Blues from the Neighborhood? Neighborhood Characteristics and Depression

Daniel Kim

From the Department of Society, Human Development, and Health, Harvard School of Public Health, Boston, MA.

Unipolar major depression ranks among the leading contributors to the global burden of disease. Although established risk factors for depression include a variety of individual-level characteristics, neighborhood etiologic factors have been relatively understudied, with several such attributes (neighborhood socioeconomic status, physical conditions, services/amenities, social capital, social disorder) possessing plausible linkages to depression. Using the PubMed database (1966–2008) and the Social Sciences Citation Index database (1956–2008), the author undertook a systematic review of the published literature on the associations between these characteristics and depression in adults. Across studies, the evidence generally supports harmful effects of social disorder and, to a lesser extent, suggests protective effects for neighborhood socioeconomic status. Few investigations have explored the relations for neighborhood physical conditions, services/amenities, and social capital, and less consistently point to salutary effects. The unsupportive findings may be attributed to the lack of representative studies within and across societies or to methodological gaps, including lack of control for other neighborhood/non-neighborhood exposures and lack of implementation of more rigorous methodological approaches. Establishing mediating pathways and effect-modifying factors will vitally advance understanding of neighborhood effects on depression. Overall, addressing these gaps will help to identify what specific neighborhood features matter for depression, how, and for whom, and will contribute to curtailing the burden of disease associated with this major disorder.

depression; environment; residence characteristics; social class; social environment; socioeconomic factors

Abbreviations: GIS, geographic information systems; SAMS, Small Area Market Statistics; SES, socioeconomic status.

INTRODUCTION

Disease burden and noneconomic costs of depression

In 2001, unipolar major depression was estimated to rank among the 10 leading contributors to the global burden of disease worldwide, as measured by disability-adjusted life-years (1), and is projected to be among the top three contributors by the year 2020 (2). It was recently estimated that 33 million US adults (16.2 percent) had experienced an episode of major depression during their lifetime (3, 4). Furthermore, major depression has been associated with significant lost work productivity in the United States, with an estimated 27.2 excess work days lost per worker per year and 225.0 million workdays and $36.6 billion in salary-equivalent productivity lost per year across the US civilian labor force (3). In the general US population, utilization of health-care services for depressive disorders has risen rapidly over the past decade. Numbers of hospital outpatient visits alone escalated by approximately 48 percent between 1995 and 2005 (5).

Relevance of neighborhood characteristics to depression

While established risk factors for depression include a number of individual-level characteristics, including gender (6), psychological factors (e.g., stressful life events (7)), and family history (8), neighborhood environmental etiologic factors for depression have been relatively understudied. Such macro-level factors could help to explain recent trends and, if the linkages prove convincing, could serve as the basis for more effective means of curbing the

Correspondence to Dr. Daniel Kim, Department of Society, Human Development, and Health, Harvard School of Public Health, 677 Huntington Avenue, 7th Floor, Boston, MA 02115 (e-mail: dkim@hsph.harvard.edu).

future burden of disease attributable to depression. Indeed, investigating etiologic determinants at multiple spatial levels recognizes the complex contexts for human health and avoids the inherent constraints of "proximate" risk factor epidemiology (9). A burgeoning body of literature is establishing neighborhood characteristics as important determinants of individual health and disease. For example, a variety of studies have observed moderate yet significant associations between neighborhood socioeconomic status (SES) and coronary heart disease mortality and all-cause mortality, with estimated relative risks between 1.1 and 1.8 (10). Such "multilevel" investigations, which estimate area-level "contextual" effects while simultaneously accounting for key confounding individual-level characteristics ("compositional" effects), have in more recent years steadily evolved to encompass the outcomes of mental health disorders, including depression.

To date, there has been no systematic review of the literature on the associations between key neighborhood attributes (neighborhood SES, physical conditions/built environment, services/amenities, social capital, social disorder) and depression in adults. Such a review would provide a useful tool for surveying the cumulative research and moving research in this important area forward. In this paper, the posited mechanisms that link these neighborhood characteristics to individual depression risk in adults are described, and the epidemiologic literature on these relations is systematically reviewed. An overview of the apparent patterns in the findings (including significant and discrepant results) is offered, and key substantive and methodological gaps are highlighted.

Proposed theories/mechanisms

Figure 1 shows the key constructs relevant to this systematic review at the neighborhood and individual levels and the interrelations (empirically demonstrated and/or hypothesized) between constructs. The neighborhood environment may be broadly categorized into material/physical and psychosocial/social environments. *Neighborhood SES*, which is the neighborhood-level analog of individual SES and is typically operationalized as an aggregate (e.g., census tract-level) measure of residential income, education, and/or occupational status derived from the US Census, is most closely linked to the material/physical environment. This includes the local food environment (e.g., density of supermarkets and grocery stores), the built environment (e.g., bicycle lanes, green spaces, housing/buildings), the presence of tobacco and alcohol vendors (e.g., tobacco outlets, liquor stores), the availability of health-related care (e.g., physicians, pharmacies), and the presence of amenities promoting social interactions (e.g., cafés, community centers, museums) (figure 1). In turn, these conditions may affect health behaviors and thereby individual physical health and levels of psychosocial stress, and ultimately influence individual risk of depression. For instance, physical activity, which is plausibly shaped by the built environment (11), has been shown to buffer stress and reduce the risk of depression (12).

Neighborhood social capital and social disorder are integral elements of the psychosocial/social environments of neighborhoods and possess plausible pathways to individual levels and risks of depression. *Social capital* has been defined as the features of social organization, including social trust, civic participation, and norms of reciprocity that facilitate cooperation for mutual benefit (13). Drawing on earlier theoretical considerations regarding associations between social capital and general health and mortality (14), neighborhood social capital could influence levels/risks of depression through several pathways. First, based on Rogers' "diffusion of innovations" theory (15), social capital may promote diffusion of knowledge about health-related innovations, including information on smoking cessation and dietary practices, and may thereby lead to better physical health and health behaviors (which in turn may affect depression through direct effects or by buffering the negative effects of psychosocial stress) (14). Based on evidence relating collective efficacy to crime, social capital may further contribute to informal social control over health-related behaviors and may plausibly facilitate collective action among residents to promote the provision of and access to local services and amenities that may be relevant to health (e.g., availability of green spaces) (14). In other words, social capital may partly determine neighborhood SES-related services and amenities (figure 1). Moreover, social capital may act through psychosocial processes, including the provision of affective support and mutual respect (14), and may generate social capital (e.g., trust) at the individual level. These psychosocial resources may then have direct protective effects against depression or buffer the adverse effects of stress on depression. The concept of *social disorder* refers to the disintegration of processes and structures that maintain order, civility, and safety (16). Signs of neighborhood social disorder include graffiti/crime, unsupervised and delinquent youth, the sale of illicit drugs, and other incivilities, stemming from the lack of informal social control needed to maintain order (16, 17). These factors may affect individual behaviors, may have direct effects on physical health, and/or may negatively affect levels of psychosocial stress and resources, through the knowledge that basic protections are lacking and that other people in the neighborhood cannot be trusted (16, 17).

