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Ellen-ge Denton

Jonathan A. Shaffer
University of Colorado Denver

Carmela Alcantra
Columbia University School of Social Work

Lynn Clemow

Elizabeth Denton
St. Johns University

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Ellen-ge D Denton¹, Jonathan A Shaffer², Carmela Alcantara²,
Lynn Clemow² and Elizabeth Brondolo³

Abstract

Background: The ethnic density hypothesis suggests that ethnic density confers greater social support and consequently protects against depressive symptoms in ethnic minority individuals. However, the potential benefits of ethnic density have not been examined in individuals who are facing a specific and salient life stressor.

Aims: We examined the degree to which the effects of Hispanic ethnic density on depressive symptoms are explained by socioeconomic resources and social support.

Methods: Patients with acute coronary syndrome (ACS, $N = 472$) completed the Beck Depression Inventory (BDI) and measures of demographics, ACS clinical factors and perceived social support. Neighborhood characteristics, including median income, number of single parent households and Hispanic ethnic density, were extracted from the American Community Survey Census (2005–2009) for each patient using his or her geocoded address.

Results: In a linear regression analysis adjusted for demographic and clinical factors, Hispanic ethnic density was positively associated with depressive symptoms ($\beta = .09$, standard error (SE) = .04, $p = .03$). However, Hispanic density was no longer a significant predictor of depressive symptoms when neighborhood characteristics were controlled. The relationship of Hispanic density on depressive symptoms was moderated by nativity status. Among US-born patients with ACS, there was a significant positive relationship between Hispanic density and depressive symptoms and social support significantly mediated this effect. There was no observed effect of Hispanic density to depressive symptoms for foreign-born ACS patients.

Conclusion: Although previous research suggests that ethnic density may be protective against depression, our data suggest that among patients with ACS, living in a community with a high concentration of Hispanic individuals is associated with constrained social and economic resources that are themselves associated with greater depressive symptoms. These data add to a growing body of literature on the effects of racial or ethnic segregation on health outcomes.

Keywords

Ethnic density, post-acute coronary syndrome, depression, residential racial segregation, social support, cardiovascular disease, United States

Introduction

Ethnic density refers to the proportion of individuals of a given ethnicity in a defined geographic area (Diez Roux & Mair, 2010). The ethnic density hypothesis suggests that ethnic density protects mental health and that this effect is mediated by social support (Yuan, Kerr, Salmon, Speedy, & Freeman, 2007). Specifically, greater ethnic density is hypothesized to provide increased opportunities for engagement with others who share similar cultural or ethnic backgrounds, and these interactions are posited to confer social advantages including increased social support (Henderson et al., 2005). In turn, social support may facilitate stress recovery and prevent or mitigate the

development of depressive symptoms or other mental health impairments in response to life stress.

¹Department of Psychology, College of Staten Island, The City University of New York, Staten Island, NY, USA

²Department of Medicine, Columbia University Medical Center, New York, NY, USA

³Department of Psychology, St. John's University, Jamaica, NY, USA

Corresponding author:

Ellen-ge D Denton, Department of Psychology, College of Staten Island, The City University of New York, 2800 Victory Boulevard, Building 4S, Room 229, Staten Island, NY 10314, USA.
Email: ellenge.denton@csi.cuny.edu

The majority of studies (12/16) report a negative relationship of ethnic density to depression among ethnic and racial minority samples (Das-Munshi, Bécaries, Dewey, Stansfeld, & Prince, 2010; Gerst et al., 2011; Halpern & Nazroo, 2000; Hwang, Myers, & Takeuchi, 2000; Leu, Walton, & Takeuchi, 2011; Mair et al., 2010; Mintz & Schuartz, 1964; Neeleman, Wilson-Jones, & Wessely, 2001; Ostir, Eschbach, Markides, & Goodwin, 2003; Pickett, Shaw, Atkin, Kiernan, & Wilkinson, 2009; Stafford, Newbold, & Ross, 2011; Walters, Ashworth, & Tylee, 2008), although there is evidence to suggest that the magnitude and direction of the effect is not completely uniform across ethnic groups (e.g. Bangladeshi's (Pickett et al., 2009), Mexicans (Lee, 2009) and African Americans; (Mair et al., 2010)). We specifically examine Hispanic ethnic density, as there is some evidence that the prevalence of depression may be higher for Hispanics than non-Hispanic individuals (Xie et al., 2008). Four of five studies have found that greater ethnic density is associated with reduced depressive symptoms among Hispanic samples (Gerst et al., 2011; Lee, 2009; Mair et al., 2010; Ostir et al., 2003; Yuan et al., 2007).

Despite the abundance of the literature on the effects of ethnic density on depression, there is an absence of data confirming the role of social support as a mediator of this relationship. Of the five studies that have tested social support as a mediator of the relationship of Hispanic ethnic density to depression (Das-Munshi et al., 2010; Halpern & Nazroo, 2000; Roh et al., 2011; Syed & Juan, 2012; Vogt Yuan, 2007), only one revealed an attenuated relationship between ethnic density and depression (and only for Black but not Hispanic individuals) when social support was included in the model. None of the studies of Hispanic ethnic density have provided evidence that increased social support explains the relationship between Hispanic density and depression. There are also mixed findings on the relation of ethnic density to social support. Across ethnic groups, five studies have indicated that ethnic density is positively associated with social support (Das-Munshi et al., 2010; Halpern & Nazroo, 2000; Mair et al., 2010; Roh et al., 2011; Syed & Juan, 2012), but three others reported no relation between ethnic density and social support.

