HHS Public Access

Author manuscript

Soc Sci Med. Author manuscript; available in PMC 2016 April 01.

Published in final edited form as:

Soc Sci Med. 2015 April ; 130: 172–180. doi:10.1016/j.socscimed.2015.02.006.

The impact of neighborhood quality, perceived stress, and social support on depressive symptoms during pregnancy in African American women

Carmen Giurgescu, PhD, RN,
Assistant Professor, College of Nursing, Wayne State University, Detroit, MI

Dawn P. Misra, PhD,
Professor and Associate Chair for Research, Department of Family Medicine and Public Health Sciences, School of Medicine, Wayne State University, Detroit, MI

Shawnita Sealy-Jefferson, PhD, MPH,
Postdoctoral Fellow, Department of Family Medicine and Public Health Sciences, School of Medicine, Wayne State University, Detroit, MI

Cleopatra Howard-Caldwell, PhD,
Associate Professor and Director of Center for Research on Ethnicity, Culture and Health, School of Public Health, University of Michigan, Ann Arbor, MI

Thomas N. Templin, PhD,
Professor, College of Nursing, Wayne State University, Detroit, MI

Jaime C. Slaughter, PhD, MPH, and
Assistant Professor, College of Nursing and Health Professions, Drexel University, Philadelphia, PA

Theresa L. Osypuk, SD, SM
Associate Professor, Division of Epidemiology and Community Health, School of Public Health, University of Minnesota, Minneapolis, MN

Abstract

Living in a lower-quality neighborhood is associated with higher levels of depressive symptoms in the general population as well as among pregnant and postpartum women. However, little is known of the important pathways by which this association occurs. We proposed a model in which perceived stress and social support mediated the effects of neighborhood quality on depressive symptoms during pregnancy (measured by the 20-item Center for Epidemiologic Studies-Depression, CES-D, scale) in a sample of 1383 African American women from the Detroit

Corresponding author: Carmen Giurgescu, PhD, RN, College of Nursing, Wayne State University, Cohn Bldg. 368, 5557 Cass Ave., Detroit, MI 48202, carmen.giurgescu@wayne.edu.

metropolitan area interviewed during their delivery hospitalization. Using structural equation modeling (SEM), we built a latent variable of neighborhood quality using 4 measures (neighborhood disorder, neighborhood safety/danger, walking environment, overall rating). We then tested two SEM mediation models. We found that lower neighborhood quality was associated with higher prevalence of depressive symptoms during pregnancy (standardized total effect=.16, p=.011). We found that perceived stress partially mediated the neighborhood quality association with depressive symptoms. Although the association of social support with depressive symptoms was negligible, social support mediated associations of neighborhood quality with perceived stress [standardized path coefficient=.38 (.02), p=.009]. Our results point to the need for public health, health care, as well as non-health related interventions (e.g. crime prevention programs) to decrease overall exposure to stressors, as well as stress levels of women living in poor quality neighborhoods. Interventions that increase the levels of social support of women during pregnancy are also needed for their potential to decrease stress and ultimately improve mental health at this important time in the life course.

Keywords

Neighborhood quality; neighborhood disorder; crime; stress; social support; depressive symptoms; African American

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Women face a higher risk of depression than men (Kessler, 2003; Weissman & Olfson, 1995), and onset of depression peaks for women during the childbearing years (Eaton et al., 1997; Weissman & Olfson, 1995). In a meta-analysis, Gavin and associates (Gavin et al., 2005) reported depression prevalence during pregnancy of 11.0% in the first trimester, and 8.5% in the second and third trimesters. Although some studies have documented that African Americans have higher risk of depressive symptoms compared with non-Hispanic white women (Holzman et al. 2006; Mustillo et al. 2004), reports from other nationally representative samples have not demonstrated racial differences in any psychiatric disorder (Vesga-López et al., 2008). Depressive symptoms have been related to negative birth outcomes including preterm birth and low birthweight infants, maladaptive mother-child interactions and less than optimal child neurobehavioral development (Davalos, Yadon, & Tregellas, 2012; Dunkel Schetter, 2011; Field, 2011; Field et al., 2004; Grigoriadis et al., 2013; Grote et al., 2010; Hanley, Brain, & Oberlander, 2013; Meltzer-Brody et al., 2013; Szegda, Markenson, Bertone-Johnson, & Chasan-Taber, 2014; Witt et al., 2011). Although maternal low socioeconomic status and previous medical history (e.g., chronic hypertension) are known to increase the risk of depressive symptoms, these factors do not fully account for the higher rates of depressive symptoms in African American women in those studies in which disparities were reported (Field, 2011; Holzman et al., 2006; Ko, Farr, Dietz, & Robbins, 2012; Monti, Agostini, Fagandini, La Sala, & Blickstein, 2009; Toffol, Koponen, & Partonen, 2013).

A growing body of research linking neighborhood quality to depressive symptoms among non-pregnant populations has documented inverse associations. Disorder, defined as “visible cues indicating a lack of order and social control” (Ross & Mirowsky, 2001, p. 413) in the community, can be both physical (e.g., vacant housing, vandalism, walkability) and social

(e.g., drug dealing, prostitution) (Ross & Mirowsky, 2001; Skogan, 1990). Physical and social disorder have each been positively associated with depressive symptoms in community residents (J. Kim, 2010; Wallace, 2012). Wallace (2012) found that the associations of perceived physical and social disorder in the neighborhood with depression were mediated by the fear of crime (i.e., fear of being robbed, attacked, or injured; home intrusion; walking alone at night). Perceived neighborhood disorder has also been associated with depression in a sample of disadvantaged women receiving welfare benefits (Hill & Angel, 2005).