Figure 1 further illustrates that physical amenities in a neighborhood may contribute to levels of neighborhood social capital. For example, the presence of abundant physical structures which provide opportunities for social interactions among residents (e.g., cafés, malls, town halls) may aid in bolstering social capital within neighborhoods.

METHODS

Search strategy

A systematic literature review was conducted of all studies published in English that had examined neighborhood characteristics in relation to individual-level depression measures in adults. Citations were searched using the PubMed database (which includes citations from MEDLINE and other life science journals) for the period between 1966 and April 1, 2008, and the Social Sciences Citation Index database for the period between 1956 and April 1,
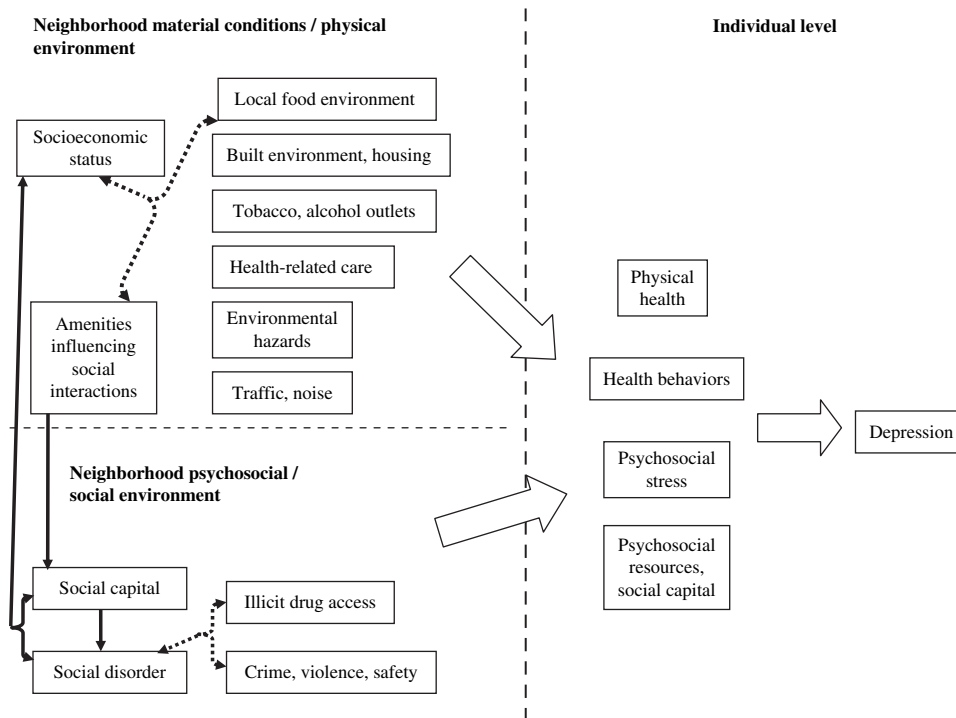
FIGURE 1. Relations between key neighborhood characteristics and adult depression. Double-headed dashed arrows indicate conceptually related constructs/indicators. All of the neighborhood constructs shown were explored in relation to individual depression across studies included in the systematic review. In two studies (17, 46), investigators examined potential mediation of the effects of neighborhood socioeconomic/physical environment on depression by social capital/social disorder. No studies investigated individual-level behavioral and/or psychosocial pathways mediating neighborhood effects on depression.

2008. The keyword combination ''neighborhood'' and ''depression'' was used, as well as the combinations of each of the following keywords with ''depression'': ''neighborhood socioeconomic status,'' ''neighborhood poverty,'' ''neighborhood deprivation,'' ''neighborhood physical environment,'' ''neighborhood built environment,'' ''neighborhood amenities,'' ''neighborhood services,'' ''neighborhood social environment,'' ''neighborhood social capital,'' and ''neighborhood disorder.'' ''Community'' was also subsequently substituted for ''neighborhood'' in the keyword combinations.

Articles were then obtained and reviewed. Studies that analyzed depression-specific measures as individual-level outcomes were included, while studies that more broadly examined psychological distress or common mental disorders were excluded. Studies were further restricted to those that included population-based samples of adults (i.e., samples predominantly comprised of persons aged 18 years or older) rather than clinical samples and studies that applied multivariable models (i.e., models with adjustment for potential confounders, including the sociodemographic/socioeconomic characteristics of individuals). Population-based samples restricted to specific geographic areas (including low-SES areas), racial/ethnic groups, and/or age groups (e.g., elderly populations) were included. The reference sections of retrieved articles were further searched to identify additional potential articles for inclusion.

Tabulation of findings

For each qualifying study, the following information was tabulated: study authors and year of publication; data sets analyzed; sample size, population, and setting; age range of study participants; analytic framework and study design (multilevel vs. (single-level) multivariable, cross-sectional vs. prospective/longitudinal); measures applied for neighborhood SES, physical conditions/built environment, services/amenities, social capital, social disorder, and depression; model-adjusted potential confounders; and key findings (from the fully adjusted models), including results from tests for statistical interactions.

RESULTS

Twenty-eight studies met the inclusion criteria. Table 1 shows the salient characteristics of these studies, listed chronologically by year of publication. Because in a number of studies investigators examined multiple neighborhood characteristics (e.g., neighborhood SES, social capital, social disorder) simultaneously, all studies are listed chronologically rather than being grouped by specific neighborhood characteristic. Table 2 cross-tabulates the neighborhood characteristics and the total numbers of studies with particular findings (significant in the expected direction, significant

TABLE 1.   Findings from studies of the relations between key neighborhood characteristics and adult depression

