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Are neighbourhood characteristics associated with depressive symptoms? A review of evidence

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ABSTRACT

A review of published observational studies of neighbourhoods and depression/depressive symptoms was conducted to inform future directions for the field. Forty-five English-language cross-sectional and longitudinal studies that analysed the effect of at least one neighbourhood-level variable on either depression or depressive symptoms were analysed. Of the 45 studies, 37 reported associations of at least one neighbourhood characteristic with depression/depressive symptoms. Seven of the 10 longitudinal studies reported associations of at least one neighbourhood characteristic with incident depression. Socioeconomic composition was the most common neighbourhood characteristic investigated. The associations of depressive symptoms/depression with structural features (socioeconomic and racial composition, stability and built environment) were less consistent than with social processes (disorder, social interactions, violence). Among the structural features, measures of the built environment were the most consistently associated with depression but the number of studies was small. The extent to which these associations reflect causal processes remains to be determined. The large variability in studies across neighbourhood definitions and measures, adjustment variables and study populations makes it difficult to draw more than a few general qualitative conclusions. Improving the quality of observational work through improved measurement of neighbourhood attributes, more sophisticated consideration of spatial scale, longitudinal designs and evaluation of natural experiments will strengthen inferences regarding causal effects of area attributes on depression.

The notion that environmental features may be related to psychological well-being and mental health has a long history. As far back as 1939, Faris and Dunham¹ found that schizophrenia and substance abuse rates were highest amongst individuals living in socially disorganised Chicago neighbourhoods.² In *My Name is Legion*, published in 1959, Alexander Leighton³ explored how the expression of mental illness was shaped by local context and concluded that processes underlying the sociocultural disintegration of neighbourhoods may be shaping patterns of mental health and psychiatric disorder.⁴

In recent years, there has been an explosion of interest in the peer-reviewed medical and public health literature about the ways in which neighbourhoods and residential environments may affect a variety of health outcomes, including mental health and depression.⁵ This interest has been spurred by theoretical discussions of the ecologic determinants of health^{6,7} as well as by the growing popularity and availability of multilevel analysis,⁸ a

statistical technique that has been used to assess the relation between neighbourhood context and health after controlling for potential individual-level confounders.^{9,10}

There are many theoretical reasons why neighbourhood environments may be particularly relevant to mental health, and specifically to depression and depressive symptoms. Features of neighbourhoods such as lack of resources, disorder, violence, inadequate housing, and lack of green spaces may function as stressors.^{11,12} Neighbourhood features may also act as buffers of individual-based sources of stress related to mental illness. For example, physical and social features of neighbourhoods may affect social connections and the levels of social support experienced by residents. Social support may in turn affect residents' vulnerability to stress and depressive symptoms.¹³

Despite some theoretical rationale for neighbourhood effects on depressive symptoms, the results of the literature in this area are still somewhat mixed.¹⁴ In this review we take stock of the published observational studies of neighbourhoods and depression and depressive symptoms in order to identify future directions for the field. We summarise the main research questions, study populations, neighbourhood definitions, neighbourhood measures, depressive symptom measures, study designs, analytic techniques and results from these studies. The review concludes by discussing the remaining gaps in our knowledge about the relationship between neighbourhood context and depression, and suggests future research directions. This review complements a prior review of neighbourhoods and mental health by focusing specifically on the more narrow outcomes of depression and depressive symptoms, extending the review to also encompass articles published from 2004 to 2007 (a time of increasing publications in this area), and focusing on observational studies and their limitations.¹⁵

METHODS

Studies were primarily identified using a biomedical database (PubMed) and two databases of psychological literature (PsycINFO and PsycARTICLES). The search terms "depression," "depressive symptoms," or "psychological distress" were entered together with "neighbourhood" or "neighbourhood characteristics". These terms were selected since we were interested in any type of neighbourhood effect on either depression or depressive symptoms. These searches retrieved 79 articles in PubMed and 168 articles in

PsycINFO. PsycARTICLES did not turn up any studies that were not found using the PsycINFO database. Additional studies were identified from the reference lists of the papers identified in the PubMed and PsycINFO searches. Studies included in this review are English-language cross-sectional and longitudinal studies that used at least one neighbourhood-level variable in the analysis, and had either depression or depressive symptoms as the outcome. All studies were published between January 1990 and August 2007. Excluded articles included reviews and opinion pieces, studies without any geographical component, studies that looked at depression or depressive symptoms only as mediators, and articles that did not differentiate between depression and other psychiatric conditions such as schizophrenia. In total, 45 reports of observational studies of the relation between depression and neighbourhood characteristics were identified using these search methods.

RESULTS

The main research questions, study populations, neighbourhood definitions, neighbourhood features, depression measures, study design, analytical technique and key results of the 45 studies are described in table 1 (online).

Research questions

Of the 45 studies reviewed, the majority (n = 26) focused solely on the main effects of neighbourhood-level variables on depression,^{2 11 13 16-38} three were primarily interested in how neighbourhood characteristics moderate the association between individual-level risk factors and depressive symptoms,³⁹⁻⁴¹ and 15 examined both the main effects of neighbourhood conditions and the interactions of these characteristics with individual-level variables.⁴²⁻⁵⁶ One study was primarily interested in the interaction of two neighbourhood characteristics.⁵⁷

Study population

Studies have varied widely both in sample size and in the characteristics of the populations studied. The size of study populations varied from 117 to 56 428 subjects. Some of the studies restricted their populations to specific racial/ethnic groups or age categories, whereas others included a wide range of demographic characteristics. Twenty-nine studies examined the association between neighbourhood characteristics and depressive symptoms in adult populations across broad age ranges,^{2 11 21 23-25 27-38 40-43 46 47 49 50-52 57} 10 studies focused on groups of children or teenagers,^{18-20 22 26 39 44 53 54 56} and six restricted their populations to people aged 65 and over.^{13 16 17 45 48 55} The gender distribution across most studies was relatively evenly balanced. Five of the studies excluded men from analyses,^{37 41 42 49 51} whereas 40 sampled both men and women. Eight studies restricted their study population to African-Americans^{19 22 39 41 42 49 53 56} and one study only examined Mexican-Americans.¹⁷ The remaining studies enrolled a mixture of racial/ethnic groups, most commonly using random sampling of their study populations. The majority of studies were conducted in metropolitan or urban areas: only 14 studies included non-urban dwelling subjects in their populations.^{16 17 19 22 23 25 29 32-34 44 46 50 51}

Neighbourhood definitions

The definition and size of a neighbourhood varied widely across studies. Neighbourhood definitions ranged from participant-defined areas to census-defined areas (census blocks, tracts or

clusters of tracts). Among the 34 studies conducted in the USA the vast majority (n = 21) used census or administratively defined areas: five used census block groups (average population approximately 1000 people),^{39 40 42 49 52} nine used census tracts (average population approximately 4000),^{2 11 13 16 17 38 48 55-57} and seven used clusters of block groups or tracts.^{18-21 27 28 44} Twelve studies asked each study participant to define their own neighbourhood^{22-26 41 45 47 51 53 54 56} and one study used circular buffers of varying sizes around residences to define neighbourhoods.³⁶

The nine studies conducted in the UK used government-defined areas as proxies for neighbourhood, ranging from British electoral wards (mean population about 5500) to larger regional units, such as the 22 regional unitary authorities of Wales (mean population 122 850).^{29-35 46 50} Studies conducted in Canada and the Netherlands also used administratively defined areas (census tracts in Canada⁴³ and boroughs in Amsterdam³⁰).

