

Urban—Rural Differences in Older Adult Depression:
A Systematic Review and Meta-analysis of
Comparative Studies



Jonathan Purtle, DrPH, MPH, MSc,^{1,2} Katherine L. Nelson, MPH,^{1,2} Yong Yang, PhD,³
Brent Langellier, PhD,^{1,2} Ivana Stankov, PhD,² Ana V. Diez Roux, MD, PhD, MPH^{2,4}

Context: Depression among older adults (aged 60 years or older) is a problem that could be exacerbated by global trends in urbanization and population aging. The study purpose was to assess whether urban, relative to rural, residence is associated with depression among older adults and whether associations differ in countries with developed versus developing economies.

Evidence acquisition: In 2017, the authors identified and extracted information from comparative studies of urban—rural depression prevalence among older adults. Studies were identified in PubMed, PsychINFO, and Web of Science and limited to English language articles published after 1985. Eighteen studies met inclusion criteria. Random effects meta-analysis was conducted to produce weighted pooled ORs estimating the association between urban—rural residence and depression for all study participants (N=31,598) and sub-analyses were conducted for developed ($n=12,728$) and developing ($n=18,870$) countries.

Evidence synthesis: Depression prevalence was significantly higher among urban residents in ten studies and significantly higher among rural residents in three studies (all three conducted in China). Associations between urban—rural residence and depression generally remained significant after adjusting for covariates. In developed countries, the odds of depression were significantly higher among urban than rural residents (pooled OR=1.44, 95% CI=1.10, 1.88). However, in developing countries, this association was not observed (pooled OR=0.91, 95% CI=0.46, 1.77).

Conclusions: Converging trends of urbanization and population aging could increase the global burden of depression among older adults. The pathways through which urban—rural residence influences depression risk among older adults might differ by country context. Future research should focus on measuring variation in these contexts.

Am J Prev Med 2019;56(4):603–613. © 2018 American Journal of Preventive Medicine. Published by Elsevier Inc. All rights reserved.

CONTEXT

Human longevity is increasing, and the demographic composition of societies is aging. Between 2015 and 2050, global life expectancy at birth is projected to increase from 70 to 77 years.¹ By 2050, the proportion of the world's population aged older than 60 years is projected to double and the proportion aged older than 80 years is projected to triple.^{2,3} In Europe, the proportion of the population aged older than 60 years is expected to increase from 24% to 34% between 2015 and 2050. Increasing trends are also

From the ¹Department of Health Management and Policy, Dornsife School of Public Health, Drexel University, Philadelphia, Pennsylvania; ²Urban Health Collaborative, Dornsife School of Public Health, Drexel University, Philadelphia, Pennsylvania; ³Division of Social and Behavioral Sciences, School of Public Health, University of Memphis, Memphis, Tennessee; and ⁴Department of Epidemiology and Biostatistics, Dornsife School of Public Health, Drexel University, Philadelphia, Pennsylvania

Address correspondence to: Jonathan Purtle, DrPH, MPH, MSc, Department of Health Management and Policy, Dornsife School of Public Health, Drexel University, 3215 Market Street, Philadelphia PA 19104. E-mail: jpp46@drexel.edu.

0749-3797/\$36.00

<https://doi.org/10.1016/j.amepre.2018.11.008>

expected in Latin America (from 11% to 26%), North America (from 21% to 28%), and Asia (from 12% to 25%).³ These increases in longevity pose challenges for policymakers, as they are forced to address the implications of population aging within the context of other societal changes. As Beard and Bloom⁴ describe, “Population ageing is not taking place in isolation. Other broad social changes are transforming society. . . . Understanding the interplay between these trends is crucial if policymakers are to make the best decisions to promote the health and wellbeing of older people.”

Urbanization and urban migration are social changes that are important to understand within the context of population aging. The proportion of the world’s population living in cities increased from 43% to 54% between 1990 and 2014 and is projected to increase to 66% by 2050.¹ Rates of urbanization are accelerating fastest in countries with developing economies. For example, between 2014 and 2050, the proportion of people living in cities is projected to increase from 40% to 56% in Africa and from 48% to 66% in Asia, compared with increases from 73% to 82% in Europe and 80% to 86% in North America.¹ As trends in population aging, urbanization, and urban migration converge, there is an increasing need for evidence about how urban contexts can maximize the health benefits, and minimize the health risks, of cities for older adults.^{5–8}

Although urban–rural differences in the physical health of older adults have been the focus of numerous initiatives,^{5–8} questions regarding how city living influences the mental health of older adults have received less attention. Such questions are important because the risk and protective factors for mental health conditions change as people age.⁹ Moreover, a substantive body of research suggests that urban residence increases risk for mental health conditions and that rates of mental health conditions are generally higher in urban than rural areas.^{10–16}

However, the dynamics through which urban residence influences mental health are complex and likely to vary for different mental health conditions, populations, and country contexts.^{10,17} Depression is one mental health condition for which the social and physical characteristics of cities could increase the risk for, or be protective against, depression among older adults.

Depression Among Older Adults

Systematic reviews and meta-analyses estimate that the global prevalence of major depressive disorder (MDD) is in the range of 1% to 5% among adults aged 65 years or older.^{18–24} Global estimates of the prevalence of clinically significant depressive symptoms (CSDSs), which do not meet the full criteria for MDD, among adults aged 65 years or older hover around 15%.^{18,23,25–27}

Although the prevalence of MDD and CSDS among older adults are similar to that of middle-aged adults, depression among older adults has widely been recognized as a public health priority for at least two reasons.^{27,28} First, the consequences of depression are more severe among older adults than among their middle-aged counterparts. In addition to adversely affecting quality of life, depression among older adults substantially increases the risk for myriad adverse outcomes—including physical health problems; suicide; mortality; and reduced physical, cognitive, and social functioning.^{18,20,27,29–34} For example, the association between MDD and suicide is stronger among older adults than any other age group¹⁸ and at least eight prospective studies have found that CSDSs increase risk for subsequent physical limitations.²⁷

Second, depression is potentially more preventable among older adults than their younger counterparts. Approximately half of cases of MDD among older adults are new cases experienced by people who never had MDD earlier in life.^{18,35,36} These older adults are also less likely to have a family history of depression.^{18,37} This suggests that depression among older adults is less influenced by inherited genetic factors and more influenced by social and environmental factors.⁹

Potential Importance of Urban Versus Rural Residence

An integration of findings from the fields of geriatric psychiatry and urban health reveals numerous pathways through which features of cities could increase depression risk among older adults or, alternatively, be protective against depression. For example, urban environments could increase depression risk via disrupted sleep. Poor sleep is one of the strongest risk factors for depression among older adults^{38,39} and could be exacerbated by urban environments because excessive exposure to artificial light at night is more prevalent in urban than rural areas and disrupts sleep quality.^{10,40–43} Urban residence could also increase depression risk via direct and indirect exposure to neighborhood crime. Negative perceptions of neighborhood safety are strong risk factors for depression among older adults^{44–48} and violent crime rates are generally higher in urban than rural areas.⁴⁹

Alternatively, some features of urban environments could reduce depression risk among older adults. For example, physical inactivity^{50–55} and social isolation^{18,23,56} are strong risk factors for depression among older adults. Public transportation networks and walkable streetscapes, which are generally both more robust in urban than rural areas, could reduce these risk factors

by facilitating physical activity, active transport, and social connectivity.^{51,57–62}

Potential Differences Between Countries With Developed Versus Developing Economies

