REVIEW

Neighborhood characteristics and depressive mood among older adults: an integrative review

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ABSTRACT

Background: There is growing evidence that neighborhood environments are related to depressive mood in the general population. Older adults may be even more vulnerable to neighborhood factors than other adults. The aim of this paper is to review empirical findings on the relationships between neighborhood characteristics and depressive mood among older adults.

Methods: A search of the literature was undertaken in PsycINFO and MEDLINE.

Results: Nineteen studies were identified. Study designs were most often cross-sectional, included large sample sizes, and controlled for major individual characteristics. Mediational effects were not investigated. Statistical analysis strategies often included multilevel models. Spatial delimitations of neighborhood of residence were usually based on administrative and statistical spatial boundaries. Six neighborhood characteristics were assessed most often: neighborhood socioeconomic disadvantage, neighborhood poverty, affluence, racial/ethnic composition, residential stability, and elderly concentration. Selected neighborhood characteristics were associated with depressive mood after adjusting for individual variables. These associations were generally theoretically meaningful.

Conclusions: Neighborhood variables seem to make a unique and significant contribution to the understanding of depressive mood among older adults. However, few studies investigated these associations and replication of results is needed. Several substantive neighborhood variables have been ignored or neglected in the literature. The implications of neighborhood effects for knowledge advancement and public health interventions remain unclear. Recommendations for future research are discussed.

Key words: depression, aged, elderly, built environment, literature review

Introduction

Depression is the most common mental health problem among older adults (Buchanan et al., 2006), affecting between 1% and 5% of people aged 65 years and older (Fiske et al., 2009). The strongest predictors of depressive mood in older populations identified in a literature review were female gender, greater number of chronic illnesses, presence of cognitive and functional impairments, weak social ties (i.e. social contacts, social support, social isolation, social activities), prior history of depression, use of depression medication, presence of stressful life events, widowhood, housing in institutional care, low income, and low educational levels (Djernes, 2006).

Psychological and pharmacological models of depression have provided keen insights as to the etiology of depression, and both approaches have led to effective treatments of late-life depression (for psychotherapy, see Cuijpers et al., 2006; for pharmacotherapy, see Petrovic et al., 2005). However, depression is a complex disorder, and a substantial number of individuals report little or no benefit from treatment. For example, the response rate to antidepressants in older populations is about 50% (Mittmann et al., 1997). Additional parameters are needed to understand the...
determinants of depressive mood more completely. One interesting avenue is to investigate the role of neighborhood characteristics in eliciting and reducing depressive mood. Identification of associations between neighborhood characteristics and depressive mood (and of mechanisms underlying these associations) could shed new light on environmental intervention strategies to promote older adults’ mental health. Intervening at a neighborhood level could potentially reach a greater number of individuals in contrast to psychological and pharmacological treatments, which are delivered on a one-to-one or small group basis.

According to Galster (2001), neighborhood can be defined as “the bundle of spatially based attributes associated with a cluster of residences, sometimes in conjunction with other land uses,” and is characterized by ten attributes: (i) residential and non-residential non-structural elements (type, materials, state of built environment); (ii) infrastructure characteristics (roads, sidewalks, services); (iii) demographic characteristics of the population (elderly concentration, racial composition, religious affiliations, families); (iv) socioeconomic characteristics of the population (income, labor, education); (v) characteristics of public services (schools, public security, administration, parks); (vi) environmental characteristics (noise, pollution, elements of the topography); (vii) proximity characteristics (access to commercial or cultural services); (viii) political characteristics (mobilization of elected officials); (ix) social-interactive characteristics (social networks, relationships among residents); and (x) emotional characteristics (sense of belonging to the neighborhood).

Glass and Balfour (2003) proposed a model of neighborhood effects on aging. According to these authors, neighborhood characteristics lead to buoying (i.e. supportive) or pressing (i.e. detrimental) environments. These environments interact with personal competencies resulting in adaptive or maladaptive responses that can affect health and functioning. For example, living in a non-walking-friendly neighborhood (pressing environment) may lead to physical passivity and social isolation (maladaptive responses) among people with poorer coping skills or physical disability (personal competencies), which in turn could result in muscle atrophy and sadness (health and functioning).

There is growing evidence that neighborhood environments are related to depressive mood in the general population (Kim, 2008; Mair et al., 2008; Paczkowski and Galea, 2010). Older adults may be even more vulnerable to neighborhood factors than other adults (Glass and Balfour, 2003; Schieman and Meersman, 2004; Walters et al., 2004; Beard et al., 2009; Yen et al., 2009) for several reasons. First, a decline in physical and cognitive competencies decreases the capacity of older people to cope with stressors in their environment (Glass and Balfour, 2003). Second, elderly people may feel more vulnerable in neighborhoods bearing specific characteristics such as greater crime rates (e.g. Whitley and Prince, 2005). Third, a decrease in social support attributed to death of close ones or children moving out of town may force older people to rely on community resources for social contacts (Glass and Balfour, 2003). Fourth, older adults may have been exposed for longer periods of times to deleterious neighborhoods than younger adults (Elreedy et al., 1999), resulting in greater distress coupled with a lower sense of control than younger counterparts. Finally, because of retirement and decreased mobility, the life of older people may be more restricted to their immediate residential neighborhood than younger adults involved in many spheres (i.e. work, community, recreational; Lawton, 1977).

Empirical findings on the relationships between neighborhood variables and depressive mood among older adults have thus far been equivocal with some studies showing associations and others not. The aim of this paper was therefore to review empirical findings on the relationships between neighborhood characteristics and depressive mood among older adults. We add to the literature by examining three interrelated aspects. First, methodological issues are identified and discussed. Then, the conceptualization and operationalization of neighborhood constructs are examined. Finally, associations between neighborhood variables and depressive mood are reviewed in light of their theoretical coherence and degree to which results are replicated in the literature.

