How neighborhood poverty structures types and levels of social integration

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Abstract:

Social integration is fundamental to health and well-being. However, few studies have explored how neighborhood contexts pattern types and levels of social integration that individuals experience. We examined how neighborhood poverty structures two dimensions of social integration: integration with neighbors and social integration more generally. Using data from the United States Third National Health and Nutrition Examination Survey, we linked study participants to percent poverty in their neighborhood of residence (N = 16,040). Social integration was assessed using a modified Social Network Index and neighborhood integration based on yearly visits with neighbors. We fit multivariate logistic regression models that accounted for the complex survey design. Living in high poverty neighborhoods was associated with lower social integration but higher visits with neighbors. Neighborhood poverty distinctly patterns social integration, demonstrating that contexts shape the extent and quality of social relationships.

Keywords: Social integration | Social relationships | Neighborhood poverty | Social determinants of health

Article:

Introduction

Over the past few decades a consistent body of literature has demonstrated that neighborhoods influence a range of health outcomes, including mortality, cardiovascular disease, cardiovascular risk factors, depression, and perinatal risk (Bird et al. 2010; Chaix et al. 2007; Diez-Roux et al. 1997; Echeverria et al. 2008; Mair et al. 2015; Major et al. 2010; Merkin et al. 2009; Meyer et

al. 2014; Pickett et al. 2002; Pickett and Pearl 2001; Subramanian et al. 2005; Yen and Kaplan 1999). Neighborhoods represent geographic spaces within which individuals reside and are hypothesized to influence health through structural dimensions such as levels of poverty, access to resources, and environmental exposures, as well as social dimensions such as levels of social cohesion, collective efficacy and social integration (Diez-Roux et al. 1997; Diez Roux 2012; Meyer et al. 2014; Sampson et al. 1997, 2002; Thorpe et al. 2015). These features of the neighborhood context have, for the most part, been examined as independent variables associated with health.

In a separate body of literature, numerous studies have shown that increased access to social relationships is associated with better health (Berkman et al. 2000; Cho et al. 2015; Holt-Lunstad et al. 2010; House et al. 1988a; Kawachi and Berkman 2001). Social relationships are generally defined as interactions among individuals that can produce a sense of belonging and comfort, in addition to providing formal and informal sources of material support. In a comprehensive review of the evidence to date, House et al. (1988a) argued that the impact of social relationships on health rivaled that of other more widely accepted health risks such as smoking, obesity and high blood pressure. Further, several epidemiologic studies have shown that a lack of social relationships is associated with increased mortality risk (Berkman et al. 2000; Berkman and Syme 1979; Holt-Lunstad et al. 2010; Seeman 1996; Seeman et al. 1987). Evidence points to an increase in disease risk behaviors, such as smoking and poor diet, that may partially explain the social integration-mortality association (Andrews et al. 2014; Samuel et al. 2015).

Despite the abundant literature on how neighborhoods and social relationships each influence health, less is known about the role that neighborhoods themselves play in patterning social integration and support. Earlier work by House et al. (1988a, b) explicitly called for more research examining factors that contribute to social relationships, but only select studies to date have modeled social relationships as the outcome of interest (Almeida et al. 2009). In one of the few studies examining the contribution of neighborhood poverty to social relationships, Small (2007) showed that neighborhood poverty, not race, best accounted for the smaller number and reduced quality of social relationships among racial/ethnic minority groups. Further, Berkman, a pioneer in the study of the role of social relationships on health (Berkman 1977; Berkman and Syme 1979), has posited that social relationships lie on the causal pathway between broader, social-structural contexts and the behavioral, psychological and physiological factors that are more proximal determinants of health (Berkman 2009; Berkman et al. 2000). Some of the key social-structural contexts noted include culture, communities, governmental policies, work environments and neighborhoods (Berkman et al. 2000). Thus, an improved understanding of the extent to which neighborhoods shape social relationships could inform the development of public policies and interventions that are supportive of community or neighborhood-level interventions that ultimately impact physical and psychological health.

Study Objectives

In the present study, we examined whether neighborhood poverty was associated with the amount of general social integration individuals report and the level of interaction reported with neighbors. We hypothesized that those living in high poverty neighborhoods would generally have low social integration when compared to individuals living in more affluent neighborhoods

but the effect of neighborhood poverty would differ depending on the type of social integration examined. Our study is one of the first to examine types and levels of social integration using a nationally representative sample of the US population living across neighborhoods of varying socioeconomic condition.

