.20 (1.07-1.34)*	2.07 (1.87-2.28)*	2.47 (2.19-2.79)*
Asian	1.06 (0.89-1.26)	1.16 (0.97-1.39)	1.23 (0.99-1.51)
Native American/Pacific Islander	1.19 (0.85-1.68)	1.19 (0.88-1.62)	1.42 (0.98-2.07)
Other	0.92 (0.79-1.07)	1.20 (1.03-1.40)*	1.10(0.93-1.31)
Hispanic	---	---	
English Spoken at Home	---	---	
Parents Married	0.93 (0.84-1.03)	0.94 (0.85-1.03)	0.87 (0.78-0.97)*
BMI	---	---	
BMI^2	---	---	
Parental Income (ref = 20-40,000 Annual)			
<20,000	1.02 (0.91-1.14)	0.99 (0.89-1.10)	1.01 (0.83-1.14)
40-60,000	1.13 (1.01-1.26)*	0.85 (0.76-0.95)*	0.96 (0.84-1.10)
60-80,000	1.07 (0.93-1.23)	0.77 (0.66-0.89)*	0.82 (0.70-0.98)*
>80,000	0.964 (0.829-1.121)	0.65 (0.55-0.78)*	0.63 (0.52-0.76)*
Parental Education Level (ref=college graduate)			
Did not Graduate High School	1.20 (0.94-1.29)	1.14 (0.98-1.34)	1.26 (1.05-1.51)*
High School or Equivalent	1.12 (0.98-1.28)	1.17 (1.02-1.33)*	1.30 (1.12-1.52)*
Some College or Equivalent	1.12 (0.98-1.27)	1.09 (0.95-1.24)	1.21 (1.04-1.41)*
Post-graduate Professional	0.96 (0.81-1.12)	0.89 (0.74-1.06)	0.85 (0.69-1.04)
Generally Healthy (Self Report)	0.97 (0.89-1.06)	0.84 (0.77-0.91)*	0.81 (0.74-0.90)*
Frequently Cries	---	---	---
Frequently Feels Fearful	---	---	---
Repeated a Grade in School	0.96 (0.86-1.06)	1.17 (1.06-1.29)*	1.12 (0.99-1.25)
Difficulty Using Hands and Feet (Self Report)	---		---

Note. CI = confidence interval; OR = Odds Ratio; Neighborhood Contentedness and Violent Experience interaction tested for and not significant; Sedentary Activity defined as: High ≥ 30 hours per week, Moderate = 9-29 hours per week, Low ≤ 8 hours per week
* = $P<0.05$

Table 4.4: Effect of Neighborhood Contentedness on Sedentary Activity Duration in Wave II of the Add Health Population

	Low to Moderate Sedentary Activity OR (95% CI) (n=8,082)	Moderate to High Sedentary Activity OR (95% CI) (n=7,861)	Low to High Sedentary Activity OR (95%CI) (n=5,586)
Neighborhood Contentedness	0.95 (0.92-0.99)*	0.96 (0.93-1.000)	0.92 (0.88-0.96)*
Violent Experience	1.07 (0.96-1.075)	1.09 (0.98-1.21)	1.16 (1.03-1.13)*
Male Gender	1.76 (1.60-1.95)*	1.45 (1.31-1.61)*	2.565 (2.28-2.88)*
Age	0.90 (0.87-0.93)*	0.91 (0.88-0.94)*	0.82 (0.79-0.85)*
Race (ref. white)			
African American	1.29 (1.12-1.48)*	2.37 (2.139-2.726)*	3.05 (2.63-3.53)*
Asian	1.3 (1.05-1.62)*	1.26 (1.01-1.57)*	1.64 (1.27-2.12)*
Native American/Pacific Islander	1.19 (0.80-1.77)	1.05 (0.71-1.53)	1.24 (0.78-1.96)
Other	1.12 (0.91-1.40)	0.86 (0.69-1.07)	0.96 (0.74-1.25)
Hispanic	1.14 (0.96-1.34)	1.09 (0.92-1.30)	1.24 (1.02-1.51)*
English Spoken at Home	---	---	---
Parents Married	0.90 (0.80-1.02)*	1.05 (0.94-1.18)	0.95 (0.83-1.09)
BMI	0.96 (0.90-1.03)	1.07 (1.01-1.14)*	1.03 (0.95-1.11)
BMI^2	1.00 (1.00-1.00)	0.99 (0.99-1.00)	1.000 (0.99-1.00)
Parental Income (ref = 20-40,000 Annual)			
<20,000	0.91 (0.80-1.05)	1.04 (0.91-1.19)	0.95 (0.87-1.11)
40-60,000	1.01 (0.89-1.15)	0.81 (0.70-0.93)*	0.82 (0.70-0.96)*
60-80,000	0.92 (0.78-1.08)	0.84 (0.70-1.01)	0.77 (0.63-0.94)*
>80,000	0.81 (0.68-0.96)*	0.67 (0.54-0.82)*	0.54 (0.43-0.68)*
Parental Education Level (ref=college graduate)			
Did not Graduate High School	1.04 (0.86-1.26)	1.21 (1.00-1.47)*	1.26 (1.01-1.57)*
High School or Equivalent	1.16 (1.00-1.35)*	1.06 (0.90-1.24)	1.23 (1.02-1.47)*
Some College or Equivalent	1.07 (0.92-1.24)	1.01 (0.87-1.19)	1.08 (0.91-1.29)
Post-graduate Professional	0.96 (0.80-1.16)	0.85 (0.68-1.05)	0.81 (0.64-1.03)
Generally Healthy (Self Report)	0.91 (0.82-1.01)	0.89 (0.80-0.99)*	0.81 (0.72-0.92)*
Frequently Cries	0.83 (0.69-0.99)*	1.15 (0.94-1.42)	0.96 (0.77-1.20)
Frequently Feels Fearful	1.04 (0.84-1.29)	1.21 (0.97-1.50)	1.26 (0.98-1.61)
Repeated a Grade in School	0.87 (0.78=0.99)*	1.20 (1.06-1.35)*	1.04 (0.91-1.20)
Difficulty Using Hands and Feet (Self Report)	---	---	