Similarly, neighborhood violent crime has been related to depressive symptoms. In a large sample of low socioeconomic status adults, neighborhood violent crime indirectly influenced depressive symptoms through both objectively measured neighborhood disorder and individual perceptions of disorder (Curry, Latkin, & Davey-Rothwell, 2008). Perceived neighborhood crime also has been associated with depressive symptoms for African American mothers of adolescents (Budescu, Taylor, & McGill, 2011), and exposure to objectively measured neighborhood violent crime has been associated with increased depressive symptoms in a non-pregnant population (Diez Roux & Mair, 2010).

Although there is a growing literature on how neighborhood context is associated with depressive symptoms (Diez Roux & Mair, 2010; D. Kim, 2008; Mair, Diez Roux, & Galea, 2008; Truong & Ma, 2006), little is known about these associations in pregnant African American women. African American populations live in considerably lower quality neighborhoods than non-Hispanic white populations in the US (Osypuk, Galea, McArdle, & Acevedo-Garcia, 2009), and these disparities in neighborhood quality are just as stark among pregnant women (Laraia et al., 2006; Messer, Kaufman, Dole, Herring, & Laraia, 2006).

The small but growing body of research suggests that pregnant women living in neighborhoods with higher vacancy rates and disorder have higher levels of depressive symptoms (Messer, Maxson, & Miranda, 2012). Pregnant women, in a predominantly African American sample, who reported higher levels of neighborhood violence also had higher levels of perceived stress and depressive symptoms (Patterson, Seravalli, Hanlon, & Nelson, 2012). In a pilot study of 72 African American women, Giurgescu and colleagues found that women who reported higher levels of perceived disorder and crime also reported higher levels of stress during the prenatal period (Giurgescu et al., 2012).

Stress (Diez Roux & Mair, 2010) or social support (Berkman, Glass, Brissette, & Seeman, 2000) may mediate the associations of neighborhood physical and social disorder with depressive symptoms. For example, perceived social support refers to a sense of being cared for and having someone who would offer advice and provide help if necessary (Sherbourne & Stewart, 1991). Some studies have indicated that negative aspects of neighborhood environment are related to lower levels of social support (Dupere & Perkins, 2007; J. Kim, 2010; Messer et al., 2012). One study found that residents of neighborhoods with higher levels of disorder were less likely to report social support; and social support accounted for about one third of the relationship between neighborhood disorder and depression (J. Kim, 2010). In another study, participants (66% women) from different racial groups living in

very disadvantaged neighborhoods (i.e., high levels of disorder and fear of crime) had lower levels of social support compared with participants in more advantaged neighborhoods (Dupere & Perkins, 2007). In one of the few studies of pregnant women, those residing in neighborhoods with more property damage, vacant housing, and violent crime reported lower levels of social support (Messer et al., 2012). Individuals residing in disadvantaged neighborhoods may not have the social networks and support necessary to buffer the influence of adverse residential exposures (Menjivar, 2000), which could result in higher levels of depressive symptoms. Indeed, lack of social support was associated with higher levels of stress and depressive symptoms for pregnant women (Giurgescu, Penckofer, Maurer, & Bryant, 2006; Rudnicki, Graham, Habboushe, & Ross, 2001).

While studies have reported different links between depressive symptoms, stress, social support, and neighborhood environment, and speculate as to their covariation, these factors have not been concurrently empirically examined to our knowledge. Additionally, the potential mediating role of perceived stress or social support on the associations of neighborhood disorder or crime with depressive symptoms during pregnancy has not been examined. The purpose of this study was therefore to examine whether perceived stress and social support mediated associations between perceived neighborhood quality and depressive symptoms during pregnancy for African American women (see Figure 1). Specifically, we address the following research questions:

1. Are perceptions of poor quality neighborhoods correlated with perceived stress, social support and depressive symptoms? We hypothesize that less perceptions of quality neighborhoods will be related to higher levels of perceived stress and depressive symptoms and lower levels of social support for African American women during pregnancy.
2. (a) Do perceived stress and social support mediate the relationship between neighborhood quality and depressive symptoms? We hypothesize that perceived stress and social support will mediate the relationship between neighborhood quality and depressive symptoms. (b) Does social support mediate the relationship between neighborhood quality and perceived stress? We hypothesize that social support will mediate the relationship between neighborhood quality and perceived stress.

Methods

Sample

Data derived from a retrospective cohort study of 1383 African American new mothers participating in the Life-course Influences on Fetal Environments (LIFE) study conducted in the Detroit Metropolitan area (Osypuk, Caldwell, Platt, & Misra, 2012; Straughen, Caldwell, Osypuk, Helmkamp, & Misra, 2013). Women were included in the study if they self-identified as Black or African American, were 18 to 45 years old and had just given birth to a singleton baby. Women were excluded if they: (1) did not understand English, (2) had mental retardation, serious cognitive deficits, or significant mental illness, on the basis of history or any prior records, or (3) were currently incarcerated. Women were recruited from

Labor and Delivery and Postpartum units of a Detroit suburban hospital from June 2009 to December 2011.