It is plausible that the direction of an association between urban–rural residence and depression differs in countries with developed versus developing economies because the characteristics of urban and rural environments might vary across these contexts. For example, residents of rural areas in developed countries are likely to have some access to mental health services, whereas residents of rural areas in developing countries might have no access because services are exclusively concentrated in urban areas.⁶³ Residents of urban areas in developed countries are likely to have access to public transportation, whereas residents of urban areas in developing countries might not have such access and rely on walking as their primary mode of transit.^{64,65} The importance of country context when considering the pathways through which urban and rural environments influence mental health is highlighted by a 2018 study of 42 low- and middle-income countries that found no association between urban (versus rural) residence and psychosis—a finding contrary to the well-established relationships between urban residence and psychosis that is typically observed in high-income countries.¹⁷ This and other findings have promoted calls for greater examination of how the influence of urban and rural environments on mental health might vary between country contexts.⁶⁶

Study Purpose

Reviews have examined various aspects of depression among older adults and identified individual and neighborhood-level risk and protective factors.^{23,25–27,30,32,38,44,50,67–70} However, with the exception of one meta-analysis of studies in China published nearly 20 years ago,⁷¹ evidence of the association between urban–rural residence and depression among older adults has not been systematically assessed or integrated. The purpose of this study was to address this knowledge gap and provide directions for future research. A systematic review and meta-analysis were conducted of comparative studies focused on urban–rural differences in depression (including both MDD and CSDSs) among older adults aged 60 years or older. The specific aims are to: assess whether urban versus rural residence is associated with depression among older adults; identify factors that are significantly associated with depression among urban but not rural older adults, and vice versa; and assess whether the association between urban–rural residence and depression differs between developed and developing countries.

EVIDENCE ACQUISITION

Search Strategy

The present review was conducted in accordance with PRISMA guidelines. In July 2017, the authors searched PubMed, PsychINFO, and Web of Science for articles that mentioned any of the following combinations of terms in the title, abstract, or keywords: (*depression* OR *depressive*) AND (*elderly* OR *older adult* OR *late life*) AND (*urban* OR *city* OR *cities* OR *metropolitan* OR *urbanization*) AND (*rural* OR *countryside*). The selection of these terms was informed by those used in prior reviews of depression among older adults^{23,25–27,30,32,38,44,50,67–71} and urban–rural differences in mental health.^{10–16} The search was limited to articles published in English since 1985. After removing duplicates, this search identified 170 articles that were screened for inclusion (Figure 1).

Inclusion/Exclusion Criteria

Two authors read the abstracts of the 170 articles and screened for inclusion. Articles were included if they assessed urban–rural differences in MDD and CSDSs among older adults aged ≥ 60 years. Studies that focused on urban or rural populations only, without considering urban–rural differences, were excluded. Moreover, non-empirical articles (e.g., commentaries); exclusively qualitative studies; and studies limited to clinical interventions, institutionalized populations, or caregivers of older adults were excluded.

Thirty-nine articles met screening criteria. The full texts of these articles were obtained, reviewed by the two coders, and excluded if they did not meet screening criteria or did not present data on the prevalence of MDD or CSDSs among adults aged ≥ 60 years stratified by urban–rural residence. When articles met all inclusion criteria but did not present information on urban–rural differences in depression prevalence ($n=2$), the study's authors were contacted and the article was included if the information could be obtained ($n=1$). This process resulted in 18 articles that were included in the meta-analysis.

Data Extraction, Quality Assessment, and Analysis

For each article, information was extracted on the characteristics of study participants (e.g., age, country), instruments and scoring thresholds used to assess depression, definitions of urban–rural residence, and sample size. When available in studies that used multivariable regression, information was extracted on the AOR of urban–rural depression prevalence and the variables that were adjusted for in the final model. Information was also extracted on variables that were significantly associated with depression risk among urban but not rural older adults, and vice versa.

Authors assessed the methodologic quality of each study on nine domains using a quality assessment instrument (Appendix 1, available online) adapted from the review by Luppá and colleagues⁶⁹ of depression prevalence among older adults. Two authors independently reviewed the 18 studies and each domain was scored as 2 if criteria were fully met, 1 if partially met, and 0 if not met. An aggregate quality score was then calculated for each study. Studies in the >75th percentile (score ≥ 14) were coded a high quality, those in the 50th to 75th percentile (score 9–13) were coded as moderate quality, and those in the <50th percentile (score ≤ 8) were coded as low quality.

Using the definitions of depression and urban–rural residence from each study, information on the number of depressed and

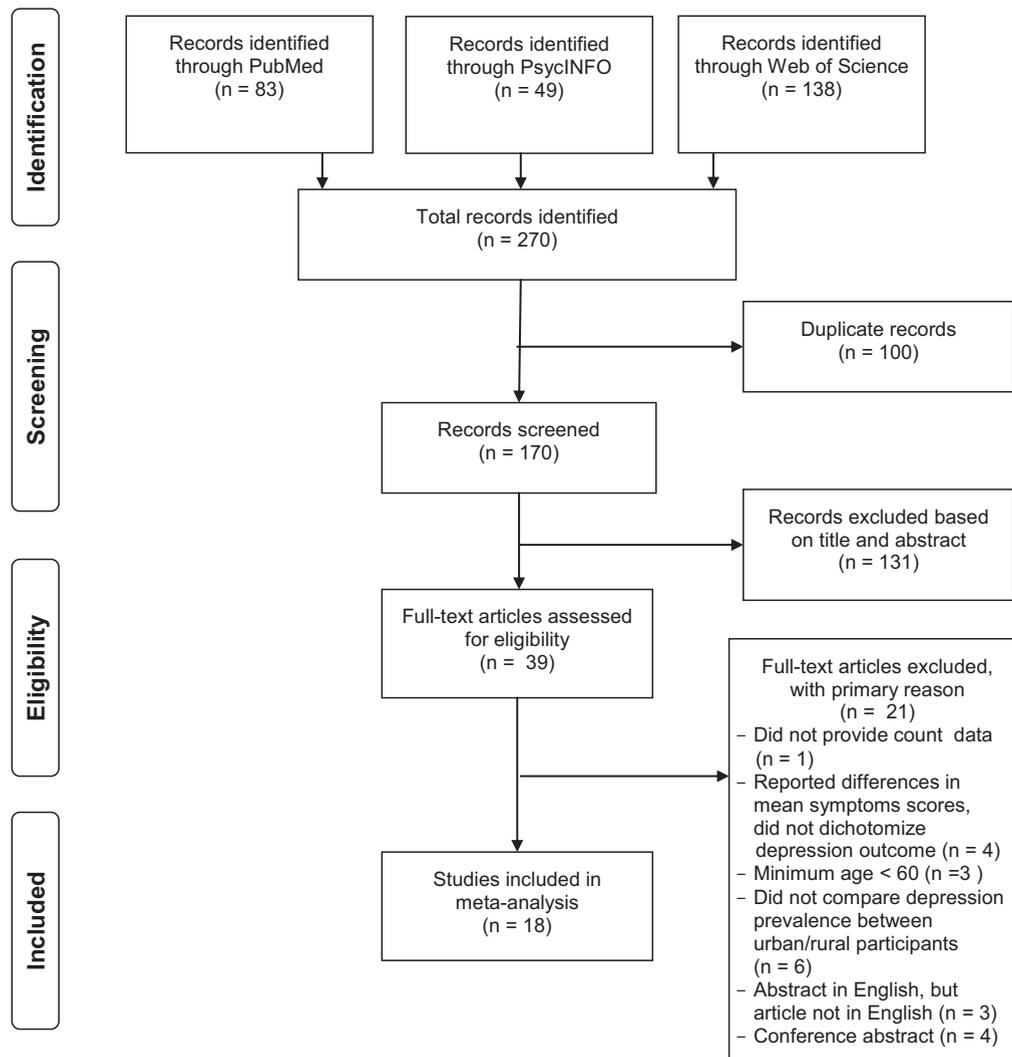


Figure 1. PRISMA flow diagram to identify comparative studies of urban–rural differences in depression among older adults.

non-depressed older adults in the urban and rural populations, respectively, were extracted. Outcomes of MDD and CSDSs were combined because there were substantial differences in how these two outcomes were operationalized across studies and because this study’s aims were focused on assessing the relative association between urban–rural residence and depression among older adults—not on estimating depression prevalence in urban and rural areas.

