

# Impact of Built Environment and Neighborhood on Promoting Mental Health, Well-being, and Social Participation in Older People: an Umbrella Review

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## Abstract

**Background.** *The built environment, especially in the context of the neighborhood, affects older people's health. This umbrella review aims to summarize the associations between factors and interventions in the built environment as regards modifying or improving mental health, well-being, social inclusion and participation in the elderly.*

**Methods.** *We searched articles in the following databases: PubMed, Embase, Cochrane Library, Scopus, Avery Index, Sage, Web of Science, Health Evidence, and Google Scholar, without any time limits. The factors and interventions examined have been classified into three categories (urban infrastructure, green infrastructure, built environment), and we have assessed their relationships with each of the health outcomes.*

**Results.** *Eight reviews have been included. The results show a positive association between factors and interventions and health outcomes, even though this tends to differ with respect to some of the elements (study design, sample size, built environment and health outcome measurements, and the quality of the primary studies included in the reviews) in the selected studies.*

**Conclusions.** *In conclusion, the present study suggests and confirms that acting on the built environment has a positive impact on mental health and social inclusion.*

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## Introduction

The environment is defined as “the physical and social characteristics in which people live” (1) and represents one of the most influential factors in the life of every single person. According to Barton and Grant (2), the built environment – which refers to places and spaces constructed by humans, such as cities, buildings, open spaces, and infrastructures – is considered as a determinant of health and well-being (3). The increase in urbanization worldwide and the rise in the population density in cities have negative impacts on ecosystems, as well as human health (4). Moreover, overbuilding and the development of new areas, leading to the urbanization of green spaces and reducing the number of communal spaces, have modified the normal shapes of countries. All these factors contribute to the impact on human health by various pathways. On the one hand, the effects of the built environment on people’s health can act by means of a direct mechanism through different kinds of determinants and risk factors (e.g., air pollution, infections, carcinogenic exposure). On the other, it can also affect people’s health in a more indirect way, conditioning people’s lifestyles and thus affecting mental health, well-being, and social inclusion (5).

In a world population that is aging rapidly (6), mental disorders are becoming a priority. Mental health can be defined as a state of well-being in which an individual realizes his or her own abilities, can cope with the normal stresses of life, can work productively, and is able to contribute to his or her community (7). It is affected by multiple determinants, from organic causes to external conditioning, such as the built environment (8). Moreover, there is a growing body of evidence on the effectiveness (positive impact) of green spaces and natural environments on mental health and well-being (9, 10).

The definition of well-being is debated

(11). Within a model of well-being that exceeds the individual dimension of mental health via social components and burdens (12), socioeconomic factors impact health inequalities, with consequences on social inclusion and social capital (13). Social inclusion is strongly related to mental health and well-being and is a strategic issue seeking to promote the health of the elderly. In fact, in a resolution related to a strategy and action plan on healthy aging in Europe for 2012-2020 (14), published by the WHO, Regional Committee for Europe, one of the key interventions is a preventive strategy aimed at reducing loneliness, social isolation and social exclusion – risk factors exerting a particular effect on the health and well-being of older people. Social inclusion can be defined as a person’s involvement in social activities that provide social interactions within his/her community or society (15). It is a key factor in health and good quality of life (QoL) (16) and offers protection against cognitive decline (17). Disabilities and reduced possibilities of access to the surrounding environment and neighborhood can limit social participation, thus reducing independence and self-sufficiency. On one hand, disability is therefore considered one of the most powerful factors promoting social exclusion (18); on the other hand, social participation is acknowledged as a useful tool to help avoid social isolation, exclusion, and mental problems. Vulnerable subgroups of populations, such as older people, are particularly affected by this kind of condition (19, 20). On the other hand, social exclusion limits people’s active participation in society, and is related to poor health and poor QoL (21, 22). It is considered a dynamic (23) and multidimensional phenomenon, since it involves a wide range of domains of activities from which an individual can be excluded (24). These are commonly related to interactions among people, civic engagement, material resources and access to services (from the post office to the chemist,

health and social care services, and transport) (19, 25). For older people who live in cities, the neighborhood environment is of extreme importance in determining a condition of social inclusion or exclusion. First, older adults, compared to younger people, spend more time in their neighborhood, are less involved in productive business, and have more opportunities to participate in other activities and experience the neighborhood environment for a longer time (26). Moreover, they are often very attached to their neighborhood because of long periods of residency (27) and want to live in their homes whenever possible. This kind of place attachment seems important in creating a sense of belonging for an older population, leading to physical comfort and well-being (28-30). The urban planning and architecture sectors have increasingly been dialoguing with Public Health actors to find answers to health problems (31-33), highlighting the relevance of the neighborhood environment and communities (34).

Many studies have assessed the relationship between the built environment and mental health and well-being, mainly in the general population (35-37). Evidence has shown the presence of an association between mental health and environmental characteristics, with a negative effect where there is a shortage in green spaces, perceived problems in the built environment, or insecurity among people. This was found to be especially important during the recent COVID-19 pandemic, which had a huge impact on mental health worldwide and raised awareness about the neighborhood and its key role in promoting mental health, well-being, and social participation, not only among the elderly but also in the population (38). As an example, Guzman et al. highlighted the importance of the built environment in helping people cope with COVID-19 restrictions, reporting high perceived benefits of having access to the outdoors or green and blue spaces (39). Capolongo et al. underlined indeed the need

to rethink and design resilient systems and local facilities that can act as valuable health assets in situations like the recent pandemic (40).