Methods

Data Sources

Data for this study come from the Third National Health and Nutrition Examination Survey (NHANES III). The survey, conducted by the Centers for Disease Control and Prevention, employed a complex, multi-stage, stratified sampling design intended to recruit a nationally representative sample of the non-institutionalized, civilian US population. NHANES III was conducted from October 1988–October 1994. Its design and methods are fully described elsewhere (National Center for Health Statistics 1996). The data for the present study are drawn from the household interview portion of NHANES III. The data were geocoded according to participants' home address, matched to 1990 Census tracts and made available for restricted-use only by the National Center for Health Statistics (NCHS). The restrictions assure confidentiality of the study participants.

Measures

Social Integration (Dependent Variable)

We used a previously published modified Social Network Index (SNI) (Ford et al. 2006; Galea et al. 2011; Obisesan and Gillum 2009) that captures the four domains of marriage or partnership, friends and relatives, religious activity, and voluntary associations as first assessed by Berkman and Syme (1979). A total score of 0–4 was created by adding a value of 1 for those who are married or living as married, having over 156 contacts (phone and/or visits) with family and friends, attending four or more religious services per year, and being members in a voluntary organization. This approach has been shown to have good predictive validity (Ford et al. 2006; Obisesan and Gillum 2009) and similar measures demonstrate consistent associations with health outcomes (Berkman and Syme 1979; Cohen et al. 1997; Kawachi and Berkman 2001; Stringhini et al. 2012; White et al. 2009). The SNI score was classified as high (score of 3–4), moderate (score of 2) or low (score of 0–1). For purposes of logistic regression models, we created a dichotomous variable by comparing individuals with low social integration to those who had high or moderate levels of integration.

The measure of social integration with neighbors was based on the question, "How often per year do you visit with neighbors?" Preliminary analyses indicated that over half of the study sample had no visits with neighbors. Thus, a three-level variable was created where 0 = never, low number of visits equaled 1–51 visits per year, and high neighbor social integration was defined as 52 or greater visits. For logistic regression models, participants were classified into less than 52 visits compared to 52 visits or greater. This classification is justified empirically as no established thresholds exist and 52 visits per year is approximately equal to one visit per week, whereas more than 52 visits suggests more frequent contact.

Neighborhood Socioeconomic Condition (Main Independent Variable)

Census tracts were used to proxy the neighborhood context, which has been extensively applied in prior neighborhood research (Braveman et al. 2005; Echeverria et al. 2009; Krieger 2006; Krieger et al. 2005; Small 2007; Subramanian et al. 2005). To represent neighborhood socioeconomic condition, we used a variable measuring the percent of residents within a census tract living below the federally-defined poverty line. This variable is based on data files available through the Public Health Disparities Geocoding Project (2004). A four-level categorical measure of neighborhood poverty was created using previously published categories of 0–4.9, 5–9.9, 10–19.9, and ≥20 % (Subramanian et al. 2005), where the last category (≥20 %) represents those living in highly impoverished neighborhoods.

Covariates

Due to their associations with social integration, age, sex, and race/ethnicity were adjusted for in regression models. In addition, individual SES at the time of the baseline interview is accounted for via the household poverty income ratio (PIR) and the individual's years of education completed. Past studies report that age has a curvilinear relationship with social integration (Campbell and Lee 1992) and is included here as a categorical variable. Individual SES is a strong predictor of health; therefore, 5 levels of PIR are used to account for the fine gradations of its potential effects on social integration (Braveman et al. 2005; Campbell and Lee 1992; Merkin et al. 2009; Small 2007). To ensure that the study participants had a substantial exposure to their neighborhood of residence, the sample was limited to those who had lived in their city/town/area of residence for at least 1 year.

Statistical Analysis

Descriptive statistics were used to present the distribution of key covariates by neighborhood poverty, using weighted estimates that accounted for the complex sample design of NHANES III. Bivariate associations between neighborhood poverty and visits with neighbors and the modified SNI were calculated using Chi square tests. Logistic regression models were fit to assess the relationship between neighborhood poverty and social integration while controlling for theorized confounders. For each social integration outcome, two models were fit. Model 1 is unadjusted and model 2 adjusts for age, sex, race/ethnicity, PIR, and years of education. Fit of the models was examined using the log likelihood, the likelihood ratio and the Cox and Snell's pseudo R-square statistic (Hosmer and Lemeshow 2000).