Using data on the number of depressed and non-depressed older adults in the urban and rural populations of each study, random effects meta-analysis was conducted using the “metan” command in Stata, version 17, to produce weighted pooled ORs with 95% CIs estimating the association between urban–rural residence and depression. A random effects model was used because the characteristics of urban and rural environments and study populations were assumed to vary substantially between studies and because I^2 statistics demonstrated high heterogeneity between studies (i.e., >75%).⁷² Weighted pooled ORs were produced for all studies together and also separately for studies conducted in

countries with developed and developing economies, based on the UNs’ World Economic Situation and Prospects classifications.⁷³ Forest plots were created to display results.

To conduct sensitivity analysis, authors systematically assessed the influence of each study on the pooled results by producing weighted pooled ORs without each individual study. This was carried out for all studies together and separately for countries with developed versus developing economies. To assess publication bias, funnel plots were created and Egger’s tests were conducted.⁷⁴

EVIDENCE SYNTHESIS

Study Characteristics

Appendix Table 1 (available online) summarizes the characteristics, methodologic quality, and results of the 18 studies.^{75–92} Nine studies were conducted in developed countries (Japan, U.S., Sweden, Italy, Canada, Great Britain) and nine were conducted in developing

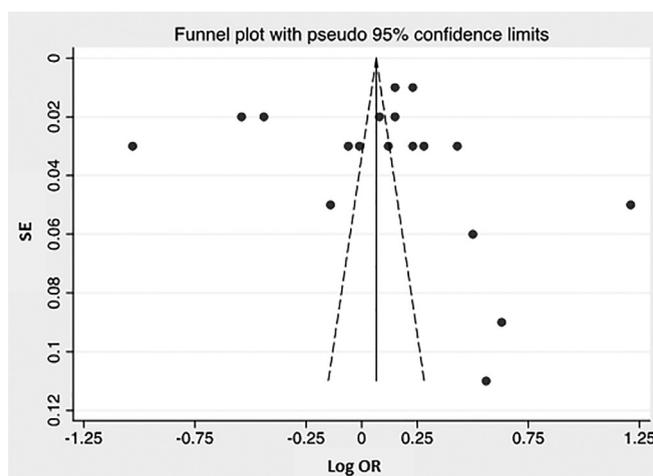


Figure 2. Funnel plot of urban–rural differences in depression among older adults, 18 studies.

countries (Iran, China, Taiwan, Peru, Mexico, Venezuela, South Korea, India). Study sample size ranged from 86 to 6,178 and the median sample size was 1,169.

Seven studies were coded as high quality, eight were moderate quality, and three were low quality. The quality of studies was similar for those conducted in developed and developing countries. There were substantial differences in how depression outcomes and urban–rural residence were operationalized across studies. Six different instruments were used to assess depression. The 15-item Geriatric Depression Scale was used most frequently (six studies), but five different scoring thresholds were used with the scale to classify older adults as having CSDSs (threshold range, ≥ 5 to ≥ 9). Five studies used the addresses of study participants and national urban–rural classification systems (e.g., U.S. Census Bureau definitions, Chinese Hukou System designations) to classify participants as urban or rural and four included information about the population density of urban–rural classifications.

Unadjusted Associations From Individual Studies

The study prevalence of depression was significantly higher among urban residents in ten studies, significantly higher among rural residents in three studies, and there was no significant difference between the urban and rural residents in five studies. All studies in which depression was significantly higher among rural residents were conducted in China, which was classified as a developing country. The strength of the association between urban–rural residence and depression varied dramatically between studies. Among individual studies conducted in developed countries, the unadjusted OR of depression between urban and rural (ref) residents ranged from 0.72 (95% CI=0.45, 1.15)⁷⁸ to 4.29 (95%

CI=1.84, 9.99).⁸⁹ Among individual studies conducted in developing countries, the ORs ranged from 0.09 (95% CI=0.06, 0.15)⁸² to 16.36 (95% CI=2.19, 122.28).⁷⁶

Pooled Analyses

When the results of all 18 studies were pooled ($N=31,598$), the study prevalence of depression was not significantly different between urban (10.2%) and rural (10.7%) residents (chi-square $p=0.168$). The pooled OR from random effects meta-analysis was 1.18 (95% CI=0.84, 1.65). I^2 was 93.4% (chi-square $p<0.001$), indicating high heterogeneity between studies. A funnel plot (Figure 2) demonstrates that studies fall on both sides of zero with moderate symmetry, suggesting the absence of major publication bias. Egger's test suggested that there was no significant small studies effect (Egger's test $p=0.356$). In the sensitivity analyses that assessed influence of individual studies, pooled ORs ranged from 1.10 (95% CI=0.78, 1.56) to 1.32 (95% CI=1.01, 1.74).

When the results of all studies conducted in developed countries were pooled ($n=12,728$), the study prevalence of depression was significantly higher among urban (16.0%) than rural (11.8%) residents (chi-square $p<0.001$). The pooled OR from random effects meta-analysis was 1.44 (95% CI=1.10, 1.88) with high heterogeneity between studies ($I^2=75.3%$, chi-square $p<0.001$; Figure 3). In the sensitivity analysis, pooled ORs for developed countries ranged from 1.32 (95% CI=1.03, 1.68) to 1.56 (95% CI=1.18, 2.07).

When the results of all studies conducted in developing countries were pooled ($n=18,870$), the study prevalence of depression was significantly lower among urban (7.5%) than rural (9.6%) residents (chi-square $p<0.001$). The pooled OR from random effects meta-analysis was 0.91 (95% CI=0.46, 1.77) with high heterogeneity ($I^2=96.2%$,