Procedures

The study received Institutional Review Board approval from the participating site. Research staff reviewed hospital delivery logs for eligible participants. All eligible women were approached for study enrollment within approximately 48 hours after birth. Women completed an informed consent if they agreed to participate in the study. Interviews were conducted by a trained interviewer in a private hospital room, and lasted about one hour. Women received a $50 gift card to a local store for their time and participation. The final study sample included 1,411 women, which represented 71% of the women approached for study participation. The analytic sample included 1,383 women (98% of the interviewed sample) who had complete data for all of the variables of the study. Due to the very low rate of missing data (2% of respondents were missing any variable), we excluded these participants from analysis rather than imputing data. Most interview questions asked about experiences during the pregnancy but a few referred to lifetime exposures or experiences. If measures were asked with regard to the woman's lifetime, we have noted them below.

Measures

Exposure: Neighborhood quality—Women reported detailed characteristics of the neighborhood of their current address, or where they lived at the time of the birth. Scale variables were created by summing the individual items in each of the following neighborhood domains: social and physical disorder, safety, and walking environment. We also used one item where women ranked their neighborhood quality. We used confirmatory factor analysis to identify a central uniform latent construct of neighborhood quality, and these measures were used in the measurement model (described further below) to tap the construct.

Perceived neighborhood social and physical disorder (Sampson & Raudenbush, 2004) was measured using eight items (e.g., litter, vacant houses, vandalism, public drinking and drugs) each rated on a 3-point scale (1=*a big problem*, 2=*somewhat of a problem*, 3=*not a problem*). Reverse coding was conducted and the sum of the items created a potential total score range of 8–24 with a higher score representing higher levels of perceived disorder. In the current study, internal consistency reliability, measured by Cronbach's alpha, was 0.93.

Perceived neighborhood safety was measured using six items derived from two scales measuring neighborhood safety (Echeverria, Diez-Roux, & Link, 2004; Mujahid, Diez Roux, Morenoff, & Raghunathan, 2007) and perceived neighborhood danger (Sampson, Raudenbush, & Earls, 1997). The two 3-item scales were highly correlated (rho=.78) so we combined them and reverse coded items as appropriate (e.g.," I feel safe walking in my neighborhood"), and confirmed the 6-item internal consistency reliability was high (0.90). Items (such as, "afraid to go out at night," "there are areas of this neighborhood where everyone knows 'trouble' is expected") were rated on a 5-point scale (1=*strongly agree* to 5=*strongly disagree*), with the total score ranging from 6–30 with higher scores representing a greater degree of neighborhood safety.

Perceived walking environment or walkability (Echeverria et al., 2004; Mujahid et al., 2007; Ståhl et al., 2001) was measured using six items (e.g., "people are walking," "the trees provide enough shade") rated on a 5-point scale (1=*strongly agree* to 5=*strongly disagree*). Reverse coding was conducted and the sum of items created a total score ranging from 6–30 with higher scores representing higher levels of neighborhood walkability. Internal consistency reliability was 0.79.

Overall neighborhood quality was measured by one item (Saguaro Seminar, 2000) that asked women to rank their neighborhood as a place to live on a 4-point scale (1= *excellent* to 4= *poor*). Reverse coding was conducted so that higher scores represent higher overall quality.

Mediator: Perceived stress—Perceived stress was measured by Cohen's Perceived Stress Scale (S. Cohen, Kamarck, & Mermelstein, 1983; S. Cohen & Wills, 1985). The instrument contains 14 items on a 5-point scale (1=*never* to 5=*very often*) that ask about feelings and thoughts during the prior month (e.g., "felt upset," "stressed out"). Eight items represent positive characteristics (e.g., "felt in control of life") and were reversed coded. The sum of scores can range from 14–70 with higher scores representing higher levels of perceived stress. Internal consistency reliability was 0.87.

Mediator: Social support—Social support was measured by the Medical Outcomes Study (MOS) Social Support Survey (Sherbourne & Stewart, 1991) with regard to pregnancy as the recall period (e.g., someone to help you if you were confined to bed). The instrument contains 11 items on a 5-point scale for availability of social support (1=*none of the time* to 5=*all of the time*) with a range of 11–55 with higher scores representing higher levels of social support. Internal consistency reliability was 0.90.

Outcome: Depressive symptoms—Depressive symptoms were measured by the Center for Epidemiologic Studies Depression Scale (CES-D)(Radloff, 1977). This scale assesses the presence of salient symptoms of depression within the past seven days (e.g., bothered by things more than usual, felt lonely). The CES-D has 20 items each rated on a 4-point scale referring to frequency of symptoms (0=*rarely*, 1=*some of the time*, 2=*occasionally*, 3=*most of the time*) with a total possible score ranging from 0–60. The CES-D does not provide a diagnosis of clinical depression since it is a population based screen, but CES-D values ≥23 can be used to identify severe depressive symptoms that have been correlated with major depression diagnosis (Orr, Blazer, James, & Reiter, 2007; Radloff & Locke, 1986). In the current study the CES-D was used as a continuous variable. Internal consistency reliability of the 20-item CES-D measure was 0.85.

Potential Confounders: Maternal sociodemographic characteristics—included self-reported maternal age (linearly), marital status (single vs. married or cohabiting), educational attainment (less than high school, high school grad, more than high school), and household income (≤$19,000, $20,000–39,000, or ≥40,000. See Table 1 for specification details.

Analytic Techniques

Data were entered, cleaned, and prepared for analysis using SPSS 20 (SPSS Inc., Chicago, IL) and Stata 12 (StataCorp, College Station, Texas). Latent variable structural equation modeling (SEM) was used to test the proposed mediation model (see Figure 1) using IBM-SPSS AMOS software.