In planning the regression analyses, we considered how to account for the multilevel nature of the neighborhood-level exposure within the complex sample design of NHANES III. In neighborhood research, one way to account for the potential autocorrelation of residents living in the same neighborhood is to fit models using generalized estimating equations (population average models) with variances estimated using the Taylor-series method. In our study, we opted to use SUDAAN as a statistical package, but as of this writing, the program is unable account for more than one set of stratification variables, which would be necessary to account for both the neighborhood-level poverty measure as well as the complex stratification sample design used in

NHANES III (G. Gordon Brown, Research Triangle Institute, personal communication, 2012). Thus, we used the sample design variables to analyze the data the way they were intended. This analysis is likely adequate to capture the neighborhood-level autocorrelation since the primary sampling units in NHANES are mainly individual counties which contain several census tracts and are the higher-level grouping in our regression models.

The final analytic sample consisted of 16,044 respondents. The full sample included 20,024 adults age 17 or older. Respondents were excluded from the analyses if their addresses were not able to be geocoded and matched to a 1990 Census tract (n = 2778), and if they lived in their city/town/area for less than one year (n = 1202). The sample size is less than 16,044 for some analyses when values for included variables are missing. There are 1699 individuals for whom PIR is missing and in analyses that include PIR these respondents are excluded. Individuals missing PIR data are more likely to be from extreme categories in the age spectrum (younger and older), racial/ethnic minorities, less educated and lived in their areas for shorter periods of time when compared to those where PIR is provided. All analyses were conducted using SUDAAN, version 10 (Shah and Bieler 2005). This study was approved by the principal investigator's Institutional Review Board and analysis of restricted data was approved by the NCHS Research Data Center's Ethics Review Board.

Results

Table 1 presents the weighted descriptive statistics for the full sample. Slightly more than half of the sample is female (53 %), the majority (74 %) identified as non-Hispanic white, and over half (61 %) is between 20 and 49 years of age. Most (74 %) completed at least a high school education and 82 % live above the poverty line. Over half (53 %) of the participants lived in their area of residence for twenty or more years.

Table 1. Weighted descriptive summary statistics for the total sample (N = 16,044) and by neighborhood poverty category

Variable	Total sample % (SE)	0–4.9 % neighborhood poverty % (SE)	5–9.9 % neighborhood poverty % (SE)	10–19.9 % neighborhood poverty % (SE)	≥20 % neighborhood poverty % (SE)
Neighborhood poverty (%)					
0–4.9	30.9 (1.87)				
5–9.9	25.4 (1.29)				
10–19.9	25.1 (1.59)				
≥20	18.7 (1.22)				
Individual level predictors					
Age groups (years)					
17–19	4.8 (0.35)	4.1 (0.66)	4.7 (0.53)	4.7 (0.53)	6.0 (0.51)
20–29	19.8 (0.81)	14.7 (1.07)	20.2 (1.54)	21.9 (1.27)	24.8 (1.55)
30–39	23.7 (0.75)	22.5 (1.48)	26.0 (1.45)	23.7 (1.47)	22.6 (1.33)
40–49	17.9 (0.62)	22.1 (1.47)	17.3 (1.03)	14.9 (0.93)	15.5 (1.06)
50–59	11.9 (0.41)	13.8 (0.96)	11.8 (0.93)	11.3 (0.81)	9.7 (0.63)
60–69	10.9 (0.49)	11.7 (1.19)	10.2 (0.83)	11.2 (0.80)	10.2 (0.74)
70–79	7.6 (0.41)	7.8 (0.93)	6.6 (0.62)	8.6 (0.56)	7.4 (0.62)
80+	3.4 (0.29)	3.2 (0.49)	3.1 (0.49)	3.7 (0.37)	3.7 (0.39)
Sex					
Male	47.1 (0.47)	48.0 (0.98)	48.2 (1.09)	47.6 (0.75)	43.6 (0.92)
Female	52.9 (0.47)	52.0 (0.98)	51.8 (1.09)	52.4 (0.75)	56.4 (0.92)