Methods

A search of the literature was conducted in PsycINFO and MEDLINE databases on studies published between 1 January 1967 and 13 July 2011, using combinations of keyword terms listed in Appendix 1. Titles and abstracts of the retrieved articles were then screened to select studies that met the following inclusion criteria: (i) studies conducted on samples of participants aged 65 years and older; (ii) studies providing significance tests for neighborhood variables at a multivariate level; (iii) availability of depressive mood as an outcome measure; and (iv) studies published in French or English. In addition, studies were excluded if they
were limited to simply distinguishing participants as living in either urban or rural areas as this variable appeared too broad as an operationalization of the pressor/buoy concept or if they were unpublished masters theses or doctoral dissertations. Regarding neighborhood social capital variables, studies were included if they measured participants’ perception of how neighbors interact with each other (which can be considered as a neighborhood social capital variable). Studies where neighborhood variables were covariates and not main exposures were included in this review as long as data were available for neighborhood variables in the final models; these neighborhood variables are, however, treated as main exposures in this review, and non-neighborhood main exposures as covariates. In case of ambiguity as to whether or not these criteria were met, studies were retained for further review. Additional references were identified through examination of reference lists and past readings of authors. Overall, 123 full-text articles were assessed for eligibility. In total, 19 articles satisfied the above-mentioned criteria and were included in the review. Studies that were included in this review are summarized in Table 1. The table presents the methodology used in the studies (description of respondents, study design, and statistical analysis strategy), depressive mood outcome measure and neighborhood delimitation, the potential confounding variables, a brief description of the neighborhood variables, the significant associations between neighborhood variables and depressive mood at bivariate and multivariate levels, and the direction of the multivariate associations.

Quality of designs

Samples

The sample sizes of the studies were generally large, with a mean sample size of 6,378 participants (range: 301 to 77,930). Most of the studies (11 out of 19) were conducted in the USA (Muramatsu, 2003; Ostir et al., 2003; Schieman and Meersman, 2004; Kubzansky et al., 2005; Hybels et al., 2006; Aneshensel et al., 2007; Berke et al., 2007; Bierman, 2009; Wight et al., 2009; Ahern and Galea, 2011; Gerst et al., 2011).

Results

A flow chart of articles is presented in Figure 1. The electronic database searches allowed for retrieval of 297 articles from PsycINFO and 595 articles from MEDLINE. Seventy-three additional articles were identified through examination of reference lists and past readings of authors. Ten studies investigated depressive mood on a continuum (Muramatsu, 2003; Ostir et al., 2003; Schieman and Meersman, 2004; Kubzansky et al., 2005; Hybels et al., 2006; Aneshensel et al., 2007;
### Table 1. Summary of 19 studies investigating associations between neighborhood characteristics and depressive mood among adults aged 65 years or older

<table>
<thead>
<tr>
<th>STUDY</th>
<th>METHOD</th>
<th>DEP. MEAS. AND NEIGH. DELIMIN.</th>
<th>COVARIATES</th>
<th>NEIGHBORHOOD VARIABLES</th>
<th>SIG. NEIGH-DEP. ASSOC.</th>
<th>RESULTS*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ahern and Galea (2011)</td>
<td>Sample: 690 participants aged 65+ (USA). Design: Cross-sectional. Statistical analysis: Logistic generalized estimating equation regression models and marginal modeling approach.</td>
<td>Depression: Depression as clinical category, measured by the PHQ. Neighborhood delimitation: Community district.</td>
<td>Age, sex, race, birthplace, marital status, education, income, years in neighborhood, stressful events, interview language, individual-level perception of collective efficacy, interaction terms</td>
<td>Neighborhood collective efficacy – neighborhood levelb</td>
<td>– Y</td>
<td>Living in low collective efficacy neighborhood increased risks of being depressed (difference in depression prevalence rates: 6.2%; 95% CI: 0.1, 17.5)</td>
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<tr>
<td>Aneshensel et al. (2007)</td>
<td>Sample: 3,442 non-institutionalized individuals aged 70+ and living in urban area (USA). Design: Cross-sectional. Statistical analysis: Multilevel models.</td>
<td>Depression: Depressive scores measured by the CES-D. Neighborhood delimitation: Census unit.</td>
<td>Age, sex, ethnicity, marital status, religion, education, income, wealth, ADL limitations, number of chronic illnesses, heart problems, stroke, cognitive functioning</td>
<td>Neighborhood socioeconomic disadvantage (education, public assistance, poverty, unemployment) Affluencec (% $50,000+) Racial composition % African American % Hispanic Residential stabilityd (% 5+ years) Elderly concentratione (% &gt;65 years)</td>
<td>Y N</td>
<td>Higher residential stability was related to more depressive symptoms ($\beta = 0.65$, SE = 0.26)</td>
</tr>
</tbody>
</table>
Berke et al. (2007)  
Sample: 740 individuals aged 65+; cognitively intact; living in the same home for 2+ years (USA).  
Design: Cross-sectional; tested men and women separately.  
Statistical analysis: Logistic regressions.  
Depression: Depression as clinical category, measured by the CES-D.  
Neighborhood delimitation: 100 m, 500 m, and 1,000 m buffers around residence.  
Age, race, education, income, living alone, chronic disease burden score, walking activity, smoking status  
Neighborhood walkability  
Y, N  
More walking-friendly neighborhood decreased the risks of being depressed in men (for 100 m buffer, OR = 0.31, 95% CI: 0.12, 0.81; for 500 m buffer, OR = 0.32, 95% CI: 0.13, 0.80; for 1,000 m buffer, OR = 0.33, 95% CI: 0.14, 0.82), but not in women