There has been a growing debate in the epidemiology literature in particular and in other fields as well about how best to ascertain and estimate mediation in multivariable models. Previous "traditional" approaches, where, for example, a potential mediator is simply added to the model and the change in the effect of the primary variable is examined, have been criticized for a number of reasons (Krause et al., 2010). In a recent review (Richiardi, Bellocco, & Zugna, 2013), the three primary types of biases that accompany traditional approaches to mediation are reviewed: mediator-outcome confounding, exposure-mediator interaction; mediator-outcome confounding affected by the exposure. Regression methods have been developed that overcome these limitations.

We describe here the advantages and limitations that SEM offers with regard to our modeling. We chose SEM to test mediation for several reasons. First, and foremost, we wished to develop a latent variable model. Second, structural modeling reduces bias from measurement error including measurement error correlations. Third, SEM provides the opportunity to examine every possible mediated or path-specific effects without as great a loss of statistical power as regression mediation methods. In contrast to SEM, many mediation methods cannot model multiple mediators simultaneously (Nguyen, Osypuk, Schmidt, Glymour, & E.J., in press). As acknowledged by Vanderweele (Vanderweele, 2012), SEM may be most useful when "we truly are interested in a wide range of different effects and pathways across an entire set of variables for several different outcomes" (p. 611). Despite these potential advantages, there are a number of assumptions when using SEM that we note here but in our determination are not substantially violated or we have evaluated their impact through our approach: no confounding (of exposure on mediator, of mediator on outcome, and of exposure on outcome), linear outcomes and mediators; no interaction between the exposure and mediators on the outcome; no consequence of the exposure that confounds the mediator-outcome associations (Richiardi et al., 2013). The biases, also a concern with traditional mediation approaches as discussed in the prior paragraph, may also operate within the method we have selected (SEM) but we have carefully evaluated these as recommended by Vanderweele (Vanderweele, 2012).

The neighborhood quality variables described above were potential indicators of the latent construct of perceived neighborhood quality. Because these measures have not been used in this way previously, a two-step approach was used to specify and test the model (Anderson & Gerbing, 1988). The Stage 1 models were confirmatory factor analysis (CFA) measurement models; these models were used to determine which of the neighborhood measures could most effectively define the latent neighborhood quality construct. Criteria for selecting the neighborhood measures included high factor loadings (> .6), independent contributions to the latent construct, and lack of correlated measurement error to other model constructs, namely, the mediators (perceived stress and social support) and outcome variables (depressive symptoms). Stage 2 analysis involved fitting a series of structural

equation models. Because the SEM model for mediation assumes that the mediational links are not confounded (Vanderweele, 2012), we tested all possible pathways between four sociodemographic variables (age, income, marital status, and education) and (a) the path between neighborhood quality and the mediators (perceived stress and social support), (b) between mediators and depressive symptoms and (c) between neighborhood quality and depressive symptoms. Potential confounders of the proposed mediational pathways (sociodemographic variables with significant paths) were added to the model during Stage 2. The formal fit of each SEM model was evaluated using several criteria: chi-square, root mean square error of approximation (RMSEA), and comparative fit index (CFI) (Hu & Bentler, 1999; Steiger, 2007). With large sample sizes, chi-square will almost certainly be significant, so the primary fit statistics used in evaluating the models was RMSEA < .07 (Steiger, 2007), and CFI > .95 (Hu & Bentler, 1999). Bootstrapping was also used to evaluate the fit and statistical significance of parameter estimates in the final model and to determine the robustness of the final solution to violations of multivariate normality. Mediation pathways, i.e., specific indirect effects, were tested for significance using the test of joint significance (TJS) (Mallinckrodt, Abraham, Wei, & Russell, 2006), which indicates that a mediation pathway is significant if the specific component paths are significant. For example, an indirect pathway between exposure and outcome acting through a given mediator is the product of the coefficients estimated for each component path of exposure to mediator, multiplied by the path of mediator to outcome, and the significance of such mediation pathways will be indicated by the largest p value of the paths that it includes. A summary of the models fit at each stage and the two final equally well-fitting models are shown in Table 3. The two final models had the same number of parameters; Akaike's Information Criterion (AIC) was used to compare these non-nested alternative models; the model with the smallest AIC was considered to have the best fit. Final selection between these models was made on statistical as well as theoretical grounds.

Results

Maternal Descriptive Characteristics

The mean age of women in the LIFE study was 27 years. The majority were married or cohabiting (54%), had a mean of 14 years of education and had an annual household income of less than $40,000 (63%) (see Table 1). The following mean scores [standard deviation (SD)] were reported: perceived stress 35.47(8.07), social support 48.84(6.64), and depressive symptoms 15.33 (9.7) (see Table 2). Twenty percent (N=279) of women had CES-D values ≥ 23, a level of severe depressive symptoms (data not shown).

Relationships among Variables

Correlations among variables used in the final structural models are shown in Table 2. The first block of correlations shows that the selected indicators of neighborhood quality were highly inter-correlated with correlations ranging in absolute value from .52 to .69. The next block, primary endogenous variables, shows correlations of the mediator variables (perceived stress and social support) with indicators of neighborhood quality and the outcome variable (depressive symptoms) (*r's* = .11 to .69). The last block shows the correlations of potential confounders with major variables in the model (*r's* = .04 to .26).

Structural equation (SEM) model testing

Measurement model testing—The initial measurement model contained one latent exposure variable (perceived neighborhood quality), eight indicators of neighborhood quality and the three primary endogenous variables (perceived stress, social support, and depressive symptoms). The purpose of including the primary endogenous variables in the measurement models was to determine the unique contribution of the indicators to the latent construct: residual variance in the indicator, not accounted for by the latent construct, that correlated with one or more of the primary endogenous variables could be a source of confounding. The final model fit very well as indicated by the fit statistics shown in the final measurement model (Table 3).