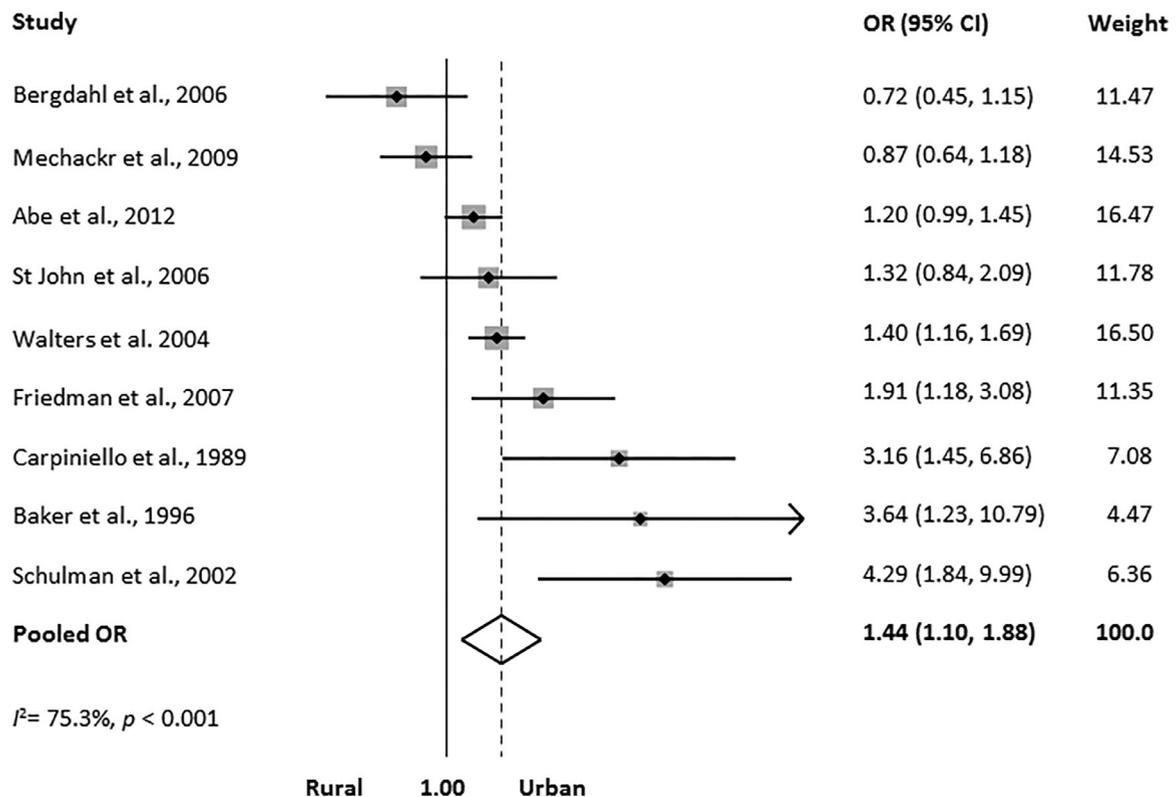


Figure 3. Odds of depression among urban versus rural older adults in developed countries ($n=12,728$).

Note: Weights are from random effects model. Arrows indicate that the 95% CIs are truncated.

chi-square $p < 0.001$; Figure 4). In the sensitivity analysis, pooled ORs for developing countries ranged from 0.76 (95% CI=0.38, 1.50) to 1.17 (95% CI=0.69, 1.99).

Adjusted Associations From Individual Studies

Nine studies conducted multivariable regression and presented AORs of the association between urban residence and depression.^{82,83,85–87,89–92} The variables most frequently included in these models were age (seven studies), gender (six studies), marital status/widowhood (six studies), functional impairment/disability (five studies), education (four studies), income/financial strain (four studies), and housing (four studies). The magnitude, direction, and significance of unadjusted and adjusted ORs were similar in most studies. For example, in the study by Walters et al.⁹² of older adults in Great Britain, the odds of depression among urban versus rural residents only increased from 1.40 (95% CI=1.16, 1.69) to 1.61 (95% CI=1.20, 2.17) after adjusting for age, gender, financial strain, housing, physical symptoms, unmet needs in activity of daily living, living alone, and impaired cognition.

Eight studies examined interactions between urban–rural residence and factors associated with depression (i.e., identified factors associated with depression risk among urban but not rural older adults, and

vice versa).^{75,78,81,83,85,86,88,91} In five of these studies, interactions between rural residence and factors related to social isolation (e.g., living alone, not having any close friends) were present in which isolation-related factors were independently and significantly associated with depression among rural, but not the urban, residents.^{75,83,85,86,91} For example, after adjusting for covariates, the study by Abe and colleagues⁷⁵ of older adults in Japan found that the odds of depression were 1.28 times higher among older adults with poor social support in rural areas, whereas the association between social support and depression was not significant among those residing in urban areas. Associations between social isolation and depression among rural older adults were identified in studies conducted in developed^{75,83,91} as well as developing^{85,86} countries. Results were mixed for other known risk factors for depression among older adults (e.g., poor physical health, financial stress, female gender).

DISCUSSION

Considered holistically, the results of this review and meta-analysis suggest that urban residence might increase depression risk among older adults. Of the 18

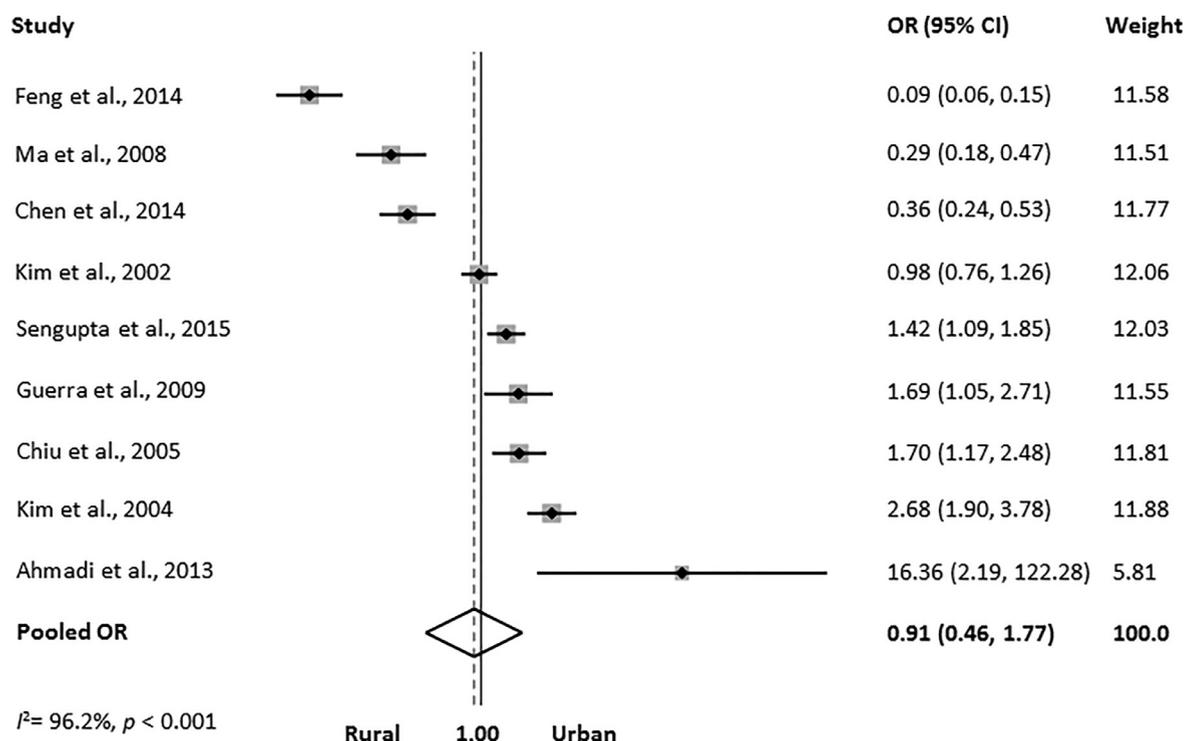


Figure 4. Odds of depression among urban versus rural older adults in developing countries ($n=18,870$).

