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San Linh Le Date

Neighborhood Cohesion and the Prevalence of Obesity in Early Childhood

By

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Master of Public Health

Epidemiology

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Neighborhood Cohesion and the Prevalence of Obesity in Early Childhood

By

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B.A.
University of Pennsylvania
2016

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An abstract of
A thesis submitted to the Faculty of the
Rollins School of Public Health of Emory University
in partial fulfillment of the requirements for the degree of
Master of Public Health
in Epidemiology
2018

Abstract

Neighborhood Cohesion and the Prevalence of Obesity in Early Childhood
By San Linh Le

Introduction: In the last forty years, obesity has become a significant concern in the United States. Prevalence of obesity in children rose from 5% in the 1970s to almost 17% in 2012. Research has shown that the neighborhood social environment may be associated with obesity, but few studies have focused on neighborhood cohesion as the primary exposure in relation to obesity in youth. This analysis aims to investigate the association between individual-level neighborhood cohesion, its constructs, and the prevalence of obesity in children while also considering potential interaction with race/ethnicity.

Methods: Data on 1,711 families were taken from the Fragile Families and Child Wellbeing Study, a nationally representative study conducted to collect five waves of data beginning in February 1998. Using only baseline and age five data, linear and logistic regression models were run to examine the association between total neighborhood cohesion (TNC), BMI percentile, and obesity status. Logistic regression models were also run with each of the three neighborhood cohesion constructs – attachment to neighborhood, safety, trust/value (attitude) consensus – as the sole exposure and obesity status as the outcome.

Results: In the linear regression model including race/ethnicity interaction and adjusted for sex, baseline household income, mother marital status, and mother's BMI, an increase in TNC score was associated with a 0.76 increase in unit of BMI ($p<0.05$). In the fully adjusted logistic regression model without race/ethnicity interaction, the odds of being obese were 0.85 (95% CI: 0.65, 1.11). Being Hispanic may influence the association between TNC and BMI percentile, but not obesity status. Neighborhoods with higher trust/value (attitude) consensus had lower odds of being obese.

Conclusions: Youth who live in higher socially cohesive neighborhoods have increased likelihood of having higher BMI percentile but lower odds of being considered obese than those who live in lower socially cohesive neighborhoods. Identifying as Hispanic may have influenced this result. As this is the first study to consider neighborhood cohesion, its constructs, and obesity specifically in youth, future research is needed to better understand the possible pathways and mechanisms in which neighborhood cohesion influences obesity among this population.

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Acknowledgements

Research reported in this publication was supported by the Eunice Kennedy Shriver National Institute of Child Health and Human Development (NICHD) of the National Institutes of Health under award numbers R01HD36916, R01HD39135, and R01HD40421, as well as a consortium of private foundations. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

I want to thank my thesis advisor Dr. Shakira Suglia for her guidance throughout this process. I could have never imagined accomplishing this on my own and without her support and expertise, this thesis would not have been possible. Additionally, my friends and family provided their much-needed and never-ending encouragement and positivity, so thank you.

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I. BACKGROUND/LITERATURE REVIEW

Obesity Overview

In the United States, the prevalence of obesity in both adults and children has increased dramatically in the last 40 years. Only 14.5% of adults over 20 years old were considered obese in 1976, but that statistic has more than doubled to 35.1% in 2012 (1). When combining overweight and obese status together, the statistic rises to 69% (1). Childhood obesity has increased as well since the 1970s by almost threefold (2). Compared to only 5% of children in the 1970s who were obese, almost 17% of children today are obese and one out of three children are either obese or overweight (2). For children between two and five years old, 8.4% are obese and 22.8% are overweight or obese (1). Higher prevalence of obesity can lead to a rise in many serious health outcomes, as it is a risk factor for conditions such as Type 2 diabetes, high blood pressure, and heart disease (3).

Obesity is defined as having excess body fat and overweight is defined as "having excess body weight for a particular height from fat, muscle, bone, water, or a combination of these factors," and can be measured in several ways (3). In studies, the most common way to measure obesity is the Body Mass Index (BMI) scale. Used by the Centers for Disease Control and Prevention (CDC) and World Health Organization (WHO), BMI assesses how different levels of adiposity, or body fat, could be associated with certain health risks (4-5). Calculation of BMI involves dividing weight in kilograms by height in meters squared. For adults, the categories for BMI are underweight (<18.5), normal weight (18.5-24.9), overweight (25-29.9) and obese (≥30) (4). There are sex- and children-specific scales as well to account for growth differences. For the children-specific BMI

scale, children are obese or overweight if they are at or above 95th percentile, or between the 85th and 95th percentile, respectively (6). Obesity can also be measured using waist-to-hip ratio or caliper measurements, but BMI is used most often because it is simple to measure height and weight and calculate without any equipment or training.

Researchers over the years have explored the associations between a variety of environmental factors and obesity as well as obesity-related behaviors. Although individual factors like metabolism and behavior affect a person's weight, environmental factors can also heavily contribute to and shape a person's diet, physical activity, and development of healthy habits. Environmental factors can include the neighborhood physical and social environment, individual perceptions and emotions of the community, and socio-demographic characteristics such as neighborhood education and poverty. In addition to environmental factors impacting obesity, obesity-related behaviors, and other health conditions, studies have shown that these factors interact with and influence each other as well (7-15).

Neighborhood Environments

Neighborhood environment is commonly known to play a role in obesity because it can impact multiple aspects of daily lives, such as diet and physical activity. The neighborhood environment is comprised of two primary domains: physical and social (16). The physical environment of a neighborhood is defined as environmental exposures as well as the man-made physical structure of communities (16). Environmental exposures include air pollution or hazardous

chemicals, whereas physical structure can include important resources such as recreational spaces, sidewalks, healthy and well-stocked grocery stores, or public transportation (17). Thus, the lack or presence of these resources greatly influences individuals' decisions to exercise and maintain a healthy diet. Papas et al. conducted a study summarizing research related to the built environment and risk of obesity, in which 17 out of 20 studies found a statistically significant positive relation (18). However, inconsistent measures of physical environment, overall definition of neighborhood, and cross-sectional study design were brought up as limitations of the studies.

Perceptions of the neighborhood environment, such as the amount of traffic, trash or litter, and other physical conditions are also influential to the prevalence of obesity (10). Negative perceptions of the neighborhood environment, in particular, are associated with increasing BMI among adults (10).

Neighborhood Social Environment

Neighborhood social environment, defined as the "relationships, groups, and social processes that exist between individuals and groups who live and work in a neighborhood," is the second major domain of the neighborhood environment (7, p. 107). Concepts such as social cohesion, social capital, collective efficacy, social norms, neighborhood crime and safety, poverty, and segregation are considered as "social" features of a neighborhood (19-24).

Beyond neighborhood socioeconomic status, the neighborhood social environment and its impact on physical health outcomes are not as widely

investigated as it is with the neighborhood physical environment. Research on the social environment of the neighborhood focuses primarily on mental health outcomes like depression and depressive symptoms (16). For example, Diez Roux and Mair reviewed literature on neighborhoods and health and found associations between violence or hazardous conditions and depression in half of 12 studies (16). The mechanisms or pathways in which the social environment impacts health are still unclear; however, the neighborhood social environment is hypothesized to "facilitate the transmission of behaviors, enforce norms and social control," thereby affecting health by reducing and buffering stress (16).

It is only recently that researchers have started to investigate associations between neighborhood social environment and physical health outcomes, mostly body mass index, self-rated health, and cardiovascular outcomes. Several studies reported more crime, less safety, and higher levels of social disorder being linked to worse self-rated health or higher mortality and BMI (25-28). However, another study examining safety reported contrasting results and most studies are limited by individual-level measures and cross-sectional designs (9).

Neighborhood Cohesion

Although the neighborhood social environment is beginning to gain traction in research, the concept of neighborhood cohesion is still often overlooked or rarely examined on its own in relation to health outcomes. Neighborhood cohesion is defined as a "collective characteristic measured by the levels of trust, reciprocity and the formation of strong social bonds within neighbourhoods or communities" (29). In measurement, the concept can

translate to value consensus, feelings of safety, and social interaction to refer to the strength of individual ties and relationships and attachment to the neighborhood. General measurement of the neighborhood social environment can be difficult and multi-faceted but by focusing on solely neighborhood cohesion, researchers would touch on the elemental "social" factors that influence other subjective aspects like disorder. However, it is important to distinguish between individual- and neighborhood-level measures of neighborhood cohesion to appropriately evaluate the association of interest.

Based on the studies examined, results have shown associations between neighborhood cohesion and a variety of health outcomes (30-44). In a systematic review, Kim et al. noted in 10 out of 17 studies on adults and children that lower scores of social cohesion or capital was associated with worse self-rated health (23). A 2009 study of 3,394 adults in Australia found a significant 17% increase in the odds reporting good-or-above health for higher levels of perceived neighborhood cohesion (30). Similarly, a 2013 study of 2,368 adults in Los Angeles County reported a statistically significant 17% decrease in the odds of reporting fair or poor health for higher perceived neighborhood cohesion as well as when neighborhood-level cohesion is considered (38). Another study based in Switzerland found similar results (44). Five studies considered the additional effect of race/ethnicity or immigrant status on the association between neighborhood cohesion and self-rated health, mental health, or hypertension and diabetes, and all yielded statistically significant odds or coefficients (32, 34, 37, 39, 41). For mental health outcomes, 11 out of 16 studies have found that greater social cohesion, social capital, and reciprocal exchanges between individuals in

the same neighborhood are protective against depression (16). A cross-sectional study of 2,022 adults in the U.S. determined that higher neighborhood cohesion resulted in fewer daily stressors (33). Analysis of 2,619 adults living in neighborhoods in Maryland, New York, and North Carolina indicated that the effect of neighborhood cohesion is slightly more negatively associated with depressive symptoms for women (OR = 0.89) than for men (OR = 0.96) (42).

Several studies have focused specifically on obesity and obesity-related health behaviors, but results are mixed. A longitudinal study on 680 youth in Chicago linked living in high socially cohesive areas to less inactivity in recreational program participation and higher frequency of physical activity (31). In 2017, Yu found that for 7,717 adults older than 65 years, neighborhood cohesion was not associated with obesity, but that the probability of obesity is lower with more physical activity (36). A cross-sectional study of 2,300 participants in Toronto, Canada reported a statistically significant 4% decrease in BMI for those living in neighborhoods with higher social cohesion (OR = 0.96); it is an additional 2% decrease for women (40).