Bierman (2009)  
Sample: 836 individuals aged 65+; socially and economically diverse sample (USA).  
Design: Longitudinal; tested predictors of change in depressive symptoms at two-year follow-up.  
Statistical analysis: Full-information maximum likelihood regression.  
Depression: Depressive scores (continuous), measured by the HSC.  
Neighborhood delimitation: Defined as “the area around where you live.”  
Age, sex, race, marital status, years in marital status, education, work status, income, financial strain, number of people in household, number of children, home ownership, years in neighborhood, ADL limitations, baseline mastery, change in mastery, baseline depression, frequency visiting friends, frequency speaking on the telephone, volunteering, organizational attendance, religious attendance, interaction terms  
Neighborhood problemsb (noise, vandalism, run-down houses, trash on streets, people hang around, crime, alcohol and drug use, heavy traffic)  
N Y  
More neighborhood problems predicted more depressive symptoms in the future (b = 0.15, SE = 0.06, Total \( R^2 = 0.37 \)). Neighborhood problems were correlated with baseline depressive symptoms but not with change in depressive symptoms.
<table>
<thead>
<tr>
<th>STUDY</th>
<th>METHOD</th>
<th>DEP. MEAS. AND NEIGH. DELIMIN. COVARIATES</th>
<th>NEIGHBORHOOD VARIABLES</th>
<th>SIG. NEIGH-DEP. ASSOC.</th>
<th>RESULTS (^a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gerst et al.</td>
<td>Sample: 1,857 Mexican Americans aged 75+ (USA). Design: Cross-sectional; tested men and women separately. Statistical analysis: Multilevel models.</td>
<td>Depression: Depressive scores (continuous), measured by the CES-D. Neighborhood delimitation: Census unit. Age, sex, immigrant status, marital status, education, ADL limitation, number of chronic illnesses</td>
<td>Neighborhood poverty (% living in poverty) Racial composition (% Mexicans)</td>
<td>BV MV</td>
<td>N(_1), N(_2)</td>
</tr>
<tr>
<td>Hahn et al.</td>
<td>Sample: 863 participants aged 65–74 (Taiwan). Design: Cross-sectional. Statistical analysis: Logistic regressions.</td>
<td>Depression: Depression as clinical category, measured by the TDQ. Neighborhood delimitation: Probably based on participant’s delimitation of neighborhood. Sex, marital status, education, work status, income, physical illness, religious attendance, interaction terms</td>
<td>Perceived neighborhood social capital (^b) (greeting, mutual concerning, mutual help, help from community professional, community activities, working together for benefit of community, norms and regulation obedience)</td>
<td>Y Y</td>
<td>Living in neighborhood with high social capital decreases the risks of being depressed (OR = 0.91, 95% CI: 0.87, 0.94)</td>
</tr>
<tr>
<td>Hybels et al.</td>
<td>Sample: 2,998 individuals aged 65+ (USA). Design: Cross-sectional. Statistical analysis: Multilevel models.</td>
<td>Depression: Depressive scores (continuous), measured by the CES-D. Neighborhood delimitation: Census unit. Age, sex, race, marital status, education, income, ADL limitations</td>
<td>Neighborhood poverty (% living in poverty) Affluence (% $75,000+) Racial composition (% Blacks) Residential stability (% 5+ years) Elderly concentration (% 65+ years)</td>
<td>Y N</td>
<td>None of the neighborhood variables were related to depressive symptoms</td>
</tr>
<tr>
<td>Study</td>
<td>Sample Description</td>
<td>Design</td>
<td>Statistical Analysis</td>
<td>Depressive Measure</td>
<td>Age, Sex, Site of Study</td>
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<tr>
<td>Johnson et al. (2011)</td>
<td>1,091 individuals aged 70 (Scotland).</td>
<td>Cross-sectional</td>
<td>Hierarchical</td>
<td>Depressive scores (continuous), measured by the HADS</td>
<td>Sex, education, social class, age-11 home environment deprivation, father's education and social class, age-11 IQ, change in IQ ages 11–70, interaction terms</td>
</tr>
<tr>
<td>Kubzansky et al. (2005)</td>
<td>1,884 non-institutionalized individuals aged 65+ (USA).</td>
<td>Cross-sectional</td>
<td>Multilevel models</td>
<td>Depressive scores (continuous), measured by the CES-D</td>
<td>Age, sex, race, marital status, education, income, ADL limitations</td>
</tr>
<tr>
<td>Kvall et al. (2008)</td>
<td>2,535 participants aged 65+ (England and Wales).</td>
<td>Cross-sectional</td>
<td>Multilevel models</td>
<td>Depression as clinical category (depression with anxiety, depression with subthreshold anxiety, pure depression, other clinical groups, compared with the well group), measured by the GMS AGECAT</td>
<td>Age, sex, site of study</td>
</tr>
<tr>
<td>STUDY</td>
<td>METHOD</td>
<td>NEIGH. DELIMIN.</td>
<td>COVARIATES</td>
<td>NEIGHBORHOOD VARIABLES</td>
<td>SIG. NEIGH-DEP. ASSOC.</td>
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<tr>
<td>Menec et al.</td>
<td>Sample: 77,930 community dwelling participants aged 65+ (Canada). Design: Cross-sectional. Statistical analysis: Multilevel models.</td>
<td>Depression: Depression as clinical category, defined according to ICD-9-CM. Neighborhood delimitation: Census unit.</td>
<td>Age, sex, marital status</td>
<td>Neighborhood income areas (in quintiles, from lowest to highest income) Residential stability (% 5+ years) Elderly concentration (% 65+)</td>
<td>– Y</td>
</tr>
<tr>
<td>Muramatsu</td>
<td>Sample: 6,640 non-institutionalized participants aged 70+ (USA). Design: Cross-sectional. Statistical analysis: Multilevel models.</td>
<td>Depression: Depressive scores (continuous), measured by the CES-D. Neighborhood delimitation: County unit.</td>
<td>Age, sex, ethnicity, marital status, education, income, wealth (net assets), ADL, IADL, number of chronic illnesses, interaction terms</td>
<td>County-level income inequality (distribution of household income from absolute equality to absolute inequality) County mean income</td>
<td>– Y</td>
</tr>
<tr>
<td>Ostir et al.</td>
<td>Sample: 2,710 non-institutionalized Mexican American aged 65+ (USA). Design: Cross-sectional. Statistical analysis: Multilevel models.</td>
<td>Depression: Depressive scores (continuous) measured by the CES-D. Neighborhood delimitation: Census unit.</td>
<td>Age, sex, birthplace, marital status, education, income, ADL limitations, number of chronic illnesses, interaction terms</td>
<td>Neighborhood poverty (% living below census tract definition) Racial composition (% Mexicans)</td>
<td>N Y</td>
</tr>
</tbody>
</table>

