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REVIEW ARTICLE

Neighborhood Environment and Cognition in Older Adults: A Systematic Review

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Context: Some evidence suggests that treating vascular risk factors and performing mentally stimulating activities may delay cognitive impairment onset in older adults. Exposure to a complex neighborhood environment may be one mechanism to help delay cognitive decline.

Evidence acquisition: PubMed, Web of Science, and ProQuest Dissertation and Theses Global database were systematically reviewed, identifying 25 studies published from February 1, 1989 to March 5, 2016 (data synthesized, May 3, 2015 to October 7, 2016). The review was restricted to quantitative studies focused on: (1) neighborhood social and built environment and cognition; and (2) community-dwelling adults aged ≥45 years.

Evidence synthesis: The majority of studies were cross-sectional, U.S.-based, and found at least one significant association. The diversity of measures and neighborhood definitions limited the synthesis of findings in many instances. Evidence was moderately strong for an association between neighborhood SES and cognition, and modest for associations between neighborhood demographics, design, and destination accessibility and cognition. Most studies examining effect modification found significant associations, with some evidence for effect modification of the neighborhood SES—cognition association by individual-level SES. No studies had low risk of bias and many tested multiple associations that increased the chance of a statistically significant finding. Considering the studies to date, the evidence for an association between neighborhood characteristics and cognition is modest.

Conclusions: Future studies should include longitudinal measures of neighborhood characteristics and cognition; examine potential effect modifiers, such as sex and disability; and study mediators that may help elucidate the biological mechanisms linking neighborhood environment and cognition.
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CONTEXT

At least 10% of older adults (aged ≥65 years) have mild cognitive impairment[1] and approximately 5 million Americans have Alzheimer disease dementia (AD),[2] conditions that will increase in incidence with the projected rise in population of older adults.[3,4] To date, no effective treatments are available to ameliorate or cure AD, the most common neurodegenerative cause of cognitive impairment. However, some research suggests that treating vascular risk factors and performing cognitively stimulating activities may delay the onset of cognitive impairment[5] and reduce AD pathology.[6] Exposure to complex, stimulating neighborhood environments may be one mechanism that delays cognitive impairment.[7]

Recently, studies have started examining how the neighborhood social environment and built environment (BE) may affect cognition in older adults. The BE encompasses the physical aspects of living and work environments, including the placement and configuration of roads, homes, commercial buildings, and public

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spaces; whereas the social environment includes human-centered characteristics, such as demographics, SES, social disorder, and social climate. A literature review of neighborhood environment and health in older adults[8] found that neighborhood SES (NSES) was more frequently associated with health than neighborhood BE measures, and the only study of cognition found that living in neighborhoods with less-educated residents was associated with worse cognition.[9] In another systematic review focused on community environment and cognition in older adults,[10] the authors also found that lower community SES was frequently associated with worse cognition.

The same mechanisms that link the neighborhood environment and physical activity, blood pressure, obesity, depression, and quality of life[11–15] may explain associations between the neighborhood environment and cognition. The mechanisms may relate to the neighborhood's impact on personal mobility; one's sense of security and safety; potential for chance interactions; exercise and social engagement; access to healthy foods and green space; and exposure to pollution, crime, and social deprivation. For older adults, the neighborhood may become more important, with increasingly less time in motorized transportation and more time in the neighborhood.[16] The neighborhood environment's impact on health may be intensified by physical disability or difficulty navigating and interacting in the neighborhood due to normal cognitive aging.[7] Additionally, the neighborhood may play a strong role in determining the social ties and social participation among older adults,[17,18] which can affect psychological health and well-being.

Approximately 80% of the U.S. population lived in urban areas in 2010[19] and more than 90% of older adults would like to age in place, staying in their homes and neighborhoods for as long as possible.[20] Compared with the social environment, the BE is more directly targeted by city and regional planning efforts, and has been studied less in relation to cognition in older adults. Therefore, this study aimed to systematically review publications on the neighborhood social environment and BE and cognition in older adults, with added emphasis on the BE and effect modification (e.g., differential impact on vulnerable populations), two areas that were mentioned only briefly in a 2014 review of community environment and cognition.[10]

EVIDENCE ACQUISITION

Neighborhoods were defined as geographic areas smaller than towns, cities, or counties and were delineated using administrative boundaries, circumscribed areas (e.g., 0.5 miles around home), or perceived geographic boundaries. The environment surrounding the home was chosen to represent the social and physical exposures likely to affect older adults frequently.

Neuropsychological tests are one means of evaluating cognitive functioning, and have been designed to measure global cognition as well as various cognitive domains (e.g., memory, language).[21] In this review, cognition could have been determined by a clinician or assessed using brief cognitive measures such as the Mini–Mental State Examination (MMSE) or domain-specific neuropsychological tests.

Search Criteria

PubMed, Web of Science (all databases), and ProQuest Dissertation and Theses Global database were systematically reviewed for papers and dissertations published through March 5, 2016 (resulted in publications from February 1, 1989). The following keywords were searched: (*built environment* or *neighborhood environment* or *neighborhood level* or *walkability*) AND (*cognition* or *cognitive function* or *cognitive decline* or *cognitive impairment* or *dementia* or *Alzheimer* or *Alzheimer's* or *demented* or *cognitive* or *memory*). Given these search criteria, results were likely to include studies of the BE, social environment, or both. Papers were excluded if they were: not in English, not quantitative, or not focused on community-dwelling adults aged ≥45 years, neighborhood-level characteristics, and the neighborhood–cognition association.

Methods

The social environment findings were synthesized into four categories: SES (e.g., income), demographics (e.g., race/ethnicity), social disorder (e.g., crime), and social climate/social ties (e.g., social support). The BE findings were grouped according to the "5D" categories previously proposed to influence travel behavior[22]: density (e.g., population density, density of social destinations), diversity (e.g., land use mix), design (e.g., intersection density, presence of sidewalks), destination accessibility (e.g., distance to nearest store), and distance to transit (e.g., nearest bus stop). The 5D categories allow for a synthesis using terminology that is frequently used in neighborhood research and relatable to city planners. Data were synthesized between May 3, 2015 and October 7, 2016.

The studies were too disparate to evaluate whether they met the epidemiologic criteria for causality. Instead, the risk of bias by participant selection, confounding of the neighborhood–cognition association, and missing data (all variables) was determined using the Risk of Bias in Non-randomized Studies of Interventions (ROBINS-I) tool,[23–25] which helped assess the strength of evidence to date. Additionally, six criteria were developed to evaluate the neighborhood measures (did not provide validity/reliability, used one or more perceived measure, and used one or more composite measure) and cognitive measures (did not provide validity/reliability, used one or more composite measure, and no longitudinal measure used). Bias can occur if perceived measures of the neighborhood relate to cognition or if the neighborhood or cognitive measures are associated with measurement error (e.g., invalid measures, composite measure).[26–30] Each domain (e.g., selection) was evaluated for risk of bias (low=1, moderate=2, serious=3, critical=4), and overall risk of bias was calculated by a simple average of the domain scores.

EVIDENCE SYNTHESIS

The final sample included 25 studies[9,17,31–53] (Figure 1). Six non-U.S. studies were from the Netherlands, United