Mediation model testing—The initial mediation model consisted of the variables and pathways in the proposed theoretical model (Figure 1) plus empirically determined pathways from the potential confounders to the primary endogenous variables. There were four potential confounders and 12 possible pathways from the potential confounders to the primary endogenous variables; only one potential confounder pathway, marital status to social support, was significant and consequently added to the model; this model did not have an acceptable fit (see Table 3; initial mediation model). To improve the fit of this model, a covariance pathway between the error terms associated with perceived stress and social support was added ($\beta = -.38$). The resulting model, see Panel A of Figure 2, fit the data very well.

An alternative model (Panel B) also fit very well and each model had the same degrees of freedom (see Table 3). In each model, the proposed mediational paths, i.e., indirect effect of neighborhood quality on depressive symptoms through perceived stress and social support, was also significant ($p < .05$). Thus, the proposed mediation model was supported in each. The models are described in turn below.

Model 1 (Panel A) was the theoretical model specified in advance, except that a covariance pathway between the error terms associated with perceived stress and social support was added in order to achieve acceptable fit. This covariance pathway indicates the omission of predictor variables common to perceived stress and social support. This is understandable because neighborhood quality is not likely to be the only antecedent variable that perceived stress and social support have in common. While significant, the relative magnitude of the specific indirect effect between neighborhood quality and depressive symptoms involving social support is small (the indirect effect = .014, $p<.05$, which is the product of .18 (the path between neighborhood and social support) with −.08 (the path between social support and depressive symptoms). Indeed, the effect of social support on depressive symptoms in this model was almost negligible. The total effect of social support on depressive symptoms in this model was limited to a single small pathway ($\beta = .08$, $p < .01$). The mediational pathway between neighborhood and depressive symptoms involving perceived stress, on the other hand, was relatively large (−.23 *.66 = .15, $p <.01$).

Model 2 replaced the error covariance pathway between social support and perceived stress in Model 1 with a direct pathway from social support to perceived stress. This replacement did not alter the total model degrees of freedom (Lee & Hersberger, 1990), but fit was

slightly improved; chi-square was reduced by approximately 12, and Akaike's Information Criteria (AIC) was smaller for Model 2, indicating a better fit for this modified model. With this change, social support had both direct and indirect effects on depressive symptoms. The total effect of neighborhood quality on depressive symptoms was −.16 ($p < .01$) which is twice the size observed in Model 1. We put forth Model 2, Panel B in Figure 1 as our final model based on model fit, although both supported the mediation hypothesis. These results suggest that (1) the effects of neighborhood quality on depressive symptoms were mediated by perceived stress; (2) the effects of neighborhood quality on perceived stress were mediated by social support; and (3) the effects of social support on depressive symptoms were mediated by perceived stress. Therefore, African American women in our study who perceived the quality of their neighborhood as poor lacked adequate social support to reduce their stress, which was linked to higher levels of depressive symptoms.

Discussion

In the United States, African American and white populations continue to live in highly segregated neighborhoods, with the Detroit metropolitan area – the location of our study – displaying one of the highest residential segregation in the United States (Logan & Stults, 2011). One implication of high segregation is that African American women from Detroit live in lower quality neighborhoods, including those with substantially higher risk of violence, exposure to disorder, higher poverty and lower socioeconomic status (Logan, 2011; Osypuk et al., 2009; Sampson & Wilson, 1995). The toll of such adverse exposures over time may be substantial because it may affect not only depressive symptoms as we have modeled in this study, but also other health outcomes (Williams & Collins, 2001). The pathways through which these associations emerge have seldom been tested, resulting in a limited understanding of the mechanisms that may be risk or protective factors in the link between perceived neighborhood effect and depressive symptoms in pregnant African American women.

In the current study of African American women interviewed after birth, we aimed to inform by identifying mechanisms underlying neighborhood quality associations with depressive symptoms. We found that: (1) respondents reporting lower neighborhood quality also reported significantly higher mean depressive symptoms, as well as higher perceived stress and lower social support, and (2) perceived stress mediated the association of perceived neighborhood quality with depressive symptoms. These findings align with prior evidence suggesting that lower levels of perceived neighborhood quality are related to higher levels of stress and depressive symptoms during pregnancy among African American women (Giurgescu et al., 2012; Patterson et al., 2012).

We also found that women who reported lower levels of neighborhood quality reported lower levels of social support, which is consistent with prior research among pregnant women (Messer et al., 2012). The mediating influence of social support on neighborhood quality and depressive symptoms in our study was negligible. However, we did find that social support mediated the association of neighborhood quality with perceived stress. This finding is somewhat exploratory because the final SEM model was determined empirically, despite its theoretical grounding, and independent verification is needed in other samples to

confirm the mediation structure we identified here. However this finding is plausible since women who perceive their neighborhood as poor quality may not have the necessary social network or support to buffer the effects of adverse neighborhood exposures, which could result in higher levels of stress (Menjivar, 2000). Indeed, lack of social support has been related to higher levels of stress in pregnant women (Giurgescu et al., 2006). These findings suggest a more complex relation between neighborhood quality, perceived stress and social support.