Note. CI = confidence interval; OR = Odds Ratio; Neighborhood Contentedness and Violent Experience interaction tested for and not significant; Sedentary Activity defined as: High $\geq$ 29 hours per week, Moderate = 9-28 hours per week, Low $\leq$ 8 hours per week
* = $P<0.05$

5.0 CONCLUSION

5.1 SUMMARY OF FINDINGS

Overall, we have shown that neighborhood contentedness is a multi-faceted measure that is important to consider when evaluating activity patterns in adolescents and should be considered for future promotion of health activity and public health interventions to support this.

Neighborhood factors may play a role in how an adolescent decides to spend their leisure time activity. How a child or adolescent perceives their neighborhood is something that is important to understand because of this. As we promote increased physical activity and reduced sedentary activity as healthy lifestyle choices in adolescents, we must consider this as a potential barrier.

The development of a measure of perceived neighborhood contentedness is one tool that is essential in investigating this. To date, measures have been developed looking at aspects of contentedness, but we have developed a new measure using the Add Health dataset that could be used to investigate the relationship between PNC and activity choices.

Leisure time activity choices are important in promoting a healthy lifestyle in adolescents. The neighborhood environment and adolescent feelings regarding their neighborhood have shown to be a potential barrier to physical activity, for example. This should be considered when developing new plans to promote physical activity. It is important to not only make opportunities available to adolescents, but to also make sure that adolescents feel comfortable taking advantage of these opportunities. This may include community days in parks or sporting areas. It is important to note that it is not just "feeling safe" that is important, but all aspects of contentedness. Engaging the community can help with this.

5.1.1 PERCEIVED NEIGHBORHOOD CONTENTEDNESS AS A MEASURE

In our first paper, we attempted to develop a measure of perceived neighborhood contentedness using variables from the Add Health survey. This was done using exploratory and confirmatory factor analysis. Along with the Add Health survey, we also looked at the Casino & Arena Study – Impact on Neighborhood Outcomes (CASINO) study. The goal was to determine what questions should be included in our measure and to develop an index that we could use to evaluate perceived levels of comfort, familiarity and safety within the neighborhood. Looking at data from Wave I, 13 questions were used in the exploratory analysis. Two domains emerged; neighborhood contentedness and violent experience.

The questions that were part of the neighborhood contentedness domain included whether or not the respondent knew and talked to the people in the neighborhood,

whether they stuck up for each other and how happy and safe they felt in the neighborhood. The shared variance of this domain was confirmed using confirmatory factor analysis on Wave II of the Add Health survey. When we ran an additional confirmatory factor analysis using the same questions on the CASINO study, the domain was not confirmed. The demographic characteristics of the two populations, however, were distinctly different. The CASINO study was much older, and had a higher proportion of females. They were also more educated and had a higher SES than the parents of the adolescents evaluated in Add health.