Author(s) and year of publication (ref. no.)	Data set, source, and year(s)	Sample size, population, and setting	Age range (years) of subjects	Analytic framework and study design	Measure of neighborhood characteristic(s)	Measure of depression/ depressive symptoms	Adjusted potential confounders	Key findings
Yen and Kaplan, 1999 (18)	Alameda County Study, 1965–1974; US Census, 1960	1,296 persons in the city of Oakland, California	≥20	Multivariable prospective analysis	Neighborhood SES*: federal poverty area (% low-income, % living in substandard housing, % with low education, % unemployed, % unskilled male laborers, and % with children in single-parent homes)	18-item depressive symptom scale; $\alpha = 0.77$ in prior study (19)	Age, gender, race/ ethnicity, income, chronic conditions, smoking, alcohol, and body mass index	For depression (poverty residence vs. nonpoverty residence), OR* = 1.21, 95% CI*: 0.76, 1.93 No significant interactions with age, gender, race/ ethnicity, income, or education
Ross, 2000 (17)	Survey of Community, Crime, and Health, 1995; US Census, 1990	2,482 persons in US Census tracts/zip codes in Illinois	18–92	Multilevel cross-sectional analysis	Neighborhood SES: % of households in poverty, % of mother-only households; factor loadings of 0.84 and 0.89 on same factor, respectively Perceived neighborhood disorder: physical (e.g., graffiti) and social (e.g., crime, drug and alcohol abuse) disorder; $\alpha = 0.92$	Seven-item modified CES-D* Scale; $\alpha = 0.81$	Individual: age, gender, race/ ethnicity, income, education, marital and parental status, employment, and urban residence	Low neighborhood SES (unadjusted for neighborhood disorder): $\beta = 0.08$, $p < 0.05$ Low neighborhood SES (adjusted for neighborhood disorder): $\beta = 0.03$, $p > 0.05$ Neighborhood disorder (adjusted for neighborhood SES): $\beta = 0.30$, $p < 0.01$
Silver et al., 2002 (20)	Epidemiologic Catchment Area Project, 1981–1983; US Census, 1980	11,686 persons in 261 census tracts in five US cities	18–96	Multilevel cross-sectional analysis	Index of: % of households on public assistance, % husband-wife families, % living below the poverty line, % unemployment, % female-headed households, % persons in executive/managerial jobs, and % with annual income >$30,000; all loaded onto single factor	Diagnostic Interview Schedule; agreement between lay examiners and psychiatrists: concordance statistic = 0.60	Individual: age, gender, marital status, race/ ethnicity, income, education, and study site Neighborhood: residential mobility and mixed race/ ethnicity	For major depression, OR = 1.14, 95% CI: 1.01, 1.31
Hill and Herman-Stahl, 2002 (21)	Interviews	103 African-American and Euro-American mothers of kindergarten children sampled in zip codes in a semiurban US city	Mean: 36 (African Americans), 35 (Euro-Americans)	Multilevel cross-sectional analysis	Respondent-perceived and interviewer-observed neighborhood safety; $\alpha = 0.82$ (Euro-Americans), $\alpha = 0.71$ (African Americans)	20-item CES-D Scale; $\alpha = 0.88$ (Euro-Americans), $\alpha = 0.90$ (African Americans)	Individual: single-parent status and race/ethnicity	Respondent-perceived neighborhood safety: $\beta = -0.38$, $p < 0.001$ Interviewer-observed neighborhood safety: $\beta = -0.25$, $p < 0.01$ No significant interaction between either measure and individual race/ethnicity

Weich et al., 2002 (22)	Individual-level survey; Built Environment Site Survey	1,887 persons in 76 housing areas in two electoral wards in North London, United Kingdom	≥16	Multivariable cross-sectional analysis (standard errors adjusted for clustering)	% of respondents living in areas with observer-rated characteristics of built environment; κ ≥ 0.5 for items	20-item CES-D Scale	Individual: age, gender, marital status, race/ethnicity, education, employment, housing tenure, and car/van access	Three of six indicators significantly associated with depression ($p < 0.10$)
Ostir et al., 2003 (23)	Hispanic EPESE,* 1993–1994; US Census, 1990	2,710 Mexican Americans in 206 census tracts in Texas, California, Arizona, Colorado, and New Mexico	≥65	Multilevel cross-sectional analysis	% with income less than poverty level	20-item CES-D Scale	Individual: age, gender, marital status, education, native birth, activities of daily living, and chronic medical conditions Neighborhood: % Mexican-American, per capita income	$\beta = 7.63$, 95% CI: 0.57, 14.69; $p = 0.03$ No significant interactions with age, gender, activities of daily living, or chronic medical conditions
Leventhal and Brooks-Gunn, 2003 (24)	MTO,* 1994–1999; US Census, 1990	550 persons in public housing in 170 high-poverty census tracts participating in the MTO at the New York City site	Mean = 35	Randomized controlled trial	Section 8 housing voucher and special assistance to move to low-poverty (<10%) neighborhood	Depressive Mood Inventory	Individual: age, gender, marital status, race/ethnicity, education, employment, and no. of children in household	Intent-to-treat analysis (experimental vs. control neighborhood): $\beta = -0.19$, $p < 0.10$
Gee et al., 2004 (25); G. C. Gee, University of California, Los Angeles, personal communication, 2007 (results in final column)	Chinese American Psychiatric Epidemiologic Study, 1994; US Census, 1990	1,503 Chinese Americans in 36 census tracts in Los Angeles, California	18–65	Multilevel cross-sectional analysis	Neighborhood % below poverty line Respondent-perceived concerns over neighborhood physical conditions and crime; $\alpha = 0.69$ Neighborhood vehicular burden (% driving or taking public transportation)	Depression subscale of Revised Symptom Checklist 90	Individual: age, gender, income, education, social support, acculturation, and subjective traffic stress	Neighborhood % below poverty line: $\beta > 0$, $p < 0.10$ Perceived neighborhood concerns: $\beta > 0$, $p > 0.05$ Neighborhood vehicular burden: $\beta > 0$, $p > 0.05$
Fauth et al., 2004 (26)	Yonkers Project, 1992–1995	315 African Americans and Latinos living in public housing in southwestern Yonkers, New York	Mean = 36	Quasi-experimental study	Selection to move to low-poverty neighborhoods	Depression subscale of Symptom-Driven Diagnostic System for Primary Care screen; $\alpha = 0.88$	Individual: age, race/ethnicity, education, female-headed household, and no. of children	Movers vs. nonmovers: $\beta = -0.28$, $p > 0.10$
Walters et al., 2004 (27)	Medical Research Council trial, 1995–1999; United Kingdom Census, 1991	13,349 persons in enumeration districts in the United Kingdom	≥75	Multivariable cross-sectional analysis (standard errors adjusted for clustering)	Neighborhood SES (Carstairs deprivation score, based on district unemployment, overcrowding, non-car ownership, social class)	Geriatric Depression Scale; $\alpha = 0.75$, sensitivity = 0.81, specificity = 0.75 in prior study (28) with same cutoff	Individual: age, gender, living in owner-occupied housing, financial stress, living alone, impaired cognition, physical symptoms, and unmet needs in activities of daily living Neighborhood: population density	For depression (low neighborhood SES vs. high neighborhood SES), OR = 1.10, 95% CI: 0.81, 1.50