In addition to the inconsistent findings discussed above, there are two gaps in the extant literature on ethnic density and depression. First, the beneficial effects of social support for health may be seen more clearly when social support serves as a buffer against life stress. Studies of community dwelling samples may contain individuals facing varying types and intensities of life stress. Consequently, they may face different needs for social support and receive different levels of benefit from any support they receive. Therefore, the present study focuses on the effects of ethnic density on depression in a sample of individuals all of whom are facing a critical life stressor, an episode of acute coronary syndrome (ACS). ACS is known to be

depressogenic (Parker et al., 2008), and findings from Frasure-Smith and colleagues suggest that high levels of social support predicted improvements in depression symptoms over the first year post-ACS in individuals with depression (Frasure-Smith et al., 2000).

Second, ethnic density does not exist in a vacuum. The ability to receive or benefit from the social support of one's ethnic or racial group may depend on the degree to which the members of these groups have access to relevant economic and social resources. For some ethnic/racial groups, high ethnic density co occurs with low economic resources (Bécaries, Cormack, & Harris, 2013; Williams & Collins, 2001). In these cases, areas with high ethnic density may lack the social and economic capital that protects against negative mental health outcomes, as has been seen in studies of residential racial segregation (RRS; Dohrenwend, 1993; Schulz et al., 2006; Schulz et al., 2008; Warheit, Holzer, & Robbins, 1979).

Studies that have attempted to disentangle the effects of ethnic density versus socioeconomic status (SES) on depression have not yielded a clear picture of the differential contribution of ethnic density to depression. Most studies (13/16) include a measure of SES; usually an individual level indicator of education) as a covariate in analyses of the relationship of ethnic density to depression. Of these studies, nine found that the relationship of ethnic density to depression was significant when education was included in the model (Das-Munshi et al., 2010; Gerst et al., 2011; Juang, Nguyen, & Lin, 2006; Leu et al., 2011; Mair et al., 2010; Ostir et al., 2003; Stafford et al., 2011; Walters et al., 2008; Yuan et al., 2007), whereas four studies found the relationship was no longer significant (Henderson et al., 2005; Lee, 2009; Roh et al., 2011; Syed & Juan, 2012). Similarly, when various measures of neighborhood advantage (i.e. neighborhood income, space, household values, etc.) are controlled, most (Gerst et al., 2011; Halpern & Nazroo, 2000; Lee, 2009; Mair et al., 2010; Neeleman et al., 2001; Ostir et al., 2003; Yuan et al., 2007), but not all studies (Henderson et al., 2005; Mair et al., 2010; Yuan et al., 2007) have found that the relationship of ethnic density to depression remained significant for at least one ethnic subgroup. Two studies (Mair et al., 2010; Vogt Yuan, 2007) report that the negative relationship of ethnic density to depressive symptoms disappears when measures of neighborhood advantage are controlled, whereas in a majority of the studies the relationship persists (Das-Munshi et al., 2010; Gerst et al., 2011; Halpern & Nazroo, 2000; Mair et al., 2010; Mintz & Schuartz, 1964; Ostir et al., 2003; Vogt Yuan, 2007; Walters et al., 2008).

In New York City (NYC), areas with greater Hispanic density are also the areas with more foreign-born Hispanics (Karpati et al., 2004). Therefore, in areas with high Hispanic density, residents share not only ethnicity, but also the challenges associated with both discrimination

and acculturation. Despite these challenges, foreign-born individuals are less likely to be depressed than US-born individuals (Alegria et al., 2007; Grant et al., 2004; Vega et al., 1998). Three of the 16 studies of ethnic density and depression examined nativity status as a moderator. The authors of these studies have concluded that ethnic density is associated with depression for US-born minority individuals, but not foreign-born individuals (Hwang et al., 2000; Mair et al., 2010; Stafford et al., 2011). However, none of these studies explicitly examine if nativity status influenced the role of social support as a mediator of the relationship of ethnic density to depression.

The overall aim of this study is to examine the effects of ethnic density on social support and depressive symptoms in individuals facing an acute life stressor, an episode of ACS. ACS is a condition known to be depressogenic and potentially responsive to social support. We examine the degree to which the effects of ethnic density on social support and depressive symptoms persist above and beyond the effects associated with individual and neighborhood socioeconomic conditions. We are specifically interested in understanding the degree to which the relationship of ethnic density to depressive symptoms is mediated by the social support conferred when living with similar others. Therefore, we examine the effects of Hispanic ethnic density on depressive symptoms in both Hispanic and non-Hispanic individuals. As those who are foreign born may differ from those who are US born in their need for the social benefits of ethnic density, we examine the moderating effects of nativity status on the relationship of ethnic density to social support and depressive symptoms.