However, when analyzing the association between mental health and built environment, researchers often conclude that there is little evidence of an association and a lack of causality. Moreover, despite the large number of studies published on this topic, few have assessed the association within specific subgroups of populations, such as older populations. To the best of our knowledge, there are no systematic summaries of reviews that highlight evidence coming from these studies. The present study aims to collect and synthesize the literature dealing with the relationship between the built environment and mental health, well-being, and social participation of non-institutionalized older populations, looking for factors in the environment that have an influence on this specific dimension of health. Our interest has been directed towards such determinants that affect social inclusion and participation in social life, sense of cohesion, QoL, and self-perceived health. We performed an umbrella review that includes systematic and large-scoped reviews. The goal of this document is to give the scientific community some solid information based on the literature, helping in the development of healthy cities able to offer healthy aging to everyone.

## Methods

The study follows the suggestions of Aromataris et al. in the Joanna Briggs Institute Manual to realize an umbrella review (41). The methodology used is different from that used by Cochrane (42) for an overview of reviews, because we included not only Cochrane intervention reviews produced by individual Cochrane review groups, but also other reviews that met the inclusion criteria.

### *Inclusion criteria*

We used the PICO scheme (population, intervention, comparison, outcome) (Table 1) to identify the papers meeting the inclusion criteria: 1. peer-reviewed studies; 2. studies on older populations; 3. studies assessing the associations between built environmental factors and mental health, well-being or social inclusion, or studies assessing the effectiveness of intervention into the built environment in improving mental health, well-being, or social inclusion. The types of studies included were systematic, narrative, and scoping reviews.

We included systematic, narrative, and scoping reviews that examined the relationship between built environmental factors and mental health, well-being and social inclusion, and the effectiveness of interventions in improving these same outcomes. In extrapolating the environmental factors, we considered the public dimension of the built environment within the neighborhood, encompassing areas from the characteristics of buildings in terms of land-use mix and accessibility, to the presence of open spaces, such as parks, streets and squares, as well as infrastructure, especially transportation systems. We distinguished the terms factors from interventions. Since factors characterizing urban space differ from interventions aimed at modifying that space, in our data description and analysis,

we included both terms. Firstly, we described factors associated with the health outcomes, and then interventions that modify those factors that have a positive impact on said health outcomes.

We assessed studies involving older people with no age limitations (simply defined as “older” or aged > 65 years), living at home, who are not institutionalized and not housebound. We excluded papers specifically devoted to other subgroups, such as children or adults. The older population was chosen because of the huge burden of disease and disability, and for the different health outcomes they have with respect to other population groups (adults and children). We excluded studies written in other languages than English, those not published in peer-reviewed journals, and book chapters, theses, and abstracts. Moreover, we decided not to insert a data range in the search process.

### *Search strategy*

We searched articles in the following databases: PubMed, Embase, Cochrane Library, Scopus, Avery Index, Sage, Web of Science, and Health evidence. We also hand-searched the reference lists and search engines (Google, Google Scholar) without any time limits. To build the search query we included in the final strings each of the key terms related to factors and interventions,

Table 1 - PICO (Population, intervention, comparison, outcome) scheme to define inclusion criteria for the umbrella review

Parameter	Description
Population	Inclusion – older adults (defined as “older” or aged > 65 years) Exclusion – homogeneous subgroups of other age categories, institutionalised/hospitalised, housebound
Intervention	Inclusion – factors/interventions on built environment: barrier decrease, urban planning implementation, improvement of public structure, encouraging the meeting between individuals.
Comparison	No intervention
Outcome	Inclusion – mental health, well-being, quality of life, social inclusion, social participation, depression prevention Exclusion – other health outcomes, physical activity

starting from the PICO scheme. We also looked at related articles to make the research exhaustive. Appendix A shows the complete search strategy used in the PubMed database. The PubMed search strategy was then adapted for the other databases.

#### *Study selection, data extraction and quality assessment*

Two researchers reviewed the papers independently. Data extraction was performed using an internally piloted spreadsheet. The following information was extracted from each eligible article: 1. country and year in which the study was conducted; 2. number and types of studies included; 3. population; 4. health outcomes; 5. environmental factors that were analyzed. We also assessed the quality of the included reviews, using the score assigned according to the Health Evidence tool, and rating the others by means of the same criteria (43). Each study received a score from 0 to 10: a score of 4 or less meant weak study quality; medium quality was indicated if the score was 5–7; high quality was inferred if it was 8–10. The score quantified the strength of the data included in each study and was not an inclusion criterion.