Table continues

TABLE 1. Continued

Author(s) and year of publication (ref. no.)	Data set, source, and year(s)	Sample size, population, and setting	Age range (years) of subjects	Analytic framework and study design	Measure of neighborhood characteristic(s)	Measure of depression/ depressive symptoms	Adjusted potential confounders	Key findings
Cutrona et al., 2005 (16)	Family and Community Health Study, 1997–1999; US Census, 1990	720 African-American primary caregivers of children aged 10–12 years in 41 neighborhood clusters in Iowa and Georgia	24–80	Multilevel cross-sectional analysis and prospective analysis	Neighborhood SES (per capita income, % female-headed households, % on public assistance, % less than poverty line, % unemployed men); loaded onto single factor Neighborhood social disorder (combined community dilapidation scale and community deviance); $\alpha = 0.89$	University of Michigan CIDI*	Individual: age, marital status, education, no. of children, receipt of public assistance, and state of residence	Cross-sectional analyses (mean of low neighborhood SES and social disorder): for depression in past 6 months, OR = 1.92, 95% CI: 1.04, 3.52 Prospective analyses (mean of low neighborhood SES and social disorder): for incident depression in past year, OR = 0.90, 95% CI: 0.40, 2.06 Interaction between individual negative life events and neighborhood disadvantage/disorder: OR > 1, $p = 0.06$ (cross-sectional analyses), $p < 0.001$ (prospective analyses)
Kubzansky et al., 2005 (29)	New Haven component of EPESE, 1985; US Census, 1980	2,812 persons in 28 census tracts in New Haven, Connecticut	≥65	Multilevel cross-sectional analysis	Neighborhood poverty, affluence Neighborhood densities of services promoting social interactions, services providing health-related care, undesirable amenities; $\kappa > 0.85$ for each category	20-item CES-D Scale; $\alpha = 0.88$	Individual: age, gender, race/ethnicity, marital status, income, education, and disability Neighborhood: residential stability, racial/ethnic heterogeneity, and concentration of elderly	Neighborhood poverty: $\beta = 6.51$, $p = 0.01$ Neighborhood affluence: $\beta = -34.23$, $p = 0.09$ Neighborhood densities of three types of services/amenities: none significantly associated with depressive symptoms
Veenstra, 2005 (30)	Survey, 2002; Canada Census, 2001	1,435 persons in 25 communities in British Columbia, Canada	≥18	Multilevel cross-sectional analysis	Community SES: median household income Community no. of public spaces, voluntary organizations per capita; average levels of community trust ($\alpha = 0.70$) and political trust ($\alpha = 0.78$)	11-item depression scale; $\alpha = 0.88$	Individual: age, gender, native birth, income, education, trust in community members, political trust, and associational participation	Associations with higher levels of depressive symptoms— Community no. of public spaces per capita: $\beta = 0.001$, $p = 0.02$ No significant associations for other community social capital variables and community SES (estimates not reported)
Galea et al., 2005 (31)	Survey, 2002; US Census, 2000	1,355 residents sampled in 59 community districts in New York City	≥18	Multilevel cross-sectional analysis	Neighborhood characteristics of built environment (internal, external)	National Women's Study depression module; $\alpha = 0.79$	Individual: age, gender, race/ethnicity, and income Neighborhood: median household income	OR for depression in past 6 months (worse levels vs. better levels)— For four of six internal built environment indicators, ORs significantly > 1 For two of eight external built environment indicators, ORs significantly > 1 OR for lifetime depression— For four of six internal built environment indicators, ORs significantly > 1 For two of eight external built environment indicators, ORs significantly > 1

Source	Study name and year; data source	Sample	Age (years)	Study design	Neighborhood measure	Depression measure	Covariates	Results
Henderson et al., 2005 (32)	Coronary Artery Disease in Young Adults Study; US Census, 1990	3,437 persons in census blocks in four US cities	28–40	Multivariable cross-sectional analysis	Neighborhood SES: combination of median household income; median value of housing units; % of households receiving interest, dividend, or rental income; and % of adults who completed high school, % of adults who completed college, and % who were working in managerial/ professional occupations; $\alpha > 0.90$ and construct validity in prior study (33)	20-item CES-D Scale	Individual: age, income, and education; analyses stratified by gender and race/ ethnicity	Estimates comparing lowest neighborhood SES with highest— White men: $\beta > 0$, $p > 0.05$ White women: $\beta > 0$, $p > 0.05$ African-American men: $\beta > 0$, $p > 0.05$ African-American women: $\beta > 0$, $p > 0.05$ No significant interactions with income or education
Hybels et al., 2006 (34)	North Carolina component of EPESE, 1989– 1990; US Census, 1990	2,998 persons in 91 census tracts in central North Carolina	≥65	Multilevel cross-sectional analysis	Neighborhood: each of % living in poverty, % of families with annual income ≥$75,000	20-item modified CES-D Scale	Individual: age, gender, race/ethnicity, marital status, income, education, and functional status	% living in poverty: $\beta = -0.01$, $p = 0.41$ % of families with annual income ≥$75,000: $\beta = 0.018$, $p = 0.11$
Matheson et al., 2006 (35)	Canadian Community Health Survey, 2000– 2004; Canada Census, 2001	56,428 persons in 3,619 census tracts in 25 Canadian Census Metropolitan Areas	18–74	Multilevel cross-sectional analysis	Combination of: % with less than high school education, % lone-parent families, % on public assistance, % unemployed, % low-income, and % of homes needing repair; loaded onto single factor	CIDI-SF* for major depression	Individual: age, gender, marital status, visible minority status, and education Neighborhood: residential instability, dependency, and ethnic diversity	For depression, OR = 1.05, $p \le 0.01$
Aneshensel et al., 2007 (36)	Study of Assets and Health Dynamics Among the Oldest Old, 1973; US Census, 1990	3,442 persons sampled in 1,217 census tracts in US urban areas	≥70	Multilevel cross-sectional analysis	Combination of: % residents with less than high school education, % on public assistance, % less than poverty, and % unemployed (loaded onto same factor) % of households with annual income ≥$50,000	Eight-item version of CES-D Scale; $\alpha = 0.77$ and construct validity in prior study (37)	Individual: age, gender, race/ethnicity, marital status, income, wealth, education, religion, activities of daily living, and comorbid conditions	No significant associations (estimates not reported)
Galea et al., 2007 (38)	Survey, 2002– 2004; US Census, 2000	820 persons sampled in 59 community districts in New York City	≥18	Multilevel prospective analysis	Median household income	Modified version of the Structured Clinical Interview for DSM-III-R* major depressive disorder subscale; $\alpha = 0.79$	Individual: age, gender, race/ethnicity, marital status, income, education, social support, factors related to September 11 terrorist attacks, and traumatic life events/lifetime post-traumatic stress disorder	For incident depression (low neighborhood SES vs. high neighborhood SES), OR = 2.19, 95% CI: 1.04, 4.59