<p>| Depression: Depression as clinical category, measured by the GDS. Neighborhood delimitation: Census collection district. Age, birthplace, education, type of housing, living arrangement, number of chronic illnesses, social support, smoking behaviors | Neighborhood socioeconomic disadvantage (income, education, unemployment, unskilled jobs, indigenous, divorce) Age composition | Neighborhood walkability Street connectivity (interconnectedness of the street network in the neighborhood) Residential density (average density of residential developments in the neighborhood) Land-use mix (indicator of diversity of land uses in the neighborhood) Land-use availability Retail goods (sale of goods from shops) Other retail (sale of goods differing from regular shops) Offices and business Welfare, health, and community services Entertainment, recreation, and culture | Y | N₁, N₂, N₃ | Living in neighborhoods with greater land-use diversity increased risks of being depressed (for 2nd tertile, OR = 1.54, 95% CI: 1.10, 2.16; for 3rd tertile, OR = 1.52, 95% CI: 1.08, 2.14), and presence of retail in the neighborhood increased risks of being depressed (OR = 1.40, 95% CI: 1.04, 1.90) |
|---|---|---|---|---|---|---|
| % 0—14 | N | – |
| % 15—24 | N | – |
| % 65+ (elderly concentration) | N | – |
| Neighborhood walkability | N | N₁ |
| Street connectivity | N | N₂ |
| Residential density | Y | N₂ |
| Land-use mix | Y | Y₂ |
| Land-use availability | – | Y₁ |
| Retail goods (sale of goods from shops) | – | N₃ |
| Other retail (sale of goods differing from regular shops) | – | N₃ |
| Offices and business | – | N₁ |
| Welfare, health, and community services | – | N₁ |
| Entertainment, recreation, and culture | – | N₃ |</p>
<table>
<thead>
<tr>
<th>STUDY</th>
<th>METHOD</th>
<th>DEP. MEAS. AND NEIGH. DELIMIN.</th>
<th>COVARIATES</th>
<th>NEIGHBORHOOD VARIABLES</th>
<th>SIG. NEIGH-DEP. ASSOC.</th>
<th>RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schieman and Meersman (2004)</td>
<td>Sample: 1,167 individuals aged 65+ (USA). Design: Cross-sectional; tested men\textsubscript{1} and women\textsubscript{2} separately. Statistical analysis: Least-square regressions.</td>
<td>Depression: Depressive scores (continuous), measured by a home-made questionnaire. Neighborhood delimitation: Defined as “the area around where you live.”</td>
<td>Age, race, marital status, education, income, home ownership, years in current residence, number of people in household, sense of mastery, received social support, donated social support, taking care of grandchild, in caregiving role, interaction terms</td>
<td>Sense of belonging to neighborhood\textsuperscript{b}</td>
<td>Y</td>
<td>N\textsubscript{1}, N\textsubscript{2}, Y\textsubscript{1}, Y\textsubscript{2}</td>
</tr>
<tr>
<td>Walters et al. (2004)</td>
<td>Sample: 13,349 community-dwelling individuals aged 75+ (Britain). Design: Cross-sectional. Statistical analysis: Logistic regressions.</td>
<td>Depression: Depression as clinical category, measured by the GDS. Neighborhood delimitation: Enumeration district.</td>
<td>Age, sex, financial stress, housing status, living alone, number of chronic illnesses, ADL limitations, cognitive impairment</td>
<td>Neighborhood socioeconomic disadvantage (% unemployment, overcrowding, non-car ownership, social class) Population density (number of people/km)</td>
<td>N</td>
<td>N</td>
</tr>
</tbody>
</table>
### Neighborhood characteristics and depression

<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Sample: 2,632 participants at two- and 1,871 participants at five-year follow-up; non-institutionalized individuals aged 70+ living in urban area (USA).</th>
<th>Design: Longitudinal; tested predictors of change in depressive symptoms two and five years later.</th>
<th>Statistical analysis: Multilevel models.</th>
<th>Neighborhood characteristics</th>
<th>None of the neighborhood variables were related to change in depressive symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wight <em>et al.</em> (2009)</td>
<td>Depression: Depressive scores (continuous), measured by the CES-D. Neighborhood delimitation: Census unit. Age, sex, race, marital status, religion, education, income, wealth, ADL limitations, number of chronic illnesses, heart problems, stroke, cognitive functioning, baseline depressive symptoms</td>
<td>Neighborhood socioeconomic disadvantage (education, public assistance, poverty, unemployment)</td>
<td>Affluence (% $50,000+)</td>
<td>N1, N2</td>
<td></td>
</tr>
<tr>
<td>Wilson <em>et al.</em> (1999)</td>
<td>Sample: 3,298 participants at baseline (well and (sub)depression), aged 65+, and 1,886 participants available at two-year follow-up (England). Design: Cross-sectional and longitudinal; tested predictors of depression cases at baseline, and new depression cases at follow-up. Statistical analysis: Logistic regressions.</td>
<td>Depression: Depression as clinical category, measured by the GMS AGECAT. Neighborhood delimitation: Postal district. Age, sex</td>
<td>Neighborhood socioeconomic disadvantage (household with more than one person per room, unemployment, car ownership, home ownership)</td>
<td>Y1, Y2</td>
<td>Higher neighborhood socioeconomic disadvantage increased risks of being depressed (coefficients not provided) or becoming depressed 2 years later (for 2nd sixtile, OR = 2.64, 95% CI: 1.33, 5.29; for 3rd sixtile, OR = 1.30, 95% CI: 0.78, 2.17; for 4th sixtile, OR = 1.28, 95% CI: 0.78, 2.11; for 5th sixtile, OR = 1.89, 95% CI: 1.16, 3.08; for 6th sixtile, OR = 2.00, 95% CI: 1.16, 3.47)</td>
</tr>
<tr>
<td>STUDY</td>
<td>METHOD</td>
<td>DEP. MEAS. AND NEIGH. DELIMIN. COVARIATES</td>
<td>NEIGHBORHOOD VARIABLES</td>
<td>SIG. NEIGH-DEP. ASSOC. RESULTS&lt;sup&gt;a&lt;/sup&gt;</td>
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<tr>
<td>Yen et al. (2008)</td>
<td>Sample: 301 participants aged 65–74 years (Taiwan).</td>
<td>Depression: Depression as clinical category, measured by the TDQ (derived from the CES-D).</td>
<td>Neighborhood poverty (% living in poverty)</td>
<td>BV N</td>
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<td></td>
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<td>Age, sex, marital status, education, work status, income, number of chronic illnesses, cerebrovascular diseases, heart diseases, hypertension, diabetes, cholesterol, low- and high-density lipoprotein, triglyceride, Apolipoprotein E genotypes, cognitive impairment</td>
<td>Residential stability (% 5+ years)</td>
<td>N</td>
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<td>Population ratio (ratio sum of inhabitants to neighborhood area)</td>
<td>N</td>
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<td></td>
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<td>Density of physician population (ratio physicians to population)</td>
<td>N</td>
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<td>Disposable money (income less necessary expenditure)</td>
<td>N</td>
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<td>Home ownership (%)</td>
<td>N</td>
<td></td>
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<td>Welfare expenditure (welfare expenditure divided by inhabitants)</td>
<td>N</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>Neighborhood quality (security, community participation, social control and collective efficacy, physical environment, ties among neighbors, social support)</td>
<td>N</td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup>Results of the final model are presented.