Variable	Total sample % (SE)	0–4.9 % neighborhood poverty % (SE)	5–9.9 % neighborhood poverty % (SE)	10–19.9 % neighborhood poverty % (SE)	≥20 % neighborhood poverty % (SE)
Race/ethnicity					
Non-Hispanic white	73.6 (1.35)	89.5 (1.32)	77.8 (2.66)	72.9 (2.38)	42.4 (2.30)
Non-Hispanic black	12.3 (0.74)	3.6 (0.53)	8.5 (1.16)	11.0 (1.02)	33.5 (2.07)
Mexican–American	5.6 (0.48)	1.8 (0.31)	4.4 (0.81)	6.3 (0.76)	12.6 (1.06)
Other	8.5 (0.93)	5.1 (1.14)	9.2 (1.82)	9.8 (1.52)	11.5 (1.72)
Living below poverty (PIR < 1)	12.7 (0.90)	3.3 (0.64)	8.4 (1.48)	16.1 (1.49)	30.6 (1.86)
Highest year of school completed (years)					
0–8	11.1 (0.61)	4.5 (0.42)	7.7 (1.06)	13.9 (0.97)	22.7 (1.11)
9–11	14.8 (0.60)	8.8 (0.86)	13.1 (1.14)	18.7 (1.10)	21.7 (0.90)
12	32.8 (0.83)	29.9 (1.59)	36.2 (1.75)	33.7 (1.25)	31.9 (1.48)
13+	41.3 (1.27)	56.8 (2.08)	43.0 (2.14)	33.6 (1.61)	23.8 (1.29)
How long lived in city/town/area (years)					
Whole life	26.8 (1.14)	24.7 (2.04)	25.1 (2.08)	27.2 (1.69)	31.9 (1.35)
>20	26.6 (0.89)	27.3 (2.00)	26.2 (1.26)	26.1 (1.56)	26.8 (1.45)
11–20	15.6 (0.72)	17.5 (1.51)	15.7 (1.31)	14.9 (1.15)	13.3 (1.03)
5–10	14.6 (0.76)	15.9 (1.41)	15.3 (1.20)	14.3 (1.28)	11.9 (0.97)
3–4	7.6 (0.48)	6.4 (0.86)	8.4 (0.87)	8.2 (0.81)	7.6 (1.00)
1–2	8.7 (0.59)	8.1 (1.00)	9.2 (1.14)	9.2 (0.82)	8.4 (1.45)

This table displays column percentages

Demographic differences by degree of neighborhood poverty are also shown in Table 1. Those living in the highest poverty areas (at least 20 %) are more likely to be female, of a racial or ethnic minority group, have low income and are less educated than those in the neighborhoods with less poverty. As neighborhood poverty increased, the proportion of non-Hispanic whites decreased from 73 % in the 10–19.9 % neighborhood poverty category to 42 % in the 20 % and over neighborhood poverty category.

Table 2 displays bivariate associations between social integration and neighborhood poverty. As neighborhood poverty increased, the percentage of individuals reporting low social integration increased (Chi square $p < 0.0001$). However, individuals in the highest poverty neighborhoods reported a greater frequency of visits with neighbors than individuals living in neighborhoods with a lower percentage of poverty (Chi square $p < 0.0001$).

Table 2. Bivariate analysis examining neighborhood poverty and the 3-level social integration variables

Neighborhood poverty (%)	Social Network Index ($p < 0.0001$)			Visits with neighbors ($p < 0.0001$)		
	Low (score 0, 1) (%)	Moderate (score = 2) (%)	High (score 3, 4) (%)	No visits (%)	Low (<52/year) (%)	High (52+/year) (%)
0–4.9	31	35	34	45	22	34
5–9.9	35	36	29	51	15	33
10–19.9	42	35	23	51	14	35
≥20	48	34	18	47	11	42

Table 3 displays the results of logistic regression models examining associations between neighborhood poverty and general social integration. In model 1 (crude), the odds of low social integration among those living in high poverty neighborhoods was 2.05 (95 % CI 1.68, 2.52) times that of individuals living in neighborhoods with less than 5 % poverty. Those living in neighborhoods with 10–19.9 % poverty also had higher odds of having low scores on the SNI

(OR 1.67; 95 % CI 1.36, 2.06). In model 2 (adjusted), the relationships between neighborhood poverty and SNI score remained statistically significant although the odds ratios were attenuated. Individuals in the highest poverty neighborhoods had 1.43 (95 % CI 1.10, 1.86) times the odds of having a low score on the SNI when compared to those living in the most affluent neighborhoods. Individuals living in neighborhoods with 10–19.9 % poverty had 1.29 times the odds (95 % CI 1.01, 1.64) of low social integration.