Table continues

TABLE 1. Continued

Author(s) and year of publication (ref. no.)	Data set, source, and year(s)	Sample size, population, and setting	Age range (years) of subjects	Analytic framework and study design	Measure of neighborhood characteristic(s)	Measure of depression/ depressive symptoms	Adjusted potential confounders	Key findings
Schootman et al., 2007 (39)	African American Health Study, 2000–2004; US Census, 2000	998 African Americans in 123 census block groups and 43 census tracts in low-SES inner-city area and suburban area of St. Louis, Missouri	50–64	Multilevel prospective analysis	"Deprivation" index: % living below poverty line, % on public assistance, % with less than high school education, % of housing units lacking plumbing, % African-American, % unemployed, % residing in area for >5 years, % residing in owner-occupied housing, % female-headed households, and % aged >64 years Interviewer rating of block of residence of respondent Respondent-perceived neighborhood conditions	11-item modified CES-D Scale; α = 0.84 in prior study (40)	Propensity score based on: individual gender, income, perceived income inadequacy, limitations in visual acuity, body mass index, hospitalization in past year, social support, medical conditions, functional limitations, no. of severe chronic conditions, smoking, alcohol misuse, and physical activity	Low block group deprivation vs. mean block group deprivation: OR = 1.58, 95% CI: 0.50, 4.99 Block conditions (4–5 conditions rated as fair/poor vs. 0–1 conditions rated as fair/poor): OR = 0.54, 95% CI: 0.24, 1.23 Respondent-perceived neighborhood conditions (worst condition vs. mean condition): OR = 1.42, 95% CI: 0.70, 2.86
Lofors and Sundquist, 2007 (41)	Register of the Total Population and the Immigration Register; Swedish National Hospital Discharge Register; Cause of Death Register, 1997–1999	2,287,349 men and 2,229,438 women in 729 clusters of Small Area Market Statistics areas in Sweden	25–64	Multilevel prospective analysis	Index of %: low education, unemployed, elderly living alone, children aged <5 years, single parents, moving during past year, and foreign birth Mean participation in local governmental elections	First hospitalization with diagnosis of selected affective disorders including depression	Individual: age, marital status, country of birth, education, housing tenure, and employment	Neighborhood SES (low vs. high)— Men: OR = 1.20, 95% CI: 1.11, 1.30 Women: OR = 1.33, 95% CI: 1.24, 1.43 Neighborhood voting participation (low vs. high), unadjusted for neighborhood SES— Men: OR = 1.16, 95% CI: 1.09, 1.23 Women: OR = 1.11, 95% CI: 1.06, 1.17 Neighborhood voting participation (low vs. high), adjusted for neighborhood SES— Men: OR = 1.05, 95% CI: 0.98, 1.13 Women: OR = 0.97, 95% CI: 0.92, 1.03
Stockdale et al., 2007 (42)	Healthcare for Communities, 1998–1999; US Census, 2000; InfoUSA (Omaha, Nebraska), 2003; US Census Bureau and US Department of Commerce, 2001; Uniform Crime Reporting Program, 2000	12,716 persons in 60 US communities (census tract, zip code, or county)	Mean = 48	Multilevel cross-sectional analysis	Neighborhood SES (median family income, % of owner-occupied units) Neighborhood alcohol outlet density; density of alcohol, drug, and mental-health facilities Neighborhood violent crime arrest rate	CIDI-SF	Individual: age, gender, race/ethnicity, income, education, and having witnessed a beating, abuse, or murder in the past year Neighborhood: median years of occupied residence, average housing occupancy County level: no. of churches per 1,000 population	ORs for probable depression/ anxiety disorder— Neighborhood median family income: OR = 1.00, p < 0.05 Neighborhood % of owner-occupied units: OR = 1.00, p > 0.05 Neighborhood alcohol outlet density: OR = 1.00, p > 0.05 Neighborhood density of alcohol, drug, and mental-health facilities: OR = 0.998, p > 0.05 Interaction between individual-witnessed beating, abuse, or murder and neighborhood violent crime arrest rate: OR > 1, p < 0.05

Source	Data source(s) and year(s)	Study population	Age, years	Study design	Neighborhood assessment	Depression measure	Covariates	Findings
Berke et al., 2007 (43)	Adult Changes in Thought Study, 2001–2003; Walkable and Bikable Communities Project, 2002	740 persons in buffer zones around respondents' residences in King County, Washington	≥65	Multivariable cross-sectional analysis	Walkability score based on physical attributes around home	20-item CES-D Scale	Individual: age, race/ethnicity, income, education, chronic disease burden, living alone, smoking, and walking activity; analyses stratified by gender	ORs for depression (corresponding to walkability score within 1-km radius of home)— Men: OR = 0.33, 95% CI: 0.14, 0.82 Women: OR = 0.89, 95% CI: 0.51, 1.55
Gary et al., 2007 (44)	Exploring Health Disparities in Integrated Communities	1,408 Whites and African Americans in two census tracts in Baltimore, Maryland	≥18	Multivariable cross-sectional analysis	Respondent-perceived neighborhood problems (e.g., public transportation, no. of grocery stores, crime) Respondent-perceived neighborhood social cohesion	Patient Health Questionnaire-9	Individual: age, gender, income, education, and desirable resources; analyses stratified by race/ethnicity Neighborhood: community leader available, interviewer-observed desirable amenities/resources	ORs for depression— Whites—severe problems in community: OR = 2.2, $p < 0.05$; social cohesion: OR = 0.5, $p < 0.05$ African Americans—severe problems in community: OR = 1.9, $p < 0.05$; social cohesion: OR = 1.1, $p > 0.05$
Kling et al., 2007 (45)	MTO, 1994–2002; US Census, 1990 and 2000	3,526 persons living in public housing in high-poverty census tracts in five MTO cities	25–54	Randomized controlled trial	Section 8 housing voucher and special assistance to move to low-poverty (<10%) neighborhood	CIDI-SF	Individual: age, gender, marital status, race/ethnicity, education, employment, public assistance, mobility history, attitudes about neighborhood, ability to move to other part of city, reason for moving, and previous application for voucher Household: possession of car, member with disability, victim of crime in past 6 months, teen children, and household size Also adjusted for study site	Intent-to-treat analysis (experimental vs. control neighborhood): $p < 0.10$
Kruger et al., 2007 (46)	Interview; Flint Environmental Block Assessment, 2000	801 persons in 129 census tracts in Flint and Genesee County, Michigan	18–100	Cross-sectional path analysis	Environmental block assessment of neighborhood residential and commercial building deterioration; $\alpha = 0.70$ (residential), $\alpha = 0.94$ (commercial) Respondent-perceived neighborhood social capital, fear of crime	Brief Symptom Inventory-18 depression subscale; $\alpha = 0.73$	Individual: age, gender, marital status, race/ethnicity, education, and employment	Good fit of path model with building deterioration determining lower neighborhood social capital/higher fear of crime, in turn predicting higher individual depressive symptoms; adding direct effect of building deterioration on depressive symptoms did not improve fit

Table continues

TABLE 1. Continued

Author(s) and year of publication (ref. no.)	Data set, source, and year(s)	Sample size, population, and setting	Age range (years) of subjects	Analytic framework and study design	Measure of neighborhood characteristic(s)	Measure of depression/ depressive symptoms	Adjusted potential confounders	Key findings
Yen et al., 2008 (47)	Interviews/blood testing, 2002; Taiwan Census data report, 1997	500 persons in four urban, suburban, and rural townships in southern Taiwan	65–74	Multilevel cross-sectional analysis	Neighborhood: % in poverty, physician density, household income, home ownership, government welfare expenditure; Neighborhood Quality Index (index of 16 indicators including perceived neighborhood security, social control and collective efficacy, weak ties with neighbors, satisfaction with physical environment); $\alpha = 0.67–0.84$ and construct validity for subscales in prior study (48)	Taiwanese Depression Questionnaire; $\alpha = 0.90$, sensitivity $= 0.89$, specificity $= 0.92$	Individual: age, gender, marital status, income, education, occupation, no. of chronic conditions, and apolipoprotein E genotype	Neighborhood SES indicators and density of physicians: each not significantly associated with depression; Neighborhood quality: not significantly associated with depression
Echeverria et al., 2008 (49)	Multi-Ethnic Study of Atherosclerosis, 2000–2002; US Census, 2000	5,943 persons in 1,187 census tracts in six US communities	45–84	Multilevel cross-sectional analysis	Respondent-perceived and other respondent-derived measures of neighborhood problems (e.g., lack of parks, lack of access to adequate food shopping, violence); respondent-perceived and other respondent-derived measures of neighborhood social cohesion	20-item CES-D Scale	Individual: age, gender, race/ethnicity, income, education, and length of neighborhood residency; Neighborhood: SES (combination of census-derived indicators, as in study by Henderson et al. (32))	Respondent-perceived neighborhood problems (low vs. high): $\beta = -0.34$, $p < 0.05$; Other respondent-derived neighborhood problems (low vs. high): $\beta = -0.21$, $p < 0.05$; Respondent-perceived neighborhood social cohesion (low vs. high): $\beta = 0.13$, $p < 0.05$; Other respondent-derived neighborhood social cohesion (low vs. high): $\beta = 0.05$, $p > 0.05$; Significant interaction between respondent-perceived neighborhood problems and race/ethnicity (stronger associations among Latinos and Chinese vs. persons in other racial/ethnic groups)

