



Review

Environments for healthy ageing: A critical review

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ABSTRACT

Population health outcomes are shaped by complex interactions between individuals and the environments in which they live, work and play. Environments encompass streets and buildings (physical environment), attitudes, supports and relationships with others (social environment), as well as social and political systems and policies. The impact of environments on the physical, mental health and functioning of individuals has emerged as a growing body of research in population health and health disparities. Yet, the majority of studies in this area do not focus on older adults even though older adults are particularly susceptible to the characteristics of their local environments. In this paper we review the current state of the health literature on physical environments for healthy ageing, using the International Classification of Functioning Disability and Health as a framework. Collectively, the literature emphasizes the role of supportive, barrier-free environments particularly for older adults who are at greater risk for disability and poor health. As part of our review we identify conceptual as well as methodological limitations in the current literature, including (i) a theoretical and empirical neglect of the underlying mechanisms behind the person–environment relationship; (ii) a lack of studies using nationally representative samples; (iii) over-reliance on cross-sectional data; and (iv) a need for better definition and measurement of person-centered environments. We conclude by offering some suggestions and directions for future research in this area.

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1. Introduction

Population health outcomes are shaped by complex interactions between individuals and the diverse physical, social, and political contexts (including the human made environment, social supports and relationships, attitudes, services, systems and poli-

cies) in which they are situated over the life course. These divergent contexts contribute to population health disparities both cross-sectionally as well as cumulatively over time, since mortality, disease prevalence, physical function and mental health have been found to vary across different environments [1]. Yet, the majority of studies in this area do not focus on older adults even though older adults are particularly susceptible to barriers in their local environments, especially when they experience limitations in their functional abilities and are in need of accessible transportation and services. As a result of declining health and functional status, financial strain and social isolation, persons at the latter stages of the life

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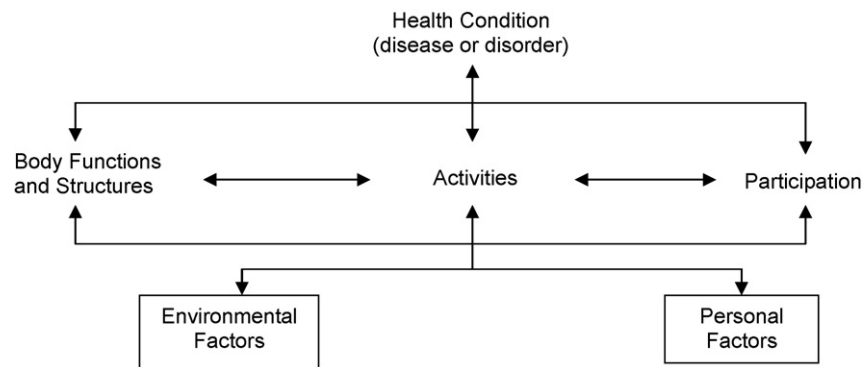


Fig. 1. Interactions between the Components of the International Classification of Functioning, Disability and Health (ICF) (WHO [6]). Note: Personal factors are included in the framework but are not classified in the current version of the ICF.

course are especially vulnerable to barriers in their surrounding social and physical environment [2,3].

In this paper we review the current state of the health literature on environments for healthy ageing with a focus on the neighborhood in which the person lives. Throughout our review, we use the term “environment” to capture a broad array of physical and social contexts (also referred to as neighborhoods within this literature) that people experience when engaging in activities outside the home. In order to contain the scope of the review we do not directly consider the literature on housing quality and health (e.g. [4]), which is also relevant for healthy ageing, nor do we provide a comprehensive review of the rehabilitation literature, which addresses environmental factors as they intersect with underlying disease processes and assistive technology. We first summarize a conceptual framework that builds on the need identified in ageing research to better understand how environments interact with underlying pathophysiological processes to influence health and functioning in older adults [5]. We then go on to review studies in this area, and identify conceptual as well as methodological limitations in the current literature. We conclude by offering some suggestions and directions for future research.

2. The ICF: a framework for healthy aging

Scholars agree that aging is a complex process in which environmental and personal lifestyle factors are influential. As Franco et al. [5] argue, there is a need for a comprehensive, holistic, multidisciplinary approach to better understand healthy aging trajectories. To meet this need it is relevant to look at a uniform framework, the International Classification of Functioning, Disability and Health (ICF) [6]. The ICF was developed to operationalize health and health-related domains within the context of environmental and personal factors. The ICF is an internationally recognized classification developed under the auspices of the World Health Organization to enhance the collection, analysis and interpretation of uniform health- and disability-related data at the individual and population level. More specifically, the ICF provides a scientific foundation for understanding and measuring health and health-related states.