Subjects and methods

Individuals were enrolled in the Prescription Use, Lifestyle, Stress Evaluation (PULSE) study, an ongoing, single cohort, observational, prospective study of 1,087 individuals who presented to Columbia University Medical Center (CUMC) with ACS. Individuals were eligible for the parent PULSE study if they met criteria for ACS (either acute myocardial infarction with or without ST segment elevation or unstable angina) as verified by study cardiologists. This analysis includes data from the first 500 individuals enrolled. Only individuals who completed the baseline depression assessment and whose census tracts were located using Geographic Information Software (GIS) were included in this substudy ($n = 472$). The institutional review board approved the study, and patients provided written informed consent. The sample was on average 63 years old (standard deviation (SD): 11.17). Approximately one-third were women (34.3%, $n = 162$); 40% ($n = 189$) were foreign born, and one-third self-identified as Hispanic (32.8%, $n = 155$). A total of 60%

($n = 285$) of patients self-identified as non-Hispanic Whites and 19% as non-Hispanic Black ($n = 90$).

Hispanic ethnic density. Individuals' mailing addresses were ascertained during intake. Using GIS, each patient address was assigned a census tract (Figure 1). Density measures were extracted from Census American Community Survey 2005–2009 and matched to each patient-assigned census tract. Individuals were distributed across 363 census tracts. On average, each census tract is populated by 5,800 people. Hispanic ethnic density was defined as the percentage of Hispanics living within each census tract.

Neighborhood SES. Percent female-headed household was defined as the proportion of female-headed households, defined as the number of family households with a woman, related child under 18 years old, and no husband divided by the total number of households within that census tract. Data were extracted from the Census American Community Survey 2005–2009. The median household income was extracted from the 2000 US Census.

Individual characteristics

Key demographic variables were assessed via interview during the patient's index hospitalization for ACS. Validated Spanish versions of the measures were used for Spanish-speaking individuals whenever possible; if no Spanish version was available, the measures were translated from English to Spanish and back translated by three independent persons. Variables included patient reported age, sex, race and number of years of schooling completed. Patients also reported their nativity status (US born or foreign born).

Disease severity was calculated using the Charlson comorbidity index (an index of 22 medical conditions weighted by patient associated mortality risk, Charlson, Pompei, Ales, & MacKenzie, 1987).

Perceived social support was assessed using the ENRICH Social Support Instrument (ESSI). Six items were used to assess tangible (e.g. *Is there someone available to help you with daily chores?*) and emotional social support (e.g. *Is there someone available to you who you can count on to listen to you when you need to talk?*), using a Likert-type scale from 1 (*none of the time*) to 5 (*all of the time*). These items are summed to create a total score, with higher scores indicating greater social support. Cronbach's alpha for the ESSI was .87.

Depression was assessed with the Beck Depression Inventory (BDI-I; Beck, Ward, Mendelson, Mock, & Erbaugh, 1961) and a total sum of the responses to all items was used as the continuous dependent measure. Cronbach's alpha for the BDI was .84.