* SES, socioeconomic status; OR, odds ratio; CI, confidence interval; CES-D, Center for Epidemiologic Studies Depression; EPESE, Established Populations for the Epidemiologic Study of the Elderly; MTO, Moving to Opportunity for Fair Housing Demonstration; CIDI, Composite International Diagnostic Interview; CIDI-SF, Composite International Diagnostic Interview–Short Form; DSM-III-R, *Diagnostic and Statistical Manual of Mental Disorders*, Third Edition, Revised.

TABLE 2. Distribution of studies of the relations between key neighborhood characteristics and adult depression, by type of findings

Neighborhood characteristic	Studies with significant* findings in the expected† direction		Studies with significant* findings in the direction opposite of that expected†		Studies with mixed (significant* and nonsignificant) findings		Studies with null findings	
	No. of studies	Ref. no(s).	No. of studies	Ref. no(s).	No. of studies	Ref. no(s).	No. of studies	Ref. no(s).
Neighborhood socioeconomic status	11	16, 17, 20, 23–25, 29, 35, 38, 41, 45	0		1	42	10	16, 18, 26, 27, 30, 32, 34, 36, 39, 47
Physical conditions (e.g., noise)/built environment	3	43, 44, 49	0		2	22, 31	2	25, 39
Specific services/amenities (e.g., alcohol outlets)	2	44, 49	1	30	0		2	29, 42
Social capital	1	44	0		1	49	3	30, 41, 47
Social disorder	6	16, 17, 21, 42, 44, 49	0		0		2	16, 47

* $p < 0.10$ (where reported).

† For this systematic review, the "expected" direction of associations corresponded to lower neighborhood socioeconomic status, worse physical conditions and services/amenities, a lower level of social capital, and a higher level of social disorder being related to higher levels/odds of depression.

in the direction opposite of that expected, mixed (significant and nonsignificant) findings for different indicators of the same construct, and null findings). For the purpose of this systematic review, the ''expected'' direction of associations corresponded to lower neighborhood SES, worse physical conditions and services/amenities, a lower level of social capital, and a higher level of social disorder being related to higher levels/odds of depression. In stratified analyses or tests of interaction in which associations were significant for the same indicator in at least one population subgroup (e.g., as defined by gender or race/ethnicity), the overall study findings were classified as significant.

As table 1 shows, the first study of neighborhood characteristics and depression that met the inclusion criteria appeared in 1999. Nearly two thirds (18 of 28) of the studies have been published since 2005.

Study designs and control for confounding

In two studies, both drawing on data from the Moving to Opportunity for Fair Housing Demonstration (24), investigators applied a randomized controlled trial and prospective design; one study was quasi-experimental (26); and five studies were observational and prospective. Across these prospective studies, follow-up times ranged from 18 months (36) to 9 years (18). The remaining studies were observational and cross-sectional. In all studies, investigators controlled for multiple key potential confounders at the individual level, including sociodemographic characteristics (e.g., age and race/ethnicity), SES (e.g., income or education), and, in elderly populations, functional status/comorbid conditions, either through adjustment in statistical models or through stratification. In only one study (47) did investigators adjust for either a possible genetic risk factor for depression or a family history of psychiatric disorder. In that study, there was no evidence of confounding of neighborhood characteristics by the genetic factor examined (apolipoprotein E genotype). This observation is not unexpected, since a genetic factor would in general not be anticipated to be clustered in particular neighborhoods (and hence should not be correlated with specific neighborhood attributes). Key potential confounders at the neighborhood level include neighborhood SES or social capital/social disorder (when the main effect of one or the other main characteristic is being examined), residential stability, racial/ethnic heterogeneity, and residential segregation. However, only about half (13 of 25) of the observational studies controlled for any such neighborhood factors, despite their known or anticipated variation in the study samples, and no studies adjusted for nonresidential contextual (e.g., workplace) characteristics, which have been shown in prior studies to independently predict risk of depression (50).

Study populations and geographic units

The largest sample analyzed to date was in the study by Lofors and Sundquist (41). This sample included 2,287,349 men and 2,229,438 women (i.e., the entire Swedish population aged 25–64 years) in 729 clusters of Small Area Market Statistics (SAMS) areas in Sweden. Other large data sets

analyzed included those of the Epidemiologic Catchment Area Project, with analyses of 11,686 adults in 261 census tracts in five US urban areas (20), and the Canadian Community Health Survey, with a total sample of 56,428 adults in 3,619 census tracts in 25 Census Metropolitan Areas in Canada (35).

Adult study participants varied widely in age, from 18 years to 100 years, with seven studies exclusively focusing on elderly populations (i.e., persons aged ≥65 years). The vast majority of studies sampled US populations (at the national or state level or in selected rural/urban areas), while other studies were based on populations in Canada, the United Kingdom, Sweden, and Taiwan. In several of the US-based studies, investigators limited their samples to a single racial/ethnic group (Mexican-American, Chinese-American, or African-American populations).

Neighborhoods were defined using a variety of geographic units, ranging from US Census block groups to clusters of SAMS areas in Sweden and to townships in Taiwan. In two studies, researchers operationalized neighborhoods as circular "buffer zones" around each study participant's home, through the application of geographic information systems (GIS) methods to accurately map locations (43, 46). In all but three studies (39, 41, 44) that combined multiple indicators as measures of the same neighborhood-level construct, investigators reported current or prior estimates of internal consistency reliability (all of which were reasonably high, with Cronbach's α > 0.65); kappa (κ) statistics for assigning indicators to the same category; or results of factor analysis that indicated loading of indicators onto the same factor.

Neighborhood measures

Neighborhood SES measures were predominantly single indicators based on US Census data (e.g., percentage of households living in poverty) or multiple Census indicators whose standardized values were combined through averaging (e.g., mean of standardized percentage of households in poverty, percentage of mother-only households). Measures of neighborhood physical conditions/built environment and specific services/amenities were based on data from the Census, commercial information databases, study surveys, or interviewer observation. Neighborhood social capital and social disorder were taken as the individual response to the survey (if a respondent-perceived measure) or were survey-derived aggregate measures for all respondents within a defined neighborhood unit.