Interaction Between Race/Ethnicity and Neighborhood Cohesion

There are few studies examining the possible interaction between race/ethnicity and neighborhood cohesion. Five studies considered the additional effect of race/ethnicity or immigrant status on the association between neighborhood cohesion and self-rated health, mental health, or hypertension and diabetes, and all yielded statistically significant odds or coefficients (32, 34, 37, 39, 41). However, these studies either looked at populations of a single

race/ethnicity or the racial composition of neighborhoods and how that may influence the exposure and outcome of interest. For obesity as an outcome, Yu's 2017 study on physical activity and neighborhood cohesion also explored racial/ethnic differences in obesity by using stratified analyses (36). Yu found a significant result for Hispanic older adults, where meeting the recommended level of physical activity was associated with lower likelihood of obesity (36).

Neighborhood Cohesion Constructs

Neighborhood cohesion is one aspect of the neighborhood social environment, but there are different constructs of cohesion that play a role in influencing health. Few studies look at cohesion at this theoretical level. Some constructs include trust, attachment to neighborhood, and tolerance or respect. In 2003, Stafford discussed an approach to measuring and developing a scale for neighborhood cohesion (43). She explained the structural, such as family and friendship ties, participation in organized activities, integration into wider community, and cognitive aspects of cohesion, like trust, attachment to neighborhood, tolerance/respect, and practical help. Both structural and cognitive aspects are important contributors to cohesion as a whole. In 2017, Dupuis' study validated the Perceived Neighborhood Social Cohesion questionnaire, which consisted of three subscales: trust, attachment to neighborhood, and tolerance and respect (44). These are also the three dimensions of neighborhood cohesion. The results supported the validity and reliability of the questionnaire and its use of the subscales. Including constructs

of neighborhood cohesion may aid in understanding its influence on both mental and physical health.

Literature Summary & Overview of Analysis

Overall, there has been a multitude of studies on the impact of the neighborhood environment – both physical and social – on various mental and physical health outcomes. Often cross-sectional, these studies attempt to capture the many aspects of the neighborhood environment by measuring concrete factors, such as the number of grocery stores or sidewalks, and the more subjective factors like perceived safety and social interaction. In terms of the neighborhood social environment, studies have focused more on mental rather than physical health outcomes, and include multiple social features. Neighborhood cohesion, a social feature, can affect behaviors related to physical activity, diet, and overall motivation to live healthily. The lack of a cohesive neighborhood throughout childhood could reinforce unhealthy behaviors leading to obesity, thus studying neighborhood cohesion and its potential effects on childhood obesity could reveal the importance of having support from external sources within close proximity to home. While there are some studies investigating specifically neighborhood cohesion, the population of interest is usually adults. Few studies have examined the association between neighborhood cohesion and obesity in youth, and even fewer have considered cohesion constructs and possible interaction with race/ethnicity.

Goals of this analysis are to assess the extent to which neighborhood cohesion factors, and neighborhood cohesion as a whole, contribute to obesity in

children while also considering interaction with race/ethnicity. The primary hypothesis is that youth who live in high socially cohesive neighborhoods are less likely to have a higher BMI percentile and be considered obese than those who live in low socially cohesive neighborhoods.

II. MANUSCRIPT

Neighborhood Cohesion and the Prevalence of Obesity in Early Childhood
By San Linh Le

Introduction: In the last forty years, obesity has become a significant concern in the United States. Prevalence of obesity in children rose from 5% in the 1970s to almost 17% in 2012. Research has shown that the neighborhood social environment may be associated with obesity, but few studies have focused on neighborhood cohesion as the primary exposure in relation to obesity in youth. This analysis aims to investigate the association between individual-level neighborhood cohesion, its constructs, and the prevalence of obesity in children while also considering potential interaction with race/ethnicity.

Methods: Data on 1,711 families were taken from the Fragile Families and Child Wellbeing Study, a nationally representative study conducted to collect five waves of data beginning in February 1998. Using only baseline and age five data, linear and logistic regression models were run to examine the association between total neighborhood cohesion (TNC), BMI percentile, and obesity status. Logistic regression models were also run with each of the three neighborhood cohesion constructs – attachment to neighborhood, safety, trust/value (attitude) consensus – as the sole exposure and obesity status as the outcome.

Results: In the linear regression model including race/ethnicity interaction and adjusted for sex, baseline household income, mother marital status, and mother's BMI, an increase in TNC score was associated with a 0.76 increase in unit of BMI ($p<0.05$). In the fully adjusted logistic regression model without race/ethnicity interaction, the odds of being obese were 0.85 (95% CI: 0.65, 1.11). Being Hispanic may influence the association between TNC and BMI percentile, but not obesity status. Neighborhoods with higher trust/value (attitude) consensus had lower odds of being obese.

Conclusions: Youth who live in higher socially cohesive neighborhoods have increased likelihood of having higher BMI percentile but lower odds of being considered obese than those who live in lower socially cohesive neighborhoods. Identifying as Hispanic may have influenced this result. As this is the first study to consider neighborhood cohesion, its constructs, and obesity specifically in youth, future research is needed to better understand the possible pathways and mechanisms in which neighborhood cohesion influences obesity among this population.

Introduction

In the last forty years, obesity has become a significant concern in the United States. Childhood obesity has increased since the 1970s by almost threefold (2). Prevalence of obesity in children rose from 5% in the 1970s to almost 17% in 2012. For children between two and five years old, 8.4% are obese and 22.8% are overweight or obese (1).

The rising prevalence of obesity is a concern in multiple fields for several reasons. Obesity is a risk factor for many serious health conditions, such as Type 2 diabetes, high blood pressure, and heart disease, which can lead to a decline in mental health and quality of life as well as increased mortality (3). Although children are constantly developing in their early years, having obesity as a child can set up unhealthy behaviors and lead to unwanted health outcomes, including the increased risk of adolescent and adult obesity, in their mature years (3). Additionally, annual medical costs for care associated with obesity and obesity-related conditions were estimated at $190 billion in the U.S. (45).

A variety of individual factors contribute to higher prevalence of obesity overall. Nutrition and physical activity are two of the main factors because dietary preferences have become increasingly unhealthy due to processed foods and new technology has led to a rise in sedentary behavior. Other factors leading to obesity include genetic, social, environmental, and behavioral determinants. Though genetic components are mostly out of the individual's control, behavioral interventions can be effective in changing dietary and exercise habits. Social and environmental factors are more difficult to modify, but they are nonetheless

important influences that are worth evaluating to better improve obesity interventions.

Neighborhood social environment, defined as the "relationships, groups, and social processes that exist between individuals and groups who live and work in a neighborhood," is one of the major domains of the neighborhood environment influencing health behaviors (7, p. 107). Concepts such as social cohesion, social capital, collective efficacy, social norms, neighborhood crime and safety, poverty, and segregation are included as "social" features of a neighborhood (19-24). Although the mechanisms or pathways in which the social environment impacts health are still unclear, the neighborhood social environment is hypothesized to "facilitate the transmission of behaviors, enforce norms and social control" (16).

Neighborhood cohesion – a less studied concept of the neighborhood social environment – is defined as a "collective characteristic measured by the levels of trust, reciprocity and the formation of strong social bonds within neighbourhoods or communities" (29). Neighborhood cohesion can affect behaviors related to physical activity, diet, and overall motivation to live healthily. Several studies have focused specifically on adult obesity and obesity-related health behaviors, but results are mixed. For example, a 2017 study found that for adults older than 65 years, neighborhood cohesion was not associated with obesity, but physical activity was associated with lower likelihood of obesity for Hispanic older adults (36). Yu's study was the only one exploring racial/ethnic differences in obesity by using stratified analyses (36). On the other hand, a

cross-sectional study of participants in Toronto, Canada reported a statistically significant 4% decrease in BMI for those living in neighborhoods with higher social cohesion (OR = 0.96); it is an additional 2% decrease for women (40). The lack of a cohesive neighborhood throughout childhood could also reinforce unhealthy behaviors leading to adult obesity. For instance, a longitudinal study on 680 youth in Chicago linked living in high socially cohesive areas to less inactivity in recreational program participation and higher frequency of physical activity (31). Another study in 2006 found low levels of collective efficacy – a construct involving cohesion and informal social control – to be associated with obesity in adolescents of Los Angeles County (19). However, to our current knowledge there are no studies looking at neighborhood cohesion as the primary exposure in relation to obesity in youth.

Neighborhood cohesion can also consist of separate constructs, notably on the structural and cognitive levels, that play a role in influencing health (43). Some constructs include family and friend ties, trust, attachment to neighborhood, and tolerance or respect. In 2017, Dupuis' study validated the Perceived Neighborhood Social Cohesion questionnaire, which consisted of three dimensions of neighborhood cohesion: trust, attachment to neighborhood, and tolerance and respect (44). The results supported the validity and reliability of the questionnaire and its use of the subscales. Few studies look at cohesion at this theoretical level, but including constructs of neighborhood cohesion may aid in understanding its influence on both mental and physical health.

Using data from the Fragile Families and Child Wellbeing Study (FFCWS), this analysis aims to investigate the association between individual-level neighborhood cohesion, its constructs, and the prevalence of obesity in children while also considering potential interaction with race/ethnicity. It is hypothesized that youth who live in high socially cohesive neighborhoods are less likely to have a higher BMI percentile and be considered obese than those who live in lower socially cohesive neighborhoods.

Methods

Study Design

Data for this analysis was obtained from the publicly available Fragile Families and Child Wellbeing Study (FFCWS), a nationally-representative study conducted in a joint effort by Princeton University's Center for Research on Child Wellbeing (CRCW) and Center for Health and Wellbeing (CHW), the Columbia Population Research Center (CPRC), and the National Center for Children and Families (NCCF) at Columbia University (46). The study began collecting baseline data in February 1998 and continued throughout September 2000. FFCWS also conducted five waves of follow-up when the children were ages one, three, five, nine, and fifteen; we are using only baseline and age five data. In a collaborative study – the In-Home Longitudinal Study of Pre-School Aged Children – primary caregiver surveys and in-home assessments were included from the third wave onward to collect information on the child's environment and health status.