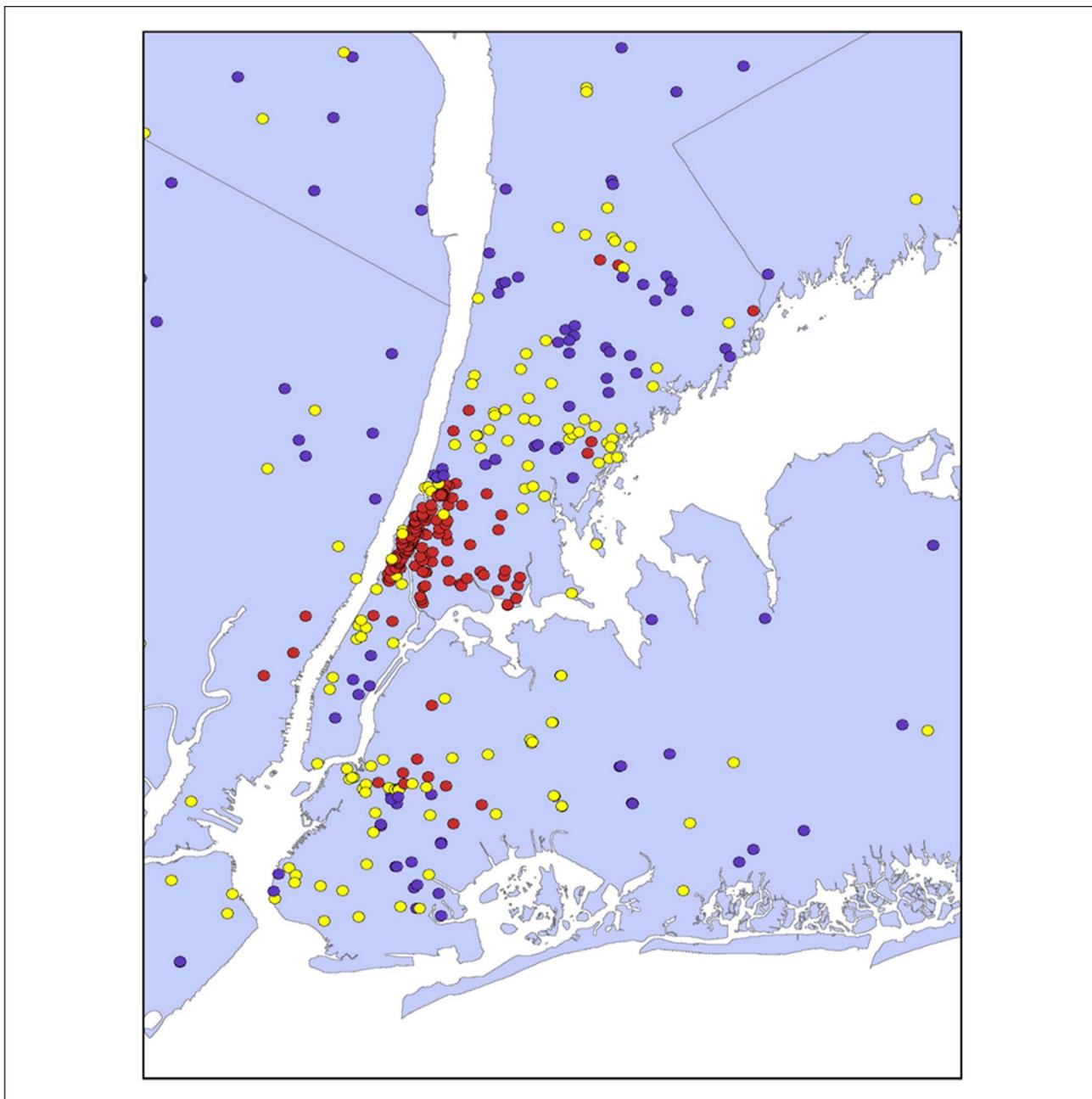


Figure 1. Demographic mapping of PULSE $N = 472$ post-ACS individuals. Each dot represents one patient. Hispanic density: red = high; yellow = moderate; purple = low. ACS: acute coronary syndrome.

Analytic plan

All analyses were performed using SAS 9.2. The primary independent variable, Hispanic ethnic density, was treated as both a categorical (tertiles) and a continuous variable (percentage Hispanic within a given census tract). We report the continuous effects in the text of the article, and display categorical results in the table. In every case, if the regression analyses of continuous variables were significant, the categorical results were significant as well. Both

ethnic density and depression scores were positively skewed and consequently log transformed. All reported analyses reflect use of transformed variables. With one minor exception as noted in Table 3, there were no significant differences between analyses performed with log transformed versus untransformed measures.

Initial analyses examine the relationship of ethnic density to demographic variables (i.e. age, gender, race and nativity status), as well as individual (e.g. education) and neighborhood (e.g. median income, percentage of

Table 1. Demographic characteristics, perceived social support, self-reported depression and neighborhood characteristics for the full sample and by Hispanic density, gender and nativity status.

Characteristics	Overall (N = 472)	Hispanic density			<i>p</i> ^b	Gender		<i>p</i> ^c	Nativity status		<i>p</i>
		Low (n = 160)	Moderate (n = 155)	High (n = 157)		Male (n = 310)	Female (n = 162)		US born (n = 277)	Foreign born (n = 189)	
Age, <i>M</i> (<i>SD</i>)	63.5 (11.2)	65.5 (10.5)	63.8 (11.3)	61.1 (11.4)	.002	62.8 (11.1)	64.9 (11.3)	.71	64.5 (11.1)	61.8 (11.0)	.01
Female	162 (34.3)	49 (30.6)	47 (30.3)	66 (42.0)	.05	–	–	–	90 (32.5)	71 (37.6)	.26
Foreign born	189 (40.0)	29 (18.1)	53 (34.2)	107 (68.2)	<.001	118 (38.7)	71 (43.8)	.26	–	–	–
Hispanic	155 (32.8)	9 (5.6)	29 (18.7)	117 (74.5)	<.001	91 (29.4)	64 (39.5)	.03	32 (11.6)	123 (65.1)	<.001
Black	90 (19.1)	20 (12.5)	32 (20.6)	38 (24.2)	.03	46 (14.8)	44 (27.2)	<.001	46 (16.6)	42 (22.2)	.13
White	285 (60.4)	130 (81.3)	94 (60.6)	61 (38.9)	<.001	197 (63.5)	88 (54.3)	.05	207 (74.7)	75 (39.7)	<.001
Years in school, <i>M</i> (<i>SD</i>)	13.2 (4.2)	15.3 (3.1)	13.6 (3.9)	10.7 (4.3)	<.001	13.8 (4.3)	12.1 (3.8)	.03	14.6 (3.5)	11.2 (4.4)	<.001
Beck Depression Inventory, <i>M</i> (<i>SD</i>)	9.2 (7.2)	7.3 (5.4)	9.5 (6.7)	11.0 (8.8)	<.001	7.5 (5.7)	12.7 (8.6)	<.001	8.9 (6.7)	9.7 (8.1)	.26
Perceived social support, <i>M</i> (<i>SD</i>)	26.3 (4.9)	27.0 (4.6)	26.3 (4.3)	25.5 (5.5)	.02	26.7 (4.8)	25.5 (4.9)	.02	26.5 (4.7)	25.9 (5.1)	.20
Disease severity, <i>M</i> (<i>SD</i>)	1.7 (1.6)	1.5 (1.5)	1.8 (1.6)	1.8 (1.8)	.16	1.4 (1.5)	2.1 (1.8)	.08	1.7 (1.6)	1.7 (1.7)	.99
Median household income, <i>M</i> (<i>SD</i>)	\$43,314 (27,802)	\$61,844 (34,549)	\$39,302 (19,623)	\$28,390 (12,033)	<.001	\$45,767 (29,981)	\$38,620 (22,415)	<.001	\$48,364 (30,564)	\$35,847 (21,479)	<.001
Proportion of female-headed households, <i>M</i> (<i>SD</i>)	10.5 (8.6)	4.8 (4.9)	7.7 (7.0)	19.1 (6.1)	<.001	9.6 (8.4)	12.2 (8.8)	.05	7.6 (7.5)	14.6 (8.5)	<.001