Neighbourhood features

The neighbourhood characteristics investigated fall into two categories: structural characteristics—such as neighbourhood socioeconomic and racial/ethnic composition, residential stability, and the built and service environments—and measures of social processes—such as neighbourhood disorder, social cohesion and ties with neighbours, and perceived exposure to crime, violence, drug use and graffiti. Structural characteristics were the most common features examined (33 out of the 45 studies). Twenty-five studies examined the contextual⁸ effect of neighbourhood socioeconomic position (after accounting for compositional differences)^{2 11 13 16 17 19-21 28-34 37 39 40 42 43 46 48-50 57} and nine of these studies included no other type of neighbourhood characteristic.^{21 28-30 32-34 46 50} Racial/ethnic composition (examined in 10 studies)^{13 16 17 19 20 38 40 43 48 55} and residential mobility (examined in eight studies)^{2 11 13 16 18 20 43 48} were the other two structural characteristics most commonly examined. Four studies investigated the role of the built environment^{26 27 35 36} and one study examined the available service environment.¹³

Twenty-five of the 45 studies examined the association between neighbourhood social processes and depressive symptoms.^{11 18 19 22-25 31 37 39 41 42 44 45 47 49 51-57} Of these, 10 examined neighbourhood disorder and related domains,^{11 24 44 45 47 49 51 52 56 57} 16 examined social interactions between neighbours^{18 19 22-24 31 37 39 41 42 47 52 54-57} and 12 investigated exposure to violence and other hazardous conditions.^{18 19 22 25 26 41 42 44 52-54 56}

Twelve studies examined both neighbourhood structural characteristics and social processes.^{11 18-20 31 37 39 42 49 51 55 57} Nine of the 12 studies looked at both neighbourhood socioeconomic characteristics and social processes.^{11 19 20 31 37 39 42 49 57}

Measurement of neighbourhood features

Neighbourhood characteristics were measured using a variety of techniques. Census-derived neighbourhood variables were the most common measures used (16 studies),^{2 16 17 21 28-30 32-34 38 40 43 46 48 50} followed by self-reports of neighbourhood characteristics by study participants (14 studies).^{22-26 36 37 41 45 47 52-54 56} Ten studies included both census-derived measures and participant self-reports.^{11 18-20 39 42 49 51 55 57} A small number of studies created measures by using objective raters who did not live in the neighbourhoods^{27 35 44} or by using resources such as phone books to construct neighbourhood measures,¹³ and investigated the measures so constructed either on their own or in combination with census measures.

Table 1 Summary of key features of 45 reviewed studies

Author, year	Primary research questions addressed	Study sample	Neighbourhood definition used	Neighbourhood features investigated*	Depression measure investigated	Study design	Key analytical technique	Results (support for neighbourhood effects on depression?)
Anehsensel <i>et al</i> , 2007 ⁴⁸	Are depressive symptoms in older individuals associated with low SES, high concentrations of ethnic minorities, low residential stability and low proportion of residents aged 65+ in urban neighbourhoods?	3442 individuals aged >70 years living in urban areas in the USA, from AHEAD	Census tracts	Socioeconomic disadvantage, affluence, racial/ethnic composition (proportion of African-American residents, proportion of Hispanic residents), residential stability, proportion of persons >65 years (all from census)	Eight-item version of CES-D	Cross-sectional	Multilevel analysis	Y and N: depressive symptoms are associated with residential stability (β (SE) 0.72 (0.27)) after controlling for individual-level characteristics, but not with any of the other neighbourhood characteristics
Aneshensel <i>et al</i> , 1996 ⁴⁹	Are adolescents' experiences of their neighbourhood as threatening or cohesive associated with their mental health?	877 adolescents aged 12–17 from Los Angeles County	Census tracts, grouped using cluster analysis into eight clusters	Participant-reported subjective neighbourhood measures (ambient hazards, social cohesion), neighbourhood stability	CDI	Cross-sectional	Single-level linear regression	Y: Adolescents' perceptions of ambient hazards (β (SE) 0.022 (0.008)) and negative social cohesion (β (SE) $-0.122(0.032)$) are both associated with depressive symptoms.
Berke <i>et al</i> , 2007 ⁴⁸	Is there an association between neighbourhood walkability and depressive symptoms in older adults?	740 adults aged 65 + from King County, Washington	Circular buffers of radius 100, 500, and 1000 m around each subject's home	Neighbourhood walkability, measured by the WBC. Greater walkability was assessed, on a scale of 0 to 100, according to the probability of meeting the CDC guidelines of 150+ minutes per week of physical activity versus none	CES-D	Cross-sectional	Single-level logistic regression	Y: for men, there was an association between neighbourhood walkability and depressive symptoms (OR for the interquartile range of walkability score = 0.31–0.33 for the buffer radii, $p = 0.02$) after adjustment for key individual-level factors. This association was not significant in women ($p > 0.68$).
Caughy <i>et al</i> , 2003 ³⁹	Is there an association between how well a parent knows their neighbours and their child's internalising behaviours? Does this association differ by neighbourhood SES context?	200 African-American families with a child aged 3–4.5 in Baltimore	Census block groups	Neighbourhood poverty (from census), general sense of community, how well one knows one's neighbours (participant reported)	CBCL internalising problems score	Cross-sectional	Single-level linear regression	Y: Low sense of community was associated overall with higher levels of internalising problems (β (SE) 3.6(1.9)). In wealthy neighbourhoods, knowing neighbours decreased internalising problems; in poor neighbourhoods knowing neighbours was associated with increased internalising problems
Christie-Mizell <i>et al</i> , 2003 ⁵¹	Are the subjective appraisal of the neighbourhood and living in an urban versus rural area associated with maternal psychological distress? Does this differ by race?	2204 women with at least one child from NLSY	Participant-defined neighbourhoods (for the subjective appraisal) and type of neighbourhood subjects lived in, as defined by the census (central city vs urban vs rural area)	Living in a SMSA, perceived neighbourhood disorder (participant reported)	Seven-item version of CES-D score	Longitudinal	Single-level linear regression with change in CES-D as outcome	Y: Across all racial groups, neighbourhood perceptions influence maternal distress (β (SE) 0.17 (0.02)). Also, objective neighbourhood location influences how mothers perceive their neighbourhoods
Cutrona <i>et al</i> , 2005 ⁴⁹	Are women who reside in poor and/or dangerous neighbourhoods more likely to experience episodes of major depression than those in safe, affluent ones, after controlling for individual-level risk factors?	720 women from FACHS (large-scale study of African-American families who live outside large metropolitan inner cities in the USA)	Census block groups	Economic disadvantage index (from census), neighbourhood-level social disorder (combination of community dilapidation and community deviance scales)	UM-CIDI	Cross-sectional and longitudinal	Multilevel analysis	Y: neighbourhood disadvantage/social disorder was associated with recent onset of depression, after controlling for individual-level risk factors (OR 1.92, 1.04 to 3.52). However, neighbourhood disadvantage and disorder did not predict onset of depression at a later date