<sup>b</sup>Self-reported measure.

<sup>c</sup>Proportion of people with high income in the neighborhood.

<sup>d</sup>Proportion of individuals in the neighborhood who have lived in their household for a certain period of time.

<sup>e</sup>Proportion of individuals in older age range in the neighborhood.

<sup>f</sup>Although this study used a measure of intelligence at age 11, depression and neighborhood variables were measured at a cross-sectional level; therefore, the study was considered as having a cross-sectional design.

<sup>g</sup>Authors report similar but attenuated results for depression as a clinical category.

<sup>h</sup>Depression as a clinical category was also investigated, but for greater clarity, these results are not reported here.

<sup>i</sup>Note: When studies included participants less than 65 years old, results from participants aged 65+ years were isolated and are reported in this table. For the multivariate analyses, results of the final model are summarized. Subscript numbers under the Significant Neighborhood-Depression Associations heading refer to the subscript sample or time of measurement numbers under the Method or Depression Measures and Neighborhood Delimitation headings.

DEP. MEAS. AND NEIGH. DELIMIN. = Depression measures and neighborhood delimitation; SIG. NEIGH-DEP. ASSOC. = Significant neighborhood-depression associations; BV = Bivariate associations; MV = Multivariate associations; PHQ = Patient Health Questionnaire; Y = Yes; CI = Confidence interval; CES-D = Center for Epidemiologic Studies-Depression scale; ADL = Activities of daily living; N = No; SE = Standard error; OR = Odds ratio; HSC = Hopkins Symptoms Checklist; TDQ = Taiwanese Depression Questionnaire; HADS = Hospital Anxiety and Depression Scale; IQ = Intelligence quotient; GMS AGECAT = Geriatric Mental State and the Automated Geriatric Examination for Computer-Assisted Taxonomy; ICD-9-CM = Internal Classification of Disease, Clinical Modification; IADL = Instrumental activities of daily living; GDS = Geriatric Depression Scale.
Bierman, 2009; Wight et al., 2009; Gerst et al., 2011; Johnson et al., 2011) whereas nine studies examined it as a dichotomous variable (possible clinical depression vs. non-depressed; Wilson et al., 1999; Hahn et al., 2004; Walters et al., 2004; Berke et al., 2007; Kvaal et al., 2008; Yen et al., 2008; Menec et al., 2010; Ahern and Galea, 2011; Saarloos et al., 2011). Depressive mood was assessed by eight questionnaires: the Center for Epidemiologic Studies-Depression scale (CES-D; Radloff, 1977), the Geriatric Depression Scale (GDS; Yesavage et al., 1983), the Patient Health Questionnaire (PHQ; Spitzer et al., 1999), the Hopkins Symptoms Checklist (HSC; Derogatis et al., 1974), the Hospital Anxiety and Depression Scale (HADS; Zigmond and Snaith, 1983), the Geriatric Mental State and the Automated Geriatric Examination for Computer-Assisted Taxonomy (GMS AGECAT; Copeland et al., 1986), a home-made questionnaire, and the Taiwanese Depression Questionnaire (TDQ, a questionnaire derived from the CES-D; Lee et al., 2000). In addition to these questionnaires, the ICD-9-CM diagnosis criteria were also used in one study (Menec et al., 2010). The CES-D was by far the most commonly used questionnaire, being included in eight studies (Muramatsu, 2003; Ostir et al., 2003; Kubzansky et al., 2005; Hybels et al., 2006; Aneshensel et al., 2007; Berke et al., 2007; Wight et al., 2009; Gerst et al., 2011).

**Design**

Sixteen studies had a cross-sectional design (Muramatsu, 2003; Ostir et al., 2003; Hahn et al., 2004; Schieman and Meersman, 2004; Walters et al., 2004; Kubzansky et al., 2005; Hybels et al., 2006; Aneshensel et al., 2007; Berke et al., 2007; Kvaal et al., 2008; Yen et al., 2008; Menec et al., 2010; Ahern and Galea, 2011; Gerst et al., 2011; Johnson et al., 2011; Saarloos et al., 2011), two had a longitudinal design (Bierman, 2009; Wight et al., 2009), and one had both cross-sectional and longitudinal designs embedded (Wilson et al., 1999).