Note: Weights are from random effects model.

included studies, depression prevalence was significantly higher among urban residents in ten studies and significantly higher among rural residents in only three studies (all three conducted in China). Although the review was not designed to elucidate the mechanisms through which urban–rural residence might influence depression, the magnitude of unadjusted and adjusted ORs of urban–rural depression were generally similar in the nine studies that controlled for potential confounders. This suggests that urban and rural environments might have independent effects on depression risk among older adults.

In the pooled sub-analysis of studies conducted in developed countries, the present study found that the odds of depression were significantly higher among older adults residing in urban, as opposed to rural, areas. This finding is very similar to the pooled results of the meta-analysis by Peen et al.¹⁶ of urban–rural differences of depression among people of all ages in developed countries. In the pooled sub-analysis of studies conducted in developing countries, however, the present study found that the odds of depression were not significantly higher among older adults residing in urban than rural areas. This finding is consistent with the results of the meta-analysis by Chen and

colleagues⁷¹ (published in 1999) of risk factors for depression among older adults in China and two more recent studies conducted in China both found that symptom mean scores were significantly higher among rural than urban residents.^{93,94}

The finding that the odds of depression appear to be significantly lower among older adults in rural than urban areas of China could partially be the result of mass migration of older adults with greater socioeconomic resources (i.e., lower depression risk) from rural to urban areas.^{93,95} Li et al.⁹³ found that the association between rural residence and depression among older adults in China lost significance after adjusting for socioeconomic factors at household- and community-levels. It is also possible that the elevated prevalence of depression among older adults in rural China could be the result of an “empty nest” trend in which the children of rural older adults are leaving home to work in cities at an accelerated rate.⁹⁶ In a sample drawn from older adult empty nest households in China, Su and colleagues⁹⁴ found that depression symptoms scores were significantly higher for those in rural than urban areas.

Future research in countries other than China that have rapidly developing economies and are experiencing major trends in rural–urban migration (e.g., India,

Nigeria)¹ should test the hypothesis that rural residence is associated with depression among older adults. Relatedly, future research should integrate measures of urban–rural residence and depression into longitudinal studies of older adults to examine how the age at which migration occurs might affect depression risk. In their cross-sectional study of older adults in South Korea, Kim and colleagues⁸⁶ retrospectively assessed past urban–rural residence via self-report and found that depression prevalence was higher among those who moved from rural to urban areas between the ages of 21 and 60 years (20.3%), and after age 60 years (25.5%) than those who lived in urban areas their entire lives (19.3%).

Given the large heterogeneity in the magnitude of associations between urban–rural residence and depression, additional research is needed to understand how social and economic factors might interact with features of urban and rural environments to influence depression risk among older adults. For example, a significant interaction was identified between social isolation, rural residence, and depression in five studies^{75,83,85,86,91} and future research should test the hypothesis that social isolation mediates the relationship between rural residence and depression in countries with developing economies. Relatedly, more research is needed on how macro-level factors that vary across countries (e.g., public transportation infrastructure, pensions, access to healthcare services) might mediate and moderate associations between urban–rural residence and depression.

Limitations

This review and meta-analysis has seven main limitations. First, urban and rural residence was not operationalized consistently between studies. Even within a single country, an inherent challenge to reviews of urban–rural differences in health is the fact that various definitions of urban and rural exist and are accepted—ranging from measures of population density to algorithm-based definitions produced by government agencies.^{97,98} This challenge is exacerbated in cross-national reviews because definitions of urban and rural vary dramatically between countries.^{99,100} However, country definitions of urban are similar to standardized UN definitions.¹⁷ Second, there are many different types of urban and rural areas (e.g., agriculture communities versus indigenous communities, in the case of rural) and this review did not assess these distinctions. Third, this review was limited to comparative studies that presented data on the prevalence of depression among both urban and rural older adults. Authors limited the review to comparative studies because a wide range of depression instruments and

scoring thresholds are used in the literature and limiting the review to comparative studies, in which the same instrument and scoring threshold were applied to both urban and rural groups, allowed authors to ensure that the pooled measures of association would not be biased by systematic differences in how depression was measured between urban and rural groups. This study was also limited to English language peer-reviewed literature and did not include gray literature (e.g., government reports). Fourth, authors did not differentiate between MDD and CSDSs because there were substantial differences in how these outcomes were operationalized across studies and because the study's aims were focused on assessing the relative association between urban–rural residence and depression among older adults—not estimating depression prevalence in urban and rural areas. Fifth, studies included in this review were only conducted in six developed countries and eight developing countries and the results are not representative of all developed or developing countries. Sixth, the studies included in the review were published over a 26-year period and pooled results might not reflect recent changes in urban and rural environments. For example, in the U.S., suicide rates are increasing at a faster pace in rural than urban counties and such a trend could indicate that features of rural environments related to mental health are changing.¹⁰¹ Finally, it should be emphasized that all 18 studies included in the review were cross-sectional and only nine articles presented adjusted estimates of urban–rural depression risk. Thus, the results demonstrate associations between urban–rural residence and depression among older adults but should not be interpreted as implying causality.

CONCLUSIONS

This review of comparative studies generally suggests that converging trends of urbanization, urban migration, and population aging could increase the global burden of depression among older adults. The heterogeneity of results between studies suggests that the nature of the relationship between urban–rural residence and depression among older adults varies across contexts. Future research is needed to identify the specific factors that moderate the impact of urban living on depression and the most effective intervention strategies.

ACKNOWLEDGMENTS

This study was supported by the European Union Horizon 2020 Programme under grant agreement #667661 (Promoting mental wellbeing in the ageing population—MINDMAP). The study does not necessarily reflect the Commission's views and in no way anticipates the Commission's future policy in this area. The

study sponsor had no role in study design; collection, analysis, and interpretation of data; writing the report; and the decision to submit the report for publication.

No financial disclosures were reported by the authors of this paper.

SUPPLEMENTAL MATERIAL

Supplemental materials associated with this article can be found in the online version at <https://doi.org/10.1016/j.amepre.2018.11.008>.