Study Population

FFCWS follows a cohort of 4,898 families in 20 large – defined as populations of 200,000 or more – U.S. cities between 1998 and 2000. Sixteen of the 20 cities were selected using a stratified random sample of U.S. cities, categorized according to their "policy environments and labor market conditions" (47, p. 4). The study focuses on "fragile families" – unmarried parents and their children who have a higher risk of breaking up and living in poverty – and thus includes an oversample of non-marital births (46). Approximately 3,700 children were born to unmarried parents.

Participants were sampled from birthing hospitals within each city. To oversample unmarried births, interview quotas for the number of unmarried and married parents were set at each hospital to represent the hospital's 1996-1997 unmarried birth rates. All possible maternity beds had an equal chance of being sampled, but eligibility requirements for the study were based on the need to interview both parents of a child who would be residing with the mother, father, or both over the next five years. The study population excluded mothers who: 1) placed infants for adoption, 2) reported the child's father as deceased, 3) are minors in hospitals that do not permit inclusion of minors in studies, 4) discharged from the hospital before screening, 5) were not able to participate in an interview in English or Spanish, or 6) were screened after the quota for married and unmarried participants had been reached. Fathers were only eligible if the mother completed the baseline interview.

Once eligibility was confirmed during the screening, mothers immediately completed a baseline interview unless the father was visiting; in this case, the father was interviewed first since his availability varied more than the mother's. Following the baseline interview, all mothers who remained eligible were contacted for follow-up interviews in each wave. For the primary caregiver surveys and in-home assessments of the In-Home Longitudinal Study of Pre-School Aged Children, respondents were only invited to participate if they completed the Three-Year Core survey. For the Core survey in all waves, there was a response rate of at least 85% for mothers and at least 70% for fathers. Due to the higher response rate for mothers, we are considering only Core surveys completed by mothers for our analysis.

Of the 4,898 eligible families in the FFCWS study, we excluded 1,875 families who were lost to follow-up and did not complete the in-home assessment for Year 5. We further excluded 858 families without child BMI percentile data and 299 families without mother responses to all survey questions related to neighborhood cohesion since this would make scoring impossible or inconsistent. Finally, an additional 152 families with missing data or implausible values for child's sex, maternal race/ethnicity, household income, maternal marital status, or mother's BMI were excluded because they were included as covariates for analysis and require completeness. The final sample for our analysis consists of 1,711 families, which represents families with complete covariate, exposure, and outcome data for baseline and Year 5 waves. Compared to the families who were loss to follow-up, our final sample differs only in the distributions of non-

Hispanic Black (41.7% versus 52.6%) and Hispanic ethnicity (31.3% versus 24.1%).

Data Collection

FFCWS baseline maternal data are collected by field staff in birthing hospitals. All follow-up interviews with mothers and fathers were conducted by telephone using a Computer Assisted Telephone Instrument (CATI) (47, p. 23). Field interviewers were assigned to those who could not be contacted by phone. Original FFCWS data was coded based on survey responses and minor changes were made to questions such as income. However, limited data cleaning was performed to allow users to consider different methods in analysis.

The Core study consists of interviews with both mothers and fathers at each wave. The parent interviews include relevant information such as demographic characteristics, economic and employment status, attitudes, and neighborhood characteristics. Neighborhood cohesion survey questions were asked in Year 3 and Year 5 waves during the in-home assessments. The in-home interview also collected information on children's health, including measurements of child and maternal height and weight.

Measures

Outcome Variable

The main outcomes of this study are child BMI percentile and dichotomous obesity based on data from Year 5. A constructed BMI percentile

variable was included in the dataset, calculated by FFCWS researchers using height and weight measurements collected from the first activity of the in-home assessments. Obesity was defined using the Centers for Disease Control and Prevention (CDC) children-specific guidelines for a BMI at or above the 95th percentile (6). Based on a BMI percentile variable included in the dataset, a dichotomous obesity variable was created to separate individuals into obese or not obese statuses, with 1 coded as obese. BMI percentile and dichotomous obesity were examined.

Exposure Variable

Neighborhood cohesion was the exposure of interest in this study. The survey questions related to neighborhood cohesion were obtained from the Year 5 Core mother interview. The neighborhood cohesion survey questions were reconstructed from the Informal Social Control Scale, the Social Cohesion and Trust Scale, and the Neighborhood Environment for Children Rating Scales (48-50). Total neighborhood cohesion (TNC) was calculated using ten items from two multi-part questions. The first 5-item question asked how likely it would be for neighbors to intervene or get involved if "children were skipping school and hanging on the street," "children were spray painting buildings with graffiti," "children were showing disrespect to an adult," "a fight broke out in front of the house," and "the fire station closest to the neighborhood was threatened and its budget was cut" (51, p. 108). This 5-item question addressing intervention is commonly used to measure informal social control, a construct that is closely related to social cohesion (19, 48). The second 5-item question asked how

strongly the mother agreed that “people around here are willing to help their neighbors,” “this is a close-knit neighborhood,” “people in neighborhood generally don't get along with each other,” “people in this neighborhood do not share the same values,” and “gangs are a problem in this neighborhood” (51, p. 108). This second 5-item question has been commonly used to measure neighborhood cohesion in previous studies (49). Responses were measured on a four-point scale and reverse-coded so that a score of 1 is “very unlikely” and “strongly disagree,” respectively, and a score of 4 is “very likely” and “strongly agree,” respectively. Scores of the ten items were averaged to create a total neighborhood cohesion variable ranging from 1 to 4, with a higher number indicating a higher degree of neighborhood cohesion.

In addition, three constructs of neighborhood cohesion were also assessed: (1) Attachment to neighborhood, (2) safety, and (3) trust/value (attitude) consensus. The subscales were partially adapted from the P-NSC Questionnaire developed by Dupuis et al., which consists of three dimensions of neighborhood cohesion: trust, attachment to neighborhood, and tolerance and respect (52). Although safety can often be characterized as a separate construct related to the physical neighborhood environment, Baum and colleagues found that neighborhood cohesion could make people feel safer, thus the “two concepts overlap and interact at the community level, reinforcing or detracting from each other” (30, p. 933). Abada et al. included safety in the study’s neighborhood cohesion scale and reported statistically significant coefficients for general health (37). The addition of safety as a subscale instead of tolerance and respect will

allow us to capture the complexities of neighborhood cohesion related to the physical environment. Attachment to neighborhood was assessed by survey questions asking about agreement with (1) “this is a close-knit neighborhood” and (2) “people in neighborhood generally don't get along with each other.” Safety was assessed by agreement with “gangs are a problem in this neighborhood." Trust/value (attitude consensus) was assessed by the remaining two agreement and five intervention questions.

For analysis, a variable was created for the log of the safety subscale since it was not normally distributed.

Covariates

The following covariates were considered in the analysis examining the association between neighborhood cohesion and obesity. These factors were included based on previous literature.

The mother’s BMI from year 5 was a constructed continuous variable given in the dataset. FFCWS used height and weight measurements collected from the in-home assessments to calculate BMI. This variable was included to account for the potential effect of genetic factors and maternal behaviors on BMI and obesity.

Mother marital status from baseline was also an included constructed variable, with yes and no as response options. This variable was included to control for potential psychological stressors of a single-parent household.

Demographic Characteristics

Demographic characteristics included in the analysis are individual SES, sex of the child, and race/ethnicity. These demographic covariates were included based on existing literature demonstrating the relationship between these characteristics and BMI percentile.

Individual-level SES

Individual-level SES is measured as the total household income in this analysis. Total household income was collected in the Core surveys as a continuous variable. For analysis, a categorical total household income variable was created to group incomes into five roughly equally distributed categories: less than $7,500, $7,500 to less than $17,500, $17,500 to less than $30,000, $30,000 to less than $42,500, and greater than $42,500.

Sex (child)

Sex of the child was collected from the birthing hospital medical records, and is coded as “female” or “male.”

Race/Ethnicity

Race and ethnicity were collected by FFCWS and reported in the Core surveys. There were five different race options for respondents to select: (1) White, (2) Black, African-American, (3) Asian or Pacific Islander, (4) American Indian, Eskimo, Aleut, or (5) Other, not specified. Hispanic ethnicity was reported as “yes” or “no.” FFCWS constructed a separate race/ethnicity variable with four categories to avoid having small numbers in certain groups. These categories include non-Hispanic white, non-Hispanic black, Hispanic, and other.

Analysis

All analyses were conducted using SAS Version 9.4. There were six steps involved in the analysis of neighborhood cohesion and obesity.

First, descriptive statistics of the characteristics of the sample population were obtained through univariate analysis. Characteristics were examined first by baseline and Year 5 waves, and then by obesity status. Chi-square analyses were performed to determine if there were demographic differences between the two obesity strata. Two-sample t-tests were also performed to test if total neighborhood cohesion, safety, and child BMI percentile were differential by sex.

Second, unadjusted linear regression analyses were conducted to examine the relationship between BMI percentile and selected demographic characteristics and neighborhood cohesion variables. Each demographic characteristic or neighborhood cohesion variable was used as a single predictor in each model.

Third, multivariate linear regression analyses were run with total neighborhood cohesion as the exposure and BMI percentile as the outcome. Demographic characteristics – including sex of the child, baseline household income, and mother marital status – and mother's BMI were potential confounders and thus were adjusted for in the model. Mother race/ethnicity was a potential effect modifier so interaction terms between mother race/ethnicity and the exposure were considered in the full model. An interaction assessment was performed for mother race/ethnicity indicator variables, and terms not meeting statistical significance of $\alpha = 0.05$ were eliminated. Afterwards, the final

model for multivariate linear regression was determined. Considering the significance of racial interaction, multivariate linear regression analyses were also run with stratification by mother's race/ethnicity.

Fourth, logistic regression bivariate analyses were conducted to obtain crude odds ratio estimates of obesity for each demographic variable, all of which are categorical, in order to examine the relationship between dichotomous obesity and selected demographic characteristics.