**Statistical analysis strategies**

The statistical analysis strategies used were either regression analyses, which were used in nine studies (Wilson et al., 1999; Hahn et al., 2004; Schieman and Meersman, 2004; Walters et al., 2004; Berke et al., 2007; Bierman, 2009; Ahern and Galea, 2011; Johnson et al., 2011; Saarloos et al., 2011), or multilevel models, which were used in ten studies (Ostir et al., 2003; Walters et al., 2004; Kubzansky et al., 2005; Hybels et al., 2006; Aneshensel et al., 2007; Kvaal et al., 2008; Yen et al., 2008; Wight et al., 2009; Menec et al., 2010; Gerst et al., 2011). Multilevel models are more complex statistical analyses that account for the fact that people living in the same neighborhood may be more similar than those living in different neighborhoods (thereby accounting for violations of the independence of measures assumption). Our review did not reveal any studies investigating mediating effects in the relationships between neighborhood variables and depressive mood using structural equation modeling or other statistical methods.

**Conceptualization and operationalization of the neighborhood construct**

Spatial delimitations of neighborhood of residence were based on three sources: (i) administrative or statistical boundary (census units or districts, geographic data zone, postal district, county unit, enumeration district, township unit, or community district), used in 15 studies (Wilson et al., 1999; Muramatsu, 2003; Ostir et al., 2003; Walters et al., 2004; Kubzansky et al., 2005; Hybels et al., 2006; Aneshensel et al., 2007; Kvaal et al., 2008; Yen et al., 2008; Wight et al., 2009; Menec et al., 2010; Ahern and Galea, 2011; Gerst et al., 2011; Johnson et al., 2011; Saarloos et al., 2011); (ii) local areas defined by residence-centered buffers (circular boundaries around each participant’s address), used in one study (Berke et al., 2007); and (iii) self-reported subjective delimitations of neighborhood, used in three studies (Hahn et al., 2004; Schieman and Meersman, 2004; Bierman, 2009).

Six neighborhood characteristics were most often evaluated in the studies: neighborhood socioeconomic disadvantage, neighborhood poverty, affluence, racial/ethnic composition, residential stability, and elderly concentration. Neighborhood socioeconomic disadvantage is an aggregate of dimensions such as educational level, poverty, unemployment, or home ownership in the neighborhood. Related to this indicator is neighborhood poverty, the proportion of individuals or family living in poverty (most often according to census tract boundaries). In contrast to these two parameters, neighborhood affluence measures the proportion of individuals or families with high income in the neighborhood. Racial/ethnic composition pertains to the proportion of immigrants in the neighborhood (e.g. proportion of Hispanics, Mexicans). Residential stability refers to the proportion of individuals in the neighborhood who have lived in their household for a certain period of time (e.g. at least five years). Finally, elderly concentration represents the proportion of individuals in an older age range in the neighborhood.
The vast majority of neighborhood parameters depicted in Table 1 were drawn from government organizations (e.g., percentage of people living in poverty in the neighborhood). In contrast, five self-reported neighborhood variables were identified in the studies and represent participants' perception of their neighborhood (either at the individual or neighborhood levels). These variables were neighborhood collective efficacy, neighborhood problems (e.g., noise, vandalism, trash on streets, crime rate), neighborhood social capital, sense of belonging to the neighborhood, and neighborhood quality (e.g., satisfaction with physical environment, community participation, social support).

**Associations between neighborhood and depressive mood**

**Empirical findings**

In bivariate associations (unadjusted correlations, analyses of variance, or simple regressions), 58% of the tested neighborhood variables (22 out of 38) showed significant associations with depressive mood. The associations between neighborhood variables and depressive mood were attenuated when adjusting for individual variables: 42% of the neighborhood variables that were statistically significant at a bivariate level (11 out of 26) remained statistically significant at a multivariate level when controlling for individual factors. (Note that this percentage is based on 26 associations instead of the 22 noted above because two studies tested more than one multivariate model.) Overall, around 25% of the neighborhood indicators (20 out of 81) were significant predictors of depressive mood after adjusting for individual-level variables. The 95% confidence intervals (95% CI) for neighborhood variables were sometimes large (Ostir et al., 2003; Kubzansky et al., 2005; Ahern and Galea, 2011). The proportion of variance explained in depressive mood in the final models involving significant neighborhood predictors was reported in only two studies: for Bierman (2009), $R^2 = 0.37$; and for Schieman and Meersman (2004), $R^2 = 0.17$. However, the magnitude of neighborhood effects (i.e., the unique contribution of neighborhood variables independent of individual characteristics) in the variance explained was not reported in either of these studies.

The individual variables that were controlled for often included sex, education, income, chronic illnesses, and functional limitations. Other individual covariates were, however, less often controlled for: social variables, prior history of depression, use of depression medication, stressful life events, and housing in institutional care.

**Congruence of associations between neighborhood variables and depressive mood**

Neighborhood variables and depressive mood were generally associated in a conceptually meaningful way in the final models (adjusted for individual characteristics): variables that represented pressors were linked to higher levels of depression whereas variables akin to buoys were associated with lower levels of depression. That is, as shown in Table 1, greater neighborhood socioeconomic disadvantage (Wilson et al., 1999), greater neighborhood poverty (Ostir et al., 2003; Kubzansky et al., 2005) or living in neighborhood poorest areas (Menec et al., 2010), higher population density (Walters et al., 2004), higher degree of perceived neighborhood problems (Schieman and Meersman, 2004; Bierman, 2009), higher county-level income inequity (Muramatsu, 2003), and lower neighborhood collective efficacy (Ahern and Galea, 2011) were related to higher depressive symptoms or higher likelihood of possible clinical depression whereas higher proportion of Mexicans (in Mexican American samples; Ostir et al., 2003; Gerst et al., 2011), more walking-friendly neighborhood (Berke et al., 2007), and higher neighborhood social capital (Hahn et al., 2004) were related to lower depressive symptoms or lower likelihood of possible clinical depression.

