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Examining The Association of Perceived Neighborhood Safety on BMI & Obesity In
Adolescents

By

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Master of Public Health

Epidemiology

_____

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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
2019

Abstract

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By Sierra Patterson

Childhood obesity is highly prevalent in the United States and is a growing public health concern. Some studies have investigated several features of the neighborhood social environment and their relation to obesity, but few have explored neighborhood crime and safety, particularly in adolescents. Using data collected from a prospective cohort study that follows a sample of parents and children from 20 large US cities, the association between perceived neighborhood safety and crime and obesity in adolescents was examined. Logistic regression analysis was used to gather unadjusted and adjusted associations between perceived neighborhood safety and crime and obesity. The adjusted analysis considered potential confounders such as race and ethnicity, poverty category, physical activity, and sex. Separate logistic regression analyses were conducted among males and females to examine the potential role of gender in modifying the relationship between neighborhood safety and crime and obesity. The results suggested that perceived neighborhood safety and crime was not associated with the prevalence of obesity, even after adjusting for multiple covariates. When examining males and females separately, perceived neighborhood safety during the day and night was not associated with the prevalence of obesity. However, in females there was a significant association between witnessing or knowing of a crime and obesity, but the same association was not seen for males. These findings are not completely consistent with earlier studies that have examined the relationship between the neighborhood social environment and obesity. Therefore, more research examining this association is needed to best identify ways to prevent childhood obesity.

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BACKGROUND/LITERATURE REVIEW

Childhood obesity, defined as having a high amount of excess body fat, is becoming more prevalent in the United States and is a growing public health concern (1,2). According to data from the National Health and Nutrition Examination Survey, the prevalence of obesity among U.S. youth aged 2-19 years was 18.5% in 2015-2016. Non-Hispanic black and Hispanic youth experienced a higher prevalence of obesity than non-Hispanic white and non-Hispanic Asian youth (3). Obesity is associated with the development of comorbidities and decreased quality of life. Moreover, those who are obese during childhood are more likely to be obese during adulthood (1,4-6). Examining the multiple risk factors for obesity is imperative in cultivating intervention programs that can help decrease the overall prevalence of childhood obesity.

Past studies have explored neighborhood characteristics and their relation to obesity. The neighborhood built environment in particular is a vastly studied risk factor for obesity. Issues such as a lack of parks or sidewalks and the proximity of public spaces or commercial establishments have frequently been associated with a lack of physical activity and low walkability in neighborhoods. This, in turn, has been linked to obesity (7-9). While the neighborhood built environment is an important component in studying obesity, the neighborhood social environment is another important aspect. As defined by Suglia et al., the neighborhood social environment consists of the "sociodemographic composition of the neighborhood and its residents as well as the relationships, groups, and social processes that exist between residents". Features such as social cohesion or capital, neighborhood crime and safety, segregation, and social networks or norms make up the social context of a neighborhood (9).

Some studies have investigated several features of the neighborhood social environment and their relation to obesity, but few have explored neighborhood crime and safety, particularly in adolescents. A study published by Carroll-Scott et al. produced results showing that neighborhood crime is associated with higher BMI amongst fifth and sixth graders (10). However, this study was focused on participants in early adolescence. Another study showed that a lack of perceived neighborhood safety is associated with higher BMI, but the study was focused on adults (11). Yet another studied produced similar results and while this study used data from the Fragile Families and Child Wellbeing Study, it only focused on mothers and their perceived safety (12). Lastly, while several studies have shown an overall relationship between perceived neighborhood safety and BMI and obesity, a couple of studies showed that these associations may not be consistent between males and females. For example, a study published Larson et al. found that perceived lack of safety was consistently associated with higher BMI z-score among girls, but the same wasn't true for boys after controlling for other environmental factors. While the study focused on teenage adolescents (mean age=14.4 years), its sample only came from two metropolitan areas in Minnesota (13). A separate study produced similar findings, suggesting that the association of perceived neighborhood safety and BMI differs between girls and boys; however, this study focused on younger children and used maternal perceptions instead of children's responses (14). Overall, studies which have investigated neighborhood crime and safety and its association with obesity have shown that a lack of perceived neighborhood safety and neighborhood crime is associated with a higher BMI. Furthermore, studies have shown that sex may be an effect modifier of the association between perceived neighborhood safety and crime and obesity.