This analysis suggests that determining what factors go into neighborhood contentedness varies from population to population and must be evaluated as such. Our measure is valid for the Add health dataset, however and can be used for future research in that population.

5.1.2 PERCEIVED NEIGHBORHOOD CONTENTEDNESS AND PHYSICAL ACTIVITY IN ADOLESCENTS

We looked at the relationship between perceived neighborhood contentedness and physical activity in the Add Health population, as we thought perceived neighborhood contentedness might be a potential barrier to physical activity. Overall, we saw that increased levels of contentedness were associated with significantly higher odds of being more physically active. This relationship was significant in both boys and girls. It also remained significant when controlling for various factors that have been associated with activity patterns in adolescents such as age, race, BMI, parental SES and parental education

level. A positive association was seen for all comparisons of low, moderate, and high physical activity patterns.

The direction and significance of this relationship in Wave I was also seen in Wave II of the study. This was expected, as the population in Wave II was the same as that in Wave I, and the people who were excluded did not change the demographic characteristics. The time difference between the two waves was only 1-1.5 years so the uniformity was not surprising. Survey data, especially in adolescents is subject to changes in the attitude and feelings of the respondent, so to see consistent findings at two time points is reassuring.

The literature to this date has been mixed in understanding this relationship. Although no studies have been done looking at neighborhood contentedness, studies have been done looking at facets of it. They have had mixed results. In addition, most of these have been done in smaller subsets of the population. This research presents an evaluation of the relationship in a large, representative sample and adds to the understanding of the relationship.

Overall we saw that PNC is a potential barrier to physical activity in adolescents. The effect is evident in both males and females. It is important for us to take this into consideration when developing plans to increase leisure time physical activity in this age group.

5.1.3 THE RELATIONSHIP BETWEEN PERCEIVED NEIGHBORHOOD CONTENTEDNESS AND SEDENTARY ACTIVITY IN ADOLESCENTS

The second paper assessed the relationship between perceived neighborhood contentedness and sedentary activity, as we thought that decreased perceived neighborhood contentedness would increase sedentary activity rates. We used combined screen time duration as our indicator of sedentary activity. The results indicated a small and inconsistent relationship between higher contentedness and greater odds of being less sedentary. We looked at three levels of sedentary activity and controlled for various factors that have been associated with activity patterns in adolescents such as age, gender, race, BMI, parental SES and parental education level.

Though no meaningful relationship was shown in this study, we did learn some important things. First, when looking at the distribution of sedentary activity in the population, we saw that it was comparable to that which has been shown in other adolescent populations. Boys were more likely to be sedentary, and African Americans were also more likely to be more sedentary. This was consistent across all comparisons and supported the trends that have been shown in the literature.

There are very few studies that we found looking at this relationship, and none used this measure of contentedness. The results that are shown here will help to add to this literature by presenting an analysis in a large, nationally representative sample. It will hopefully help to stimulate more research into this area and provide a tool for evaluating this relationship going forward.

In addition, when we look at the results of this assessment in combination with those from the physical activity study, we see that the results are independent. This supports the assertion that physical activity and sedentary activity are different and that an adolescent can be both physically active and highly sedentary. This is important when considering adolescent activity choices in future research.

5.2 PUBLIC HEALTH SIGNIFICNCE

Current data suggest that adolescent obesity is at an all time high. The latest Youth Risk Behavior Survey indicated that the level of adolescent obesity has reached an estimated 12-13% (CDC, 2010). In addition, the overall rate of obesity in the United States was estimated at a staggering 27%, which is more than twice the goal set by the CDC's *Healthy People 2010*.

Increasing physical activity is one way to try and reduce obesity in adolescents, but research has also shown that leisure time activity choices also reduce the risk of other adverse health indicators and diseases in both adolescents and into adulthood (Berlin & Colditz, 1990; Garcia-Aymerich et al., 2006; Jeon et al., 2007; Laaksonen et al., 2005; Maruti et al., 2008; Wolin et al., 2009). In this study, we have identified one potential barrier to physical activity, decreased perceived neighborhood contentedness. Our study indicated that a real and significant relationship exists between how content an adolescent feels in

their neighborhood and how much leisure time they spend involved in physical activity. Although the relationship between contentedness and sedentary activity was not significant, the studies suggest that physical activity is independent of sedentary activity and therefore you do not have to reduce the rate of one to increase the rate of another.