Table 3. Logistic regression analysis of neighborhood poverty as a predictor of low social integration

	Model 1		Model 2	
	Odds ratio	95 % CI	Odds ratio	95 % CI
Neighborhood poverty (%)				
<5	1.00	Ref	1.00	Ref
5–9.9	1.21	0.95, 1.55	1.00	0.77, 1.30
10–19.9	1.67	1.36, 2.06	1.29	1.01, 1.64
≥20	2.05	1.68, 2.52	1.43	1.10, 1.86
Sex				
Male			1.19	1.08, 1.32
Female			1.00	Ref
Race-ethnicity				
Non-Hisp. white			1.00	Ref
Non-Hisp. black			0.95	0.80, 1.12
Mexican-American			0.67	0.55, 0.81
Other			1.35	0.99, 1.86
Age (years)				
17–19			1.00	Ref
20–29			1.56	1.22, 2.01
30–39			0.94	0.71, 1.27
40–49			0.80	0.60, 1.08
50–59			0.76	0.55, 1.06
60–69			0.62	0.44, 0.88
70–79			0.76	0.55, 1.06
80+			1.12	0.87, 1.45
Poverty income ratio				
<1			1.52	1.14, 2.01
1–1.99			1.21	0.97, 1.51
2–2.99			0.88	0.74, 1.04
3–3.99			0.88	0.72, 1.07
4+			1.00	Ref
Education (years)				
0–8			2.12	1.66, 2.71
9–11			1.83	1.50, 2.23
12			1.60	1.35, 1.91
13+			1.00	Ref

The outcome modeled is low social integration (SNI score of 0–1) as compared to high social integration (2–4)

Table 4 displays logistic regression models examining the relationship between neighborhood poverty and number of yearly visits with neighbors. The unadjusted model (model 1) shows that individuals living in neighborhoods with the highest poverty (≥20 %) have a decreased odds of having low numbers of visits with their neighbors, meaning that they have more contact with neighbors than those living in the least impoverished neighborhoods (OR 0.70; 95 % CI 0.57,

0.86). This relationship remained when controlling for individual-level covariates (OR 0.75; 95 % CI 0.58, 0.98).

Table 4. Logistic regression analysis of neighborhood poverty as a predictor of low social integration with neighbors

	Model 1		Model 2	
	Odds ratio	**95 % CI**	**Odds ratio**	**95 % CI**
Neighborhood poverty (%)				
<5	1.00	Ref	1.00	Ref
5–9.9	1.01	0.83, 1.22	1.01	0.83, 1.24
10–19.9	0.95	0.76, 1.17	1.05	0.82, 1.33
≥20	0.70	0.57, 0.86	0.75	0.58, 0.98
Sex				
Male			1.00	0.91, 1.10
Female			1.00	Ref
Race-ethnicity				
Non-Hisp. white			1.00	Ref
Non-Hisp. black			1.32	1.10, 1.58
Mexican-American			1.68	1.32, 2.14
Other			1.08	0.77, 1.51
Age (years)				
17–19			1.00	Ref
20–29			0.89	0.70, 1.12
30–39			0.90	0.71, 1.15
40–49			1.16	0.87, 1.54
50–59			1.07	0.83, 1.37
60–69			0.78	0.60, 1.01
70–79			0.79	0.59, 1.04
80+			0.74	0.55, 0.99
Poverty income ratio				
<1			0.55	0.43, 0.71
1–1.99			0.79	0.65, 0.96
2–2.99			0.88	0.70, 1.12
3–3.99			0.87	0.65, 1.17
4+			1.00	Ref
Education (years)				
0–8			0.90	0.71, 1.15
9–11			0.93	0.76, 1.14
12			0.97	0.87, 1.09
13+			1.00	Ref

The outcome modeled is low social integration with neighbors (<52 contacts/year) as compared to high social integration with neighbors (at least 52 contacts/year)

Discussion

The results of this study indicate that neighborhood poverty influences the extent and type of social integration that individuals experience. Specifically, those living in high poverty neighborhoods had lower general social integration but more visits with neighbors. These associations were found in a large, nationally representative, sample of the US population living in varying neighborhood settings, and after adjusting for demographic characteristics and individual-level SES.