Fifth, four multivariate logistic regression models were run to obtain the odds of obesity for total neighborhood cohesion. The unadjusted model was run first, followed by a model controlling for demographic characteristics, a model controlling for mother's BMI, and a fully adjusted model with all covariates. Interaction assessment for the mother race/ethnicity variables was performed for the fully adjusted model to determine the final model for analysis. Multivariate logistic regression analyses were also run with stratification by mother race/ethnicity for the fully adjusted model.

Sixth, analyses of the unadjusted model and three adjusted models were conducted with each of the neighborhood cohesion constructs as the sole exposure to explore their relationships with obesity.

Unadjusted logistic regression model (Model 1):

$$\mathbf{P\,(OBESE = 1 \mid X) = \beta_0 + \beta_1 TOTALNC}$$

Multivariate logistic regression model, adjusted for demographic variables (Model 2):

$$\mathbf{P\ (OBESE = 1 \mid X) = \beta_0 + \beta_1 TOTALNC + \beta_2 SEX + \beta_3 BLACK + \beta_4 HISPANIC + \beta_5 OTHER + \beta_6 INCOME\_CAT1 + \beta_7 INCOME\_CAT2 + \beta_8 INCOME\_CAT3 + \beta_9 INCOME\_CAT4\ \beta_{10} MARITAL}$$

Multivariate logistic regression model, adjusted for mother's BMI (Model 3):

$$\mathbf{P\ (OBESE = 1 \mid X) = \beta_0 + \beta_1 TOTALNC + \beta_2 MOMBMI}$$

Multivariate logistic regression model, adjusted for demographic variables and mother's BMI (Model 4):

$$\mathbf{P\ (OBESE = 1 \mid X) = \beta_0 + \beta_1 TOTALNC + \beta_2 SEX + \beta_3 BLACK + \beta_4 HISPANIC + \beta_5 OTHER + \beta_6 INCOME\_CAT1 + \beta_7 INCOME\_CAT2 + \beta_8 INCOME\_CAT3 + \beta_9 INCOME\_CAT4\ \beta_{10} MARITAL + \beta_{11} MOMBMI}$$

Where OBESE = 1 if CBMI_P ≥ 95, 0 if < 95

TOTALNC = continuous total neighborhood cohesion

SEX = 1 if female, 0 if male

BLACK = 1 if Non-Hispanic Black, 0 if otherwise

HISPANIC = 1 if Hispanic, 0 if otherwise

OTHER = 1 if Other Race, 0 if otherwise

INCOME_CAT1 = 1 if INCOME_CAT = 1, 0 if otherwise

INCOME_CAT2 = 1 if INCOME_CAT = 2, 0 if otherwise

INCOME_CAT3 = 1 if INCOME_CAT = 3, 0 if otherwise

INCOME_CAT4 = 1 IF INCOME_CAT = 4, 0 if otherwise

MARITAL = 1 if unmarried at baseline, 0 if married at baseline

MOMBMI = mother's BMI

Results

Descriptive Analysis

Distributions of the neighborhood cohesion variables, demographic characteristics, and covariates of interest in the baseline and Year 5 waves are shown in Table 1. The majority of mothers in the sample was non-Hispanic Blacks (52.6%), followed by Hispanics (24.1%), non-Hispanic Whites (20.5%), and those categorized as Other (2.9%). The sample consists of more male (52%) than female children (48%). In terms of total household income, the average was $31,532.1 (SD=$30,935.6) at baseline compared to $35,404.7 (SD=38,186.7) at Year 5. At both baseline and Year 5, the distributions of household income categories stayed relatively the same despite the increase in mean income. About a third of families (29% and 28.8%, respectively) were above $29,500 and almost a quarter of families had an income between $7,500 and $17,500 (22.9% and 23.6%, respectively). Most mothers were not currently married at baseline (78.8%). In Year 5, the average BMI is 16.6 (SD=2.5) for children, and 30.1 (SD=7.7) for mothers. The mean score for total neighborhood cohesion was 2.82 (SD=0.9). For the neighborhood cohesion subscales, the average scores for attachment to neighborhood, safety, and trust/value (attitude) consensus is 2.41 (SD=0.9), 1.77 (SD=0.8), and 3.09 (SD=1.0), respectively.

Distributions of the neighborhood cohesion variables, demographic characteristics, and covariates of interest are also available by obesity status in Year 5 and are shown in Table 2. About half of both groups are Black, but closer to a third (31.7%) of obese children were Hispanic compared to less than a quarter (22.6%) of non-obese children. Chi-square analyses revealed statistically significant differences in obesity status by race/ethnicity (χ^2=13.3, p<0.05). The majority of obese children were female (53.2%), while the majority of non-obese children were male (53%). Chi-square analyses did not indicate significant differences in obesity status by sex. Among families with obese children, the average total baseline household income is $28,419.2 (SD=$27,083.3), and 25% had an income between $7,500 and $17,500 and 24.7% had an income of over $42,500. For families with non-obese children, the average household income is higher ($32,151.6 with SD=$31,618.4) and the income distributions are comparable to distributions from baseline and Year 5 in Table 1. Chi-square analyses did not result in statistically significant differences in obesity status by categorical household income. More mothers (84.9%) are unmarried in the obese group versus the non-obese group (77.6%), and the chi-square test indicates differences in obesity status by mother marital status (χ^2=7.5, p<0.01). Concerning BMI, the mean mother BMI is higher for the obese group (33.7, SD=8.8) than the non-obese group (29.4, SD=7.2). For the neighborhood cohesion scales, the mean score for all scales except for safety was lower for families with obese children (TNC=2.77, SD=0.5; attachment to neighborhood=2.39, SD=0.5; trust/value (attitude) consensus=3.01, SD=0.7)

than for families with non-obese children (TNC=2.83, SD=0.5; attachment to neighborhood=2.42, SD=0.5; trust/value (attitude) consensus=3.10, SD=0.6). The average score for safety is 1.82 (SD=0.9) for the obese group compared to 1.76 (SD=0.8) for the non-obese group. Although not included in Table 2, two-sample t-tests were also performed to compare the mean of continuous total neighborhood cohesion, safety, and BMI percentile between male and female children. In all cases, the p-values were not statistically significant so there is no evidence of neighborhood cohesion, safety, and BMI percentile being differential by gender.

Linear Regression

Unadjusted linear regression was performed to assess the association between BMI percentile as the outcome and demographic characteristics, mother BMI, and neighborhood cohesion variables. Results are shown in Table 3. All race/ethnicities, besides the White, non-Hispanic reference group, were positively correlated with BMI percentile, but only being Hispanic was statistically significant. Being female was also positively correlated with child BMI percentile but is not statistically significant. Categories for baseline household income had a negative relationship with BMI percentile and are not statistically significant at the $\alpha=0.05$ level. Mother marital status and BMI were both significantly related to child BMI percentile. Neighborhood cohesion variables were slightly positively correlated with BMI percentile but are not significant at the $\alpha=0.05$ significance level.

Table 4 shows results of the final multivariate linear regression model with covariates and interaction terms, total neighborhood cohesion as the exposure, and BMI percentile as the outcome. TNC was positively and significantly correlated with BMI percentile, with each increase in score of neighborhood cohesion associated with a 0.76 increase in unit of BMI ($p<0.05$). Identifying as non-Hispanic Black, Hispanic, or Other were positively associated with BMI percentile, with Hispanic and Other races being the strongest ($\beta=3.03$ and $\beta=3.58$, respectively). However, only Hispanic ethnicity was statistically significant. Household income categories were slightly negatively associated with BMI percentile but were not significant at the $\alpha=0.05$ significance level. Mother marital status and BMI are also slightly positively associated with child BMI percentile ($\beta=0.33$ and $\beta=0.08$, respectively), but only mother BMI was statistically significant. After the interaction assessment, race/ethnicity was found to have significant interaction with TNC so they were included in the final model for analysis. The interaction between all races/ethnicities, except for the White, non-Hispanic reference group, and TNC were negatively correlated with BMI percentile but only the interaction with Hispanic ethnicity was significant ($p<0.05$).

Considering the significant interaction between race/ethnicity and TNC, Table 5 displays stratified results of the final multivariate linear regression model with selected covariates, TNC as the exposure, and BMI percentile as the outcome. For those identifying as non-Hispanic White, TNC was positively and significantly correlated with BMI percentile, with each increase in score of

neighborhood cohesion associated with a 0.80 increase in unit of BMI ($p<0.05$). Identifying as non-Hispanic Black was also positively associated with BMI percentile, but was not statistically significant. Hispanic and Other races/ethnicities were negatively associated with BMI percentile (β=-0.17 and β=-0.39, respectively), and neither were statistically significant.

Logistic Regression

Crude logistic regression analyses were performed to assess the association between obesity status as the outcome and categorical variables. Results are shown in Table 6. The odds of being obese were significantly higher for non-Hispanic Blacks (OR=1.36, 95% CI: 0.94-1.96) and Hispanics (OR=2.00, 95% CI: 1.34, 2.96) compared to the referent group of non-Hispanic Whites. The odds of being obese was also higher for those of other races/ethnicities, but were not statistically significant (OR=1.19, 95% CI: 0.50, 2.82). Non-significant differences in odds of obesity (OR=1.28, 95% CI: 1.00, 1.65) were observed for males and females, with males as the reference group. Having a household income of less than $7,500 or greater than $42,500 resulted in lower odds of obesity (OR=0.79, 95% CI: 0.49, 1.28 and OR=0.73, 95% CI: 0.48, 1.11, respectively) when compared to the referent group with an income between $30,000 and $42,500, but were not statistically significant. Income categories of $7,500 to $17,500 and $17,500 to $30,000 did not show differences in odds of obesity (OR=0.98, 95% CI: 0.64, 1.49 and OR=1.00, 95% CI: 0.64, 1.53). Mothers who were not married are 1.62 times (95% CI: 1.15, 2.29) more likely to have

children who become obese than mothers who are married; this point estimate was significant.

Table 7 displays the four logistic regression models with obesity status as the outcome and TNC as the exposure. In Model 1, the unadjusted odds of obesity for total neighborhood cohesion were 0.78 (95% CI: 0.60, 1.00). This indicates that those living in neighborhoods with higher total cohesion are less likely to become obese than those living in neighborhoods with lower total cohesion. In Model 2, we adjusted for demographic variables, which resulted in slightly higher odds of obesity (OR=0.81, 95% CI: 0.63, 1.05). In Model 3, we solely controlled for mother's BMI because of its potential role to act as a mediator between TNC and child obesity status. The odds increased to 0.83 (95% CI: 0.64, 1.07). In Model 4, we fully adjusted for all demographic characteristics as well as mother's BMI without interaction terms. The odds of being obese were 0.85 (95% CI: 0.65, 1.11). The point estimates for all four models were not statistically significant. The full model with race/ethnicity interaction terms was also assessed, but all terms were not found to be significant and were thus dropped.