It is important to understand what barriers to physical activity exist in a neighborhood. This research suggests that adolescent neighborhood contentedness should be considered when developing new interventions to increase physical activity. Community events, such as park openings or fitness days should be promoted to increase familiarity and trust within the neighborhood. This may help to make adolescents feel more comfortable as well as make them more familiar with their neighbors, increasing their contentedness. It is helpful to build the infrastructure (ball fields, playgrounds, sort courts), but integrating the community into these developments, as mentioned, may make these even more effective.

5.3 LIMITATIONS

It is important tot note that the data collected for the Add Health survey was collected in 1994-1996. This was fifteen years ago and attitudes as well as activity patterns may have changed in adolescents since then. In addition, the data was collected using an in-home interview, which can be influenced by how the respondent feels on that particular day. If

the respondent has had a particularly disheartening week, or recently gone through an upsetting experience, it can influence his or her perspective. The fact that the survey was conducted twice (for Wave I and Wave II) in such a short time may reduce this limitation, however. In addition, the high sample size will reduce the impact of individual situations such as this.

In the second paper, we evaluated physical activity using frequency as our measure, and not duration. Adolescents were asked "how many times" per week they took part in various activities. This is less descriptive than asking them how much time was spent doing these activities. If a respondent only reported three instances of activity, but each was a two hour long soccer or basketball game, they would have been classified as moderately physical, when in fact they were very active. Conversely, a respondent can report many instances of activity that were only 5-10 minutes long, and be classified as highly active when they were not. Although duration is a better indicator of physical activity, it was not collected so we used frequency data.

When developing our measure of "neighborhood contentedness" in our first paper, we found that the validity of the index was not confirmed using the CASINO study data. It may, therefore, be useful to validate this measure using other adolescent surveys, as well as surveys that attempt to evaluate a cross section of the United States. The demographic differences between the two study populations were so stark that in retrospect it may not have been the best survey to use for validation.

In addition, it is important to note that the two studies that were conducted to investigate the relationship between PNC and activity patterns (physical and sedentary) were done using a cross-sectional analysis. The results are, therefore open to issues of

interpretation concerning temporality. It is possible that activity patterns of the adolescents may be impacting their perceptions of their neighborhood. Although this is a limitation of the cross-sectional design, it was important to us to evaluate feelings and activities concurrently to best evaluate the relationship.

5.4 FUTURE RESEARCH

The next step is to better develop the measure of neighborhood contentedness. The data presented suggests that it is a unique measure that would be of use in many public health applications. Establishing a measure that incorporates safety, comfort and familiarity in the neighborhood was one of the major goals of this research. Validation of the measure in other populations (both adolescent and adult) may help us to better hone the measure.

The development and validation of a measure of perceived neighborhood contentedness in the Add Health dataset has opened up many opportunities for future research. The Add Health survey is a continuing survey and has collected data from this population at two other time points (2001-02, 2007-08). These surveys were targeted at adults and have questions that pertain to that age group. Many more questions concerning disease were asked and, in addition, biological specimens were collected at these time points. Questions concerning arrests and experience in the criminal justice system were

asked as well. Relationships between neighborhood contentedness and some of these outcomes could be very interesting to investigate.

In addition, future research should focus on better understanding the relationship between perceived neighborhood contentedness and activity patterns, as well as other outcomes of interest. This measure should become part of questionnaires moving forward and be utilized to evaluate these feelings.

The data suggests that perceived neighborhood contentedness might affect activity choices that have been shown to lead to adverse health. Future research can focus on evaluating these measures during adolescence and investigating their relationships with some of the health outcomes late in life. Additionally, we can look at other adverse behavioral concerns that may be related to these perceptions. These include delinquent behavior and entrance into the criminal justice system.

There is also increasing evidence that behavior patterns in adolescence are a significant predictor of behavior patterns in adulthood (Li et al., 2009; Spanier et al., 2006). It would be interesting to compare the physical and sedentary activity data that were assessed in this study to leisure time activity patterns later into adulthood.

5.5 FINAL CONCLUSIONS

Developing a healthy lifestyle is important, and needs to begin at a young age. Promoting leisure time physical activity and reducing the rate of sedentary activity in adolescents is one major factor in this. It is important to better understand barriers to these lifestyle choices and try to develop interventions and promotions to overcome these barriers. This research shows that perceived neighborhood contentedness is a barrier, and should be considered.

This research has moved the understanding of this relationship forward by developing a new measure of neighborhood contentedness that builds on measures used in the past. In addition, it added to the current literature on the relationship between neighborhood perceptions and activity choices in adolescents.

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