Depression measures

The most commonly applied measure of depression/depressive symptoms was the 20-item Center for Epidemiologic Studies Depression Scale, which asks survey respondents the extent to which they have experienced depressive symptoms over the past week and which produces summary scores ranging from 0 to 60 (51). This instrument has been widely used and psychometrically validated across diverse populations, including general population samples

(52). In several studies, investigators also employed 7-, 8-, and 11-item shortened versions of the Center for Epidemiologic Studies Depression Scale and reported acceptably high levels of internal consistency reliability in those studies or in prior validation studies (table 1). Other established instruments have also been employed, including the validated full version or a shortened form of the Composite International Diagnostic Interview (53). In the majority of the remaining studies, investigators used measures with good internal consistency reliability; there were several exceptions where reliability was not apparent (24, 25, 44) (table 1). Likewise, most but not all studies (17, 18, 23, 24) documented the validity of instruments. The outcome of depression/depressive symptoms was analyzed as continuous in some studies and as categorical in others (table 1).

Statistical analyses applied

In all but three (18, 32, 44) of the observational studies, researchers explicitly applied multilevel statistical methods (54) or (single-level) multivariable regression with robust standard errors—techniques which estimate standard errors for coefficient estimates that appropriately account for the clustering of outcomes within neighborhoods. In the study by Henderson et al. (32), which did not use either method of adjustment, only 2 percent of subjects resided in neighborhood units with five or more subjects, such that there should have been little clustering within neighborhoods.

Summary of findings

As table 2 shows, most of the reported findings to date have pertained to neighborhood SES as a predictor, with 11 of 22 studies observing significant associations (at the 10 percent significance level) in the expected direction, one study having mixed (significant and nonsignificant) findings, 10 studies observing null associations, and no studies finding significant associations in the direction opposite of that expected. For specific neighborhood physical conditions/built environment and neighborhood services/amenities, both closely conceptually related to neighborhood SES, the findings were also relatively mixed, though derived from only seven and five studies, respectively (table 2). Three of the five studies that examined neighborhood social capital in relation to depression had null findings and were conducted in countries other than the United States (Canada, Sweden, and Taiwan). Of the two US-based studies, one had findings that were significant in the anticipated direction (among Whites), while the other had mixed findings. Meanwhile, six of the eight studies on neighborhood social disorder found significant relations with higher levels/risks of depression in at least one population subgroup; in the other two studies, null associations were reported.

Four of the eight studies in which investigators conducted prospective analyses (all of which included measures of neighborhood SES or changes in neighborhood SES) found significant associations (at the 10 percent level) for neighborhood SES in the expected direction. Two of these studies were based on Moving to Opportunity randomized controlled trial data. In one study in which a nonsignificant

association was observed in a prospective analysis (16), investigators had also conducted a cross-sectional analysis in which, by contrast, a significant association was found in the anticipated direction. The prospective analysis excluded participants who had moved between baseline and the follow-up survey and participants with depression at baseline, and thereby reduced the total sample size by nearly half (16). In another null prospective analysis (18), researchers employed a model that controlled for smoking, alcohol consumption, and body mass index and hence may have over-adjusted for potentially mediating factors.

No clear pattern was evident according to whether depression was modeled as continuous or dichotomous to potentially explain the discrepancies among the significant findings versus the null findings—that is, null findings on the basis of inadequate statistical power (when modeled as categorical) or nonlinear effects (when modeled as continuous).

Mediating pathways and effect modification

In one study (46), researchers applied path analysis, a technique that enables comparisons of alternative mediating pathways (55). The investigators found statistical evidence in favor of a model with residential and commercial building deterioration as a determinant of lower neighborhood social capital/higher fear of crime, with the latter in turn being a predictor of higher individual depressive symptoms—consistent with the effects of socioeconomic/physical environment on depressive symptoms being *mediated* by social capital/social disorder. The presence of such mediation was also supported in another study (17) in which researchers observed attenuation in the association for neighborhood SES to nonsignificance with the addition of perceived neighborhood social disorder to the model. Meanwhile, Lofors and Sundquist (41) found attenuation to nonsignificance in the association for a social capital indicator (voting participation) with the inclusion of neighborhood SES in the model. These findings could be compatible with either mediation or confounding of a neighborhood social capital effect on depression by neighborhood SES. No studies investigated potential individual-level behavioral and psychosocial pathways mediating the neighborhood associations.

There was some (albeit limited) evidence of effect modification in studies that tested for interactions by or stratified on individual gender (18, 23, 32, 41, 43, 49), race/ethnicity (18, 21, 32, 44, 49), age (18, 23, 32), and/or income/education (18, 32). In one study (43), higher neighborhood walkability scores appeared to be more protective against depression in men than in women. Gary et al. (44) found a significant inverse association between neighborhood social cohesion and the risk of depression among Whites but no association among African Americans. Echeverria et al. (49) determined significantly stronger inverse relations between low neighborhood problems and depression scores among Latinos and Chinese compared with people in other racial/ethnic groups. Furthermore, Stockdale et al. (42) observed that persons who reported witnessing a beating, abuse, or murder were significantly more likely to experience depression if they resided in a neighborhood with high rates of violent crime. Likewise, Cutrona et al. (16) found a positive interaction between neighborhood disadvantage/disorder and negative life events, such that women who both reported a high number of negative life events and lived in a neighborhood high in disadvantage/disorder were disproportionately more likely to develop major depression.

Findings among large, representative samples

The findings among the larger (>1,000 participants) and more representative (multiple states/provinces within a country and not confined to a single gender, racial/ethnic group, or narrow age range) study samples were then considered separately. This served as a sensitivity analysis to help rule out possible sampling error and selection bias within countries. In four of the five qualifying studies (20, 35, 41, 42, 49), investigators reported estimates for neighborhood SES, with three studies (20, 35, 41) obtaining significant findings in the anticipated direction and the fourth study (42) yielding mixed (significant and nonsignificant) results. In only two of the studies (42, 49) did researchers examine relations for specific neighborhood services/amenities, and in only two studies (41, 49) did researchers calculate associations for neighborhood social capital; findings (for specific neighborhood services/amenities) were significant in only one study (49). In both of the studies that explored associations for neighborhood social disorder (42, 49), investigators observed significant results in the expected direction.

DISCUSSION

Evaluation of findings

In this systematic review, several notable patterns were recognized, and critical substantive and methodological gaps in the published literature on associations between neighborhood characteristics and depression were revealed. Most researchers have investigated associations between neighborhood SES and depression, while studies that have explored the relations for neighborhood physical conditions/built environment, services/amenities, social capital, and social disorder are sparse. Overall, the evidence (with control in all studies for multiple individual-level factors) supports the presence of harmful effects of neighborhood social disorder, and to a lesser extent suggests protective effects for neighborhood SES. The application of more rigorous inclusion criteria yielding a much smaller number of studies also suggests the presence of these effects. The findings add to the growing body of evidence for broad neighborhood characteristics as important independent contributors to individual health and well-being, above and beyond individual-level sociodemographic and socioeconomic characteristics (10), and as "fundamental causes" (56) of health and disease. Like SES at the individual level, demonstrated in a recent meta-analysis to have a significant inverse relation with depression (57), higher neighborhood-level SES may have beneficial effects on mental health, including protecting against depression. Moreover, Ross (17) postulated that socioeconomically disadvantaged neighborhoods generate social disorder and psychological perceptions of disorder and

thereby contribute to depression in individuals, and found empirical evidence to support this postulate. This pathway could account for the similar significant results for neighborhood SES and social disorder observed in the present review.