Continued

Table 1 Continued

Author, year	Primary research questions addressed	Study sample	Neighbourhood definition used	Neighbourhood features investigated*	Depression measure investigated	Study design	Key analytical technique	Results (support for neighbourhood effects on depression?)
Cutrona <i>et al</i> , 2000 ⁴²	What is the effect of neighbourhood context on psychological distress among African-American women? Does community context interact with individual-level risk factors in the prediction of distress?	733 African-American women from the FACHS who were the primary caregiver for a 10–12-year-old child	Census neighbourhood block group areas	Neighbourhood cohesion and disorder (participant reported), community economic disadvantage (from census)	General distress and anxious arousal, two subscales from the mini-mood and anxiety symptom questionnaire (similar to UIM-CIDI)	Cross-sectional	Multilevel analysis	Y: neighbourhood disorder ($\beta = 0.38$, $p < 0.05$), but not cohesion or economic disadvantage, was associated with level of distress, after controlling for individual-level characteristics. There were significant interactions between some neighbourhood- and individual-level characteristics in the prediction of distress
Dupéré and Perkins, 2007 ⁵²	Is there variation at the block level in well-being and depression? Do community-level environmental stressors and social resources affect well-being and depression?	412 residents from 50 neighbourhoods in a large city in the Mid-Atlantic region of the USA	Census blocks	Neighbourhood disorder, fear of crime, formal participation, informal ties with neighbours (participant-reported)	The 6-item depression factor of the CES-D scale	Cross-sectional	Multilevel analysis	N: There was no significant variation at the block level for depression, although there was significant variation at the block level for well-being. The community-level stressors and resources had no impact on mental health over and above individual and block socioeconomic characteristics
Fitzpatrick <i>et al</i> , 2005 ⁴²	Do bonding social ties of youth to their family, school, and community have an inverse relationship with depressive symptoms?	1538 African-American middle and high school students from one school district in Alabama	Participant-defined neighbourhoods	Exposure to violence, human capital, social capital (participant reported)	CES-D	Cross-sectional	Single-level linear regression	Y: adolescents exposed to threatening environments had higher rates of depression ($\beta = 1.45$, $p < 0.01$); social capital had an inverse relationship with depression ($\beta = -0.18$, $p < 0.05$)
Forehand and Jones, 2003 ⁵³	What is the interactive influence of neighbourhood violence and co-parent conflict on child psychological adjustment?	117 African-American children aged 8–14 from an inner-city area of New Orleans with single mothers	Participant-defined neighbourhoods	Neighbourhood risks (physical fighting, shootings or knifings, people being killed) (participant reported)	CDI	Longitudinal and cross-sectional	Single-level multiple regression	N: neighbourhood violence was not associated with child psychosocial adjustment ($\beta = -0.04$, $t = -0.45$). However, girls living in homes with high levels of co-parent conflict were more vulnerable to the effect of neighbourhood violence (β for interaction = 0.27, $p < 0.05$)
Galea <i>et al</i> , 2005 ²⁷	Are characteristics of the internal and external physical built environment related to depression?	1355 residents of New York City	Community districts, New York City	Characteristics of the internal built environment and the external built environment (from census, the New York City housing and vacancy survey, and the fiscal 2002 New York City mayor's management report)	National women's study depression module, consistent with DSM-IV criteria	Cross-sectional	Multilevel analysis	Y: characteristics of the built environment are associated with likelihood of depression: people living in poor quality built environments were 29–58% more likely to report past 6 month depression and 36–64% more likely to report lifetime depression.
Galea <i>et al</i> , 2007 ²⁸	Is incident depression associated with urban neighbourhood poverty?	1120 adult residents of New York City	Community districts, New York City	Neighbourhood SES (from census)	Modified version of SCID, 3rd edition	Longitudinal	Multilevel analysis	Y: relative odds of incident depression were 2.19 (95% CI 1.04 to 4.59) for participants living in low versus high SES neighbourhoods

Continued

Table 1 Continued

Author, year	Primary research questions addressed	Study sample	Neighbourhood definition used	Neighbourhood features investigated*	Depression measure investigated	Study design	Key analytical technique	Results (support for neighbourhood effects on depression?)
Gary <i>et al.</i> , 2007 ⁴⁷	Are perceptions of neighbourhood characteristics associated with mental health outcomes among African-American and white adults in Baltimore? Do these associations differ by race?	1408 African-American and white adult residents of Baltimore, Maryland	Participant-defined (for perceptions), blocks (for resources)	Perceptions of potential neighbourhood problems, availability of a community leader, community cohesion, resources (desirable and undesirable) within the community (participant reported)	PHQ-9 and GHQ	Cross-sectional	Single-level linear and logistic regression	Y: perception of severe community problems was associated with depression (OR 2.2 (White), 1.9 (African-American), $p < 0.05$ (both)). Community cohesion was only associated with lower levels of depression in whites (OR 0.5, $p < 0.05$). Y and N: community rating was associated with depression (OR 0.65 (0.57 to 0.75)), but community involvement was not (OR 0.99 (0.71 to 1.36)), after adjustment
Greiner <i>et al.</i> , 2004 ²³	What are the associations between level of community participation, self-reported community ratings (trust), and depressive symptoms?	4601 subjects from the Kansas BRFSS	Counties/participant defined	Overall community ratings (neighbourhood-level trust) and social participation (participant reported)	Optional depressive symptoms question from BRFSS	Cross-sectional	Multilevel analysis, single-level logistic regression	Y: neighbourhood cohesiveness in adolescence was associated with higher levels of depressive symptoms in females in adolescence and early adulthood, and in males depressive symptoms in adolescence. Neighbourhood problems were only associated with increased levels of depressive symptoms in young female adults
Gutman and Sameroff, 2004 ⁵⁴	What are the ecological variables that influence depression in males and females from adolescence to young adulthood? Are there gender differences in these associations?	372 youth from the first (when subjects were aged 11–15) and second (7–8 years later) waves of the Philadelphia family management study, from four inner-city areas of Philadelphia	Participant defined	Neighbourhood cohesiveness, neighbourhood problems (participant-reported)	Youth depressive symptoms: nine items assessing how often they felt certain symptoms in the past couple of months	Cross-sectional and prospective	Single-level linear regression	Y: perception of neighbourhood problems was associated with adolescent mental health ($\beta = 0.04$, $p < 0.001$)
Hadley-hves <i>et al.</i> , 2000 ²⁸	Is the impact of the environment on mental health determined by perception of that environment in adolescents?	792 subjects from the Youth Service Project, aged 13–18 in St Louis, Missouri	Participant defined	Negative neighbourhood environment (extent to which drug dealing, shootings, murder, abandoned buildings, neighbours on welfare, homeless people on the street, and prostitution exist in neighbourhood), perception of violence (participant reported)	DISC-R	Cross-sectional	Single-level linear regression	Y: perception of neighbourhood problems were only associated with increased levels of depressive symptoms in young female adults
Henderson <i>et al.</i> , 2005 ⁴⁶	What is the relation between neighbourhood socioeconomic and ethnic characteristics and depressive symptoms in young adults, and do they modify the relation between individual SES and depression?	3437 adults aged 18–30 from the CAPDIA study at four US sites (Chicago Illinois, Birmingham Alabama, Minneapolis Missouri, Oakland, California)	Census block group	Six area census variables reflecting wealth/income, education, and occupation, were summed to create a neighbourhood summary score; ethnic density	CELS-D	Cross-sectional	Multilevel analysis	N: Neither neighbourhood socioeconomic characteristics nor ethnic density were consistently associated with depression after controlling for individual-level characteristics
Hybels <i>et al.</i> , 2006 ¹⁶	What is the association between neighbourhood context and level of depressive symptoms in older adults?	2998 adults 65+ years old in North Carolina	Census tracts	Neighbourhood SES, racial/ethnic heterogeneity, residential stability, and neighbourhood age structure (from census)	CELS-D	Cross-sectional	Multilevel analysis	N: none of the neighbourhood characteristics was significantly associated with depressive symptoms conditional on census tract random effects, both before and after adjustment for individual characteristics