#### *Study analysis*

The study analysis involved a description of the included studies, then a process to establish the relationship between the built environment and mental health and well-being, mostly in the older population; this means we included both specific studies on older populations and studies on adults with no specified age limit. We made a list of all the factors and interventions considered in the selected reviews, as described in the included papers. Due to the great heterogeneity of the studies included in the selected reviews, we decided to examine the primary studies, deepening the conclusions of the results of the reviews. Then, the next step was the

merging of similar factors and interventions, and the creation of three categories through an inductive process, to easily compare these data. The 3 categories of factors and interventions were as follows:

- Urban infrastructure (roads, road connections, traffic lights, traffic signs, road safety and neighborhood safety), transport infrastructure (cycle paths and pedestrian areas, bicycle parking) and their modifications;

- Urban green spaces (park, green spaces, etc.) and their modifications;

- Built environment services and public spaces, and interventions aiming at accessibility, the availability of services and urban regeneration.

Through this process, each factor or intervention, recovered from the primary studies within the selected reviews, was placed into one of the 3 categories. Firstly, for each selected review, we listed all the factors and interventions of the primary studies included. Then, we described the studies included in terms of factors/interventions, results, and limits. Finally, we described the association between each factor and category and each health outcome (mental health, well-being, and social inclusion), regardless of the paper in which it was located. Adopting this process, we tried to establish the results of the relationship, to identify the ones with a positive association, through a point scoring system (No, +/-, + and ++ refer to the strength of the association/the effectiveness of factors/interventions included in the reviews, as stated by the authors). At last, we detailed the factors most frequently related to each outcome (mental health, well-being and QoL, social inclusion, and participation).

## **Results**

The search query identified 1,043 papers (675 in PubMed, 14 in EMBASE, 12 in

Scopus, 17 in Avery Index, 2 in Cochrane Library, 62 in Health Evidence, 158 in SAGE Journal, 95 in Web of Science) and 40 after screening all the articles by titles and abstracts; 17 articles were selected after screening by full-text and 8 articles were included after removing duplicates. Figure 1 represents the flowchart of the selection process of the reviews. For each review, the studies that met the PICO criteria varied because most of the included reviews aimed at exploring other outcomes than mental health and social inclusion, and/or were

not focused on the older population only. For these reasons, all the reviews include some articles that do not meet our inclusion criteria. The included articles have been shown to be of good methodological quality; for the qualitative evaluation, they were categorized as “high quality” or “medium quality” (Table 2). Table 2 and appendix B present a summary of the features of the included reviews: year of publication; number of studies included in the review; number of studies in each review that meet the PICO criteria (sample size, population

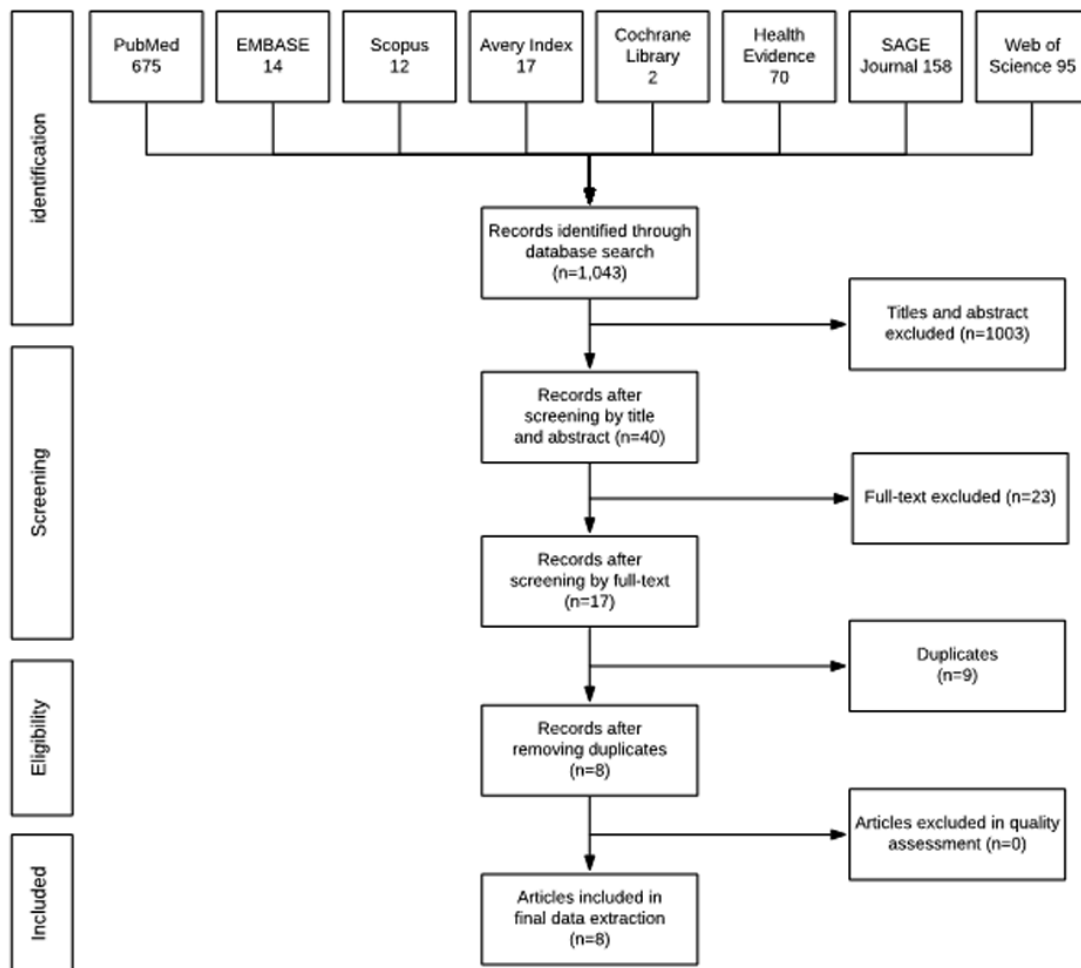


Figure 1 - Flow-chart of the literature search and umbrella review on the Impact of built environment and neighborhood on promoting mental health, well-being, and social participation in older people

Table 2 - Description of the studies included: main elements.