Our findings contribute to the literature in at least two ways. First, our study directly examined the role of neighborhood poverty in shaping social integration. One other study examining characteristics such as low collective efficacy, the ability of neighbors to look out for each other, and physical neighborhood deterioration focused on health outcomes and included only residents of Chicago neighborhoods (Cohen et al. 2003). Another study examining dimensions of social relationships suggested that larger networks that include contacts who enable upward financial or educational mobility may be responsible for the social benefits seen among those living in affluent neighborhoods (Small 2007). Further, several studies examining the association between individual SES and social integration have shown that those with low SES are less socially integrated (Antonucci et al. 1999; Stringhini et al. 2012). Our study adds to this literature by examining the association between neighborhood poverty and social relationships in a racially/ethnically representative sample of the US population, after adjusting for various individual-level demographic and socioeconomic indicators. This focus on how neighborhood poverty patterns social integration is essential for understanding the way in which neighborhood contexts ultimately affect health and allows for the exploration of policies and interventions that support enhancing health-preserving neighborhood contexts.

The second contribution of our study is that it distinguishes between general social integration and social integration with neighbors. This distinction is important as neighborhood poverty is likely to exert a more direct impact on relationships developed in the immediate geographic area in which individuals live than among family members and friends who may live in other areas. Consistent with the few studies investigating this topic (Campbell and Lee 1992), we found that living in neighborhoods characterized by poverty was associated with more visits with neighbors. In their study of Nashville neighborhoods, Campbell and Lee (1992) found that although those with low SES had a tendency toward lower general social integration and smaller networks, the frequency of contact with their neighbors was greater than that of those with high SES. They hypothesized that because of their smaller networks and reduced resources generally, those with low SES relied more heavily on their neighbors for support. Our findings support this theory, although we did not have data that provided reasons for the frequency of neighbor visits or the quality of those interactions and how this translated into social or health benefits (or barriers).

Specifically, psychological theories of stress, including the conservation of resources theory and the reserve capacity model (Gallo et al. 2005; Hobfoll and Jackson 1991), posit that individuals respond to stressful situations by protecting the resources that they already possess, including emotional, social and physical benefits. These theories suggest that those living in concentrated poverty may hold onto their resources (Gallo et al. 2005; Hobfoll et al. 2003) and may explain findings that suggest that individuals living in affluent areas are able to provide benefit to and derive benefit from their neighbors even with limited personal contact, while those in high poverty areas do not benefit from their contacts in the same way nor are they able to maintain the more resource-costly non-neighbor social relationships. Our data do not provide direct evidence for these theories; rather, we believe this may be one explanation for the apparent discrepancy in why we found that those living in high poverty neighborhoods had high numbers of neighbor contacts but low social integration generally.

Our study results are supported by Sampson et al. (2002) and Wilson (1987), who suggest that individuals of lower socio-economic position have strong bonds with neighbors but lack the economic, cultural and political resources to simultaneously transform these connections into tangible opportunities for individual or neighborhood benefits. Nonetheless, much of this work and other similar research has been based on local, mostly urban communities (Campbell and Lee 1992; Small 2007). Our use of a sample of individuals living across varying neighborhood contexts in the US adds new supporting evidence of how neighborhood poverty shapes social relationships, thus serving as a potential pathway through which neighborhoods can affect population health.

Practical Implications

The present study has several implications for future research, policy and intervention planning. Our results demonstrate that individuals living in neighborhoods high in poverty tend to have fewer social ties outside their community when compared to individuals living in higher income areas. Given what we know about the benefits of social relationships, interventions designed to foster increased social ties should be particularly targeted to those living in high poverty communities. Future research could investigate whether existing community-building programs within under-resourced neighborhoods have the expected effect of increasing social integration. In support of this notion, recent work suggests that for individuals living in neighborhoods with low socioeconomic condition perceptions of safety and social cohesion were linked to better mental health, better self-rated health and decreased levels of smoking (Andrews et al. 2014; Meyer et al. 2014). Another recent paper found that, among men, chronic disease risk was associated with neighborhood environment and that this risk was the same among white and African-American men living in the same neighborhoods (Thorpe et al. 2015). Yet another study found a link between social engagement and chronic disease related risk behavior (Samuel et al. 2015). These results all suggest that neighborhood specific interventions that improve social conditions can improve population health and address health disparities.