One value of mediation studies is the identification of alternate potential pathways by which to prevent a disease outcome, rather than just intervening on the exposure, which is sometimes difficult to do. For example, given a woman's residence in a certain neighborhood, the pathway between neighborhood quality and depressive symptoms may be reduced by intervening on perceived stress. Indeed, in a meta-analysis of 28 trials, Dennis and Dowswell found that women who received psychosocial or psychological interventions were less likely to develop postpartum depression compared with those receiving standard care (Dennis & Dowsell, 2013). These interventions included (1) postpartum home visits provided by public health nurses and midwives; (2) peer-based telephone support; and (3) interpersonal psychotherapy (Dennis & Dowsell, 2013). Although such interventions did not address neighborhood influences, they could theoretically decrease perceived stress caused by living in poor-quality neighborhoods and thereby decrease the levels of depressive symptoms for these women.

Our study did not identify social support as a pathway linking neighborhood quality and depressive symptoms, although social support did mediate the neighborhood quality-perceived stress association. That is, lower neighborhood quality predicted lower social support. This suggests that a lack of social support within the context of poor quality neighborhoods exacerbates stress rather than directly influencing depressive symptoms among African American women during pregnancy. Behavioral interventions have successfully improved social support, and for that matter, reduced stress and depressive symptoms (Berkman, 2009; Czajkowski, 2003), although the evidence is mixed (Glass et al., 2004). Even when interventions have improved these psychosocial predictors, this has not necessarily led to clinical improvements in health outcomes (e.g., post-MI or post-stroke survival)(Czajkowski, 2003).

We do not have geocoded participants' place of residence to account for neighborhood-level poverty or other potential neighborhood-level confounders. We operationalized neighborhood context with perceived, or subjective, measures of current neighborhood, in lieu of objective measures, e.g., those derived from administrative data (e.g., census data). The majority of studies that examined the links between neighborhood quality and depressive symptoms have generally relied solely on administrative data, failing to examine women's perceptions of neighborhood quality. Perceived neighborhood measures may be a more relevant construct to capture when examining the impact of neighborhood quality on depressive symptoms. African American women's perceptions of neighborhood quality may not correspond with administrative data because of discrepancies between how they define their neighborhood and administrative boundaries for which objective data are available. For psychosocial outcomes such as depressive symptoms, it may be that one's perceptions of

one's neighborhood are what is most meaningful, because the process of stress appraisal is so central to mental health outcomes (Aneshensel, 2010). Neighborhood characteristics such as disorder and lack of safety may be stress-inducing (Diez Roux & Mair, 2010). Women who perceive poor quality of their neighborhoods may use unhealthy behaviors to cope with stress such as smoking, lack of physical activity and eating high fat diets which have been related to depressive symptoms (Diez Roux & Mair, 2010). However subjective neighborhood measures have more limited variation than objective measures, and may fail to distinguish between objective contexts due to psychological processes such as conditioning, which may be especially important for surviving and/or thriving in high-poverty contexts by successfully coping with stressors (Rutter, 2012). Using both objective and subjective neighborhood measure may eliminate the biases that may occur when self-reported characteristics of the neighborhood are examined in relation to self-reported outcomes (e.g., depressive symptoms) that could affect these reports (Diez Roux & Mair, 2010). Additional research is needed to better understand the relationship between neighborhood quality and depressive symptoms.

This study examined women's perceptions of their current neighborhood quality, most likely the same as during the pregnancy. Because this is a retrospective cohort study where women were enrolled after the primary study (birth) outcome occurred, therefore, it is possible, but not likely, that women may have differentially reported their neighborhood quality based on pregnancy outcomes. A related concern is potential differential reporting of subjective neighborhood environment by other factors, including depressive symptoms or history of depression. While few (3% of) women in our sample had a history of depression and this low prevalence is unlikely to bias associations, it is possible that women with higher depressive symptomatology may have reported worse neighborhood environments than objective data might suggest. This could therefore induce reverse causation, where the outcome influenced the exposure via measurement error. This potential cannot be ruled out with this cross sectional data, and since few prior studies testing concurrent neighborhood context associations with health outcomes have examined this issue, this is a direction for future research.

Although the LIFE study has collected residential addresses, these data were not yet geocoded for use in the analyses presented here. Therefore, we did not have any census-based measures available such as neighborhood poverty which could theoretically confound the relationship between women's perceived neighborhood quality and depressive symptoms. Moreover, although we are testing an inherently multilevel hypotheses involving individuals nested within neighborhoods, since we had not geocoded the data, we could not adjust for any neighborhood-level clustering, or decompose the variance of the outcomes by neighborhood context. Our analysis could therefore have underestimated standard errors (Raudenbush & Bryk, 2002).

The LIFE study does not include diagnostic mental health measures, which are considered the gold standard for mental health assessment. Since the CES-D is a screening tool, the measure may capture symptoms that are correlated with, but not exclusively, those of major depression (Orr et al., 2007; Radloff & Locke, 1986). However dimensional measures may be more appropriate for population based assessment rather than diagnostic measures

(Aneshensel, 2005; Merikangas, Nakamura, & Kessler, 2009), and take considerably less time and staff training to implement the surveys.

The pre- and post-natal periods are opportunities for women to seek preventative health care for themselves and their baby. Some clinical models have incorporated a social determinants of health framework to not only provide medical care, but also provide other unmet needs for low income populations including housing (Acevedo-Garcia et al., 2004), legal counseling, nutritional support, or income support (E. Cohen et al., 2010). These medical-legal partnership models may therefore intervene on some of the fundamental causes of the health outcomes, that health care can only peripherally address. Educating and exposing physician residents to community challenges, such as under-resourced urban neighborhoods (E. Cohen et al., 2010) are strategies for improving health for African American women during pregnancy. Given the potential health consequences of neighborhood context, such as our analysis suggests, health care providers could be powerful advocates for public policies focused on improving neighborhood quality and improving neighborhood choice for low-income, minority households (Acevedo-Garcia, Osypuk, McArdle, & Williams, 2008). Indeed, since mental health may be but one domain among many affected by neighborhood context, such improvements to neighborhood contexts may reap substantial gains, not only to reduce health disparities, but also to improve population health.