However, exceptions to the meaningfulness of relationships between neighborhood variables and depressive mood were residential stability, land-use mix, and availability of retail goods. That is, contrary to expectations, higher residential stability in the neighborhood (Aneshensel et al., 2007), and higher land-use mix and greater availability of retail goods (Saarloos et al., 2011) were associated with higher depressive mood. There were also mixed results regarding concentration of older persons in the neighborhood which was associated with less depressive symptoms in one study (Kubzansky et al., 2005), but with increased risks of depressive mood in another (Menec et al., 2010).

**Replication of findings**

If a particular neighborhood variable is clearly related to depressive mood, then we would expect this association to be present in many studies. Our analyses were limited to neighborhood variables that were included in more than one study and for which results of the final models are reported: neighborhood socioeconomic disadvantage, neighborhood poverty, neighborhood affluence, racial composition, residential stability, elderly concentration, neighborhood problems, and neighborhood walkability.
Neighborhood socioeconomic disadvantage was related to depressive mood in three out of 12 samples (Wilson et al., 1999; Kvaal et al., 2008 vs. Walters et al., 2004; Aneshensel et al., 2007; Kvaal et al., 2008; Wight et al., 2009; Saarloos et al., 2011). (Note that the number of references does not necessarily match the number of studies, because some studies included more than one sample/final model.) Neighborhood poverty was associated with depressive mood in two out of six samples (Ostir et al., 2003; Kubzansky et al., 2005 vs. Hybels et al., 2006; Yen et al., 2008; Gerst et al., 2011). In none of four studies was neighborhood affluence related to depressive mood (Kubzansky et al., 2005; Hybels et al., 2006; Aneshensel et al., 2007; Wight et al., 2009). The associations between racial/ethnic composition and depressive mood were significant in two out of seven studies (Ostir et al., 2003; Gerst et al., 2011 vs. Kubzansky et al., 2005; Hybels et al., 2006; Aneshensel et al., 2007; Wight et al., 2009; Menec et al., 2010). Higher concentration of older persons was associated with depressive mood in two out of six studies (Kubzansky et al., 2005; Menec et al., 2010 vs. Hybels et al., 2006; Aneshensel et al., 2007; Yen et al., 2008; Wight et al., 2009; Menec et al., 2010). The relationships between neighborhood problems and depressive mood were significant in two out of three samples (Schieman and Meersman, 2004; Bierman, 2009). Finally, neighborhood walkability was related to depression in one out of three samples that investigated this relationship (Berke et al., 2007; Saarloos et al., 2011).

Moderating Effects
Moderating effects involving neighborhood variables on depressive mood were tested in six studies but results for participants aged 65 years old or older are available in only five of these studies (results not shown in Table 1). Johnson et al. (2011) reported that the effect of neighborhood quality on depressive mood was stronger when respondents’ intelligence quotient (IQ), measured when they were 11 years old, was low. Muramatsu (2003) reported that the effect of county-level income inequity on depressive symptoms was stronger among people with lower levels of physical health. However, he reported no significant interactions between county-level income inequity and other individual characteristics. Schieman and Meersman (2004) tested interaction effects between neighborhood problems on the one hand, and received social support, donated social support, and sense of mastery on the other hand. They reported that the effects of neighborhood problems on depression were stronger among women who received lower levels of social support, but no other significant interactions were reported for either men or women. Other results suggest that the relationships between neighborhood disorder and depressive scores are not moderated by marital status (Bierman, 2009). As well, the associations between neighborhood poverty or racial composition and depressive scores are not moderated by individual characteristics (Ostir et al., 2003).

Discussion
The aim of this paper was to review the relationships between neighborhood variables and depressive mood among people aged 65 years or older. Nineteen studies met criteria for the review. Depressive mood was studied most often along a continuum, as opposed to a diagnosis category, which is appropriate within a population health paradigm. However, it may be as important to understand the characteristics of depressed individuals in need of clinical interventions, as to understand what is associated with depressive symptoms in the older population. Depressive mood was mainly assessed by the CES-D, a questionnaire designed to evaluate depressive symptoms in the general population, even though the GDS was specifically created for the geriatric population. The CES-D however showed adequate psychometric properties in older populations (Lewinsohn et al., 1997).

Most of the studies had a cross-sectional design, which does not allow for inferences about causal relationships. Our review did not reveal any studies testing mediating effects between neighborhood variables and depressive mood using structural equation modeling. Such designs would allow for investigating if there is a direct relationship between neighborhood variables and depressive mood and if the relationship can be explained by other variables thought to be along the causal pathway. For example, older people living near parks may feel less depressed because parks elicit physical activities (walking) and social contacts and not because of the presence of green spaces per se. In two studies, more favorable built environment (Brown et al., 2009a) and better neighborhood climate (Brown et al., 2009b) were found to be related to
lower psychological distress through the presence of greater perceived social support. However, the outcome measure in these studies (i.e., psychological distress) was a composite of depression and anxiety symptoms and was excluded from the review. Because the onset of these two disorders seems to be associated with different factors (Kvaal et al., 2008; Vink et al., 2009), these studies do not allow for valid inferences about effects on depressive mood.

The delineation of neighborhood was mainly achieved through administrative or statistical spatial boundaries: census units, geographic data zone, postal district, county unit, enumeration district, or township unit. These boundaries may create artificial neighborhoods (Aneshensel et al., 2007) that do not adequately capture the subjective meaning of neighborhood held by the residents (Coulton et al., 2001). Using more exposure-specific and outcome-specific approaches may maximize between-neighborhood variability and minimize within-neighborhood variability (Gauvin et al., 2007) and appears to be a promising approach. Aggregating spatial units into territorial units based on other criteria could create homogeneous areas in terms of characteristics related to material and social conditions and aid uncovering associations between neighborhood characteristics and mental health outcomes (Gauvin et al., 2007). For example, a study showed that zones specifically delineated according to known correlates of walking behaviors were better predictors of the number of episodes of utilitarian walking than correlates measured at the census tract level (Riva et al., 2009).