Study	N Tot (N included studies) <sup>(a)</sup>	Types of research design included in each review	Environmental factors analyzed	Health outcome	Pop included in sample	Quality score
Garin, 2014 [39]	48 (18)	Cross-sectional Longitudinal	Traffic, public transport accessibility, road conditions, road safety	Mental health (and well-being - synonymous) (depression, psychological distress minor psychiatric morbidity) QoL Interpersonal interactions Life satisfaction Successful and healthy aging	Adults and Older adults	7
Houlden, 2018 [40]	52 (38)	Controlled case studies Longitudinal cohort stu- dies Ecological analysis Cross-sectional survey Uncontrolled case study	Green spaces	Psychological distress Life satisfaction (and mental well-being – synonymous) Mental health QoL Hedonic well-being Vitality Happiness Attention Affect	Adults aged over 16 comprehending older adults	9
Kabisch, 2017 [8]	27(4)	Cross-sectional, through self-reported interview study, postal questionnaire	Green and blue spaces	Better self-reported general and mental health conditions, such as anxiety	Older adults and Children	7
Lavasseur, 2015 [41]	50 (30)	Cross-sectional Longitudinal	Products and technology Natural environment and human- made changes to environment	Social participation	Adults and Older adults	9

*Continue*

Moore, 2018 [45]	14 (14)	RCTs <sup>(b)</sup> , cluster RCTs, CBAs <sup>(c)</sup> , IT <sup>(d)</sup> , regression discontinuity studies	Transport infrastructure modifications Improve walking and cycling Urban regeneration Improving Urban Green Spaces Land-use diversity and planning Perceived social support Neighborhood Street connectivity and walkability Living with or near family and friends Transportation services Civil protection services (for example, crime/safety)	Mental health Well-being QoL, social inclusion or isolation Social capital Fear of crime (anxiety, depression, stress)	Adults and Older adults	8
Vaughan, 2016 [42]	12 (12)	Cross-sectional or longitudinal study design		Community participation: "active involvement in activities that are intrinsically social and either occur outside the home or are part of a non-domestic role"	Older adults	10
Won, 2016 [43]	32 (4)	Cross-sectional Longitudinal	Overall/general neighborhood safety Crime-related safety Traffic-related safety proxies	Mental health (self-reported frequency or occurrence of depressive symptoms) QoL Depression	Older adults	9
Yen, 2009 [44]	33 (16)	Cross-sectional Longitudinal	Physical environment and resources (traffic, trash or litter, safety/crime, access to or quality of commercial or public services, housing density, land-use diversity, availability of services that promote social cohesion) Social environment (accessibility and availability of service, perceived social cohesion, etc.)	Self-rated health/QoL Morbidity/mortality Diagnosable mental health or mental disorders Physical activity Physical function Cognition	Older adults	8

<sup>(a)</sup>N tot: number of studies included by each systematic review. N included: number of studies included in each systematic review that were also included in this review.

<sup>(b)</sup>RCT: randomized control trial

<sup>(c)</sup>CBA: controlled before-after studies

<sup>(d)</sup>Interrupted time series



age, setting and specific type of intervention, with the inclusion criteria described before); number of databases sourced and searched; participants' details; setting and population samples; health outcomes considered; built environment and health outcome measurements. In all the reviews, some articles were excluded since they did not meet the PICO criteria.

The study designs included in the reviews are cross-sectional, longitudinal, or uncontrolled case studies (9; 44-49). Only one review included Randomized Controlled Trials (RCTs), cluster RCTs, Controlled Before-and-After studies (CBAs), Interrupted Time Series studies (ITS), and regression discontinuity studies (49). The measures of health outcomes considered in the included papers are heterogeneous (Appendix B). The same element of complexity has been verified for the factors and the typology of the interventions, and therefore for their measurement. Firstly, some authors considered as "factors" the "determinants" of the neighborhood or built environment (44-49) related to health outcomes, while others focused on interventions that, by modifying the built environment, affect those outcomes (50). As explained in the methodology section, we decided to distinguish the two terms, and to associate each intervention aimed at modifying one of the factors with one of the categories identified.