Hispanic density tertiles are defined as: low Hispanic ethnic density < 7.2% Hispanic, moderate Hispanic ethnic density 7.2% > 32.2% Hispanic and high Hispanic ethnic density > 32.2%.

^aData are given as number (percentage) of study patients unless otherwise indicated.

^b*p*-values are based on the analysis of variance for continuous measures.

^c*p*-values are based on the χ^2 test for categorical measures.

female-headed households) measures of socioeconomic resources.

As preliminary analyses revealed that ethnic density was related to individual sociodemographic variables and neighborhood socioeconomic variables, we create a series of models. To test our primary hypothesis, we examined the main effect of ethnic density on depression using both categorical and continuous measures of ethnic density in unadjusted (Model 1) and adjusted models (Models 2 and 3). In the partially adjusted model (Model 2), covariates included age, gender, years of education, nativity status, Charlson comorbidity index and Hispanic ethnicity. In the fully adjusted model (Model 3), we added neighborhood sociodemographic variables to Model 2. We examined potential moderators of the association of ethnic density with depression by including cross products of Hispanic ethnicity, SES and nativity status with ethnic density.

Next, we examined contextual effects on social support by evaluating the relationship of individual and neighborhood sociodemographic variables to social support. To test the hypothesis that perceived social support is a pathway through which ethnic density is associated with depression, mediation analyses were performed using bootstrapping described by Preacher and Hayes (Preacher & Hayes, 2008). We calculate the confidence intervals (CIs) using two methods designed to correct for potential bias (i.e. bias corrected or bias corrected and accelerated (BCA)). We further tested moderated mediation, hypothesizing that the role of individual and neighborhood level mediators of the relationship of Hispanic ethnic density to depression may

differ by ethnicity (Hispanic versus non-Hispanic), SES and nativity status (foreign born vs US born).

Results

Demographic characteristics of the sample are presented in Table 1. Intercorrelations of individual and neighborhood level sociodemographic variables are presented in Table 2.

Ethnic density in context: demographic differences

Census tracts ranged between less than 1% Hispanic to 91% Hispanic. Most of the Hispanic individuals in the study lived in areas in which there were high concentrations of Hispanics (75% lived in high density areas), 19% lived in areas with moderate concentrations of Hispanics, and 6% lived in areas with low concentrations of Hispanic (less than 7%; $\chi^2 = 191.44$, $df = 2$, $p < .001$). Put another way: among Hispanics, 67% lived in areas in which 50% or more of the residents were also Hispanic.

The residents of high density areas differ from those in low and moderate density areas in gender ($\chi^2 = 6.22$, $df = 2$, $p = .045$), nativity status ($\chi^2 = 83.77$, $df = 2$, $p < .001$) and education level ($F(2, 461) = 58.57$, $p < .001$). In this sample, women (vs men) and foreign born (vs US born) were more likely to live in areas of high Hispanic density versus moderate or low density areas. Education levels also varied by amount of Hispanic density, with high density areas

Table 2. Interrelations among neighborhood and individual level sociodemographic factors and depression.

	Education level	Disease severity	Perceived social support	Log median income	Log female-headed household	Log percent Hispanic density	Log depression severity
Age	-.01	.13**	.05	.15**	-.20**	-.17**	-.06
Education level		-.12**	.04	.27**	-.52**	-.48**	-.13**
Disease severity			.02	-.05	.13**	.06	.17**
Perceived social support				.03	-.07	-.12*	-.21***
Log median income					-.48**	-.50**	-.15**
Log female-headed household						.72**	.18***
Log percent Hispanic density							.15**

* $p < .05$, ** $p < .01$, *** $p < .001$.

housing individuals with lower mean levels of education than moderate and low density areas.

Ethnic density in context: socioeconomic effects

Hispanic density was negatively associated with individual and neighborhood measures of SES. In regression analyses, median income predicted about 15% of the variance in Hispanic density ($\beta = -43.23$, $SE = 4.74$, $p < .001$). The proportion of female-headed households shared about 52% of the variance with ethnic density ($p < .001$). Differences in income and percent female-headed household by ethnic density category are shown in Table 1.

Individual and neighborhood sociodemographic variations in depression

As shown in Table 1, women had significantly higher levels of depressive symptoms than did men, and those who were Hispanic had significantly higher levels of depressive symptoms than those who were not ($p < .001$). Education was significantly negatively related to depressive symptoms. Illness severity as assessed by the Charlson comorbidity index was positively related to depressive symptoms. Neighborhood factors were also associated with depressive symptoms (see Table 2). Both median income and proportion female-headed households served as predictors of depressive symptoms, and together they accounted for about 5% of the variance in depressive symptoms ($p < .001$).