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Table 1 Continued

Author, year	Primary research questions addressed	Study sample	Neighbourhood definition used	Neighbourhood features investigated*	Depression measure investigated	Study design	Key analytical technique	Results (support for neighbourhood effects on depression?)
Kubzansky <i>et al.</i> , 2005 ¹³	What is the contribution of neighbourhood disadvantage, neighbourhood service environment, and individual characteristics to depression in older people?	2109 non-institutionalised people 65 and older in New Haven, Connecticut	Census tract	Neighbourhood socioeconomic disadvantage and heterogeneity, residential stability, age structure (from census), service density (services promoting social engagement, providing care, and undesirable amenities) (constructed from phonebook listings)	CES-D	Cross-sectional	Multilevel analysis	Y: low neighbourhood SES ($\beta = 6.51$ (1.02, to 12.00)) and presence of more older people ($\beta = -13.55$ (-24.76 to -2.34)) were associated with depressive symptoms in older people after controlling for individual characteristics, but none of the other neighbourhood measures were
La Gory and Fitzpatrick, 1992 ⁵⁵	What is the impact of environmental context (social networks and characteristics) on depressive symptoms? Are there joint effects of personal competence and the residential environment?	725 adults aged 55+ from four metropolitan counties in Alabama	Census tracts	Racial congruence, age density (% of people aged 55+ in the census tract) (from census), neighbourhood resource accessibility (availability of automobile transport), perceived environment, social support (participant reported)	CES-D	Cross-sectional	Single-level linear regression	Y: being environmentally dissatisfied, having limited social supports, and living in neighbourhoods with transportation problems are associated with increased levels of depressive symptoms. Significant interactions were found between environmental dissatisfaction and resource accessibility and functional health ($p < 0.01$)
Latkin <i>et al.</i> , 2003 ²⁴	Do subjects from neighbourhoods with outward signs of disorder/that are decaying experience greater uncontrolled stress and symptoms of depression? Are depressive symptoms associated with neighbourhood ethnic diversity, dependency, residential instability and material deprivation? Does chronic stress explain gender differences in depression?	818 participants in high drug use areas in Baltimore, Maryland	Participant-defined neighbourhood	Social support, social integration, perception of neighbourhood characteristics (participant-reported)	CES-D	Cross-sectional, follow-up with depression	Single-level linear regression	Y: strong, prospective association between negative perceived neighbourhood characteristics and subsequent depressive symptoms, after adjusting for baseline depression ($\beta = 0.28$, $p < 0.01$).
Matheson <i>et al.</i> , 2006 ⁴³	Are depressive symptoms associated with neighbourhood ethnic diversity, dependency, residential instability and material deprivation? Does chronic stress explain gender differences in depression?	56428 adults aged 18–74 living in census metropolitan areas in Canada	Canadian Census Tracts	Residential instability, material deprivation, dependency, ethnic diversity (from Canadian census)	CIDI-SF MD	Cross-sectional	Multilevel analysis	Y: residential instability (OR 1.04, $p < 0.05$) and material deprivation (OR 1.05, $p < 0.01$) were associated with depression after controlling for individual-level characteristics. Chronic stress was not associated with gender differences in depression
Mulvaney and Kendrick, 2005 ³⁷	What is the relationship between maternal depressive symptoms and individual- and neighbourhood-level measures of deprivation, social support, and stress in mothers living in deprived areas?	846 mothers of young children living in deprived areas (Townsend deprivation scores > 0) of Nottingham, UK	Enumeration districts	Social capital, stress, perceived social support, neighbourhood deprivation (participant-reported)	CES-D	Cross-sectional	Multilevel analysis (random effects logistic regression)	Y: Neighbourhood deprivation (OR for highest vs lowest fifth 2.4 (1.28 to 4.48)), lack of social support (OR 2.51 (1.75 to 3.61)), and self-reported stress (OR 10.42 (6.29 to 17.28)) were all associated with depressive symptoms in a model adjusting for all these characteristics plus social capital, receiving means-tested benefits, and having 3+ kids < 5 years.

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Table 1 Continued

Author, year	Primary research questions addressed	Study sample	Neighbourhood definition used	Neighbourhood features investigated*	Depression measure investigated	Study design	Key analytical technique	Results (support for neighbourhood effects on depression?)
Natsuaki <i>et al</i> , 2007 ⁴⁴	Does observed neighbourhood disorder prospectively influence African-American adolescents' depressive symptoms? Does it interact with parents' engagement in inductive reasoning?	777 African-American children aged 9–12 at baseline, from Iowa and Georgia	Clusters of census block group areas	Interviewers' observed neighbourhood disorder at baseline	DISC-IV	Prospective	Multilevel analysis	Y: there is an interaction between baseline neighbourhood disorder, parents' use of inductive reasoning, and depressive symptoms, such that parental use of inductive reasoning was a protective factor for depressive symptoms especially for youths living in highly disordered neighbourhoods (β (SE) = 0.14 (0.07)) Y: after adjustment for individual characteristics, each 10% increase in neighbourhood poverty was associated with a 0.76 (95% CI 0.06 to 1.47) increase in CES-D score, while each 10% increase in Mexican-American population was associated with a 0.55 (95% CI 0.96 to 0.13) decrease
Ostir <i>et al</i> , 2003 ¹⁷	Is neighbourhood poverty associated with increased depression, and is increasing proportion of older Mexican-Americans associated with decreased depression?	2710 non-institutionalised Mexican-Americans aged 65 years or older, from five southwest states	Census tract	Percentage of Mexican-Americans in census tract, neighbourhood SES (from census)	CES-D	Cross-sectional	Multilevel analysis and single-level linear regression	N: the prevalence of mental disorders is higher in deprived areas, but can be almost fully explained by the sex and SES of residents
Reijneveld and Schene, 1998 ³⁰	Is the distribution of mental disorders associated with neighbourhood SES? If this relationship exists after controlling for individual SES, is it due either to selective migration or causation?	5121 residents of Amsterdam	Boroughs, categorised by deprivation into three levels	Area deprivation, assessed through registered income, household income below minimum, and unemployment rate	GHQ	Cross-sectional	Multilevel analysis	Y: neighbourhood disadvantage affects adult depression ($\beta = 0.228$), although more than half of the contextual effects are really due to individual disadvantage ($\beta = 0.081$ when individual-level characteristics are added). The effect of neighbourhood poverty is mediated by perceived neighbourhood disorder
Ross, 2000 ¹¹	Is the impact of neighbourhood disadvantage on adult mental health mediated by disorder in the neighbourhood?	2482 Illinois residents from the community, crime and health data set	Census tract	Ross-Mirowsky perceived neighbourhood disorder scale (participant reported), objective neighbourhood disadvantage from census	CES-D	Cross-sectional	Multilevel analysis	Y and N: neighbourhood stability is associated with psychological well-being only in economically advantaged neighbourhoods; it has a slight negative effect in poor neighbourhoods
Ross <i>et al</i> , 2000 ⁵⁷	What are the joint effects of neighbourhood stability and poverty on depression and what mechanisms connect objective neighbourhood characteristics to depression?	2482 Illinois residents from the community, crime and health data set	Census tract	Objective neighbourhood characteristics (neighbourhood stability, poverty, and their interaction) (from census), perceived neighbourhood disorder (Ross-Mirowsky scale), informal social ties with neighbours, fear, and sense of personal powerlessness (participant reported)	Seven-item modification of CES-D	Cross-sectional	Multilevel analysis	Y and N: neighbourhood stability is associated with psychological well-being only in economically advantaged neighbourhoods; it has a slight negative effect in poor neighbourhoods