Our results also suggest the continued importance of public policies that encourage revitalization and integration of neighborhoods across race/ethnicity and socioeconomic condition. Recent work has shown that improved neighborhood environments are associated with better mental health over time (Mair et al. 2015). Thus, improving neighborhood conditions could have the impact of improving not only social integration of community residents but provide a link to improve health and well-being more generally.

Research has also shown that social integration with neighbors may buffer negative environmental impacts of the neighborhood (Ross and Jang 2000). This area of research merits further exploration to determine if increased contact with neighbors, as we showed in our study, tempers the negative health impact of living in areas of concentrated disadvantage. Future research should also examine whether the varying levels and types of social integration that we found associated with neighborhood poverty are the same for all residential settings. Specifically, while the present study was national in scope and included neighborhoods of all types, we did not differentiate between urban, suburban and rural environments. These settings may influence social integration in distinct ways and thus may need to be considered when designing interventions. For example, future research could include measures on population density,

housing type, or other built environment features that may either directly influence neighborhood social relationships or serve as covariates (O'Campo et al. 2015; York Cornwell and Cagney 2014). Another avenue of research is the assessment of neighborhood attributes that may foster positive social ties. Recent studies have introduced methods that measure proactive investment in neighborhoods through new building permits (O'Brien and Montgomery 2015) and through the measurement of structural neighborhood characteristics that foster busy streets (Aiyer et al. 2014). These types of assessments could enrich our understanding of the pathways through which some neighborhoods foster positive social integration more successfully than others and help policy makers and planners design appropriate improvements.

Limitations and Strengths

The present study has some limitations that merit consideration. One limitation is the use of census tracts as proxies for neighborhood life. Census tracts capture reasonable geographic boundaries, but they may not directly map onto the same space that a person considers as his/her neighborhood. Further, our use of neighborhood poverty as the only variable to represent neighborhood socioeconomic condition may limit our ability to draw direct inferences to specific neighborhood environments. Self-reports of the number of visits with neighbors on a yearly basis likely introduced measurement error that influenced the precision of our regression estimates (Delgado-Rodriguez and Llorca 2004). Both social integration and neighborhood poverty were measured at one time point during adulthood, and some evidence suggests that a life-course approach may better elucidate the complexity of living in poverty and its many social and health consequences (Berkman 2009). Finally, although the modified SNI has shown good predictive validity, the items included in the NHANES III are not inclusive of all the items of the original SNI and did not allow us to weigh the relative importance of some social interactions over others. However, this index has been used in prior epidemiologic studies consistently showing associations between social integration and health (Ford et al. 2006; Galea et al. 2011; Obisesan and Gillum 2009), which allows us to directly connect our findings to prior published literature. The use of the NHANES III which took place between the years 1988–1994 is another potential limitation given that it is close to 20 years old. However, the variables that make up the modified SNI we used are not available in later rounds of NHANES data which would preclude direct comparisons with prior published literature. In addition, although the socio-political environment and the ways in which people socialize over the last two decades has possibly changed, census tracts remain fairly stable over time in the United States (Krieger 2006; Krieger et al. 2005), and thus, the 'causal' effect of neighborhoods on social ties should remain robust.

Additional strengths of our study include the large sample size and the representative sample of the US population in the NHANES III, allowing for the inclusion of all types of residential environments. This large sample provided sufficient power to classify neighborhood poverty into finer categories than typically possible. Further, the use of two distinct measures of social integration and how these may be differentially patterned by neighborhood poverty is a unique approach.

Conclusion

Our results highlight how neighborhood poverty shapes social integration. Having meaningful connections to others is an essential human need and supports health and wellness. The implication of our findings is that fostering stronger ties and bonds with others requires addressing the resource deficits that exist in neighborhoods where social integration is most urgently needed.

Acknowledgments

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