Main effects of ethnic density on depression: unadjusted and adjusted analyses

In unadjusted analyses, Hispanic ethnic density was positively associated with depressive symptoms ($\beta = .10$, $SE = .03$, $p = .001$). After adjusting for individual level characteristics, including age, gender, education, nativity status, Charlson comorbidity index and Hispanic ethnicity, the relationship of ethnic density to depressive symptoms remained significant ($\beta = .09$, $SE = .04$, $p = .03$). However,

when we controlled for neighborhood characteristics as well as individual characteristics, the effects of Hispanic density on depressive symptoms were no longer significant ($\beta = .05$, $SE = .05$, $p = .30$).

Test of potential moderators: ethnicity, individual and neighborhood SES and nativity status

Ethnicity. There was no significant interaction between Hispanic ethnic density and ethnicity both with ($p > .20$) and without ($p > .33$) adjustment for individual and/or neighborhood characteristics. Hispanic individuals were more depressed than non-Hispanic individuals irrespective of the ethnic density of their neighborhood.

SES. In adjusted models, there was a significant interaction of Hispanic density with individual level education ($p < .05$), but these effects were no longer significant controlling for individual and neighborhood level covariates. The interaction of Hispanic density with neighborhood income and percent female-headed household on depression was not significant when the models were adjusted for all other individual and neighborhood covariates (all $ps > .12$).

Nativity status. The interaction of nativity status and Hispanic density on depressive symptoms was significant and remained so after adjustment for both individual and neighborhood variables (Model 2, $p = .02$; Model 3, $p = .04$; see Table 3). Follow-up regression analyses conducted separately by nativity status showed a significant positive relationship between Hispanic density and depressive symptoms for US-born individuals only ($p < .001$). The effect for US-born individuals remained significant when controlling for individual and neighborhood sociodemographic variables (Model 2, $p < .05$; Model 3, $p < .05$). Neither the unadjusted nor adjusted relationships of Hispanic density to depressive symptoms were significant for foreign-born individuals ($p > .24$).

Table 3. Regression analyses testing nativity status as a moderator of the relationship of Hispanic density to depression for the full group of post-ACS individuals ($N = 472$).

	Unadjusted models				Adjusted Model 1 (individual level factors)				Adjusted Model 2 (individual and neighborhood level factors)			
	B	SE	Beta	R ²	B	SE	Beta	R ²	B	SE	Beta	R ²
Full sample												
Hispanic density to depression ^a	.10	.03	.15	.02**	.09	.04	.14	.01*	.05	.05	.08	.002
Full sample with interactions												
Nativity status	.33	.22	.20	.005	.23	.21	.14	.002	.22	.21	.14	.002
Hispanic density	.18	.04	.27	.04***	.13	.05	.21	.02*	.10	.05	.15	.006
Hispanic density × nativity status	-.15	.07	-.34	.01*	-.14	.07	-.32	.01*	-.14	.07	-.31	.008*
Follow-up analysis												
US born (Hispanic density to depression)	.18	.04	.26	.07**	.13	.05	.19	.02**	.15	.06	.22	.02*
Foreign born (Hispanic density to depression)	.03	.06	.03	–	-.00	.07	.00	–	-.09	.09	-.12	.006

Adjusted Model 1 included age, gender, education, nativity status, Charlson disease severity and Hispanic ethnicity. Adjusted $R^2 = 11.87\%$.

Adjusted Model 2 included covariates in Model 1, log median household income and proportion of female-headed household. Adjusted $R^2 = 16.61\%$.

^aNote with untransformed scores the unadjusted relationship of Hispanic density to depressive symptoms is significant, but the adjusted relationship is not significant in Model 1 or 2.

* $p < .05$, ** $p < .01$, *** $p < .001$.

Does social support mediate the relationship of Hispanic ethnic density to depression?

As shown in Table 2, ethnic density was negatively related to social support, and social support was negatively related to depressive symptoms. However, social support was unrelated to either individual or neighborhood measures of SES.

We could not examine social support as a mediator in the full sample because ethnic density was not a significant predictor of depressive symptoms once covariates were included in the analysis. However, the effects of ethnic density to depressive symptoms remained significant for US-born individuals, even when controlling for all individual and neighborhood level covariates. Therefore, to determine if social support mediates the relationship of ethnic density to depressive symptoms in US-born individuals above and beyond the mediating effects of neighborhood level SES, we used bootstrapping methods, as recommended by Preacher and Hayes (2008). The analyses controlled for all individual level covariates. Mediation analysis revealed that Hispanic density was negatively related to both perceived social support and median income and positively related to proportion of female-headed households (Figure 2). Of the total variance in depressive symptoms explained in the fully adjusted model, the multiple mediators (neighborhood income, female-headed households and social support) accounted for 43.94% of the variance. Perceived social support was the only mediator significantly related to depressive symptoms (BCA 95% CI = [.01, .05]). The total effect of ethnic density on depressive symptoms was significant ($\beta = .18$, $SE = .04$, $p = .01$). However, this effect was no longer significant

($\beta = .10$, $SE = .06$, $p < .10$) with social support included in the model. When all covariates were in the model, social support, alone, accounted for 13% of the variance between Hispanic density and depressive symptoms.