Acknowledgement

The study was funded by the National Institutes of Health, National Institute of Child Health and Human Development R01 HD058510. We thank the women who participated in the study.

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- Lower neighborhood quality was related to higher prevalence of depressive symptoms.
- Perceived stress mediated the effect of neighborhood quality on depressive symptoms.
- Social support mediated the association of neighborhood quality with perceived stress.

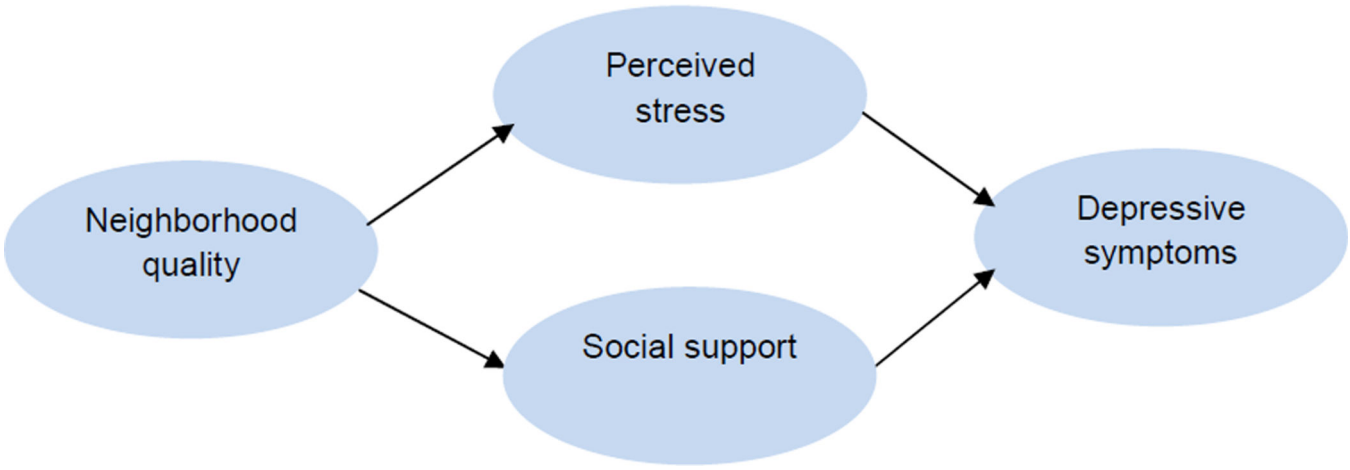

Figure 1.
Hypothesized pathways between neighborhood quality and depressive symptoms