The measures related to factors and interventions are manifold as well. All the reviews include both subjective and objective measurements of the built environment (9, 44-50). The objective and quantifiable measures of the characteristics of the built environment involve an impartial measurement that is not influenced by emotions, opinions, or personal feelings. They are independent of the observer and are based on quantifiable and measurable quantities. Examples of clear objective and independent measures relate mostly to built environment measurements, such

as those based on Geographic Information Systems (GISs) (45, 48), the use of data from indexes and databases, or tools (e.g., the Walkability Index of Walkable and Bikeable Communities Project—WBC, University of Miami Built environment coding system (UMBECS)) (44). Subjective measures are dependent on the observer's personal judgment, and so are based on opinions, feelings, and general impressions. They rely more on the observer because they regard what people say they experience. Examples of measurements of the built environment directly given by the subjects can be derived from surveys, questionnaires (e.g., Neighborhood Environment Walkability Scale—NEWS, Behavioural Risk Factor Surveillance System—BRFSS) or interviews. The use of self-reported tools gives rise to the majority of health outcome measurements, especially those related to social well-being, QoL, and life satisfaction (e.g., General Health Questionnaire—GHQ, WHO-5 Well-being Index) and mental health (e.g., Warwick–Edinburgh Mental Well-being Scale—WEMWBS, SF-36 Mental Component Summary—SF-36, MCS), but also to social participation (e.g., Participation and Activity Limitation Survey—PALS).

As regards health outcome measurements, most of the papers included self-reported measurements (9, 46-50), and some of them included both objective and self-reported ones (44-45).

### *Findings*

The interventions examined in the review have been classified, as described before, with regard to factors and related interventions able to modify these factors, set out in three categories: urban infrastructure, green infrastructure, built environment services and public spaces. According to the results, some environmental elements appear to have a stronger association with mental health than others. This is the case for green spaces: evidence emerged of associations

between mental health and visits to green space, green space accessibility and type (45), and people's participation in allotment gardening. Moreover, the evidence related to well-being is strong too: the amount of local area intended for green space is related to life satisfaction (46); closeness to urban green spaces with benches that provide shade, water, and a cooler environment is preferred by older people (51); and finally, improving green infrastructure and landscape design improves the QoL (50). To conclude, participating in allotment gardening, interacting with parks (51) and improving green infrastructure through street parks installation, trees and flower plantation, replacing asphalt with boulder stone, and the insertion of benches, tables and play equipment, all favored social inclusion (50).

Another element that emerges from the results is security from crime and traffic, which represents an important feature in age-friendly cities. It has been proven relevant to mental health, especially crime-related safety (49). Safety from traffic is associated with well-being (44), and overall safety, as connected to the quality of the area, is a predictor of QoL (49). Finally, neighborhood security, as related both to crime and traffic, shows a strict association with social inclusion (46-47).

A walkable environment, crucial to physical activity in older people (52-53), did not show a clear association with mental health (44, 49). Instead, the user-friendliness of the walking environment appears to be important to social inclusion when related to the good condition of the streets and the presence of seating facilities (46); street-level characteristics are also important, such as sidewalk conditions, curb cuts, places to sit/rest, and nice places to walk (49).

Land-use mixtures and accessibility to various destinations seem to be more related to social inclusion, described as proximity to resources and recreational facilities (46) and

as good access to shops/services, as well as the proximity of/accessibility to resources (47). Garin et al. report the importance of land-use mixes for mental health, and some studies have found a link between accessibility and both life satisfaction and healthy aging (44).

On the contrary, there is no clear consensus on transport: noise reduction due to transport infrastructure did not produce a positive effect on mental health (50); instead, it was important to well-being connected to traffic, regardless of the closeness of public transit (44). Public transportation appeared to be significantly associated with social inclusion (46). Considering a physically impaired population, Vaughan et al. (47) found some significant associations between community participation and the following factors: good local transport, composite transportation variables including having personal transportation, nearby public transportation, and possible adaptations for people with physical limitations.

The evidence is weak because of many factors. We have described and summarized the limits of the reviews as assessed by the authors (Table 2 and Appendix B). The process revealed great heterogeneity regarding population age (9, 44), study site (50), study design, built environment measurement and definition (9, 45, 46), length of study, and quality of the primary studies included, such as the control of confounding factors (45, 46) and inclusion criteria, in terms of databases, journals and languages (48-50). However, most studies report findings supporting the positive relationship between the built environment and the examined health outcomes. A list of the main results for each outcome is given in Table 3. The factors with a positive association with mental health are urban planning (roads, road connections, traffic lights, traffic signs, road safety and neighborhood safety), neighborhood safety measures (48), and green infrastructure

Table 3 - Association/effectiveness between health outcomes and built environment features.

Health outcome	Category (with included factors)	Intervention related to the corresponding category	Effectiveness/strength of association <sup>(a)</sup>
	Urban infrastructure Roads, traffic lights, traffic signs, cycle paths and pedestrian areas, bicycle parking	Improvement in urban planning (roads, road connections, traffic lights, traffic signs, road safety and neighborhood safety)	
		Neighborhood safety measures: overall/general, crime-related	Yes (++) [43]
		Neighborhood problems (perceptions of traffic, trash or litter, safety/crime)	No [39]
	Urban Green Spaces, Parks	Transport infrastructure and modifications (improve walking and cycling): Street connectivity, walkability, land-use mix, residential density, accessibility problems score, usability, street noise, heavy traffic, safety from traffic	No [45]
		Green infrastructure and improvement Allotment garden	Yes [8]
		Parks and green spaces	
Mental health	Urban Green Spaces, Parks	Visits to green space, accessibility and types of green spaces	Yes (+/-) [40]
		Views of green space and connectedness to nature	No [45]
		Availability and accessibility of services	
	Built environment Services and public spaces	Urban regeneration: community interventions with changes to the built environment or regenerating large areas of deprived areas in cities (e.g., housing demolition and improvement, new homes built, refurbishment of community buildings, reform of public spaces, construction of new amenities and services)	Yes [39] No [45]
		Improvement of urban planning (roads, road connections, traffic lights, traffic signs, road safety and neighborhood safety)	
		Transport infrastructure modifications (improve walking and cycling)	No [45]
Well-being QoL satisfaction (hedonic well-being) Personal flourishing (eudemonic well-being).	Urban Green Spaces and Parks	Improvement of Urban Green Spaces Allotment garden	
		Parks and green spaces	Yes (+) [8]
		Amount of local-area green space (yes for life sat)	Yes (+) [40]
	Built environment Services and public spaces	Amount of local area green space (no for personal flourishing)	Yes (+/-) [45]
		Availability and accessibility of services	
		Urban regeneration: community interventions with changes to the built environment or regenerating large areas of deprived areas in cities	Yes (+/-) [45]