Table 8 shows results of the fully adjusted logistic regression model, stratified by mother race/ethnicity. The odds of being obese for those identifying as non-Hispanic White are 1.53 (95% CI: 0.60, 3.92), which indicates that those living in neighborhoods with higher TNC are more likely to become obese than those living in neighborhoods with lower TNC. For non-Hispanic Black youth, the odds of being obese are 0.84 (95% CI: 0.60, 1.19). The odds continue to decrease for those identifying as Hispanic (OR=0.76, 95% CI: 0.46, 1.27). Results for those

identifying as Other were not presented because the group was unstable due to small sample size. All point estimates were not statistically significant.

The four logistic regression models were also run with attachment to neighborhood, safety, and trust/value (attitude) consensus each as the exposure instead of TNC. Results are shown in Table 9, Table 10, and Table 11. Those with higher attachment to neighborhood had lower odds of being obese than those with lower attachment to neighborhood, regardless of whether or not the model was adjusted; however, all point estimates were not statistically significant (Table 9). The odds of obesity were higher for higher scores of safety, regardless of whether or not the model was adjusted; all point estimates were not significant (Table 10). Neighborhoods with higher trust/value (attitude) consensus had lower odds of being obese for all models (Table 11). The unadjusted model was statistically significant, but models 2, 3 and 4 were not significant at the $\alpha=0.05$ significance level.

Discussion

Interpretation

Using data from FFCWS, this study aimed to assess the extent to which neighborhood cohesion factors, and neighborhood cohesion as a whole, contribute to obesity in children. The main results of this analysis demonstrated that youth who live in higher socially cohesive neighborhoods have increased likelihood of having higher BMI percentile but lower odds of being considered obese than those who live in lower socially cohesive neighborhoods. This finding

partially supports our hypothesis that youth who live in higher socially cohesive neighborhoods are less likely to be considered obese than those who live in low socially cohesive neighborhoods, even though the results were not statistically significant. However, the finding contrasted our hypothesis that youth in higher socially cohesive neighborhoods are less likely – as opposed to more likely – to have a higher BMI percentile than youth in lower socially cohesive neighborhoods. Interaction between race/ethnicity and total neighborhood cohesion appeared to be present and may have influenced this result, particularly for those identifying as Hispanic when compared to non-Hispanic White. For factors of neighborhood cohesion, youth living in neighborhoods with greater attachment and trust/value (attitude) consensus have decreased odds of being obese compared to youth living in neighborhoods with lower levels of those factors. However, greater perceived safety in a neighborhood appears to increase odds of being obese.

In existing literature, there is discussion of the possible pathways between neighborhood cohesion and obesity. Two possible pathways through which neighborhood cohesion might impact obesity are obesity-related behaviors such as physical activity and diet. Neighborhood cohesion can affect individual behaviors such as physical activity and diet if exercise and healthy eating are viewed as out-of-place, meaningless, or inappropriate in the neighborhood setting due to lack of attachment, safety, or trust in the area. Many studies have provided evidence for obesity-related behaviors as mediators. For example, in a 2009 longitudinal study, Cradock measured physical activity as the outcome and

reported a statistically significant association between neighborhood cohesion and physical activity for 680 youth in Chicago (31). In a 2017 cross-sectional study, Yu measured physical activity as the exposure instead and found significant relative risks with obesity for almost 8,000 adults over 65 years of age in the U.S. (36). Halbert et al. looked at collective efficacy – which includes social cohesion and social capital – and obesity-related behaviors in 2013 among 338 African-Americans in Philadelphia and found associations between collective efficacy and fruit (OR = 1.56, 95% CI: 1.18, 2.07, p=0.002) and vegetable intake (OR = 1.25, 95% CI: 0.94, 1.65, p=0.12) (21). Franzini et al. examined the association between the neighborhood environment – both physical and social – and physical activity and obesity in 650 fifth graders in Birmingham, Los Angeles, and Houston (8). Her results showed a positive association between favorable social environment and several measures of physical activity and a negative association between activity and obesity, suggesting that physical activity is along the pathway between neighborhood social factors and obesity (8). Similarly, the findings of Mujahid et al. found that the associations between neighborhood social factors and BMI varied by sex, but only varied after adjusting for diet and physical activity (9). In our analysis, data for diet and physical activity were not available and thus, there is potential for our estimates to have been influenced by these factors.

Another possible pathway through which neighborhood cohesion can affect obesity is stress. Much of the literature on the neighborhood social environment and cohesion focuses on mental rather than physical health

outcomes. By facilitating behaviors and enforcing norms, the neighborhood social environment influences health through stress – either by reducing or buffering it or the opposite effect (16, p. 131). Safety, for instance, is considered a feature of the social environment and can influence the level of stress an individual experiences, thereby affecting obesity. Burdette and colleagues, who also analyzed FFCWS data in 2006, found that as neighborhood safety decreased, the prevalence of obesity increased for mothers of young children ($p<0.05$) (25). Franzini et al. also considered safety in their analyses and found similar results (8). Aside from safety, there has been research examining specifically neighborhood cohesion and different mental health outcomes. Two longitudinal studies found inverse associations between neighborhood cohesion and depression even though one focused on adults aged 45 to 84 years in Maryland, New York, and North Carolina and the other looked at youth in Canada (42, 37). Two other studies investigated neighborhood cohesion with general mental health as the outcome; Dupuis et al. found a significant negative association for approximately 5,000 young men in a Swiss military center, but Mulvaney-Day et al.'s results were not significant for 2,554 Latino adults in the U.S. (44, 39). Instead of depression, Robinette et al. looked at daily stressors as the outcome and found a negative association with neighborhood cohesion for about 2,000 adults in the U.S. (33). Physiologically, stress can be represented by allostatic load, "the wear and tear the body experience[s] from stress," as expressed by Cohen et al. (17, p. 770). This can include constant high levels of cortisol excretion from experiencing daily stress, which is more likely for those living in

low collective efficacy neighborhoods and results in excess weight gain (17). Considering our non-significant results, it is possible that stress factors played a role in the analysis.

Our finding that children who live in higher socially cohesive neighborhoods have increased likelihood of having a higher BMI percentile than those who live in lower socially cohesive neighborhoods is inconsistent with current literature. In 2017, Guilcher et al. reported that for 2,300 adults in Toronto, Canada, there was a statistically significant 4% decrease in BMI for those living in neighborhoods with higher social cohesion (OR=0.96); it is an additional 2% decrease for women (40). Similarly, in 2012, Veitch et al. found a negative association between cohesion and BMI among 184 children in Melbourne, Austrialia. (20). These studies are in line with our hypothesized results. However, Guilcher et al. found a significant interaction with sex in their analysis, whereas there was only evidence of interaction with race/ethnicity in this study. Coupled with Guilcher's predominantly white sample and focus on the adult versus child population, the different interactions could affect the observed associations. On the other hand, Veitch's study examined a child population as well and is one of the few studies to also use both cross-sectional and prospective cohort designs. With a cross-sectional design, a causal inference cannot be made; regardless, Veitch's prospective association remained mostly the same (20). Because we also used a cross-sectional study design, it is possible that our finding is inconsistent with others due to unknown factors influencing the association between neighborhood cohesion and BMI. Additionally, a more cohesive

neighborhood could lead to more social interactions involving food, especially unhealthy foods that are typical of gatherings with children. This is a potential explanation for a higher BMI percentile in a more cohesive neighborhood, but not necessarily higher odds of obesity.

The results of this analysis also showed that youth who live in higher socially cohesive neighborhoods had lower odds of being considered obese than those who live in lower socially cohesive neighborhoods. This finding is consistent with Yu's cross-sectional study in 2017, which reported that for adults older than 65 years, neighborhood cohesion was inversely associated with obesity (RR=0.98, 95% CI: 0.82, 1.14) but the relative risk was not statistically significant (36). Powell-Wiley's cross-sectional study of approximately 5,000 adults in Dallas also yielded non-significant results but with a direct association instead of inverse (OR=1.08, 95% CI: 0.90, 1.30) (10). Although the studies had adult populations and found non-significant mixed results, this study can continue to add to the limited literature on the association between neighborhood cohesion and obesity. This is also the first study to examine the association for specifically children.

Based on the multivariate linear regression analyses including interaction terms, an interaction between race/ethnicity and total neighborhood cohesion may be present. The results showed a significant association between TNC and BMI percentile for those identifying as Hispanic, but stratified analysis by race/ethnicity show only a statistically significant result for the non-Hispanic White group. This indicates that although the association between TNC and BMI

percentile was not significant among Hispanic youth, the association is significant when comparing Hispanics to the non-Hispanic White referent group. A possible explanation for the non-Hispanic White group having an increased association with BMI in relation to TNC is the demographics of the neighborhood in which an individual resides. In this study, we were unable to examine factors such as the racial/ethnic distribution and median household income of neighborhoods, which may influence TNC through the stress pathway or interaction with other factors. Although the interaction between race and TNC was not present when conducting multivariate logistic regression, results from linear regression analyses warrant further research and consideration of how race/ethnicity and neighborhood cohesion may influence each other.

Along the lines of previous research, youth living in neighborhoods with greater attachment and trust/value (attitude) consensus have decreased odds of being obese compared to youth living in neighborhoods with lower levels of those factors. To our knowledge, there are currently no studies investigating the relationship of aspects of neighborhood cohesion – attachment to neighborhood and trust – and obesity. However, in 2015, Dupuis et al. found a significant negative association between neighborhood cohesion – which includes attachment to neighborhood, trust, and tolerance/respect – and physical health for approximately 5,000 young men in a Swiss military center (44). Dupuis' study focused only on young adult males who were in the military, though, which is an extremely different population from children. By breaking down neighborhood cohesion, this study could begin discussions on the different aspects of

neighborhood cohesion that affect health and obesity, specifically. In particular, trust/value (attitude) consensus appears to have a stronger relationship with obesity so it could be of value to further explore this aspect of neighborhood cohesion.