Continued

Table 1 Continued

Author, year	Primary research questions addressed	Study sample	Neighbourhood definition used	Neighbourhood features investigated*	Depression measure investigated	Study design	Key analytical technique	Results (support for neighbourhood effects on depression?)
Schieman <i>et al</i> , 2004 ⁴⁵	What is the association between perceived neighbourhood problems and mental health among older adults?	1167 men and women aged 65+ in Washington DC and two adjoining counties	Participants told to refer to "the area around where you live"	Neighbourhood problems (a modified version of the Ross-Mitrowsky perceived neighbourhood disorder scale) (participant reported)	Seven items about depressive symptoms in the past week	Cross-sectional	Ordinary least squares regression, men and women separately	Y: neighbourhood problems are associated positively with depression in men (β (SE) 0.095 (0.094)) and women (0.087 (0.082)). Received support buffers this association in women
Schulz <i>et al</i> , 2006 ⁴¹	Are household income and length of residence protective of mental health? Are these effects mediated through perceived financial stress, perceived discrimination, and perceived safety?	679 African American women living in Detroit	Participant-defined neighbourhood	Two measures of stressful neighbourhood conditions (concern about police responsiveness, safety stress scale), instrumental social support, emotional social support (participant-reported)	CEFS-D	Cross-sectional	Structural equation modelling	Y: household income may be protective of mental health, both directly and indirectly (through reduced financial stress and increased social support). Length of residence is not associated with depressive symptoms
Silver <i>et al</i> , 2002 ²	Do neighbourhood structural characteristics affect prevalence of mental disorder, after controlling for individual SES?	11686 residents from five areas of the USA, in the epidemiological catchment area	Census tract	nine census tract measures used to create two factors: neighbourhood disadvantage and neighbourhood residential mobility	Diagnostic interview schedule, DSM-III diagnoses	Cross-sectional	Single-level logistic regression	Y: depression was more prevalent in residentially mobile (OR 1.14 (1.03 to 1.27)) and disadvantaged neighbourhoods (OR 1.14 (1.01 to 1.31)), after controlling for individual risk factors
Simons <i>et al</i> , 2002 ¹⁹	What are the community-level correlates of childhood depressive symptoms in an African-American sample?	867 African-American children aged 10–12 in Georgia and Iowa.	Community groups, made up of census block group areas from cluster analysis	Community cohesion, community ethnic identification, prevalence of discrimination and crime (participant-reported), and neighbourhood poverty (from census)	DISC-IV	Cross-sectional	Multilevel analysis	Y: community ethnic identification ($\beta = -0.392$, p -value = 0.04) and prevalence of discrimination ($\beta = 0.313$, p -value = 0.04) were associated with child depressive symptoms, after controlling for individual- and community-level characteristics. The other community-level variables were not associated with depressive symptoms
Skapinakis <i>et al</i> , 2005 ²⁸	Do regional mental health differences in Wales persist after taking into account individual characteristics and regional social deprivation?	26710 people from the Welsh Health Survey (covering all of Wales)	The 22 regional unitary authorities of Wales	Welsh index of multiple deprivation	SF-36	Cross-sectional	Multilevel analysis	Y: there was a significant difference in psychiatric morbidity between regions (1.47% of variance), which was reduced but persisted after adjusting for individual-level characteristics (0.99%)
Steptoe <i>et al</i> , 2001 ³¹	Is neighbourhood stress associated with psychological distress? Is the association independent of neighbourhood SES, individual SES, and social capital differences?	658 subjects (survey respondents) living in the London area	U.K. postal sectors	Neighbourhood problems, social cohesion, informal neighbourhood SES (combined participant reports and census information)	GHQ	Cross-sectional	Multilevel analysis, single-level logistic regression	Y: Highest quartile of neighbourhood problems had higher distress levels (OR = 2.65 (1.47–4.47)), adjusted for social cohesion and control. Neither social cohesion nor social control was associated with depression.

Continued

Table 1 Continued

Author, year	Primary research questions addressed	Study sample	Neighbourhood definition used	Neighbourhood features investigated*	Depression measure investigated	Study design	Key analytical technique	Results (support for neighbourhood effects on depression?)
Stevenson, 1998 ³⁶	Do African American youth in self-reported unsafe neighbourhoods have higher levels of depression? Do teens with supportive families and neighbourhoods have better psychological outcomes than those with only one of these supports?	160 low-income, inner-city African-American adolescents in a northeastern US city	Participant-defined neighbourhoods	Neighbourhood social capital, neighbourhood risk, fear of calamity (a measure of negative urban life experiences) (participant reported)	SMDI	Cross-sectional	Single-level linear regression	Y: only neighbourhood social capital was significantly associated ($r = -2.16$, $p < 0.05$) with depression in multiple regression analyses
Tweed <i>et al</i> , 1990 ³⁸	What is the effect of exposure to racially dissonant residential environments on depressive psychopathology?	3481 adults aged 18+ from the eastern third of the city of Baltimore	Census tracts	Racial congruence (% of the residential area population that is the same racial/ethnic group as individuals)	Depressed mood (fulfilling criterion A of DSM-III), major depressive episode (DIS/DSM-III diagnosis)	Cross-sectional	Calculation of z-scores, summary tests of significance comparing prevalence rates of depression	Y: an inverse relationship exists between racial congruity and depressed mood
Wainwright and Surtees, 2004 ³³	Is there area level variation in mental functional health after controlling for individual level SES? What's the extent of the area level and individual level variation?	20921 participants in the EPIC-Norfolk study	Electoral wards	Overall index of multiple deprivation	SF-36	Cross-sectional	Multilevel analysis	Y: area deprivation was associated with poor mental health, but the residual variation after adjusting for individual level risk factors was modest for men and non-existent for women
Wainwright and Surtees, 2004 ³³	What is the relative strength of the association between individual and area-level demographic and socioeconomic factors and depression?	19687 participants in the EPIC-Norfolk study	Electoral wards	Overall index of multiple deprivation	DSM-IV criteria	Cross-sectional	Single-level logistic regression, multilevel analysis	Y: an association remained between area deprivation and current mood disorders, after adjusting for individual-level risk factors (OR for top vs bottom quartile of deprivation 1.29 (1.1 to 1.5)). Significant area-level residual variation remained
Weich <i>et al</i> , 2001 ⁴⁶	Do individuals in regions with the highest income inequality have a higher prevalence of depression, after adjustment for individual income?	5511 participants in BHPS (a representative sample of individuals in private households in England, Wales, and Scotland)	Standard regions	Gini coefficient (income inequality)	GHQ	Cross-sectional	Single-level linear regression	N: no significant association between Gini coefficient and depression (OR 0.99 (0.87 to 1.13), although there was a significant interaction between individual income and Gini ($p < 0.01$)).
Weich <i>et al</i> , 2002 ³⁵	Is depression most prevalent in areas characterised by derelict buildings and abundant graffiti, open public spaces and few buffers between public and private spaces?	1887 people from two wards in London, UK	"Housing areas," 86 areas with homogenous housing type and form	Built environment site survey checklist, an inventory for rating housing areas carried out by an urban design postgraduate who did not live in the area	CEFS-D	Cross-sectional	Single-level logistic regression, linear regression	Y: there was an association between depression and characteristics of the built environment, which remained after adjusting for individual SES and internal characteristics of dwellings (OR for properties with deck access 1.28 (1.03 to 1.58); OR for recent construction 1.43 (1.06 to 1.91)).