REFERENCES

- UN, Department of Economic and Social Affairs, Population Division. *World Urbanization Prospects: The 2014 Revision, Highlights*. New York, NY: UN; 2014.
- UN, Department of Economic and Social Affairs, Population Division. *World Population Prospects: The 2015 Revision, World Population 2015 Wallchart*. New York, NY: UN; 2015.
- UN, Department of Economic and Social Affairs, Population Division. *World Population Prospects: The 2017 Revision, World Population 2017 Wallchart*. New York, NY: UN; 2017.
- Beard JR, Bloom DE. Towards a comprehensive public health response to population ageing. *Lancet*. 2015;385(9968):658–661. [https://doi.org/10.1016/S0140-6736\(14\)61461-6](https://doi.org/10.1016/S0140-6736(14)61461-6).
- Beard JR, Petitot C. Ageing and urbanization: can cities be designed to foster active ageing? *Public Health Rev*. 2010;32(2):427–450. <https://doi.org/10.1007/BF03391610>.
- Steels S. Key characteristics of age-friendly cities and communities: a review. *Cities*. 2015;47:45–52. <https://doi.org/10.1016/j.cities.2015.02.004>.
- Buffel T, Phillipson C. Can global cities be ‘age-friendly cities’? Urban development and ageing populations. *Cities*. 2016;55:94–100. <https://doi.org/10.1016/j.cities.2016.03.016>.
- Jackisch J, Zamaro G, Green G, Huber M. Is a healthy city also an age-friendly city? *Health Promot Int*. 2015;30(suppl 1):i108–i117. <https://doi.org/10.1093/heapro/dav039>.
- Leggett A, Zarit S. Prevention of mental disorders in older adults: recent innovations and future directions. *Generations*. 2014;38(3):45–52.
- Lambert KG, Nelson RJ, Jovanovic T, Cerda M. Brains in the city: neurobiological effects of urbanization. *Neurosci Biobehav Rev*. 2015;58:107–122. <https://doi.org/10.1016/j.neubiorev.2015.04.007>.
- Galea S. The urban brain: new directions in research exploring the relation between cities and mood–anxiety disorders. *Depress Anxiety*. 2011;28(10):857–862. <https://doi.org/10.1002/da.20868>.
- Srivastava K. Urbanization and mental health. *Ind Psychiatry J*. 2009;18(2):75–76. <https://doi.org/10.4103/0972-6748.64028>.
- Sturm R, Cohen D. Proximity to urban parks and mental health. *J Ment Health Policy Econ*. 2014;17(1):19–24.
- Galea S, Uddin M, Koenen K. The urban environment and mental disorders: epigenetic links. *Epigenetics*. 2011;6(4):400–404. <https://doi.org/10.4161/epi.6.4.14944>.
- Sundquist K, Frank G, Sundquist J. Urbanisation and incidence of psychosis and depression. *Br J Psychiatry*. 2004;184(4):293–298. <https://doi.org/10.1192/bjp.184.4.293>.
- Peen J, Schoevers RA, Beekman AT, Dekker J. The current status of urban–rural differences in psychiatric disorders. *Acta Psychiatr Scand*. 2010;121(2):84–93. <https://doi.org/10.1111/j.1600-0447.2009.01438.x>.
- DeVylder JE, Kelleher I, Lalane M, Oh H, Link BG, Koyanagi A. Association of urbanicity with psychosis in low-and middle-income countries. *JAMA Psychiatry*. 2018;75(7):678–686. <https://doi.org/10.1001/jamapsychiatry.2018.0577>.
- Fiske A, Wetherell JL, Gatz M. Depression in older adults. *Annu Rev Clin Psychol*. 2009;5:363–389. <https://doi.org/10.1146/annurev.clinpsy.032408.153621>.
- Hasin DS, Goodwin RD, Stinson FS, Grant BF. Epidemiology of major depressive disorder: results from the National Epidemiologic Survey on Alcoholism and Related Conditions. *Arch Gen Psychiatry*. 2005;62(10):1097–1106. <https://doi.org/10.1001/archpsyc.62.10.1097>.
- Alexopoulos GS. Depression in the elderly. *Lancet*. 2005;365(9475):1961–1970. [https://doi.org/10.1016/S0140-6736\(05\)66665-2](https://doi.org/10.1016/S0140-6736(05)66665-2).
- Blazer D. Depression in the elderly. *N Engl J Med*. 1989;320(3):164–166. <https://doi.org/10.1056/NEJM198901193200306>.
- Friedhoff AJ, Ballenger J, Bellack AS, et al. Diagnosis and treatment of depression in late life. *JAMA*. 1992;268(8):1018–1024. <https://doi.org/10.1001/jama.1992.03490080092032>.
- Djernes JK. Prevalence and predictors of depression in populations of elderly: a review. *Acta Psychiatr Scand*. 2006;113(5):372–387. <https://doi.org/10.1111/j.1600-0447.2006.00770.x>.
- Sutin AR, Terracciano A, Milaneschi Y, An Y, Ferrucci L, Zonderman AB. The trajectory of depressive symptoms across the adult life span. *JAMA Psychiatry*. 2013;70(8):803–811. <https://doi.org/10.1001/jamapsychiatry.2013.193>.
- Blazer DG. Depression in late life: review and commentary. *J Gerontol A Biol Sci Med Sci*. 2003;58(3):249–265. <https://doi.org/10.1093/gerona/58.3.M249>.
- Beekman A, Copeland J, Prince MJ. Review of community prevalence of depression in later life. *Br J Psychiatry*. 1999;174(4):307–311. <https://doi.org/10.1192/bjp.174.4.307>.
- Meeks TW, Vahia IV, Lavretsky H, Kulkarni G, Jeste DV. A tune in “a minor” can “b major”: a review of epidemiology, illness course, and public health implications of subthreshold depression in older adults. *J Affect Disord*. 2011;129(1):126–142. <https://doi.org/10.1016/j.jad.2010.09.015>.
- Haigh EA, Bogucki OE, Sigmon ST, Blazer DG. Depression among older adults: a 20-year update on five common myths and misconceptions. *Am J Geriatr Psychiatry*. 2018;26(1):107–122. <https://doi.org/10.1016/j.jagp.2017.06.011>.
- Kok RM, Reynolds CF III. Management of depression in older adults: a review. *JAMA*. 2017;317(20):2114–2122. <https://doi.org/10.1001/jama.2017.5706>.
- Mitchell AJ, Subramaniam H. Prognosis of depression in old age compared to middle age: a systematic review of comparative studies. *Am J Psychiatry*. 2005;162(9):1588–1601. <https://doi.org/10.1176/appi.ajp.162.9.1588>.
- Chui H, Gerstorf D, Hoppmann CA, Luszcz MA. Trajectories of depressive symptoms in old age: integrating age-, pathology-, and mortality-related changes. *Psychol Aging*. 2015;30(4):940–951. <https://doi.org/10.1037/pag0000054>.
- Cole MG, Bellavance F, Mansour A. Prognosis of depression in elderly community and primary care populations: a systematic review and meta-analysis. *Am J Psychiatry*. 1999;156(8):1182–1189. <https://doi.org/10.1176/ajp.156.8.1182>.
- Chapman DP, Perry GS. Depression as a major component of public health for older adults. *Prev Chronic Dis*. 2008;5(1):A22.
- Rodda J, Walker Z, Carter J. Depression in older adults. *BMJ*. 2011;343(8):d5219. <https://doi.org/10.1136/bmj.d5219>.
- Brodsky H, Luscombe G, Parker G, et al. Early and late onset depression in old age: different aetiologies, same phenomenology. *J Affect Disord*. 2001;66(2):225–236. [https://doi.org/10.1016/S0165-0327\(00\)00317-7](https://doi.org/10.1016/S0165-0327(00)00317-7).
- Bruce ML, McAvay GJ, Raue PJ, et al. Major depression in elderly home health care patients. *Am J Psychiatry*. 2002;159(8):1367–1374. <https://doi.org/10.1176/appi.ajp.159.8.1367>.
- Heun R, Papassotiropoulos A, Jessen F, Maier W, Breitner JC. A family study of Alzheimer disease and early-and late-onset depression in elderly patients. *Arch Gen Psychiatry*. 2001;58(2):190–196. <https://doi.org/10.1001/archpsyc.58.2.190>.