Social inclusion Social participation	Urban infrastructure Roads, traffic lights, traffic signs, cycle paths and pedestrian areas, bicycle parking	Improvement of urban planning (Roads, road connections, traffic lights, traffic signs, road safety and neighborhood safety) Transport infrastructure modifications (improve walking and cycling) Proximity to resources and recreational facilities, social support, car or driver's license, public transportation and neighborhood security Poor user-friendliness of the walking environment and neighborhood insecurity Mobility assistive device	Yes (+) [41] Yes (+) [42] No [41]
	Urban Green Spaces and Parks	Improving Urban Green Spaces Allotment garden Parks and green spaces	Yes [8] Yes (+/-) [45]
	Built environment Services and public spaces	Availability and accessibility of services Urban regeneration: community interventions with changes to the built environment or regenerating large areas of deprived areas in cities (e.g., modernization of social housing, new homes built, remodeling residential environments, improvements to properties exterior, etc.)	Yes (+) [42] No [45]

<sup>(a)</sup> No, +/-, + and ++ refer to the strength of the association/effectiveness of factors/interventions included in the reviews, as stated by the authors.

(allotment garden and green spaces (9, 45). In another review, the positive association with urban regeneration was shown to be small (50). Urban green spaces appeared to be the most positively associated with well-being and QoL (9, 45, 50). As regards social inclusion and participation, the strongest association appeared to be with green infrastructure (9, 50), as well as with urban planning, in particular transport infrastructure (walking and cycling) (50) and neighborliness (47).

In establishing the positive associations in the studies included in the reviews, we did not consider the total number of studies in which associations are documented. Moreover, we described the study design and the risk of bias for factors and interventions in which a positive association has been documented. Primary studies showing a positive association between factors and interventions in the built environment and

health outcomes are longitudinal and cross-sectional. Only one review included quasi-experimental studies (50), but it concluded that there is a lack of sufficient solid evidence to indicate either the presence of a positive association between factors/interventions and health outcomes or the effectiveness of interventions in modifying (improving) the outcomes. The results are generally minimal, there is a lack of evidence, and the studies contain a high risk of bias. In this review, the authors conclude that there is a lack of evidence on the effects of built environmental interventions on mental health and well-being outcomes.

## Discussion

The relationship between built environment and health has been widely studied in the general population, focusing on how built

environmental factors (such as pollution, safety, green spaces, social connectedness, transport, and infrastructures, etc.) impact on many health outcomes—both physical and mental, but also on physical activities, social inclusion, and well-being (34, 48, 54-61). Older people are particularly susceptible to being affected by a dysfunctional built environment, especially in the context of the neighborhood. In fact, this setting plays a key and determinant role in defining the quality of life and health of the older populations as they are those who use services and facilities more than others. The awareness of the association between health and a sustainable built environment has intensified the international commitment to prioritize healthy political choices in all domains of city governance, and to measure the health impact of all activities. Consequently, an interdisciplinary approach combining the skills and competencies of urban planning and architecture sectors with those of public health actors needs to be encouraged. This is particularly relevant if we consider the growth of the elderly population worldwide (6).

In this scenario, our systematic review of the available reviews should be considered as an attempt to summarize existing data using an interdisciplinary approach, so as to help policy makers in promoting well-being, mental health and social inclusion, and to highlight the lack of knowledge to be addressed with future primary studies. To fulfill this aim and to make a better use of and improve the data, we decided to merge the results by identifying three categories of factors (urban infrastructure, green infrastructure, built environment) with related interventions, and then ascribing the factors and interventions examined in the primary studies to one, two or all the three categories, for each of the three chosen health outcomes. The analysis of the results shows a positive association between most of the factors and of the outcomes. However, associations tend to differ with respect to

many factors, such as study design, sample size, built environment and health outcome measurement, and the quality of the primary studies included in the reviews.