Continued

Table 1 Continued

Author, year	Primary research questions addressed	Study sample	Neighbourhood definition used	Neighbourhood features investigated*	Depression measure investigated	Study design	Key analytical technique	Results (support for neighbourhood effects on depression?)
Weich <i>et al.</i> , 2003 ⁵⁰	Do people living in urban areas have higher rates of depression, after adjusting for personal SES? Do people living in disadvantaged neighbourhoods have higher rates of depression, after adjusting for personal SES?	8978 respondents from the BHPS in Britain, Scotland, and Wales	Electoral wards, grouped into 14 principal groups by demographic and socioeconomic composition, and households	Carstairs index of socioeconomic deprivation	GHQ	Cross-sectional	Multilevel logistic and linear regression	N: there is little independent area-level variance in the prevalence of depression and anxiety, except amongst unemployed residents. There is no association between socioeconomic deprivation and depression, but there is household-level variation
Weich <i>et al.</i> , 2005 ³⁴	What is the variance in onset and maintenance of common mental disorders at individual, household and electoral ward levels? Will ward-level socioeconomic deprivation be associated with episode maintenance after controlling for individual and household factors?	BHPS participants aged 16–74; 9518 at wave 1 and 7659 at wave 2	Electoral wards	Carstairs index of socioeconomic deprivation	GHQ	Prospective	Multilevel logistic regression	N: differences in rates of maintenance and onset of depression and change in score between waves across electoral wards are negligible (<1%) compared to those between households and individuals. Ward level socioeconomic deprivation does not influence the onset and maintenance of common mental disorders
Xue <i>et al.</i> , 2005 ²⁰	Is children's mental health associated with neighbourhood structural characteristics (concentrated disadvantage, residential stability, immigrant concentration)? Do collective efficacy and organisational participation underlie these effects? Will poverty area residence lead to increased levels of depressive symptoms?	2805 children from Chicago, Illinois	Neighbourhood clusters, made up of two or three census tracts	Neighbourhood structural measures from census loaded into three factor scores (concentrated disadvantage, immigrant concentration, residential stability), informal social control, and social cohesion (participant reported)	CBCL/4–18	Prospective	Multilevel analysis	Y: neighbourhood concentrated disadvantage was associated with the prevalence of children's mental health problems, after controlling for individual characteristics ($\beta = 0.088$, $p < 0.01$). This effect was accounted for by informal social control and social cohesion
Yen and Kaplan, 1999 ⁴¹	Will poverty area residence lead to increased levels of depressive symptoms?	1737 participants in the Alameda County study who resided in Oakland County California in 1965 and who responded in 1974	Poverty areas and non-poverty areas	Poverty area (contiguous census tracts based on 1965 criteria)	From response to 18 questions; similar to CES-D	Longitudinal	Single-level logistic regression	Y: living in a poverty area was associated with increased risk of depressive symptoms after adjustment for age and sex (OR 2.09 (1.49 to 2.99)); this became non-significant (OR 1.21 (0.76 to 1.93)) with additional confounders added to the model
Yen <i>et al.</i> , 2006 ²⁵	What are the associations between perceived neighbourhood problems and quality of life and depressive symptoms amongst adults with asthma?	435 adults with asthma in northern California	Participant-defined neighbourhoods	Neighbourhood problems (too much traffic, excessive noise, trash and litter, smells, smoke) (participant reported)	CES-D	Cross-sectional	Single-level linear regression	Y: subjects in the top quartile of neighbourhood problems were more likely to have depressive symptoms than the bottom quartile, after adjustment (OR 4.8 (2.4 to 9.5)).

*It is difficult to distinguish between neighbourhood constructs and neighbourhood measures in some studies, so they have been combined for the purposes of this table. AHEAD, Study of Asset and Health Dynamics Among the Oldest Old; BHPS, British Household Panel Survey; BRFSS, Behavioral Risk Factors Surveillance System; CARDIA, Coronary Artery Risk Development in Young Adults; CBCL, Child Behavior Checklist; CES-D, Center for Epidemiologic Studies-Depression score; CDI, Children's Depression Inventory; CIDI-SF MD, Composite Diagnostic Interview Schedule Short Form for major depression; DISC-IV, Diagnostic Interview Schedule for Children, Version 4; DISC-R, Diagnostic Interview Schedule for Children; DSM-IV, Diagnostic and Statistical Manual of Mental Disorders; FACHS, Family and Community Health Study; EPIC-Norfolk, European Prospective Investigation into Cancer and Nutrition in Norfolk, UK; GHQ, General Health Questionnaire; N, no; NLSY, National Longitudinal Survey of Youth; PHQ-9, Patient Health Questionnaire; SCID, Structured Clinical Interview for Diagnostic and Statistical Manual of Mental Disorders; SES, socioeconomic status; SF-36, Mental health index of the Short Form Health Survey 36; SMDI, Multiscore Depression Index, short form; SMSA, Standard metropolitan statistical area; UM-CIDI, University of Michigan Composite International Diagnostic Instrument; WBC, Walkable and Browsable Communities Project; Y, yes.

Depression measures

The most common outcome measure examined was the CES-D (Center for Epidemiologic Studies-Depression) scale (either full or modified) (19 out of 45 studies).^{11 13 16 17 21 22 24 25 35 36 37 40 41 45 48 51 52 55 57} Nine studies relied on measures approximating DSM-IV (Diagnostic and Statistical Manual of Mental Disorders) criteria, a measure of clinical depression.^{2 27 28 33 38 42 43 47 49} Studies of children or adolescents also tended to use instruments that approximated DSM criteria.^{18-20 26 39 44 53 54} Six studies, mainly carried out in the UK, used the GHQ (General Health Questionnaire),^{30 31 34 46 47 50} a scale created to assess four elements of non-psychotic distress, including depression.⁵⁸ The SF-36 (Mental health index of the Short Form Health Survey 36) was used in two studies^{29 32} and a question from a general health survey (Behavioural Risk Factors Surveillance System) was used in one study.²³

Study designs

The majority of the studies (35) were cross-sectional in nature. Only 10 of the 45 studies used any type of follow-up or prospective analysis.^{20 21 24 28 34 44 49 51 53 54} Thirty-two studies had multilevel designs in that they included data on individuals nested within neighbourhoods and collected data at both levels.^{2 11 13 16 17 19-21 23 27-35 37 38 40 42-44 46 48-52 55 57} Thirteen were purely individual-level studies in which individual-level reports of neighbourhood characteristics were linked to individual-level outcomes in an individual-level analysis.^{18 22 24-26 36 39 41 45 47 53 54 56}

Analytical techniques

Twenty-one of the studies used linear or logistic multilevel models to investigate the relationship between depression or depressive symptoms and area-level characteristics.^{11 13 16 19 20 27-30 32 34 37 40 42-44 48-50 52 57} The remaining studies used single-level linear or logistic regression,^{2 18 21 22 24-26 35 36 39 45-47 51 53-56} structural equation modelling,⁴¹ or tests of significance of the difference in prevalence rates between groups.³⁸ The four studies that contrasted results from multilevel analysis with an analysis ignoring the multilevel structure reported similar results with both approaches.^{17 23 31 33} Individual-level confounders, most commonly age, gender, marital status, ethnicity, education, employment status, financial strain, and number of current physical health problems, were included in models in all 45 studies.