The ICF framework (see Fig. 1) is particularly useful for this review. It is based on the concept that health and social functioning are influenced by complex interactions between environmental factors and body functions and structures (e.g. hemiparesis due to stroke), as well as activities and participation (e.g. mobility) [6]. Personal factors (such as gender, race, age, education, fitness, lifestyle, habits, and coping styles) are also included in the framework, but are not classified in the current version of the ICF. In this review we focus only on environmental factors.

The ICF addresses functioning at three levels (Fig. 1): the body (e.g. mental, physiological, or anatomical structures or functions), activities (e.g. dressing oneself, walking, reading, driving a car), and social participation (social activities, recreation and leisure, voting, or attending public events). For example, an individual with arthritis may experience pain (impairments in body functions and structures) that leads to severe difficulty in walking (activity limitation), which may restrict his or her involvement in life situations, such as meeting with close friends (participation restriction). Further, due to difficulty walking, this person is at increased risk of developing secondary health conditions such as cardiovascular disease or obesity, with further implications for restricted functioning and participation.

The ICF promotes a complex biopsychosocial approach in which environmental factors can facilitate or impede a person’s functioning in terms of activities and/or participation. Extending the example presented above, a person who has difficulty walking due to arthritis may continue to be active in social participation if he or she lives in an environment with an extensive, accessible public transit system. The comprehensive list of environmental factors in the ICF identifies a wide range of potential environmental barriers and facilitators [6].

3. Environments for healthy ageing: a review of the literature

Over the last two decades, the impact of environments on the physical and mental health and functioning of individuals has emerged as a frontier of research in population health and health disparities ([7]; for reviews, see [8,9]). Aspects of residential context may combine additively or interactively with individual-level variables to significantly increase our ability to explain variation in health and functional outcomes and/or their risk factors, hence offering new avenues for health-promoting interventions. However, only a minority of these studies has looked specifically at older adult populations, and very few studies have used a theoretical framework (such as the ICF) to guide their work. As a result, the findings are often atheoretical without explicit discussion of the underlying processes behind the person–environment fit or misfit [3,10], which has consequences for our ability to develop effective interventions.

The environmental barriers subjectively reported by older adults include poor transportation, discontinuous or uneven sidewalks, curbs, noise, and inadequate lighting [11,12]. Temperature extremes have also been related to older adult health outcomes [13,14]. In other research pedestrian-oriented designs (e.g. continuous, barrier-free sidewalks, four-way stop signals, and pedestrian amenities) and access to recreational facilities have been shown

to be positively associated with physical activity and self-rated health in older adults, and negatively related to obesity [15–23]. Poor street conditions, heavy traffic, and excessive noise have been shown to be associated with the onset of mobility impairments even up to 3 years later [24,25], offering evidence of a bidirectional relationship between activities and impairments, as advocated by the ICF framework (Fig. 1).

Curbs cuts (depressed curbs that act as ramps in sidewalks), smooth pavement, and barrier-free sidewalks are some of the environmental factors that can enhance independence and social participation in older adults at greatest risk, such as those who are socially isolated, prone to falling, or those with underlying weakness in movement-related functions and balance. Clarke and George [26] investigated the relationship between the built environment and daily activities (such as shopping, managing money, and getting around outside the home) with a sample of older adults living in central North Carolina. Consistent with the ICF framework, car dependent neighborhoods were inversely associated with independence in these activities but *only* among those with underlying impairment in movement and balance related functions. Environmental characteristics played no modifying role for those without mobility impairments [26].

A subsequent paper [27] examined the relationship between mobility and the built environment in the City of Chicago. Among residents with movement-related impairments, the odds of reporting severe difficulty walking were over four times greater for those living in neighborhoods with streets in poor condition (e.g. cracks, broken curbs, potholes) compared to those living in neighborhoods with streets in good condition. Street conditions had no effect on walking among those with no lower extremity impairments. These findings highlight the importance of residential context as a consequential factor in the degree to which limitations in physical functioning translate into actual difficulty in activities outside the home, but also suggest that built environments may have little or no effect among those with mild or no impairment [27].

Socially disadvantaged older adults are potentially more vulnerable to environmental barriers because of their greater need to access social services, such as a community meal programs and senior centers [12]. Women, minority, and low income seniors, are especially vulnerable because of their greater propensity to live alone in socially and economically disadvantaged areas without the language, education or economic resources to negotiate or even improve their environment. For example, low income and minority seniors are more likely to live in substandard housing with a decaying front porch or inaccessible front steps [11,12].