The present study aims to investigate the relationship between childhood obesity and the neighborhood social environment. Using data collected from a prospective cohort study that follows a sample of parents and children from 20 large US cities, the association between perceived neighborhood safety and crime and obesity in adolescents will be examined. The association will be examined while adjusting for potential confounders such as race and ethnicity, poverty category, physical activity, and sex. This study expands on the current literature by using cohort data that samples from various U.S. cities. It is hypothesized that overall, lower perceived neighborhood safety will be associated with a higher obesity prevalence and that this association will differ between males and females.

METHODS

Study Population

The Fragile Families and Child Wellbeing Study (FFCWBS) is a prospective birth cohort study following 4898 children and their parents. A detailed description of the study design can be found in Reichman et al. Briefly, women who gave birth at 75 hospitals between 1998 and 2000 in 20 large cities (population $\geq$ 200,000) were recruited. After determining eligibility and obtaining consent, the mothers completed a baseline interview at delivery and the fathers completed the interview shortly thereafter. Nonmarital births were oversampled relative to marital births by a ratio of 3:1. Interviews with mothers, fathers, and/or primary care givers were conducted again when the children were ages one, three, five nine, and fifteen. Additionally, the children were interviewed at ages nine and fifteen. Data from the teens' interview at age fifteen considered for analysis in the present study. A total of 3,444 teens participated in the Year 15 interview. For the present study, 551 participants were excluded from sample due to missing information for any of the following characteristics: neighborhood safety, BMI, physical activity, and demographic characteristics such as race, poverty, mother's marital status at baseline and primary caregiver's education. After excluding these participants, 2893 individuals remained and were included in the final analysis. No major demographic differences were observed in between individuals included and excluded in the final analysis.

Measures

Neighborhood Safety – To assess neighborhood safety, participants were asked about their level of agreement to the following statements: 1)I feel unsafe walking around my neighborhood during the day and 2)I feel unsafe walking around my neighborhood during the night. There were four response options – strongly agree, somewhat agree, somewhat disagree, and strongly disagree. Frequency distributions of responses to these statements were assessed. For each of these statements, the distribution was skewed, with a majority of respondents answering that they "strongly disagree". Therefore, the responses to these statements were recoded to be dichotomous – strongly disagree versus strongly agree, somewhat agree and somewhat disagree. This was done under the assumption that a response of strongly agree, somewhat agree or somewhat disagree symbolized at least some level of agreement to the statements. Neighborhood crime was assessed by asking the teens if they had ever been a witness to or known of a crime.

BMI & Obesity – Using the Center for Disease Control and Prevention (CDC) instructions, BMI was calculated in SAS using the following variables: teen's exact age (abstracted from administrative records of teen's birth date), teen's gender, teen's height in centimeters, and teen's weight in kilograms. Two sets of BMI measurements were calculated. The first measurement of BMI was based on the teens' self-reported height and weight measurements. The second measurement of BMI was based on actual anthropometric measurements of height and weight completed by study staff during the in-home activity portion of the survey. Since not all teens participated in the in-home activity, some teens had only a BMI measurement based upon self-reported height and weight (N=3180). Other teens had two BMI measurements: one based on self-reported height and weight and

another based on measured height and weight (N=1083). The Pearson correlation between both BMI measurement types (self-reported vs measured height and weight) were assessed. There was a positive correlation between these variables (r=0.90; p-value<0.01). Therefore, BMI measurements based on self-reported height and weight were used for each participant. Using the CDC's BMI growth reference chart, BMI percentiles for each child was also calculated. Obesity was defined as having a BMI greater than or equal to the 95th percentile (15).

Covariates – Using the baseline survey completed at the beginning of the study, participants' gender and their mother's marital status was abstracted. At the 15 year assessment teens were asked to self-identify their race and ethnicity via an open-ended question.. Household poverty categories were constructed based on a family's poverty ratio (total household income to the official poverty threshold as established by the U.S. Census Bureau). The primary caregiver's survey administered during Year 15 was used to identify the highest level of education completed by the primary caregiver for each individual. Teens self-reported their physical activity by answering the question "During the past seven days, on how many days were you physically active for a total of at least 60 minutes per day?". Responses to the question were dichotomized to be either daily or one to six times per week. This dichotomization method was decided upon based on the CDC's recommendation of 60+ minutes of daily physical activity for youth (16).