38. Cole MG, Dendukuri N. Risk factors for depression among elderly community subjects: a systematic review and meta-analysis. *Am J Psychiatry*. 2003;160(6):1147–1156. <https://doi.org/10.1176/appi.ajp.160.6.1147>.
39. Perlis ML, Smith LJ, Lyness JM, et al. Insomnia as a risk factor for onset of depression in the elderly. *Behav Sleep Med*. 2006;4(2):104–113. https://doi.org/10.1207/s15402010bsm0402_3.
40. Fonken LK, Finy MS, Walton JC, et al. Influence of light at night on murine anxiety- and depressive-like responses. *Behav Brain Res*. 2009;205(2):349–354. <https://doi.org/10.1016/j.bbr.2009.07.001>.
41. Stevens RG, Brainard GC, Blask DE, Lockley SW, Motta ME. Adverse health effects of nighttime lighting: comments on American Medical Association policy statement. *Am J Prev Med*. 2013;45(3):343–346. <https://doi.org/10.1016/j.amepre.2013.04.011>.
42. Chepesiuk R. Missing the dark: health effects of light pollution. *Environ Health Perspect*. 2009;117(1):A20–A27. <https://doi.org/10.1289/ehp.117-a20>.
43. Salgado-Delgado R, Tapia Osorio A, Saderi N, Escobar C. Disruption of circadian rhythms: a crucial factor in the etiology of depression. *Depress Res Treat*. 2011;2011:839743. <https://doi.org/10.1155/2011/839743>.
44. Julien D, Richard L, Gauvin L, Kestens Y. Neighborhood characteristics and depressive mood among older adults: an integrative review. *Int Psychogeriatr*. 2012;24(8):1207–1225. <https://doi.org/10.1017/S1041610211002894>.
45. Elliott J, Gale CR, Parsons S, Kuh D, Team HS. Neighbourhood cohesion and mental wellbeing among older adults: a mixed methods approach. *Soc Sci Med*. 2014;107:44–51. <https://doi.org/10.1016/j.socscimed.2014.02.027>.
46. Richardson R, Westley T, Gariépy G, Austin N, Nandi A. Neighborhood socioeconomic conditions and depression: a systematic review and meta-analysis. *Soc Psychiatry Psychiatr Epidemiol*. 2015;50(11):1641–1656. <https://doi.org/10.1007/s00127-015-1092-4>.
47. Ivey SL, Kealey M, Kurtovich E, et al. Neighborhood characteristics and depressive symptoms in an older population. *Aging Ment Health*. 2015;19(8):713–722. <https://doi.org/10.1080/13607863.2014.962006>.
48. Wilson-Genderson M, Pruchno R. Effects of neighborhood violence and perceptions of neighborhood safety on depressive symptoms of older adults. *Soc Sci Med*. 2013;85:43–49. <https://doi.org/10.1016/j.socscimed.2013.02.028>.
49. Marc A, Willman AM. *Violence in the City: Understanding and Supporting Community Responses to Urban Violence*. Washington, DC: World Bank; 2010.
50. Sjösten N, Kivelä SL. The effects of physical exercise on depressive symptoms among the aged: a systematic review. *Int J Geriatr Psychiatry*. 2006;21(5):410–418. <https://doi.org/10.1002/gps.1494>.
51. Barbour KA, Blumenthal JA. Exercise training and depression in older adults. *Neurobiol Aging*. 2005;26(1):119–123. <https://doi.org/10.1016/j.neurobiolaging.2005.09.007>.
52. McAuley E, Rudolph D. Physical activity, aging, and psychological well-being. *J Aging Phys Act*. 1995;3(1):67–96. <https://doi.org/10.1123/japa.3.1.67>.
53. Brown DR. Physical activity, aging, and psychological well-being: an overview of the research. *Can J Sport Sci*. 1992;17(3):185–193.
54. Arent S, Landers M, Etnier J. The effects of exercise on mood in older adults: a meta-analytic. *J Aging Phys Act*. 2000;8(4):407–430. <https://doi.org/10.1123/japa.8.4.407>.
55. Blake H, Mo P, Malik S, Thomas S. How effective are physical activity interventions for alleviating depressive symptoms in older people? A systematic review. *Clin Rehabil*. 2009;23(10):873–887. <https://doi.org/10.1177/0269215509337449>.
56. Nolen-Hoeksema S, Ahrens C. Age differences and similarities in the correlates of depressive symptoms. *Psychol Aging*. 2002;17(1):116–124. <https://doi.org/10.1037/0882-7974.17.1.116>.
57. Choi NG, DiNitto DM. Depressive symptoms among older adults who do not drive: association with mobility resources and perceived transportation barriers. *Gerontologist*. 2016;56(3):432–443. <https://doi.org/10.1093/geront/gnu116>.
58. Musselwhite C, Holland C, Walker I. The role of transport and mobility in the health of older people. *Transp Health*. 2015(1):1–4. <https://doi.org/10.1016/j.jth.2015.02.001>.
59. Mammen G, Faulkner G. Physical activity and the prevention of depression: a systematic review of prospective studies. *Am J Prev Med*. 2013;45(5):649–657. <https://doi.org/10.1016/j.amepre.2013.08.001>.
60. Beard JR, Petitot C. Ageing and urbanization: can cities be designed to foster active ageing? *Public Health Rev*. 2010;32(2):427–450. <https://doi.org/10.1007/BF03391610>.
61. Evans GW. The built environment and mental health. *J Urban Health*. 2003;80(4):536–555. <https://doi.org/10.1093/jurban/jtg063>.
62. Guite H, Clark C, Ackrill G. The impact of the physical and urban environment on mental well-being. *Public Health*. 2006;120(12):1117–1126. <https://doi.org/10.1016/j.puhe.2006.10.005>.
63. WHO. Mental Health ATLAS 2017. www.who.int/mental_health/evidence/atlas/mental_health_atlas_2017/en/. Published 2018. Accessed July 1, 2018.
64. Montgomery B, Roberts P. *Walk Urban: Demand, Constraints, and Measurement of the Urban Pedestrian Environment*. Washington, DC: World Bank; 2008.
65. Cervero R. Transport infrastructure and the environment in the Global South: sustainable mobility and urbanism. *J Region City Plan*. 2014;25(3):174–191.
66. Kirkbride JB, Keyes KM, Susser E. City living and psychotic disorders—implications of global heterogeneity for theory development. *JAMA Psychiatry*. In press. Online October 10, 2018. <https://doi.org/10.1001/jamapsychiatry.2018.2640>.
67. Franck L, Molyneux N, Parkinson L. Systematic review of interventions addressing social isolation and depression in aged care clients. *Qual Life Res*. 2016;25(6):1395–1407. <https://doi.org/10.1007/s11136-015-1197-y>.
68. Jorm AF. Does old age reduce the risk of anxiety and depression? A review of epidemiological studies across the adult life span. *Psychol Med*. 2000;30(01):11–22. <https://doi.org/10.1017/S0033291799001452>.
69. Luppá M, Sikorski C, Luck T, et al. Age- and gender-specific prevalence of depression in latest-life—systematic review and meta-analysis. *J Affect Disord*. 2012;136(3):212–221. <https://doi.org/10.1016/j.jad.2010.11.033>.
70. Vink D, Aartsen MJ, Schoevers RA. Risk factors for anxiety and depression in the elderly: a review. *J Affect Disord*. 2008;106(1):29–44. <https://doi.org/10.1016/j.jad.2007.06.005>.
71. Chen R, Copeland JR, Wei L. A meta-analysis of epidemiological studies in depression of older people in the People's Republic of China. *Int J Geriatr Psychiatry*. 1999;14(10):821–830. [https://doi.org/10.1002/\(SICI\)1099-1166\(199910\)14:10<821::AID-GPS21>3.0.CO;2-0](https://doi.org/10.1002/(SICI)1099-1166(199910)14:10<821::AID-GPS21>3.0.CO;2-0).
72. Higgins JP, Thompson SG, Deeks JJ, Altman DG. Measuring inconsistency in meta-analyses. *BMJ*. 2003;327(7414):557–560. <https://doi.org/10.1136/bmj.327.7414.557>.
73. UN. World Economic Situation and Prospects 2014. www.un.org/en/development/desa/policy/wesp/wesp_current/2014wesp_country_classification.pdf. Accessed July 1, 2018.
74. Sterne JA, Egger M. Funnel plots for detecting bias in meta-analysis: guidelines on choice of axis. *J Clin Epidemiol*. 2001;54(10):1046–1055. [https://doi.org/10.1016/S0895-4356\(01\)00377-8](https://doi.org/10.1016/S0895-4356(01)00377-8).
75. Abe Y, Fujise N, Fukunaga R, Nakagawa Y, Ikeda M. Comparisons of the prevalence of and risk factors for elderly depression between urban and rural populations in Japan. *Int Psychogeriatr*. 2012;24(8):1235–1241. <https://doi.org/10.1017/S1041610212000099>.
76. Ahmadi SM, Mohammadi MR, Mostafavi SA, et al. Dependence of the geriatric depression on nutritional status and anthropometric indices in elderly population. *Iran J Psychiatry*. 2013;8(2):92–96.
77. Baker FM, Okwumabua J, Philipose V, Wong S. Screening African-American elderly for the presence of depressive symptoms: a