Freedman [28] examined the link between neighborhood socioeconomic characteristics (using tract-level indicators from the 2000 US Census) and stages of the disablement process among a nationally representative sample of American adults age 55 and older. Neighborhood socioeconomic advantage (represented by the percent owner-occupied housing units in each tract, percent families with income greater than \$75,000, and percent adults with a college degree) was associated with a reduced risk of lower body limitations. They also found marked gender differences. Among men, neighborhood socioeconomic disadvantage (captured by percent population in poverty; age 65+ population in poverty; proportion of households receiving public assistance income; proportion unemployed; and number of housing units without a vehicle) was associated with greater risk of difficulties with self-care activities (e.g. eating, dressing, bathing), but living in a census tract area with greater street connectivity was associated with a lower risk of IADL difficulty (again for men, but not for women) [28].

A similar association has been found between neighborhood socioeconomic disadvantage and self-rated poor health [29,30], a higher number of chronic health conditions [31], increased

cardiovascular, as well as all-cause, mortality [32–34] and progressive chronic kidney disease [35] in older adults. However, the association between neighborhood disadvantage and subclinical cardiovascular disease (e.g. asymptomatic peripheral vascular disease or carotid atherosclerosis) was not statistically significant after adjusting for individual risk factors that select individuals with poor health and fewer socioeconomic resources into socioeconomically disadvantaged environments [36].

A number of studies have found that neighborhood socioeconomic disadvantage is also associated with mental health outcomes including depression [37–39], cognitive impairment [40], and psychological well-being [41], operating over and above individual risk factors that select people into more disadvantaged neighborhoods over time. However, not all studies were able to rule out compositional effects for mental health outcomes [42].

The demographic structure of one's environment has also been found to be important for health in older adults. Living in an area with a higher proportion of older adults has been found to be associated with fewer depressive symptoms in later life [38] and better self-rated health [30]. Some data in the US suggest that older black Americans report better self-rated health when living in neighborhoods with a higher percentage of Black residents [43]. Cagney et al. [44] found that neighborhood socioeconomic advantage partly explains racial disparities in self-rated health.

Evidence also shows that the spatial distribution of health care resources is not equitable since physicians are concentrated in communities with greater economic wealth [45]. A higher proportion of older adults in a neighborhood may indicate a greater density of health and social services that are targeted towards older adults [30], with positive consequences for health and functioning [46]. Yet, not all studies have found that the number of health services mediates the relationship between neighborhood socioeconomic disadvantage or neighborhood age structure and the health of older adults [30,38].

4. Understanding the mechanisms behind the health–environment relationship

For the most part these findings are limited to cross-sectional data (for exceptions see [24,25]), preventing an understanding of the dynamic changes in health among representative samples of older adults living across diverse built environments as they age. During the aging process adults may experience a reduction in functional capacities, including walking, hearing, seeing, and cognitive function. In addition, individuals can experience a variety of different contextual conditions as they move in and out of different neighborhoods over the life course. Even over a defined period of time, neighborhood characteristics may change substantially following infrastructure and community development, and as adults age in place, their social participation and independence may be enhanced as their surrounding contexts are modified.

In one of the early studies of environments on health change in later life, Krause [47] found that exposure to deteriorated neighborhoods was associated with declines in self-rated health and functional independence over a 4 year period. However, true change in neighborhood exposure over the interval was not assessed. More recently, Sheffield and Peek [48] found that older Mexican Americans living in socioeconomically disadvantaged neighborhoods experienced significantly faster rates of cognitive decline over a 5 year period.

However, the “most pressing issue” in this research area [49], is the need for the development of better theory and understanding on the mechanisms by which environments affect health. This is a repeated concern raised also by other researchers [8,50] who argue that it is not sufficient to simply investigate community influences

without also developing an understanding of the dynamic processes by which neighborhood characteristics operate to influence different health outcomes. In spite of increasing evidence suggesting that place of residence matters to health, we are still unclear why and how this occurs and are consequently unable to “translate” such knowledge to interventions.

The ICF can operate as a unifying theoretical framework to better understand the mechanisms underlying observed relationships as well as to bridge findings across disciplines using a common language. For example, rather than examining the effects of environmental characteristics among older adults in general, the ICF framework directs us to examine environmental effects across those with different levels of underlying risk [26,27]. These modifying effects help to identify the mechanisms through which the environment is most operational. Yet, such stratified analyses are rarely performed in the extant literature.