Discussion

Although prior literature has, in general, found a negative relationship between ethnic density and depression, research has not confirmed the importance of social support as a mediator. In fact, ethnic density itself is not uniformly associated with increased social support (Henderson et al., 2005; Leu et al., 2011). We hypothesized that the failure to document the role of social support as a mediator of the relationship of ethnic density to depression could be a function of the demands facing the participant sample, affecting their need for social support. To date, no prior studies have specifically examined the effects of ethnic density in a sample of individuals who are facing an acute, depressogenic stressor, and who therefore might be particularly in need of increased support. We examined these relationships in a sample of individuals all of whom had recently been hospitalized for an ACS event, a salient stressor known to be depressogenic. Within this sample, we examined the effects of ethnic density on depressive symptoms, examining the potential mediating role of social support. In addition, we investigated the degree to which the effects of ethnic density on support and depressive symptoms might vary depending on other social and economic characteristics associated with ethnic density.

In contrast to much of the literature (Das-Munshi et al., 2010; Gerst et al., 2011; Halpern & Nazroo, 2000; Hwang et al., 2000; Leu et al., 2011; Mair et al., 2010; Mintz &

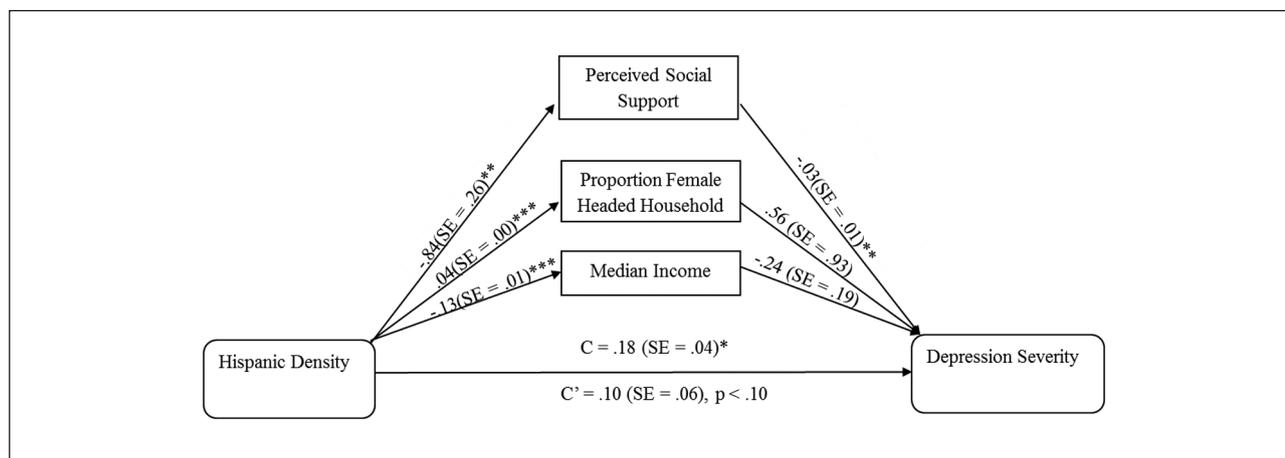


Figure 2. US-born ACS patients. Model testing perceived social support, neighborhood income and female-headed household as mediators of the association between Hispanic density to depressive symptoms. The number provided for each path is regression coefficients and standard errors derived from a bootstrap procedure. ACS: acute coronary syndrome.

Schurtz, 1964; Neeleman et al., 2001; Ostir et al., 2003; Pickett et al., 2009), our findings indicate that neighborhood levels of Hispanic ethnic density were positively associated with depressive symptoms. Individuals who lived in high Hispanic density neighborhoods had depression scores more than three points higher than those in low density neighborhoods, a difference likely to have clinical relevance (Davidson et al., 2013). The effects were consistent for Hispanic and non-Hispanic individuals.

It may be that the potential benefits associated with ethnic density depend on the socioeconomic and demographic context in which the participants lived. In this sample, individuals who lived in areas of high ethnic density were more likely to be foreign born, to be women and to have lower levels of education. Nativity status, greater family responsibilities and limited education can all present barriers to economic achievement.

Ethnic density was also negatively associated with neighborhood socioeconomic resources. Across the sample as a whole, the association of ethnic density to depression was fully accounted for by neighborhood level SES (i.e. median income and proportion female-headed household). These findings suggest that in our sample, ethnic density co-occurs with a range of other individual and neighborhood level characteristics that may add to the overall stress burden facing the participants. The limited economic resources may mitigate the ability of ethnic density alone to buffer the effects of stress on depression. These findings are consistent with those of LaVeist et al. (2011) who argues that the sociodemographic characteristics of a neighborhood (i.e. place) may be more important than the individual's race in contributing to health disparities.