- preliminary investigation. *J Geriatr Psychiatry Neurol*. 1996;9(3):127–132. <https://doi.org/10.1177/089198879600900304>.
78. Bergdahl E, Allard P, Lundman B, Gustafson Y. Depression in the oldest old in urban and rural municipalities. *Aging Ment Health*. 2007;11(5):570–578. <https://doi.org/10.1080/13607860601086595>.
 79. Carpinello B, Carta MG, Rudas N. Depression among elderly people: a psychosocial study of urban and rural populations. *Acta Psychiatr Scand*. 1989;80(5):445–450. <https://doi.org/10.1111/j.1600-0447.1989.tb03004.x>.
 80. Chen R, Hu Z, Wei L, Wilson K. Socioeconomic status and survival among older adults with dementia and depression. *Br J Psychiatry*. 2014;204(6):436–440. <https://doi.org/10.1192/bjp.bp.113.134734>.
 81. Chiu H-C, Chen C-M, Huang C-J, Mau L-W. Depressive symptoms, chronic medical conditions and functional status: a comparison of urban and rural elders in Taiwan. *Int J Geriatr Psychiatry*. 2005;20(7):635–644. <https://doi.org/10.1002/gps.1292>.
 82. Feng L, Li P, Lu C, et al. Burden and correlates of geriatric depression in the Uyghur elderly population, observation from Xinjiang, China. *PLoS One*. 2014;9(12):e114139. <https://doi.org/10.1371/journal.pone.0114139>.
 83. Friedman B, Conwell Y, Delavan RL. Correlates of late-life major depression: a comparison of urban and rural primary care patients. *Am J Geriatr Psychiatry*. 2007;15(1):28–41. <https://doi.org/10.1097/01.JGP.0000224732.74767.ad>.
 84. Guerra M, Ferri CP, Sosa AL, et al. Late-life depression in Peru, Mexico and Venezuela: the 10/66 population-based study. *Br J Psychiatry*. 2009;195(6):510–515. <https://doi.org/10.1192/bjp.bp.109.064055>.
 85. Kim JM, Shin IS, Yoon JS, Stewart R. Prevalence and correlates of late-life depression compared between urban and rural populations in Korea. *Int J Geriatr Psychiatry*. 2002;17(5):409–415. <https://doi.org/10.1002/gps.622>.
 86. Kim JM, Stewart R, Shin IS, Yoon JS, Lee HY. Lifetime urban/rural residence, social support and late-life depression in Korea. *Int J Geriatr Psychiatry*. 2004;19(9):843–851. <https://doi.org/10.1002/gps.1175>.
 87. Ma X, Xiang YT, Li SR, et al. Prevalence and sociodemographic correlates of depression in an elderly population living with family members in Beijing, China. *Psychol Med*. 2008;38(12):1723–1730. <https://doi.org/10.1017/S0033291708003164>.
 88. Mechakra-Tahiri S, Zuzunegui MV, Preville M, Dube M. Social relationships and depression among people 65 years and over living in rural and urban areas of Quebec. *Int J Geriatr Psychiatry*. 2009;24(11):1226–1236. <https://doi.org/10.1002/gps.2250>.
 89. Schulman E, Gairola G, Kuder L, McCulloch J. Depression and associated characteristics among community-based elderly people. *J Allied Health*. 2002;31(3):140–146.
 90. Sengupta P, Benjamin AI. Prevalence of depression and associated risk factors among the elderly in urban and rural field practice areas of a tertiary care institution in Ludhiana. *Indian J Public Health*. 2015;59(1):3–8. <https://doi.org/10.4103/0019-557X.152845>.
 91. St John PD, Blandford AA, Strain LA. Depressive symptoms among older adults in urban and rural areas. *Int J Geriatr Psychiatry*. 2006;21(12):1175–1180. <https://doi.org/10.1002/gps.1637>.
 92. Walters K, Breeze E, Wilkinson P, Price GM, Bulpitt CJ, Fletcher A. Local area deprivation and urban-rural differences in anxiety and depression among people older than 75 years in Britain. *Am J Public Health*. 2004;94(10):1768–1774. <https://doi.org/10.2105/AJPH.94.10.1768>.
 93. Li LW, Liu JY, Xu HW, Zhang ZM. Understanding rural–urban differences in depressive symptoms among older adults in China. *J Aging Health*. 2016;28(2):341–362. <https://doi.org/10.1177/0898264315591003>.
 94. Su D, Wu XN, Zhang YX, et al. Depression and social support between China's rural and urban empty-nest elderly. *Arch Gerontol Geriatr*. 2012;55(3):564–569. <https://doi.org/10.1016/j.archger.2012.06.006>.
 95. The World Bank. New Bank report looks at China's rural elderly. <http://www.worldbank.org/en/news/press-release/2012/04/09/new-bank-report-looks-at-china-rural-elderly>. Published April 9, 2012. Accessed July 1, 2018.
 96. Liu L-J, Guo Q. Loneliness and health-related quality of life for the empty nest elderly in the rural area of a mountainous county in China. *Qual Life Res*. 2007;16(8):1275–1280. <https://doi.org/10.1007/s11136-007-9250-0>.
 97. Ratcliffe M, Burd C, Holder K, Fields A. *Defining Rural at the U.S. Census Bureau: American Community Survey and Geography Brief*. Washington, DC: U.S. Census Bureau; 2016.
 98. Hall SA, Kaufman JS, Ricketts TC. Defining urban and rural areas in U.S. epidemiologic studies. *J Urban Health*. 2006;83(2):162–175. <https://doi.org/10.1007/s11524-005-9016-3>.
 99. Definition of “Urban.”. Demographic Yearbook 2005, table 6. https://unstats.un.org/unsd/demographic/sconcerns/densurb/Definition_of%20Urban.pdf. Published 2005. Accessed July 1, 2018.
 100. UN Statistics Division. Population density and urbanization. <https://unstats.un.org/UNSD/demographic/sconcerns/densurb/densurbmethods.htm>. Published 2017. Accessed July 1, 2018.
 101. Rossen LM, Hedegaard H, Khan D, Warner M. County-level trends in suicide rates in the U.S., 2005–2015. *Am J Prev Med*. 2018;55(1):72–79. <https://doi.org/10.1016/j.amepre.2018.03.020>.