Study results

Thirty-seven of the 45 studies found support for an association between neighbourhood characteristics and depression or depressive symptoms after controlling for a variety of individual-level characteristics, usually a combination of race/ethnicity, age, gender, marital status, education and income. When categorised by study design six of the seven purely longitudinal studies^{20 21 24 28 44 51} and 29 of the 35 purely cross-sectional studies reported associations.^{2 11 13 17-19 22 23 25-27 29 31-33 35-39 41-43 45 47 48 55-57} Three studies had both cross-sectional and prospective elements: one of these found a significant association with both types of analyses,^{53 54} while another only found a significant association in their cross-sectional data.⁴⁹ The six studies that reported ICCs (intraclass correlations) for depression measures generally reported ICCs in the 0.4–2.9% range for cross-sectional studies of adult populations,^{30-33 43} 11% for children²⁰ and 1% for longitudinal analyses.⁴⁴

Differences based on neighbourhood characteristics and definitions

Study results differed depending on which neighbourhood characteristics were being studied. Overall, 24 of the 46 different structural characteristics (52%) examined were significantly associated with depressive symptoms/depression. Thirteen of the 25 studies that examined the effect of neighbourhood socioeconomic position on depressive symptoms found evidence to support the presence of an association after adjustment for individual-level characteristics.^{11 13 17 20 21 28 29 32 33 37 41 43 49} Four of the eight studies that examined the association between depression and residential mobility found evidence of an association.^{2 43 48 57} Only four of the 10 studies that examined racial/ethnic composition of neighbourhoods found support for the association between neighbourhood context and depression.^{17 19 38 55} All four studies that looked at the association between depressive symptoms and the built environment (specifically the internal and external built environment, the quality of housing areas, the walking environment and a negative neighbourhood environment, identified by factors such as violence, abandoned buildings and homeless people on the streets) found an association with depressive symptoms.^{26 27 35 36}

Twenty-five of the 37 social processes (68%) examined in the studies were significantly associated with depression/depressive symptoms. All but one⁵² of the nine studies that assessed whether individual perceptions of the conditions and disorder in one's neighbourhood affected risk of depression concluded that these factors were associated with depressive symptoms.^{11 24 44 45 47 51 56 57} Eleven out of 16 studies found positive social interactions between neighbours to be a protective factor against depression.^{18 22 24 37 39 41 47 54 55 56 57} Exposure to violence and hazardous conditions was found to be associated with depressive symptoms in six out of 12 studies.^{18 22 25 41 42 44}

Both of the studies that systematically compared results for different scales found no consistent evidence that results differed systematically by neighbourhood size, although one study suggested that small scales (smaller than electoral ward in the UK) may be most relevant to depression.^{34 36} Study results differed somewhat in the USA and in the UK. Regardless of how they defined neighbourhood, UK studies found evidence for associations between neighbourhood environments and depression in only two-thirds of the studies (6 out of 9), whereas studies in the USA, independent of the size or definition of neighbourhood, found associations between at least one neighbourhood characteristic and depression in 30 out of 34 studies.^{2 11 13 16-28 36 38-42 44 45 47-49 51-57}

Heterogeneity in the effects of neighbourhood-level variables

It is often hypothesised that the effect of neighbourhood context on depression may vary by gender, age, racial/ethnic group or socioeconomic position. Of the nine studies that reported results either stratified by gender or with interaction terms between gender and neighbourhood characteristics, two found that neighbourhood characteristics were more strongly associated with depressive symptoms in women^{22 54} and one found a stronger association in men,³⁶ whereas others had mixed results^{40 45 53 56} or found no difference between genders.^{32 43} Although the number of studies of children or of older people was generally small, there was limited evidence of more consistent associations in children or older people: four of the five studies that restricted their populations to older people and 9 of the 10 studies of children aged 18 and under found evidence of an association between neighbourhood characteristics and depressive symptoms, compared with 24 of 30 studies of adult populations. Very few studies have investigated heterogeneity

by race/ethnicity.^{17 18 40 47} In a Baltimore study, community cohesion was associated with less depression amongst White people, but was not associated with depression amongst African-Americans.⁴⁷ One study found Mexican-Americans had better mental health in areas with high concentrations of Mexican-Americans, whereas another study found that African-Americans had worse mental health in areas with higher concentrations of African-Americans, although this association disappeared after adjustment for individual-level variables.^{17 40}

Five studies examined interactions of neighbourhood characteristics with individual-level socioeconomic position. Three of these studies found no interaction,^{40 48 49} whereas two found a significant interaction between individual-level economic status and neighbourhood conditions.^{46 50} Wealthy individuals living in areas with high income inequality had higher levels of mental disorders than those living in more equal areas, but the opposite was true for poor individuals.⁴⁶ Living in a poverty area was only associated with worse mental health outcomes among the unemployed in another study.⁵⁰ Other sets of interactions have also been examined in a small number of studies: knowing one's neighbours was more strongly associated with higher levels of childhood anxiety and depression in poverty area neighbourhoods than in wealthy neighbourhoods;³⁹ parents' use of inductive reasoning was a protective factor for African-American teenagers' levels of depressive symptoms only for those living in disordered neighbourhoods;⁴⁴ and residential stability was associated with lower levels of depressive symptoms in wealthy neighbourhoods and higher levels in poor neighbourhoods.⁵⁷

Longitudinal studies

Ten of the 45 studies used some type of follow-up or prospective analysis.^{20 21 24 28 34 44 49 51 53 54} Two studies had 1 year or less of follow-up time,^{24 34} six studies had 1–2 years of follow-up,^{20 28 44 49 51 53} one study had 7–8 years of follow-up⁵⁴ and one study followed subjects for 10 years.²¹ Nine of the 10 studies had two waves of data,^{20 21 24 34 44 49 51 53 54} whereas one study used three waves of data collection.²⁸ Four studies defined incident depression/depressive symptoms as all subjects who did not have depression or fell below a certain cut-off level of depressive symptoms at baseline, but who did have depression or were above the cut-off level at follow-up time(s),^{21 28 34 49} one study used a change score,⁵¹ and five studies simply used the level/presence of depressive symptoms at follow-up, with three of these controlling for baseline levels in their models.^{20 24 44 53 54} Four studies restricted their populations to children^{20 44 53 54} and two to women,^{49 51} whereas the remainder enrolled representative adult populations.^{21 24 28 34} Each of these studies used a different definition of neighbourhood: New York City community districts, census block groups, clusters of census block group areas, British electoral wards, clusters of multiple census tracts, poverty areas/non-poverty areas and participant-defined neighbourhoods. Five of these studies focused on measures of neighbourhood socioeconomic position and disadvantage,^{20 21 28 34 49} and two of these additionally examined social cohesion and neighbourhood disorder as predictors.^{20 49} Four of the five studies that examined the association between neighbourhood socioeconomic status and development of depressive symptoms found evidence of an association,^{20 21 28 49} after controlling for combinations of age, education, sex, race/ethnicity, income, stressors, marital status, number of children, receiving government assistance, perceived health status, body mass index, smoking and alcohol consumption, whereas one found no association.³⁴ Neighbourhood disorder was prospec-

tively associated with depressive symptoms in four out of five studies.^{24 45 51 53} Neighbourhood cohesiveness was associated with depressive symptoms in two^{20 54} of the three studies that examined this process.^{20 24 54}

DISCUSSION

Of the 45 studies reviewed, 37 reported associations of at least one neighbourhood characteristic with depression or depressive symptoms after controlling for individual-level characteristics. The percentage of positive results was similar in cross-sectional (82%) and longitudinal (70%) studies. The associations of depressive symptoms/depression with structural features were less consistent (52% significantly associated) than with social processes (68%). Among the structural features, measures of the built environment appeared to be more consistently associated with depression than socioeconomic deprivation, residential stability or race composition, although only a few studies to date have investigated the built environment.