Unlike in previous research on safety and obesity, this study demonstrated that greater perceived safety in a neighborhood appears to increase odds of being obese. Although Burdette and colleagues also analyzed FFCWS data, they found that as neighborhood safety decreased, the prevalence of obesity increased for mothers of young children ($p<0.05$) (25). However, this could have been differential by gender, as shown by studies conducted by Mujahid et al. and Bacha et al. (9, 53). Franzini et al. considered safety in their analyses as well and found similar results with 650 fifth graders in Birmingham, Los Angeles, and Houston (8). Both studies included similar ethnic makeups to this study's racial/ethnic distribution. However, Burdette looked at the mothers of the children in FFCWS instead and also adjusted for television time. Franzini's study uniquely looked at associations with physical activity using multiple measures, whereas this study did not include physical activity in the analysis. While there are similar ethnic makeups between all studies, the different ages of the populations and inclusion of other covariates could lead to contrasting results.

Results were consistent with existing literature that observed an association between certain races/ethnicities and being obese. In this study, children who are non-Hispanic Black or Hispanic had greater odds of obesity

than children who are non-Hispanic White or other races/ethnicities. This relationship, regardless of age, is observed in literature (54, 55).

Limitations

As with many of the studies relating to neighborhood cohesion, a limitation of this study is the cross-sectional design. Using a cross-sectional design does not allow for causal inference and therefore the observed associations could be a result of other unknown factors. However, this study attempted to adjust for all known factors.

Another study limitation is the assessment of neighborhood cohesion, a neighborhood level variable, on the individual level. Neighborhood cohesion is based on individual perceptions (from the mother) of the social cohesiveness in the area she lives in and thus could likely vary based on personality or other individual characteristics. This likely did not affect the analysis since the study also looked at individual aspects of neighborhood cohesion. It was not possible to assess neighborhood cohesion on an aggregate level using FFCWS data.

Diet, physical activity, and stress were discussed as potential pathways between neighborhood cohesion and obesity, but were not included in the analysis due to lack of data. This is a limitation because the observed associations could be influenced by those factors. However, the study attempted to account for diet and physical activity with mother's BMI and stress with mother marital status.

Neighborhood cohesion is a construct that is hard to capture and thus has been measured in many different ways in previous literature. Because the definition of neighborhood cohesion varies from study to study, it is more difficult to compare this study to others. This was addressed by including three different aspects of neighborhood cohesion.

For this particular study, selection bias is likely because of the differential loss to follow-up. As a result, there may be other variables affecting both neighborhood cohesion and obesity that researchers have not accounted for.

Lastly, this study used data from FFCWS that oversampled unmarried mothers that make up "fragile families." Because the sample contains low-income single mothers, the results are not as generalizable to other populations with different characteristics.

Strengths

Despite the limitations, this study has many strengths. First, the sample taken from FFCWS data is large, nationally representative, and inclusive of Black and Hispanic participants. Second, height and weight were objectively measured instead of self-reported; this results in accurate BMI percentile calculations. Third, although the sample consists of mostly "fragile families" and is not as generalizable, the study attempts to look at disadvantaged populations with health disparities in mind.

One unique strength of the study is the inclusion of neighborhood cohesion constructs: attachment to neighborhood, safety, and trust/value

(attitude) consensus. In previous literature, researchers measured neighborhood cohesion as a whole instead of looking at the different aspects that make up cohesion. By examining the factors that contribute to neighborhood cohesion, we are able to test independent associations with obesity as the outcome of interest. Additionally, including safety within neighborhood cohesion is another strength of this study. There is existing literature on safety as its own construct, but not as an aspect of cohesion. However, because of the overlapping influences of safety and neighborhood cohesion on each other, this study added safety as a subscale to account for the complexities of cohesion related to the physical environment.

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TABLES

Table 1. Baseline and Year 5 characteristics among children and mother FFCWS study participants in the United States (N = 1,711)[a]

	Baseline		*Year 5*	
	N or Mean (SD)	**%**	**N or Mean (SD)**	**%**
Race/Ethnicity (mother)				
White, non-Hispanic	350	20.5		
Black, non-Hispanic	900	52.6		
Hispanic	412	24.1		
Other	49	2.9		
Sex (child)				
Male	882	52.0		
Female	889	48.0		
Household Income	31,532.1 (30,935.6)		35,404.6 (38,186.7)	
< 7,500	245	14.3	246	14.4
7,500 to <17,500	392	22.9	404	23.6
17,500 to <30,000	350	20.5	319	18.6
30,000 to <42,500	228	13.3	249	14.6
> 42,500	496	29.0	493	28.8
Mother Marital Status				
Married	363	21.2		
Not Married	1,348	78.8		
BMI				
Child			16.6 (2.5)	
Mother			30.1 (7.7)	
Neighborhood Cohesion[b]				
Attachment to Neighborhood[c]			2.41 (0.9)	
Safety[d]			1.77 (0.8)	
Trust/Value (attitude) Consensus[e]			3.09 (1.0)	
Total[f]			2.82 (0.9)	

[a]The total sample size in this analysis excludes those lost to follow-up from baseline to year 5, children without BMI measurements in both baseline and Year 5, those without parental responses for neighborhood cohesion survey questions, and those with missing values for covariates.

[b]Scores are on a scale of 1-4. (1) Strongly disagree or Very unlikely, (2) Disagree or Unlikely, (3) Agree or Likely, (4) Strongly Agree or Very Likely

[c]Assessed by survey questions asking "Do you strongly agree, agree, disagree, or strongly disagree?: (1) This is a close-knit neighborhood, (2) People in neighborhood generally don't get along with each other."

[d]Assessed by survey question asking "Do you strongly agree, agree, disagree, or strongly disagree?: Gangs are a problem in this neighborhood."

[e]Assessed by survey questions asking "Do you strongly agree, agree, disagree, or strongly disagree?: (1) People around here are willing to help their neighbors, (2) People in this neighborhood do not share the same values" and "Would you say it is very likely [your neighbors] would intervene, somewhat likely, not very likely, or very unlikely?: (1) If children were skipping school and hanging on the street, (2) If children were spray painting buildings with graffiti, (3) If children were showing disrespect to an adult, (4) If a fight broke out in front of the house, (5) If the fire station closest to the neighborhood was threatened and its budget was cut."

[f]Assessed by combining survey questions related to attachment to neighborhood, safety, and trust/value (attitude) consensus.

Table 2. Baseline characteristics among children and mother FFCWS study participants in the United States, by child obesity status in year 5 (N = 1,711)[a]

	Not Obese (n = 1,427)		*Obese (n = 284)*		
	N or Mean (SD)	**%**	**N or Mean (SD)**	**%**	**χ^2 (p-value)**
Race/Ethnicity (mother)					13.3 (<0.05)
White, non-Hispanic	307	21.5	43	15.1	
Black, non-Hispanic	756	53.0	144	50.7	
Hispanic	322	22.6	90	31.7	
Other	42	2.9	7	2.5	
Sex (child)					3.6 (0.06)
Male	756	53.0	133	46.8	
Female	671	47.0	151	53.2	
Household Income	32,151.6 (31,618.4)		28,419.2 (27,083.3)		4.5 (0.34)
< 7,500	208	14.6	37	13.0	
7,500 to <17,500	321	22.5	71	25.0	
17,500 to <30,000	286	20.0	64	22.5	
30,000 to <42,500	186	13.0	42	14.8	
> 42,500	426	29.9	70	24.7	
Mother Marital Status					7.5 (<0.01)
Married	320	22.4	43	15.1	
Not Married	1,107	77.6	241	84.9	
Neighborhood Cohesion[b]					
Attachment to Neighborhood[c]	2.42 (0.5)		2.39 (0.5)		
Safety[d]	1.76 (0.8)		1.82 (0.9)		
Trust/Value (attitude) Consensus[e]	3.10 (0.6)		3.01 (0.7)		
Total[f]	2.83 (0.5)		2.77 (0.5)		

[a]The total sample size in this analysis excludes those lost to follow-up from baseline to year 5, children without BMI measurements in both baseline and Year 5, those without parental responses for neighborhood cohesion survey questions, and those with missing values for covariates.

[b]Scores are on a scale of 1-4. (1) Strongly disagree or Very unlikely, (2) Disagree or Unlikely, (3) Agree or Likely, (4) Strongly Agree or Very Likely

[c]Assessed by survey questions asking "Do you strongly agree, agree, disagree, or strongly disagree?: (1) This is a close-knit neighborhood, (2) People in neighborhood generally don't get along with each other."

[d]Assessed by survey question asking "Do you strongly agree, agree, disagree, or strongly disagree?: Gangs are a problem in this neighborhood."

[e]Assessed by survey questions asking "Do you strongly agree, agree, disagree, or strongly disagree?: (1) People around here are willing to help their neighbors, (2) People in this neighborhood do not share the same values" and "Would you say it is very likely [your neighbors] would intervene, somewhat likely, not very likely, or very unlikely?: (1) If children were skipping school and hanging on the street, (2) If children were spray painting buildings with graffiti, (3) If children were showing disrespect to an adult, (4) If a fight broke out in front of the house, (5) If the fire station closest to the neighborhood was threatened and its budget was cut."

[f]Assessed by combining survey questions related to attachment to neighborhood, safety, and trust/value (attitude) consensus.

Table 3. Unadjusted linear regression of BMI percentile with demographic characteristics and neighborhood cohesion variables (N = 1,711)

Variable	Regression Coefficient	p-value	R^2
Race/Ethnicity (mother)			0.01
White, non-Hispanic	Ref	-	
Black, non-Hispanic	0.13	0.42	
Hispanic	0.72	<0.0001	
Other	0.01	0.98	
Sex (child)	0.22	0.07	<0.01
Baseline Household Income			<0.01
< 7,500	-0.42	0.07	
7,500 to <17,500	-0.28	0.18	
17,500 to <30,000	-0.16	0.45	
30,000 to <42,500	Ref	-	
> 42,500	-0.39	0.05	
Mother Marital Status	0.34	0.02	<0.01
Year 5 Mother BMI	0.08	<0.0001	0.06
Neighborhood Cohesion[a]			
Attachment to Neighborhood[b]	0.04	0.78	
Safety[c]	0.03	0.85	
Trust/Value (attitude) Consensus[d]	0.09	0.93	
Total[e]	0.02	0.88	

Each line represents a separate unadjusted model.