Statistical Analysis

Tabulations of multiple sample demographics were performed and either the proportion or mean and standard deviation of each variable was reported. A logistic regression analysis

was used to examine unadjusted and adjusted associations between perceived neighborhood safety and crime and obesity. Each model examined either neighborhood safety during the day, neighborhood safety during the night, or witnessing or knowing about a crime. Existing literature was used to identify the following a priori confounders: race/ethnicity, mother's marital status at birth, primary caregiver's highest level of education completed, poverty category, physical activity, and sex. Indicator variables were created for race, primary caregiver's education, and poverty variables. A collinearity assessment was completed to examine whether poverty category and primary caregiver's education were collinear. There was no collinearity found. Another logistic regression analysis was conducted among males and females separately to examine the potential role of gender in modifying the relationship between neighborhood safety and crime and obesity. This was completed due to the fact that existing literature showed the association between neighborhood safety and crime differed by gender. The aforementioned confounders were also used in this analysis. All analyses were performed using SAS 9.4 (SAS Institute, Cary NC).

RESULTS

The proportion or mean and standard deviation of multiple sample characteristics were tabulated (Table 1). The sample was almost evenly split between males and females. The majority of respondents were non-Hispanic Blacks. Using Census Bureau data from the year preceding survey administration, 30% of respondents lived between zero and 99% of the poverty threshold, meaning they made less than the suggested amount needed to meet basic household needs. Additionally, about 36% of respondents had primary caregiver's whose highest completed education level was high school or less than high school, with the remaining 64% completing some college or higher. The mean BMI percentile of respondents was 68, with 18.91% of respondents being obese. Approximately 81% of respondents reported daily physical activity for 60+ minutes in the past week. About 25% of respondents reported feeling unsafe during the day while about 53% of respondents reported feeling unsafe during the night. Lastly, 34% of respondents reported that they had witnessed or known about a crime.

The results from the first logistic regression analysis are shown in Table 2. Multiple regression models were computed for unadjusted and adjusted analyses. For the unadjusted analysis, the prevalence of obesity among those who reported feeling unsafe walking through their neighborhood during the day was 1.08 times that of those who did not feel unsafe. (PR=1.08, 95% CI 0.91-1.28). A similar result was seen in those who reported feeling unsafe walking through their neighborhood at night compared to those who did not feel unsafe (PR=1.08, 95% CI 0.92-1.25). The prevalence of obesity among those who had witnessed or known of a crime was 1.16 times that of those who had not witnessed or known of a crime. (PR=1.16, 95% CI 0.99-1.36). When further adjusting for the

aforementioned covariates, these results did not change in regards to neighborhood safety during night and witnessing a crime. However, in regards to neighborhood safety during the day, the prevalence of obesity among those who reported feeling unsafe walking through their neighborhood during the day was four percent lower than those who did not feel unsafe. (PR=0.96, 95% CI 0.81-1.14). None of these findings were statistically significant at an alpha level of 0.05.

The results from the stratified logistic regression analysis are shown in Table 3. Among males, the prevalence of obesity among those who reported feeling unsafe walking through their neighborhood during the day was seven percent lower than those who did not feel unsafe. (PR=0.93, 95% CI 0.73-1.19). The prevalence of obesity among those who reported feeling unsafe walking through their neighborhood during the night was 1.01 times that of those who did not feel unsafe. (PR=1.01, 95% CI 0.82-1.24). Amongst males who reported witnessing or knowing of a crime, the prevalence of obesity among those who reported witnessing or knowing of a crime was 1.03 times that of those who did not witness or know of a crime. (PR=1.03, 95% CI 0.83-1.28). None of these findings were statistically significant at an alpha level of 0.05.

Among females, the prevalence of obesity among those who reported feeling unsafe walking through their neighborhood during the day was three percent lower than those who did not feel unsafe. (PR=0.97, 95% CI 0.76-1.23). The prevalence of obesity among those who reported feeling unsafe walking through their neighborhood during the night was 1.01 times that of those who did not feel unsafe. (PR=1.01, 95% CI 0.81-1.26). Neither of these findings were statistically significant at an alpha level of 0.05. The prevalence of obesity among females who reported witnessing or knowing of a crime was 1.28 times that of those

who did not report witnessing or knowing of a crime. (PR=1.28, 95% CI 1.03-1.59). This finding was significant at an alpha level of 0.05.