The more limited body of evidence on neighborhood physical conditions/built environment, services/amenities, and social capital is generally more mixed and less supportive, despite the conceptual relations between neighborhood SES and physical conditions/built environment and services/amenities and between neighborhood social disorder and social capital. Such findings might potentially be accounted for on two principal sets of grounds.

First, the identified nonsignificant associations may be real for the populations and contexts in which they were estimated, yet may not necessarily be representative across diverse populations and societies. For instance, for social capital, all three of the null studies were carried out in countries that are relatively more egalitarian than the United States, while in the two US-based studies investigators observed significant associations or inverse associations of mixed significance. For social disorder, one of the two null studies was based on a Taiwanese population, whereas all six of the studies that observed significant associations in the anticipated direction were US-based. In two recent systematic literature reviews of area-level social capital and individual health and physical health (58, 59), investigators similarly found patterns of significant relations in relatively inegalitarian countries and weaker to nonsignificant relations in more egalitarian countries. Countries which are more egalitarian may supply a wider range of social safety nets (including health-related public services such as health care and welfare assistance) than relatively unequal countries such as the United States. Consequently, in the former contexts, neighborhood social capital and social disorder may play a lesser role in the mental health of residents (59).

In three of the four studies with null results for neighborhood physical conditions/built environment and services/amenities, study populations were confined to specific racial/ethnic groups and/or older age groups. In these select populations, relevant characteristics for the onset of depression could possibly be relatively race/ethnicity-specific and/or age-specific; that is, there might still be significant associations in other segments of the general population through effect modification. Likewise, in the other null study, investigators employed the indicators of neighborhood alcohol outlet density and neighborhood density of alcohol, drug, and mental-health treatment facilities. These characteristics could simply be less relevant for depression than other neighborhood physical attributes. Nonetheless, given the correspondingly few studies carried out to date, such explanations are speculative. Additional studies covering a wider range of indicators for physical conditions/built environment and services/amenities (with indicators analyzed both individually and in combination) and spanning diverse and representative sample populations are clearly needed.

Second, the discrepant associations may be attributed to methodological limitations of particular studies to date. Principal among these limitations is the lack of control for other neighborhood attributes as well as non-neighborhood attributes in the majority of studies, which could have contributed to residual confounding bias. This potential source of bias may be more paramount when relatively specific neighborhood characteristics (rather than a broad construct like neighborhood SES) are being examined. Moreover, few investigators implemented a randomized controlled trial, quasi-experimental, or prospective observational study design or applied propensity score methods. These more rigorous study designs and methods can serve to minimize residual confounding, establish temporality, and avert the threat to validity of reverse causation (e.g., since depression could plausibly lead to downward drift and movement into poorer neighborhoods). The propensity score is the probability of an individual's treatment/exposure category (e.g., residence in a low-SES neighborhood) given observed covariates (e.g., income, which may determine one's likelihood of living in a low-SES neighborhood). In large samples, the propensity score becomes balanced across treatment/exposure and control groups, such that confounding by covariates is effectively removed. Because experimental manipulation of neighborhood characteristics is in many instances unfeasible and/or unethical, propensity score analysis offers a relatively uncomplicated and practical means of strengthening internal validity in neighborhood observational studies (60). Finally, given the few large, representative general population studies conducted for neighborhood characteristics, selection bias within countries could potentially account in part for the observed discrepancies in associations.

The predominance of studies in the literature on neighborhood SES (as opposed to the more specific physical conditions/built environment and services/amenities) as a predictor of depression is not surprising, given the ready derivation of such measures using data routinely collected by administrative sources (e.g., government censuses). Along with neighborhood measures derived from social surveys, useful particular techniques applied in some studies to date include observer ratings of neighborhood attributes and GIS methods (61). Observer ratings can correspond to specific neighborhood characteristics of interest and at the same time can eliminate the threat of bias due to the measurement of exposures and outcomes in the same persons (i.e., same-source bias). Through the increasing availability of geocoded data on the locations of neighborhood services and amenities and the capacity to also map locations of study participants' residences, GIS methods can more accurately estimate an individual's physical access to neighborhood resources (61).

Notably, only a few researchers explored the mediating mechanisms at the neighborhood level which underlie the neighborhood-level associations, while none investigated individual-level potential mediating pathways. As indicated, the former was helpful in accounting for the similar significant findings for neighborhood SES and social disorder. Examination of mediating pathways at both the neighborhood and individual levels using appropriate statistical techniques such as path analysis would be instrumental in better establishing the plausibility of associations and the relative importance of multiple pathways, and thereby could contribute to the development of more targeted clinical and public health interventions (55).

Along similar lines, few investigators have stratified on or tested for effect modification by individual-level characteristics (e.g., gender, race/ethnicity, and SES), which may offer insights into the complex effects of neighborhood characteristics on depression. For example, Gary et al. (44) found evidence consistent with effect modification by race/ethnicity, with Whites but not African Americans appearing to benefit from the effects of neighborhood social capital/cohesion on depression. Significant cross-level interactions between community-level social capital and individual race/ethnicity have also been observed in studies of social capital with general self-rated health outcomes (62), and the interaction for depression could likewise reflect the potential ''downside'' of social capital (63) among certain population subgroups. Given that differential returns to mental health according to population subgroups may have important implications in the design of clinical and public health interventions, testing for such interactions should be more consistently integrated into future studies.

Conclusions/future directions

In summary, this systematic review documents a growing body of literature investigating potential neighborhood-level effects on depression. This parallels the rising substantive and methodological interest in neighborhood health effects in general in recent years (10). The evidence in this review supports harmful effects of neighborhood social disorder and, to a lesser extent, suggests protective effects for higher neighborhood SES. Few investigations have explored the relations for neighborhood physical conditions/built environment, services/amenities, and social capital, and as a whole less consistently point to salutary effects. Increasing recognition of the need to disentangle the complex contextual effects of neighborhoods and the relevance of *specific* neighborhood characteristics (24), along with the greater application of novel techniques such as GIS methods, will help in filling this literature void. The unsupportive findings may be attributed to the lack of representative studies within countries and across diverse societies or to methodological gaps, including the lack of control for other neighborhood and non-neighborhood attributes and lack of implementation of more rigorous methodological approaches such as prospective study designs and propensity score methods. Establishing mediating pathways and effect modifiers for the linkages between neighborhood characteristics and depression will vitally advance understanding of neighborhood effects on depression. Overall, addressing these substantive and methodological gaps will help to identify *what* specific neighborhood features matter for depression, *how*, and *for whom*, and will contribute to curtailing the burden of disease associated with this major disorder.

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