[a]Scores are on a scale of 1-4. (1) Strongly disagree or Very unlikely, (2) Disagree or Unlikely, (3) Agree or Likely, (4) Strongly Agree or Very Likely

[b]Assessed by survey questions asking "Do you strongly agree, agree, disagree, or strongly disagree?: (1) This is a close-knit neighborhood, (2) People in neighborhood generally don't get along with each other."

[c]Assessed by survey question asking "Do you strongly agree, agree, disagree, or strongly disagree?: Gangs are a problem in this neighborhood."

[d]Assessed by survey questions asking "Do you strongly agree, agree, disagree, or strongly disagree?: (1) People around here are willing to help their neighbors, (2) People in this neighborhood do not share the same values" and "Would you say it is very likely [your neighbors] would intervene, somewhat likely, not very likely, or very unlikely?: (1) If children were skipping school and hanging on the street, (2) If children were spray painting buildings with graffiti, (3) If children were showing disrespect to an adult, (4) If a fight broke out in front of the house, (5) If the fire station closest to the neighborhood was threatened and its budget was cut."

[e]Assessed by combining survey questions related to attachment to neighborhood, safety, and trust/value (attitude) consensus.

Table 4. Multivariate linear regression of BMI percentile with demographic variables and mother's BMI (N = 1,711)

Variable	Regression Coefficient	Standard Error	p-value
Intercept	11.78	1.11	<0.0001
Total Neighborhood Cohesion (TNC)	0.76	0.36	0.04
Race/Ethnicity (mother)			
White, non-Hispanic	Ref		
Black, non-Hispanic	1.61	1.14	0.16
Hispanic	3.03	1.27	0.02
Other	3.58	2.29	0.12
Sex (child)	0.20	0.12	0.09
Baseline Household Income			
< 7,500	-0.42	0.23	0.06
7,500 to <17,500	-0.29	0.20	0.16
17,500 to <30,000	-0.16	0.21	0.44
30,000 to <42,500	Ref		
> 42,500	-0.17	0.20	0.40
Mother Marital Status	0.33	0.17	0.05
Year 5 Mother BMI	0.08	0.01	<0.0001
TNC*Black	-0.62	0.39	0.12
TNC*Hispanic	-0.89	0.44	0.04
TNC*Other	-1.27	0.80	0.12

Table 5. Multivariate linear regression of BMI percentile with demographic variables and mother's BMI, stratified by mother's race/ethnicity (N = 1,711)

	White, non-Hispanic (n = 350)			*Black, non-Hispanic (n = 900)*			*Hispanic (n = 412)*			*Other (n = 49)*		
Variable	**β[a]**	**SE[b]**	**p-value**	**β**	**SE**	**p-value**	**β**	**SE**	**p-value**	**β**	**SE**	**p-value**
Intercept	11.07	1.38	<0.0001	14.28	0.61	<0.0001	13.74	1.08	<0.0001	15.18	2.53	<0.0001
Total Neighborhood Cohesion (TNC)	0.80	0.37	0.03	0.14	0.15	0.35	-0.17	0.29	0.56	-0.39	0.64	0.55
Sex (child)	0.20	0.26	0.46	0.26	0.15	0.09	0.02	0.27	0.95	0.73	0.64	0.26
Baseline Household Income												
< 7,500	-0.13	0.68	0.85	-0.79	0.26	<0.001	0.18	0.56	0.75	2.14	1.53	0.17
7,500 to <17,500	0.18	0.56	0.75	-0.58	0.25	0.02	0.08	0.47	0.86	0.02	1.24	0.99
17,500 to <30,000	1.21	0.51	0.02	-0.73	0.26	<0.001	0.21	0.48	0.66	0.94	1.23	0.45
30,000 to <42,500	Ref			Ref								
> 42,500	0.25	0.46	0.59	-0.53	0.27	0.05	0.37	0.47	0.43	0.58	1.19	0.63
Mother Marital Status	0.34	0.33	0.31	0.05	0.28	0.84	0.58	0.36	0.1	0.02	0.77	0.98
Year 5 Mother BMI	0.09	0.02	<0.0001	0.07	0.01	<0.0001	0.11	0.02	<0.0001	0.05	0.05	0.33

[a]Regression coefficient

[b]Standard error

Table 6. Crude logistic regression odds ratio estimates for obesity with categorical variables (N = 1,711)

Variable	OR	95% Confidence Interval	
		Lower	Upper
Race/Ethnicity (mother)			
White, non-Hispanic	Ref	-	-
Black, non-Hispanic	**1.36**	**0.94**	**1.96**
Hispanic	**2.00**	**1.34**	**2.96**
Other	1.19	0.50	2.82
Sex (child)			
Male	Ref	-	-
Female	1.28	1.00	1.65
Baseline Household Income			
< 7,500	0.79	0.49	1.28
7,500 to <17,500	0.98	0.64	1.49
17,500 to <30,000	1.00	0.64	1.53
30,000 to <42,500	Ref	-	-
> 42,500	0.73	0.48	1.11
Mother Marital Status			
Married	Ref	-	-
Not Married	**1.62**	**1.15**	**2.29**

Each line represents a separate unadjusted model.
Bolded point estimates indicate statistical significance.

Table 7. Multivariate logistic regression odds ratio estimates of obesity with neighborhood cohesion (N = 1,711)

Variable	Model 1: Unadjusted		Model 2: Demographics[a]		Model 3: Mother BMI[b]		Model 4: Fully Adjusted[c]	
	OR	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**
Total Neighborhood Cohesion[de]	0.78	(0.60, 1.00)	0.81	(0.63, 1.05)	0.83	(0.64, 1.07)	0.85	(0.65, 1.11)
Race/Ethnicity (mother)								
White, non-Hispanic	Ref	-	Ref	-	-	-	Ref	-
Black, non-Hispanic	-	-	1.14	(0.77, 1.69)	-	-	0.98	(0.66, 1.46)
Hispanic	-	-	**1.70**	**(1.12, 2.56)**	-	-	**1.56**	**(1.02, 2.38)**
Other	-	-	1.17	(0.49, 2.79)	-	-	1.12	(0.46, 2.70)
Sex (child)	-	-	1.26	(0.97, 1.63)	-	-	1.27	(0.98, 1.66)
Baseline Household Income					-	-		
< 7,500	-	-	0.77	(0.46, 1.23)	-	-	0.76	(0.46, 1.26)
7,500 to <17,500	-	-	0.92	(0.60, 1.42)	-	-	0.95	(0.62, 1.48)
17,500 to <30,000	-	-	0.94	(0.61, 1.45)	-	-	0.98	(0.62, 1.52)
30,000 to <42,500	Ref	-	Ref	-	-	-	Ref	-
> 42,500	-	-	0.84	(0.54, 1.31)	-	-	0.92	(0.58, 1.43)
Mother Marital Status	-	-	**1.49**	**(1.00, 2.21)**	-	-	1.43	(0.96, 2.15)
Year 5 Mother BMI	-	-	-	-	**1.07**	**(1.05, 1.09)**	**1.07**	**(1.05, 1.09)**

Bolded point estimates indicate statistical significance.

[a]Adjusted for demographic variables: race/ethnicity (mother), sex (child), baseline household income, mother marital status.

[b]Adjusted for mother's BMI from year 5 only.

[c]Adjusted for both demographic variables (race/ethnicity of mother, sex of child, baseline household income, mother marital status) and mother's BMI from year 5.

[d]Scores are on a scale of 1-4. (1) Strongly disagree or Very unlikely, (2) Disagree or Unlikely, (3) Agree or Likely, (4) Strongly Agree or Very Likely.

[e]Assessed by survey questions asking "Do you strongly agree, agree, disagree, or strongly disagree?: (1) People around here are willing to help their neighbors, (2) People in this neighborhood do not share the same values" and "Would you say it is very likely [your neighbors] would intervene, somewhat likely, not very likely, or very unlikely?: (1) If children were skipping school and hanging on the street, (2) If children were spray painting buildings with graffiti, (3) If children were showing disrespect to an adult, (4) If a fight broke out in front of the house, (5) If the fire station closest to the neighborhood was threatened and its budget was cut."

Table 8. Multivariate logistic regression fully adjusted odds ratio estimates of obesity with neighborhood cohesion, stratified by mother's race/ethnicity (N = 1,711)[ab]

Variable	*White, non-Hispanic (n = 350)*		*Black, non-Hispanic (n = 900)*		*Hispanic (n = 412)*	
	OR	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**
Total Neighborhood Cohesion[cd]	1.53	(0.60, 3.92)	0.84	(0.60, 1.19)	0.76	(0.46, 1.27)
Sex (child)	1.45	(0.75, 2.81)	**1.48**	**(1.02, 2.14)**	0.88	(0.54, 1.44)
Baseline Household Income						
< 7,500	0.65	(0.07, 6.57)	0.67	(0.36, 1.23)	0.76	(0.27, 2.17)
7,500 to <17,500	1.85	(0.45, 7.57)	0.76	(0.43, 1.38)	1.08	(0.46, 2.53)
17,500 to <30,000	2.60	(0.73, 9.29)	0.57	(0.31, 1.04)	1.50	(0.64, 3.54)
30,000 to <42,500	Ref	-	Ref	-	Ref	-
> 42,500	1.53	(0.44, 5.34)	0.77	(0.42, 1.42)	0.97	(0.41, 2.34)
Mother Marital Status	1.29	(0.56, 2.98)	1.38	(0.70, 2.75)	2.01	(0.94, 4.29)
Year 5 Mother BMI	**1.07**	**(1.03, 1.12)**	**1.06**	**(1.04, 1.09)**	**1.08**	**(1.05, 1.12)**

Bolded point estimates indicate statistical significance.

[a]Adjusted for both demographic variables (race/ethnicity of mother, sex of child, baseline household income, mother marital status) and mother's BMI from year 5.

[b]The "Other" race group was unstable because of the small sample size, thus results for the group are not presented in this table.