DISCUSSION

The results above suggest that perceived neighborhood safety and crime does not have a significant effect on the prevalence of obesity, even after adjusting for multiple covariates. When examining males and females separately, perceived neighborhood safety during the day and night did not have a significant effect on the prevalence of obesity. However, in females there appeared to a significant association between witnessing or knowing of a crime and obesity, but the same association was not seen for males.

These findings are not completely consistent with earlier studies that have examined the relationship between the neighborhood social environment and obesity. As previously mentioned, several studies have shown that neighborhood crime and a lack of perceived neighborhood safety is associated with higher BMI. Cross-sectional analyses performed by Carroll-Scott et al. showed that neighborhood crime was associated with higher BMI amongst fifth and sixth graders (10). In the present analysis, when males and females were considered together, those who witnessed or knew of a crime experienced a higher prevalence of obesity when compared to those who had not witnessed or known of a crime, but this finding was not significant. Prior studies have also examined gender differences in the association between neighborhood safety and crime and obesity. Larson et al. found that perceived lack of safety was associated with higher BMI z-scores among girls, but the same wasn't true for boys (13). Conversely, results from the present study showed that in regards to perceived neighborhood safety and its association with obesity, there appeared to be no difference between girls and boys. However, there did appear to be a difference between these two genders when looking into crime. The association between

crime and obesity among girls was significant while the association was not significant for boys.

Multiple factors can be attributed to the inconsistencies found between the current study and prior studies. In prior studies, crime was measured using total crime incidents based on police reports. Personal, violent, or property crimes were the only types of crimes considered and the crime had to occur in a defined geographical region (10,13). Alternatively, the present study used self-reports of witnessing a crime and the type of crime was not considered. Using this method to gather crime data introduces the possibility of capturing crimes that may not have been reported to the police, as well as crimes outside of personal, violent, or property crimes. Furthermore, crime was not restricted to a specific geographic region due to the fact that the survey question did not specifically ask where the crime occurred.

In regards to neighborhood safety, prior studies used perceived safety responses from participants, though some studies only looked into perceived safety after dark, or perceived safety due to the presence of gangs, strangers, and traffic in the neighborhood (10,11). Prior studies also used other neighborhood characteristics outside of perceived neighborhood safety to examine an association with BMI or obesity. For example, social ties and collective efficacy, along with perceived safety, were amongst some of the other neighborhood characteristics used in prior studies (10,12). Therefore, those studies were able to capture both the individualistic and interdependent components of the neighborhood social environment and their association with BMI unlike the present study, which only captured individual associations between various neighborhood social characteristics and obesity. Lastly, while the present study focused on 15 year old adolescents, prior studies focused on either younger adolescents or adults (10-12). During age 15, individuals are

beginning to explore their neighborhoods without adult supervision. Therefore, this age group could be seen as more vulnerable to the impact of crime and neighborhood safety. If these individuals feel unsafe or have witnessed crime, they may be less likely to want to be out in their neighborhood, which could then have an effect on their physical activity, which in turn may affect their obesity status.

The different associations between males and females as it relates to crime and obesity could stem from the way in which the question regarding crime was posed. The question asked if individuals had ever witnessed or known of a crime, which does not necessarily capture an individual's feeling of overall safety due to crime. Instead, the question more so captures crime exposure, such as violence or other traumatic experiences. In a sense, females may cope or deal with these experiences differently than males. More specifically, females who have witnessed crime may experience a set of emotions, feelings, or actions that in turn lead to behaviors which promote obesity whereas males do not have this same experience. Therefore, posing the question in a way that captures feelings of overall safety due to crime, would be a better approach to better understand why the association between crime and obesity differs between males and females.

Strengths & Limitations

The strengths of this study include the adjustment of multiple potential confounders, a relatively large sample size, and the utilization of cohort data that samples from various U.S. cities. Furthermore, this study uses adolescents' perceived neighborhood safety and crime characteristics. This captures adolescents' actual feelings and experiences and can provide insight into how they may modify their behaviors based upon their perceptions. There are also several limitations to be noted about the study. First, the

analyzed data is cross-sectional, which eliminates the possibility to establish a causal relationship between neighborhood safety and crime and obesity. Also, since the data comes from a larger cohort study that has experienced loss to follow-up, many participants in the original FFCWBS were excluded from this analysis due to missing data, though no major differences were observed in regards to gender, race, and poverty category between individuals included and excluded in the final analysis.