In the studies reviewed, six neighborhood characteristics were assessed most often: neighborhood socioeconomic disadvantage, neighborhood poverty, affluence, racial/ethnic composition, residential stability, and elderly concentration. These characteristics cover two out of ten categories of neighborhood attributes identified by Galster (2001): demographic (racial/ethnic composition, residential stability, elderly concentration) and socio-economic (neighborhood socioeconomic disadvantage, neighborhood poverty, affluence) characteristics of the population. Similarly to neighborhood delineation, the vast majority of neighborhood variables used in studies was derived from census units. It is important to go beyond census unit parameters to investigate specific neighborhood variables (Kubzansky et al., 2005). Other neighborhood attributes have received little or no attention in the literature: residential and non-residential non-structural elements, infrastructure, public services, environmental, proximity, political, social-interactive, and emotional characteristics. The attributes identified by Galster (2001) may not all be of equal importance for the study of the determinants of depressive mood. For example, political characteristics of neighborhoods may play a less important role in depressive mood than the other attributes (e.g., social-interactive, proximity) that contribute to daily functioning. Moreover, we identified five self-reported neighborhood variables in the studies (neighborhood collective efficacy, neighborhood problems, perceived neighborhood social capital, sense of belonging, and neighborhood quality). Just as with social interactions (e.g., Evans, 2009), self-reported measures of neighborhood may be more strongly related to depressive mood than objective measures. For example, satisfaction with availability of key resources may decrease depressive symptoms whereas objective availability of key resources may not be related to depressive symptoms. Future research could therefore include both self-reported and actual markers of neighborhood features.

In multivariate associations, neighborhood variables were found to make a unique and significant contribution to the understanding of depressive mood independent of some of the strongest individual predictors of depressive mood in older adults. Confidence intervals for neighborhood variables were sometimes large, suggesting that some of these estimates may be less reliable. Where measured, the proportion of variance explained (R^2) by individual covariates and neighborhood variables in depressive mood is small to moderate and no studies reviewed provided information regarding the unique contribution of neighborhood variables (i.e., independent of individual characteristics). This unique contribution may be significant, but small. However, large neighborhood effects on depressive mood are unlikely. Neighborhood variables may complement or supplement other stronger predictors of depressive mood such as female gender, physical illnesses, or functional limitations. That is, when investigating relationships between neighborhood variables and depressive mood, we may be looking at small associations that explain equally small portions of the variance left unaccounted for by stronger predictors. As a result, the implications of the size of neighborhood effects for knowledge advancement and public health interventions remain unclear (Gauvin et al., 2007).

Neighborhood variables were generally associated with depressive mood in a conceptually meaningful way, but overall, the quantity of studies was limited, and it is not clear if these relationships are different as a function of another variable (moderating effects). Additional studies are required to draw more far-reaching conclusions about neighborhood effects and to clarify complex patterns of associations. Studies
in non-industrialized countries would also be of interest to investigate if results can be replicated and extended.

Longitudinal and experimental studies are also needed to uncover both the time course and plausible processes by which neighborhood characteristics may be related to depressive mood. The direction of causal relationship between neighborhood variables and depressive mood is also unclear: do deleterious neighborhoods cause older people to become depressed, does depressive mood coincide with other socioeconomic factors to lead depressed older people to live in deleterious neighborhoods, or does depressive mood in many citizens at once contribute to creating more deleterious neighborhood environments? Although determining the direction of the causal relationship may be difficult to achieve, interesting alternatives to correlational models are available for researchers. Research would benefit from increased use of natural experiments (Petticrew et al., 2005). One example would be to exploit public investments in green spaces or street improvements and assess impact on depressive mood. Another option is to target individuals who moved and investigate if moving to a neighborhood bearing similar, less desirable, or more desirable characteristics than the initial neighborhood is related to change in depressive mood. It could be hypothesized that moving to a less desirable neighborhood deteriorates mood whereas moving to a more desirable neighborhood improves mood compared to moving to a neighborhood with characteristics similar to the initial one. In keeping with this idea, Leventhal and Brooks-Gunn (2003) found that parents who were relocated by a housing relocation program from high-poverty neighborhoods to lower-poverty neighborhoods reported less distress and depressive symptoms than parents who remained in high-poverty neighborhoods.

Returning to the conceptualization of Glass and Balfour (2003), the current review supports the notion that selected neighborhood variables, especially those related to poverty and material deprivation, are associated with worse mental health. However, thus far, there is limited empirical evidence to fully ascertain this notion and information is even more scarce on the processes that might explain any relationships between neighborhood variables and depressive mood among older adults. Future research examining the extent to which neighborhood variables create buoying or pressing environments that interact with personal competencies, leading to adaptive or maladaptive responses as well as health and functioning, is warranted. Until the relationships between neighborhood variables and depressive mood are more fully understood, it seems premature to conclude that neighborhood interventions are useful (or not useful) in alleviating older adults’ depressive mood.

**Conflict of interest**

None.

**Description of authors’ roles**

All authors formulated the research questions and designed the study. D. Julien performed the literature review and wrote the first draft of the paper. All authors commented on drafts and contributed to writing the paper.

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Appendix 1. Combinations of keyword terms used in database searches

(1) Depression, depression (emotion), major depression, major depressive disorder, depressive disorder, depressive symptoms, or depressive mood; with (2) aging, aged, elder(s), elderly, older adults, or senior(s); with (3) neighborhood(s), neighborhood characteristic(s), neighborhood environment, environment design, built environment, urban environments, residence characteristics, urbanization, social cohesion, neighborliness, neighborhood social capital, neighborhood environmental quality, residential stability, population density, neighborhood quality, neighborhood affluence, neighborhood socioeconomic advantage, racial composition, ethnic composition, racial heterogeneity, ethnic heterogeneity, neighborhood walkability, or neighboring behavior.