#### *Evidence on health and built environment*

Evidence emerging from the studies is often weak and the results are inconsistent, so conclusive remarks are not readily available. One difficulty in interpreting the results is largely due to the fact that different authors tend to give their own opinion, according to cultural as well as social elements they consider more important. The determinants of health include both the socioeconomic status and the environment wherein an individual lives, since health is the outcome of a complex system in which connected and interdependent elements condition each other (built environment, but also many individual variables, such as income, employment, educational status, family, etc.) (62, 63). All these factors heavily influence Mental Health and social inclusion. As an example, in Dalherberg's review—which deals with the association between neighborhood characteristics and well-being (64)— and in some of the included manuscripts (44, 51, 65-66), the authors hypothesize that socioeconomic health determinants could limit the effectiveness of interventions in the built environment. Moreover, Yen et al reported that the neighborhood-level socioeconomic status is the strongest and most consistent predictor of a variety of health outcomes (49).

#### *Built environment and health outcomes measures*

Firstly, the kind of measurement used (objective vs. perceived measures) for both the built environment and health outcomes is suggestive; some studies showed stronger associations when using objective measures, and vice-versa. This suggests that objective and perceived measures may be differentially related to health outcomes (or, perhaps, they

measure the same outcomes in different ways). Built environmental attributes may relate differently to different behaviors. For example, attributes within the safety and aesthetics domains are more subjective in their interpretation, and thus depend on perceptions that may vary greatly between individuals, while attributes related to function and destinations are more objective, and hence are associated with lower levels of interpersonal differences in the perceptions. Another factor that is useful in explaining the association concerns the scarcity of studies devoted to the older population (47-51). This element has represented a critical problem in the attempt to synthesize the results, and in extracting information on the association between factors and outcomes, specifically for older populations.

#### *Study site*

Another factor to be discussed concerns the context (continent or country; urban or rural). Differences across continents and countries must be considered: it is not possible to draw generalizable conclusions when a review considers only studies coming from North America. Caution should be taken when translating country-focused findings to other countries. Local context and cultural norms are important considerations with global implications when trying to understand the relationship between the built environment and health. For example, when considering discrepancies in safety, it is important to consider that in high-income countries, safety may not really be an issue (48). In fact, some studies have demonstrated that living in rural areas, far from the services offered by the city and from potential social interactions, represents a determining factor in social isolation. Social exclusion may also occur in the urban context too (19, 64), affecting more frail subcategories of the population. The reviews included in the present study, conclusions remain non-definitive (9, 46).

#### *Neighborhood spatial definition*

Lastly, the definition of neighborhood differs significantly. The use of units that are easier for sampling (e.g., administrative units, census tracts or zip codes) may not reflect patterns of social interactions, the use of services, or preferred routes among older persons, and assume the centrality of the user in the selected area. In general, it is better to consider the space around individuals. Defining the neighborhood in terms of time to reach a destination (e.g., 10–20 min walk from home) rather than set distances (e.g., objective 400 m home-centered buffers) may more closely represent the individuals and their definitions of “neighborhood”: defining a neighborhood using time as a parameter (as in self-reported measures) may be more appropriate for this age group than defining it in terms of distance (as in objective measures of the environment).

#### *Environmental factors insight*

Many elements cited in the reviews represent some fundamental principles of global age-friendly cities (67). They concern transportation and outdoor spaces, such as green spaces with adequate shelter and seating, pedestrian-friendly walkways and pavements, security from crime and traffic, and accessibility to services. The factors here are diverse and sometimes contradictory.

Regarding the environmental themes, sometimes, only vague details are provided (for example, there are few in-depth studies regarding micro-scale architecture), and some aspects are not analyzed. First, a key element in the history of urban design related to social inclusion and urban vitality is missing, that is, the importance of the interface regions between external and internal, which determine the permeability of the street front and are strongly interlinked with urban vitality and safety (68).

Some architectural components relevant to sociality are not analyzed. For example, street walls (the vertical plane parallel to the

street in which many front building façades are located), which allow visual as well as physical interpersonal interactions, and determine the nature of the edge of the street, through vertical definition, the relationship of the base to the street, the characteristics of the façade above the base, and the roofscape (69). In particular, the physical properties of the base of the street wall are key to structuring the interaction. This mainly relates to the manipulation of some architectural elements (thresholds, steps, windows) or the presence of architectural solutions able to allow visual as well as physical interpersonal interactions, such as arcades, porches, hallways, lawns, or a space for external activity with houses set back from the roadway (70-72). Similar strategies characterize the design of numerous buildings, such as museums or multifunctional edifices, the ground floors of which are transformed into a sort of urban square thanks to their transparency, open spaces, and their continuity with public land to ensure urban life is welcome. Therefore, the environmental elements emerging from the reviews fail to deal with some typical architectural themes related to social performativity, such as frontage performability. To better recognize the relation between the built environment and social inclusion, we think future research should include other properties of urban form in their analysis.

#### *Methodological perspectives*

To conclude, all the reviews affirming a positive association between the built environment and mental health, or social inclusion outcomes include cross-sectional or longitudinal studies (9, 44-49). The only review that included studies of interventions, exploring the effects of changes to the built environment on mental health, social inclusion and well-being, reported a lack of effectiveness in the interventions examined, and the need to reflect on which study design

should be used to derive evidence (50).