Future Directions

More research is needed in order to gain insight about the association between perceived neighborhood safety and crime and obesity. Aside from studying each of these neighborhood characteristics separately, it is important to investigate the role of potential mediators and their effect on the relationship between perceived neighborhood safety and crime and obesity. For example, sleep routines and physical activity are plausible mediators and should be studied alongside neighborhood safety and crime. Additionally, longitudinal analyses should be used in the future to examine how the prevalence of obesity may change over time. Doing this may identify crucial timepoints during childhood at which neighborhood interventions targeting obesity can be put into place.

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TABLES

Table 1. Sample Demographics of FFCWBS Participants During Year 15 (n=2893)

Variable	Proportion
Gender	
Male	50.67
Female	49.33
Race	
White (non-Hispanic)	18.42
Black (non-Hispanic)	48.29
Hispanic or Latino	25.20
Other (non-Hispanic)	2.49
Multi-Racial (non-Hispanic)	5.60
Poverty Category	
0-49%	12.93
50-99%	16.83
100-199%	28.17
200-299%	14.45
300% & up	27.62
Primary Caregiver's Education (Highest Completed)	
Less than high school	16.87
High school or equivalent	19.32
Some college or technical training	44.21
College or graduate school	19.60
Mother's Marital Status at Birth	
Married	24.92
Single	75.08
***BMI Percentile** – mean (SD)	68.07 (27.74)
***Obese**	
Yes	18.91
No	81.09

*Based on BMI calculated from self-reports of height and weight measurements

Table 1. Sample Demographics of FFCWBS Participants During Year 15 (n=2893)

Variable	Proportion
Daily Physical Activity for 60+ Minutes in Past Week	
Yes	18.84
No	81.16
†Feeling Unsafe During the Day	
Yes	25.20
No	74.80
†Feeling Unsafe During the Night	
Yes	52.68
No	47.32
Witnessed or Known About a Crime in Neighborhood	
Yes	34.05
No	65.95

†Based on level of agreement (Yes=strongly agree, somewhat agree, somewhat disagree; No=strongly disagree)

Table 2. Prevalence Ratios (PR) & 95% Confidence Intervals (CI) for the Overall Association Between Neighborhood Safety & Crime and Obesity

	Model 1 [a]	Model 2 [a]	Model 3 [a]	Model 4 [b]	Model 5 [b]	Model 6 [b]
	Feel unsafe walking through neighborhood during the day	Feel unsafe walking through neighborhood during the night	Witnessed or known of a crime	Feel unsafe walking through neighborhood during the day	Feel unsafe walking through neighborhood during the night	Witnessed or known of a crime
PR (95% CI)	1.08 (0.91, 1.28)	1.08 (0.92, 1.25)	1.16 (0.99, 1.36)	0.96 (0.81, 1.14)	1.03 (0.89, 1.20)	1.15 (0.98, 1.34)

[a]Crude association between perceived neighborhood characteristics and obesity. [b]Adjusted for race/ethnicity, poverty category, primary caregiver's education, mother's marital status at baseline, physical activity, and sex.

Table 3. Prevalence Ratios (PR) & 95% Confidence Intervals (CI) for the Association Between Neighborhood Safety & Crime and Obesity – Stratified By Gender

	Model 1 [a,b]	Model 2 [a,b]	Model 3 [a,b]	Model 4 [a,c]	Model 5 [a,c]	Model 6 [a,c]
	Feel unsafe walking through neighborhood during the day	Feel unsafe walking through neighborhood during the night	Witnessed or known of a crime	Feel unsafe walking through neighborhood during the day	Feel unsafe walking through neighborhood during the night	Witnessed or known of a crime
PR (95% CI)	0.93 (0.73, 1.19)	1.01 (0.82, 1.24)	1.03 (0.83, 1.28)	0.97 (0.76, 1.23)	1.01 (0.81, 1.26)	1.28* (1.03, 1.59)

[a] Adjusted for race/ ethnicity, poverty category, primary caregiver's education, mother's marital status at baseline, physical activity, and sex. [b] Males only. [c] Females only.
*Significant result