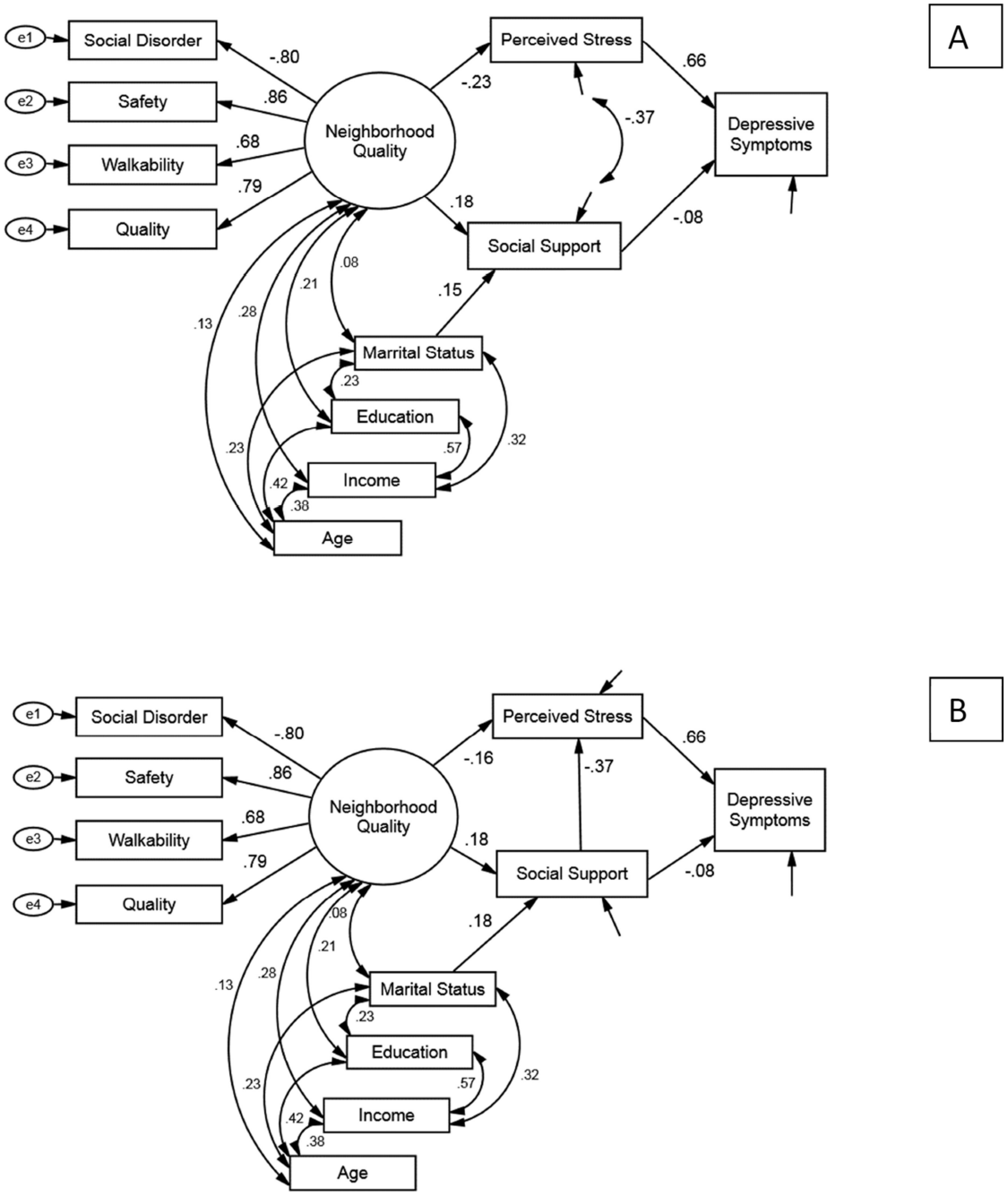

Figure 2.

Final structural equation models with standardized path coefficients, testing mediation of the neighborhood quality-depressive symptoms association in the LIFE Study. All coefficients were significant (ML asymptotic $p < .01$; bootstrapped $p < .05$). Panel A shows the proposed model with a covariance between error terms of perceived stress and social support. Panel B shows the proposed model with an additional pathway between social support and perceived

stress. Both models fit well (Panel A; χ^2 = 119.45 (df = 35), p < .01, CFI = .98, RMSEA = .04; Panel B χ^2 = 107.64 (df = 35), p < .01, CFI = .98, RMSEA = .04.

Table 1

Maternal socio-demographic characteristics (N=1383)

Variable		
	***M* (*SD*)**	***Range***
Age	27.33 (6.21)	18–45
Years of education	13.74 (1.95)	7–17
	N (%)	
Marital status		
Single	638 (46.1)	
Married or cohabiting	745 (53.9)	
Level of education		
Less than high school	141 (10.2)	
Graduated high school	302 (21.8)	
Some college or graduated college	940 (68.0)	
Household income		
Less than $19,999	402 (29.1)	
$20,000–39,999	471 (34.0)	
More than $40,000	510 (36.9)	

Table 2

Descriptive Statistics and Correlations Among Variables Used in Structural Models

Variable #		1	2	3	4	5	6	7	8	9	10	11
	Indicators of Neighborhood Quality	1	2	3	4							
1	Disorder	1										
2	Safety	−.69	1									
3	Walkability	−.52	.61	1								
4	Overall Quality	−.65	.67	.54	1							
	Primary Endogenous Variables					5	6	7				
5	Social Support	−.14	.16	.15	.16	1						
6	Perceived Stress	.19	−.19	−.16	−.17	−.40	1					
7	Depressive Symptoms	.17	−.18	−.12	−.11	−.35	.69	1				
	Potential Confounders/Sociodemographic Variables								8	9	10	11
8	Age	−.16	.08	.07	.10	.04	−.08	−.09	1			
9	Education	−.22	.15	.10	.19	.16	−.13	−.16	.42	1		
10	Income	−.26	.21	.16	.25	.18	−.14	−.15	.38	.57	1	
11	Marital Status	−.08	.04	.04	.08	.20	−.11	−.10	.23	.23	.32	1
	Mean	11.68	21.22	23.32	2.74	48.84	35.47	15.33	27.33	13.74	36.20[a]	.54
	SD	4.54	5.43	4.06	.84	6.64	8.07	9.71	6.20	1.95	20.60[a]	.50

Note. Correlations above .06 were significant at $p < .05$.

[a]Mean and SD for income is in thousands.

Table 3

Summary of Model Testing

	X^2	df	p	CFI	RMSEA
Stage 1 Models – Selection of indicators and test of measurement model					
Initial measurement model[a]	1787.02	42	<.01	.73	.17
Final measurement model[b]	34.25	11	<.01	.99	.04
Stage 2 Models – Test of mediation model					
Initial mediation model[c]	318.35	36	<.01	.95	.08
Final Model 1[d]	119.45	35	<.01	.98	.04
Final Model 2[e]	107.64	35	<.01	.98	.04

[a] One latent construct with 8 indicators + 3 primary variables

[b] One latent construct with 4 indicators + 3 primary variables

[c] This model consisted of the primary variable pathways in the proposed theoretical model plus empirically determined pathways from covariates to primary variables. There were four covariates and 12 possible covariate pathways to primary variables; only one pathway, Marital Status to Social Support, was added to the model. This model also tested a direct effect path from Neighborhood Quality to Depressive Symptoms to allow for partial mediation. The direct effect path was very small (std. path = −.03), not significant, and removed from the structural model.

[d] In order to improve model fit, a covariance pathway was added between Perceived Stress and Social Support (The modification index for this covariance term was 195). Final model fit using Akaike's IC = 203.45.

[e] A path between Social Support and Perceived Stress was added in place of the covariance pathway between Perceived Stress and Social Support. This change allows Social Support to contribute more substantially to the explanation of Depressive Symptoms through the effect it has on Perceived Stress. Neighborhood Quality and Marital Status contributed to Social Support. Final model fit using Akaike's IC = 191.64.