In addition, the health field can learn much from the attention to social processes already demonstrated in the neighborhood literature in other disciplines [51–53]. For example, neighborhoods may affect health via the availability of accessible community resources (i.e. health services, recreational facilities, food banks or food subsidy programs) or via toxic environments (pollution, crowding, poor sanitation), through collective socialization or peer influence on health behaviors [51,53], through increased stress exposure in disadvantaged neighborhoods, or through “relative deprivation” and related social comparison processes [53].

Other personal factors including age, education, managing stress, health behaviors and religious coping, have been found to partly explain the relationship between neighborhood socioeconomic disadvantage and health [47,54,55]. Low income older adults living in high income neighborhoods have been found to experience worse health than low income adults living in low income neighborhoods [56,57] suggesting that social comparison processes with one’s neighbors may play a role in the health–environment relationship [58]. Perceptions of neighborhood social capital and neighborhood social cohesion have been found to be associated with decreased heart disease and mortality [59], but their mediating role with respect to structural indicators of contextual disadvantage were not investigated.

5. Implications and areas for further research

The role of the surrounding environment may play a key role in shaping patterns of independence and dependence among older adults. As costs increase, current long term care policies are shifting the care of older adults away from nursing homes and into the home and community setting. While the majority of older adults prefer to age in place [60], the environmental characteristics that facilitate independence in later life are not well understood. The struggle to maintain independence in the community in the face of declining health and function is a dynamic process that includes interpersonal, social, and environmental resources [61]. In this paper we reviewed the existing literature on environments for healthy ageing and found a growing body of work identifying environmental effects on a wide range of physical and mental health outcomes in older adults. These findings stress the role of supportive, barrier-free environments particularly for older adults who are at greater risk for disability and poor health due to the presence of underlying disease processes.

In this final section we identify three areas for future research. First, we argue for a uniform framework in the study of environments for healthy ageing. The ICF provides a useful bidirectional framework linking contextual factors, impairments, activity limitations and participation restrictions [6]. However, very few studies

reviewed for this paper addressed the impact of the environment for social participation, which is also a key component of overall health and well-being. Most of the research has focused on activity or impairment related outcomes, yet older persons with hearing, visual, or mobility impairments may want to participate in social, cultural, religious, or recreational activities but are unable to because of environmental barriers [62]. Research in this area would contribute new knowledge about the complex interrelationships between health, functioning, and the environment.

More research is also needed on the mechanisms that underlie these complex relationships. In particular, research on the impact of the socio-political environment on the health and well-being of older adults is notably absent. Declines in functioning can be slowed or even reversed through public policy measures such as the promotion of age friendly living environments. For example, the World Health Organization urges policy makers to address the needs of the growing older population through its Age-friendly Cities Guide [63], which focuses on eight areas of urban life: outdoor spaces and buildings; transportation; housing; social participation; respect and social inclusion; civic participation and employment; communication and information; and community support and health services. The guide, however, is not linked with the ICF framework. As a result certain issues are not addressed such as the provision of health information for older individuals with cognitive impairments or the importance of making public events accessible for people with hearing and or visual impairments [64].

The second issue requiring development [8,49,50] centers on the need to incorporate longitudinal aspects of neighborhood context into research. The predominant approach emphasizes the characteristics of the current environment for current health and functioning. Yet, it is increasingly recognized that neighborhoods are not static, but evolve dynamically through time, first, because environments change but, second, because individuals move through a number of contextual settings over their lives.

Third, there are a number of methodological and measurement issues that pertain to neighborhood research more generally, including the need to use nationally representative samples, and a need for better definition and measurement of person-centered environments. This area of research would benefit from a departure from using administrative definitions of neighborhoods (e.g. Census tracts) and over-reliance on administrative data sources (e.g. Census-based measures) in favor of person-defined neighborhood boundaries and directly constructed measures to characterize environments [49,65–67].

As the number of older individuals is projected to more than triple worldwide over the next half century, there will be major implications for the health, functioning, and social participation of older adults. Interdisciplinary training that brings together health professionals with urban planners [68] has the potential to generate initiatives that could minimize the negative consequences of underlying disease and impairments for the independence of older adults, so that they can continue to maximize their health, well-being, and participation within their communities as they age.

Contributors

Philippa Clarke and Els Nieuwenhuijsen declare that they both participated in the conception and writing of the manuscript and that they have seen and approved the final version.

Competing interests

Neither Philippa Clarke nor Els Nieuwenhuijsen have any conflicts of interest.

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