[c]Scores are on a scale of 1-4. (1) Strongly disagree or Very unlikely, (2) Disagree or Unlikely, (3) Agree or Likely, (4) Strongly Agree or Very Likely.

[d]Assessed by survey questions asking "Do you strongly agree, agree, disagree, or strongly disagree?: (1) People around here are willing to help their neighbors, (2) People in this neighborhood do not share the same values" and "Would you say it is very likely [your neighbors] would intervene, somewhat likely, not very likely, or very unlikely?: (1) If children were skipping school and hanging on the street, (2) If children were spray painting buildings with graffiti, (3) If children were showing disrespect to an adult, (4) If a fight broke out in front of the house, (5) If the fire station closest to the neighborhood was threatened and its budget was cut."

Table 9. Multivariate logistic regression odds ratio estimates of obesity with attachment to neighborhood (N = 1,711)

Variable	Model 1: Unadjusted		Model 2: Demographics[a]		Model 3: Mother BMI[b]		Model 4: Fully Adjusted[c]	
	OR	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**
Attachment to Neighborhood[de]	0.88	(0.66, 1.15)	0.87	(0.67, 1.13)	0.93	(0.71, 1.21)	0.92	(0.70, 1.20)
Race/Ethnicity (mother)								
White, non-Hispanic	Ref	-	Ref	-	-	-	Ref	-
Black, non-Hispanic	-	-	1.16	(0.79, 1.72)	-	-	0.99	(0.66, 1.48)
Hispanic	-	-	**1.73**	**(1.15, 2.62)**	-	-	**1.58**	**(1.04, 2.41)**
Other	-	-	1.20	(0.51, 2.86)	-	-	1.14	(0.47, 2.74)
Sex (child)	-	-	1.26	(0.97, 1.63)	-	-	1.28	(0.98, 1.66)
Baseline Household Income					-	-		
< 7,500	-	-	0.75	(0.46, 1.23)	-	-	0.76	(0.46, 1.25)
7,500 to <17,500	-	-	0.91	(0.60, 1.40)	-	-	0.95	(0.61, 1.47)
17,500 to <30,000	-	-	0.93	(0.60, 1.44)	-	-	0.97	(0.62, 1.51)
30,000 to <42,500	Ref	-	Ref	-	-	-	Ref	-
> 42,500	-	-	0.83	(0.54, 1.29)	-	-	0.91	(0.58, 1.42)
Mother Marital Status	-	-	**1.50**	**(1.01, 2.23)**	-	-	1.43	(0.96, 2.15)
Year 5 Mother BMI	-	-	-	-	**1.07**	**(1.05, 1.09)**	**1.07**	**(1.05, 1.09)**

Bolded point estimates indicates statistical significance.

[a]Adjusted for demographic variables: race/ethnicity (mother), sex (child), baseline household income, mother marital status.

[b]Adjusted for mother's BMI from year 5 only.

[c]Adjusted for both demographic variables (race/ethnicity of mother, sex of child, baseline household income, mother marital status) and mother's BMI from year 5.

[d]Scores are on a scale of 1-4. (1) Strongly disagree, (2) Disagree, (3) Agree, (4) Strongly Agree.

[e]Assessed by survey questions asking "Do you strongly agree, agree, disagree, or strongly disagree?: (1) This is a close-knit neighborhood, (2) People in neighborhood generally don't get along with each other."

Table 10. Multivariate logistic regression odds ratio estimates of obesity with safety (N = 1,711)

Variable	Model 1: Unadjusted		Model 2: Demographics[a]		Model 3: Mother BMI[b]		Model 4: Fully Adjusted[c]	
	OR	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**
Safety[de]	1.19	(0.90, 1.57)	1.12	(0.84, 1.49)	1.11	(0.83, 1.47)	1.08	(0.80, 1.45)
Race/Ethnicity (mother)								
White, non-Hispanic	Ref	-	Ref	-	-	-	Ref	-
Black, non-Hispanic	-	-	1.14	(0.77, 1.69)	-	-	0.98	(0.65, 1.46)
Hispanic	-	-	**1.69**	**(1.12, 2.56)**	-	-	**1.56**	**(1.02, 2.38)**
Other	-	-	1.17	(0.49, 2.79)	-	-	1.12	(0.46, 2.70)
Sex (child)	-	-	1.26	(0.98, 1.63)	-	-	1.28	(0.98, 1.66)
Baseline Household Income					-	-		
< 7,500	-	-	0.73	(0.44, 1.18)	-	-	0.74	(0.45, 1.22)
7,500 to <17,500	-	-	0.90	(0.59, 1.38)	-	-	0.94	(0.61, 1.46)
17,500 to <30,000	-	-	0.93	(0.60, 1.44)	-	-	0.97	(0.62, 1.51)
30,000 to <42,500	Ref	-	Ref	-	-	-	Ref	-
> 42,500	-	-	0.83	(0.54, 1.30)	-	-	0.91	(0.58, 1.43)
Mother Marital Status	-	-	**1.50**	**(1.01, 2.23)**	-	-	1.44	(0.96, 2.16)
Year 5 Mother BMI	-	-	-	-	**1.07**	**(1.05, 1.09)**	**1.07**	**(1.05, 1.09)**

Bolded point estimates indicate statistical significance.

[a]Adjusted for demographic variables: race/ethnicity (mother), sex (child), baseline household income, mother marital status.

[b]Adjusted for mother's BMI from year 5 only.

[c]Adjusted for both demographic variables (race/ethnicity of mother, sex of child, baseline household income, mother marital status) and mother's BMI from year 5.

[d]Scores are on a scale of 1-4. (1) Strongly disagree, (2) Disagree, (3) Agree, (4) Strongly Agree.

[e]Assessed by survey question asking "Do you strongly agree, agree, disagree, or strongly disagree?: Gangs are a problem in this neighborhood."

Table 11. Multivariate logistic regression odds ratio estimates of obesity with trust/value (attitude) consensus (N = 1,711)

Variable	Model 1: Unadjusted		Model 2: Demographics[a]		Model 3: Mother BMI[b]		Model 4: Fully Adjusted[c]	
	OR	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**
Trust/Value (attitude) Consensus[de]	**0.82**	**(0.68, 0.99)**	0.86	(0.71, 1.04)	0.86	(0.71, 1.05)	0.88	(0.73, 1.08)
Race/Ethnicity (mother)								
White, non-Hispanic	Ref	-	Ref	-	-	-	Ref	-
Black, non-Hispanic	-	-	1.13	(0.76, 1.67)	-	-	0.97	(0.65, 1.45)
Hispanic	-	-	**1.70**	**(1.11, 2.54)**	-	-	**1.55**	**(1.01, 2.36)**
Other	-	-	1.16	(0.49, 2.76)	-	-	1.11	(0.46, 2.68)
Sex (child)	-	-	1.23	(0.97, 1.63)	-	-	1.27	(0.98, 1.66)
Baseline Household Income					-	-		
< 7,500	-	-	0.75	(0.46, 1.22)	-	-	0.76	(0.46, 1.25)
7,500 to <17,500	-	-	0.91	(0.60, 1.40)	-	-	0.95	(0.61, 1.47)
17,500 to <30,000	-	-	0.94	(0.61, 1.45)	-	-	0.98	(0.62, 1.52)
30,000 to <42,500	Ref	-	Ref	-	-	-	Ref	-
> 42,500	-	-	0.85	(0.54, 1.31)	-	-	0.92	(0.59, 1.44)
Mother Marital Status	-	-	1.49	(1.00, 2.21)	-	-	1.43	(0.96, 2.15)
Year 5 Mother BMI	-	-	-	-	**1.07**	**(1.05, 1.09)**	**1.07**	**(1.05, 1.09)**

Bolded point estimates indicate statistical significance.

[a]Adjusted for demographic variables: race/ethnicity (mother), sex (child), baseline household income, mother marital status.

[b]Adjusted for mother's BMI from year 5 only.

[c]Adjusted for both demographic variables (race/ethnicity of mother, sex of child, baseline household income, mother marital status) and mother's BMI from year 5.

[d]Scores are on a scale of 1-4. (1) Strongly disagree or Very unlikely, (2) Disagree or Unlikely, (3) Agree or Likely, (4) Strongly Agree or Very Likely.

[e]Assessed by survey questions asking "Do you strongly agree, agree, disagree, or strongly disagree?: (1) People around here are willing to help their neighbors, (2) People in this neighborhood do not share the same values" and "Would you say it is very likely [your neighbors] would intervene, somewhat likely, not very likely, or very unlikely?: (1) If children were skipping school and hanging on the street, (2) If children were spray painting buildings with graffiti, (3) If children were showing disrespect to an adult, (4) If a fight broke out in front of the house, (5) If the fire station closest to the neighborhood was threatened and its budget was cut."

III. SUMMARY, PUBLIC HEALTH IMPLICATIONS, POSSIBLE FUTURE DIRECTIONS

Obesity is becoming a larger problem in the United States every year. There are many efforts to attempt to reduce the prevalence of obesity, particularly in children. Using "fragile families" data from FFCWS, this study investigated the relationship between a feature of the neighborhood social environment – neighborhood cohesion – and BMI percentile as well as obesity status in youth. Results showed an inverse association, indicating that youth who live in higher socially cohesive neighborhoods have lower odds of being considered obese than youth who live in lower socially cohesive neighborhoods. Although not significant, this finding is consistent with the previous, but limited, literature studying the same relationship. Of particular interest is the strong inverse association between trust/value (attitude) consensus – an aspect of neighborhood cohesion – and obesity, which is worth exploring further to examine how certain elements of cohesion may play different roles in affecting health. As this is the first study to consider neighborhood cohesion and obesity specifically in youth, the results will hopefully facilitate more discussion and interest in the topic. This study was limited by a cross-sectional design and inability to account for potential influential factors in the analysis, so additional studies are needed to better understand the relationship between neighborhood cohesion and obesity in youth. In the future, research can add more prospective or experimental study designs to better establish a causal relation. Research can also measure the construct of neighborhood cohesion in a standard fashion to

enable comparisons between studies. Because the association between neighborhood cohesion and obesity is not fully understood, follow-up studies should account for possible pathways like diet, physical activity, and stress to determine true associations. Future research can also aim to identify mechanisms in which neighborhood cohesion influences obesity to help develop effective policies and interventions that will result in a decrease of obesity in the United States.