Although a wide variety of area definitions were investigated, very few studies systematically compared area definitions and no clear pattern emerged from the comparison of studies using different-sized areas. Controlling for individual-level confounders often reduced the magnitude of the association between neighbourhood characteristics and depression/depressive symptoms, although the association rarely disappeared all together. Interactions were investigated in only a small number of studies making it difficult to draw any conclusions about vulnerable groups, although there was some evidence of stronger effects in children and older people than in adult populations. The studies varied widely in neighbourhood definitions, in the neighbourhood-level variables investigated and in the individual-level covariates examined, making it impossible to conduct a meta-analysis of study results. Increasing comparability across studies in the geographic areas, the variables and the outcomes examined to conduct systematic reviews is an important need in the field.

Current limitations in this body of literature include limited theory about how neighbourhoods may influence depression and depressive symptoms; the lack of consistency in the definitions of neighbourhoods and the measures of neighbourhood-level properties examined; the possibility of reporting bias, reverse causation and residual confounding; the dearth of studies exploring different spatial scales; and the relative lack of longitudinal studies. Five important research directions emerge from the reviewed works. These research directions are (1) developing theory on the processes through which specific area features may affect mental health, including theories on the most vulnerable groups; (2) improving the measures of neighbourhood or area-level factors necessary to test these theories empirically; (3) investigation of a broad range of areas (or spatial scales) and neighbourhood-person interactions; (4) addressing issues of reporting bias, reverse causation and residual confounding; and (5) increasing the use longitudinal designs and quasi-experimental or experimental designs.

Developing theory on the processes through which area features may be associated with depression and depressive symptoms and empirically testing specific predictions derived from these theories is fundamental to strengthening causal inference. Empirical investigations of the processes linking neighbourhood characteristics to depression will require the measurement of the specific neighbourhood attributes involved. To date, the majority of studies have used measures of the socioeconomic composition of areas as a proxy for the more

specific area attributes that may be relevant. A growing number of studies have attempted to measure specific attributes of neighbourhoods such as the built environment, social cohesion disorder or crime.^{11 22 24 27 41 45 47} It is interesting to note that findings have generally been more consistent for studies focusing on specific neighbourhood attributes than those focusing on aggregate measures of socioeconomic position or deprivation. However, the measures used across studies have varied widely, making comparisons difficult. Developing standardised measurement instruments that can be applied across studies so that findings can be systematically compared will be an important advancement. One methodology that could potentially be explored further involves the use of geographic information systems (GIS) to construct measures of the built environment and the physical layout of neighbourhoods hypothesised to be related to mental health or to create synthetic geographical areas with optimised homogeneity of social characteristics.⁵⁹

There is little consensus on what spatial scales (ranging from the immediate built environment of the home to broader regional characteristics) may be relevant to depression or depressive symptoms in different population groups. The development of hypotheses on relevant spatial definitions will require more sophisticated theory on how persons interact with and are affected by spatial contexts. In the absence of clear theory on the spatial scale relevant to a particular process, researchers can conduct sensitivity analyses to determine the effects of different definitions of “neighbourhoods” on the results of their research.⁵⁹ The definition and size of a neighbourhood varied widely across the studies in this review and few studies have examined sensitivity of results to the use of measures corresponding to different-sized areas.^{36 50} The use of spatial analytic methods is another promising arena that has not yet been extensively used in this body of literature.⁶⁰⁻⁶² These methods can be used to investigate the spatial patterning of health outcomes without relying on arbitrary defined boundaries. This spatial patterning can provide information on the spatial scale at which the relevant processes may be operating.

An important methodological challenge in investigating neighbourhood effects on depression is reporting bias (sometimes also referred to as same-source bias). Reporting bias may arise for example if people who are already depressed report lower levels of social cohesion and a worse external environment because of their depression. Many of the studies in this review measured neighbourhood conditions from the same sample of people from whom they took measurements on depressive symptoms. The association between social cohesion and depressive symptoms, for example, might exist because depressed people feel more alone, even though their neighbourhood, objectively, does not have low social cohesion. A growing body of work on ecological measurement has begun to develop alternative ways to use survey data or objectively collected data on the built environment (though publicly available data or systematic social observation) to characterise neighbourhood environments in ways that avoid same-source bias.^{63 64} Greater use of these methods in the area of neighbourhood characteristics and depression is needed.

Reverse causation and residual confounding by individual-level variables are two additional methodological problems. Reverse causation would arise if people who are depressed tend to stay in or move into deprived neighbourhoods. In this case the exposure to the neighbourhood condition is a consequence of (and not a cause of) depression. All cross-sectional studies are

What is already known on this subject

It has been hypothesised that neighbourhood and residential environments may be related to depression in residents but research results have not been comprehensively summarised.

vulnerable to the problems of reverse causation. Longitudinal designs are necessary to rule out reverse causation as an explanation for cross-sectional associations. As in other neighbourhood effects research, the possibility of residual confounding by individual-level variables is an important limitation of observational studies of neighbourhoods and depression. Most studies in this review attempted to address this issue by controlling for a variety of individual-level variables, but there is no consensus on what the key confounders are likely to be, or on the sensitivity of results to plausible amounts of residual confounding. Other approaches sometimes used to control for multiple confounders such as propensity score analysis^{65 66} have not been used in research on neighbourhoods and depression.

The majority of existing studies of neighbourhoods and depression are cross-sectional. As noted above, longitudinal studies are necessary to rule out reverse causation. They are also needed to investigate time lags and cumulative effects of neighbourhoods on depression. Short of the ideal randomised experiment, natural experiments or quasi-experimental designs may also provide opportunities to examine causal effects of neighbourhood or area attributes on depression avoiding some of the pitfalls of observational studies. For example, a study could examine changes in depressive symptoms over time in a neighbourhood in response to some source of exogenous variation such as the inauguration of a new public space, or the implementation of a new community policing approach. These interventions, which are “naturally occurring” in neighbourhoods all the time, provide valuable but as yet untapped opportunities to investigate area or neighbourhood effects on depression. In summary, existing observational evidence supports a role of neighbourhood conditions in the development of depression and depressive symptoms. However, more refined observational work (including the study of natural experiments) is needed to determine whether the associations observed are causal and what the relevant neighbourhood-level attributes and mediating variables might be.

What this study adds

- ▶ We summarise and review existing work on neighbourhoods and depression or depressive symptoms and find that the majority of published studies on this topic (37 of 45 studies) reported associations of at least one neighbourhood characteristic with depression or depressive symptoms after controlling for individual-level characteristics.
- ▶ The percentage of positive results was similar in cross-sectional (82%) and longitudinal (70%) studies.
- ▶ The associations of depressive symptoms/depression with structural features were less consistent than with social processes. Measures of the built environment appeared to be more consistently associated with depression than socioeconomic deprivation, residential stability or race composition.

Policy implications

- ▶ We identify five important research directions: (1) developing theory on the processes through which specific area features may affect mental health, including theories on the most vulnerable groups; (2) improving the measures of neighbourhood or area-level factors necessary to test these theories empirically; (3) investigation of a broad range of areas (or spatial scales) and neighbourhood–person interactions; (4) addressing issues of reporting bias, reverse causation and residual confounding; and (5) increasing the use longitudinal designs and quasi-experimental or experimental designs.
- ▶ The confirmation of causal neighbourhood effects on depression would suggest that strategies to prevent depression should take residential context into consideration.

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