Consistent with much previous literature (Das-Munshi et al., 2010; Halpern & Nazroo, 2000; Hwang et al., 2000;

Roh et al., 2011; Syed & Juan, 2012), we found that social support was not a significant mediator of the relationship of ethnic density to depression for the sample as a whole. But the effects of ethnic density on social support and depression were not the same for all subgroups within the sample. Prior literature suggested that nativity status might moderate the effects of ethnic density on depression (Hwang et al., 2000; Mair et al., 2010; Stafford et al., 2011), with protective effects seen more clearly among foreign-born individuals. We found a significant interaction of nativity status and ethnic density, even when controlling for all individual and neighborhood level sociodemographic characteristics. Hispanic density was positively related to depressive symptoms for those who were US born, but not for those who were foreign born. This finding suggests that ethnic density may be related to mental health through different pathways for US-born versus foreign-born individuals. In support of this notion, tests of mediation revealed that social support, but not SES, mediated the relationship of ethnic density to depressive symptoms in US-born individuals. For those who were US born, ethnic density was negatively associated with social support. There was no relationship of ethnic density to social support or depressive symptoms for foreign-born individuals.

Our findings on the relationship of ethnic density to depressive symptoms among US-born individuals are consistent with the overall literature on the relationship of racial residential segregation to mental health among African American samples (Acevedo-Garcia, 2000; Lester, 2000; Peterson & Krivo, 1999). RRS shares some common conceptual characteristics with ethnic density, as RRS is sometimes quantified as the proportion of Black Americans residing in a neighborhood (Kramer & Hogue, 2009). RRS has been associated with higher levels of a

variety of mental health complaints (Dohrenwend, 1993; Schulz et al., 2006; Schulz et al., 2008; Warheit et al., 1979). At least, a portion of the health effects associated with RRS are likely to be a function of the level of socioeconomic disadvantage that co-occurs with segregation for some minority groups.

For US-born individuals, there may be a bidirectional relationship between density and depression. Depression may be a barrier to movement to more advantaged areas; those with higher levels of depression may not have the motivational or financial resources to leave more dense and disadvantaged areas (Ludwig et al., 2012). This barrier may be a particular problem for those with concomitant medical illness, such as ACS. On the other hand, for foreign-born Hispanic individuals, the problem may be more complex. In this case, the social capital available in neighborhoods high in ethnic density may partly compensate for the low levels of socioeconomic resources. In future studies of the relationship of ethnic density to health, it may be important to examine the degree to which individuals choose to live in areas of high ethnic density or believe they face significant barriers to residential mobility.

In the presence of a significant stressor such as an acute medical illness, the hardships associated with living in impoverished neighborhoods may undermine the ability to develop or benefit from supportive relationships (Brondolo, Libretti, Rivera, & Walsemann, 2012). This hypothesis is consistent with data suggesting that social support does not reliably buffer individuals from the depressogenic effects of race-related stress (Brondolo, Gallo, & Myers, 2009). The presence of high levels of stress may actually erode social relationships (Broudy et al., 2007). Structural interventions to support the development of social and economic capital in high stress communities may thus be required.

Conclusion

This study featured a single site, cross-sectional design and participants were primarily from northern Manhattan and the South Bronx, areas which have high levels of Hispanic ethnic density. Yet, there are clusters of moderate Hispanic density and low Hispanic density clusters all throughout the tri-state region. This patient population represents individuals who came to CUMC. Individuals not treated at CUMC may have different social and demographic resources (e.g. traveling resources). This study was unable to evaluate concordant and discordant ethnicity matches due to sample size (i.e. stratified analysis of Hispanics within high, moderate and low Hispanic density neighborhoods compared with non-Hispanics within high, moderate and low Hispanic density neighborhoods). However, the influences of neighborhood level effects on mental health outcomes, above individual level demographics were clear. Similarly, our sample sizes for other

ethnic groups were too small for analyses and our focus on differences between Hispanic and non-Hispanic individuals did not allow us to conduct more fine-grained analyses within the non-Hispanic group.

Future research should consider whether depression is a barrier to residential mobility (i.e. leaving impoverished areas) or if depression is exacerbated by the social and financial strains presented by living in areas with high levels of ethnic density. Social support may not be the primary mediator of ethnic density to depression, and we did not assess other psychosocial variables, including discrimination, acculturative stress or neighborhood cohesion that may mediate the density depression association.

We chose as a stressor the presence of ACS. We do not know if the same effects will emerge among samples facing other medical or non-medical stressors. However, ACS individuals are at risk of depression and depression outcomes are associated with increased risk of subsequent morbidity and/or mortality among individuals with ACS (Barth, Schumacher, & Herrmann-Lingen, 2004; Carney & Freedland, 2003; Kronish, Rieckmann, Schwartz, Schwartz, & Davidson, 2009; van Melle et al., 2004). Therefore, given the importance of depression for ACS outcomes, we consider it important for public health planning to understand the degree to which neighborhood contextual factors serve to increase the public health burden.

Despite the limitations, this study is the first to examine effects of ethnic density considering its role as a potential buffer of effects of a medical stressor (ACS) on depression. The results suggest that Hispanic ethnic density does not operate in a vacuum, independent of other social processes. The findings suggest that there are complex interrelations between ethnic density and socioeconomic and social resources that have implications for mental health. A substantial stress burden or restricted local economic and social resources may undermine the psychosocial benefits of ethnic density.

Conflict of interests

None.

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