On the other hand, intervention studies are difficult to perform in the built environment at the neighborhood level, due to the complexity of the lived environment, the many confounding factors related to such non-specific health outcomes, as well as the possibility of measuring long-term effects on health. According to Grant et al., cities can be laboratories of change, but interventions—and the assessment of their effectiveness—should be performed quickly (32). From this perspective, multidisciplinary studies aimed at combining different skills and competencies, and at synthesizing the evidence of the relationship among place, context and health in the city, should be considered (73). These kinds of studies, using the city as a laboratory to measure the relationship between the neighborhood and health, and to modify, in agreement with policymakers, the built environment to promote the well-being of older people, should be encouraged.

In fact, within a framework that foresees complex systems and interventions (74-75), many factors are interconnected, and affect both one another and the outcomes. Many conceptualizations affirm that reviews are limited in terms of utility in providing evidence and increasing value (76-77) within complex systems, such as environmental and sociological systems (74-75).

#### *Limitations of our study and of the studies included in the review*

An umbrella review itself imposes limitations on the methodological process, such as the potential loss of information due to the excess synthesis of already-produced reviews. Another possible source of bias related to this umbrella review is the use of a limited number of databases, which can lead to the potential exclusion of some relevant studies. Moreover, limitations can also be attributed to the quality of the included primary studies on which systematic

reviews are built, as stated by the authors themselves, as well as to the strength of the conclusions of systematic reviews. Another limit concerns the large number of both neighborhood factors and health outcomes considered, and, consequently, the tools used to measure these. This heterogeneity leads to further difficulty in synthesizing and comparing the different conclusions.

Concerning the reviews analyzed in our work, the main limitations are listed here. First, the lack of a specific focus on older people and the inclusion of a general adult population lead to great heterogeneity in the primary studies included. Moreover, the reviews include health outcomes other than social inclusion, mental health and well-being, but it is hard to separate and independently analyze the different outcomes. In general, the primary studies included in the reviews vary in terms of the study design, population included, sample size, length of the study, study site, and built environment and health outcome measurement.

Finally, the interdisciplinary approach to studying the relationship between the characteristics of the neighborhood and the health (well-being, mental health, and social inclusion) of elderly people from a Public Health perspective has led to many difficulties in the interpretation and synthesis of the selected papers, owing to, inter alia, the research methodology used and the intended goals. This has reduced the possibility of deriving conclusive evidence, which could have led to the definition of guidelines, or at least better guidance for policymakers.

## Conclusions

Although some limitations reduce the amount of conclusive evidence, the present study suggests and confirms that acting on the built environment has a positive impact on mental health and social inclusion.

Urban planning and built environment interventions, within the framework of the determinants of health and health promotion, should become a major focus and an area of innovation for Policy & Decision Makers. In this perspective, the use of multi-criteria evaluation tools should be encouraged to increase public awareness about the link between urban quality and Public Health (78). Indeed, only intensive dialogue among all stakeholders could give rise to comprehensive knowledge on the topic, enabling them to implement experimental projects and structural interventions within the neighborhood and thus offer older people better opportunities related to their health and QoL. The development of a Health City Manager core curriculum should help define the strategic aspects of action to improve health in cities through a holistic approach (79).

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## Riassunto

*L'impatto dell'ambiente costruito e del quartiere sulla promozione della salute mentale, del benessere e della partecipazione sociale negli anziani: una umbrella review*

**Introduzione.** L'ambiente costruito, soprattutto nel contesto dei quartieri urbani, ha un forte impatto sulla salute della popolazione anziana. Questa umbrella review si propone di sintetizzare e valutare l'associazione tra determinanti ambientali alla scala di quartiere e indicatori di salute identificati nella salute mentale, benessere e inclusione sociale degli anziani.

**Metodi.** La revisione è stata effettuata consultando i seguenti database: PubMed, Embase, Cochrane Library, Scopus, Avery Index, Sage, Web of Science, Health Evidence, and Google Scholar, senza restrizioni temporali. I fattori riguardanti l'ambiente costruito sono stati classificati in tre categorie (infrastrutture urbane, infrastrutture



verdi, ambiente costruito) ed è stata analizzata la loro associazione con ciascuno degli esiti di salute indagati.

**Risultati.** I risultati mostrano una associazione positiva tra elementi dell'ambiente costruito da una parte, ed esiti di salute dell'altra, anche se la relazione tende a variare in base ad alcuni elementi (tipo di studio, numerosità, tipologie di ambiente, tipologie di esiti sanitari e modi per misurarli, qualità degli studi inclusi nelle revisioni).

**Conclusioni.** Questo studio conferma come intervenire sull'ambiente costruito possa avere un impatto positivo sulla salute mentale e sull'inclusione sociale di soggetti anziani.

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## Appendix A: Description of the search strategy

### Appendix A.1. Pubmed database (1)

1	((("Environment"[Mesh]) OR "Social Environment"[Mesh]) OR "Environment Design"[Mesh]) OR "Environment and Public Health"[Mesh]) OR "Built Environment"[Mesh] OR environment OR "built environment" OR "environment design" OR "social environment" OR "walkable environment" OR neighborhood OR "neighborhood design"	8258056
2	well-being OR (social AND participation OR "social participation ") OR (mental AND health OR "mental health" OR mental health [Mesh]) OR ("social interaction" OR social AND interaction) OR (depression OR depression [Mesh]) OR loneliness	741683
3	#1 AND #2	369651
4	older* OR senior* OR elder*	643209
5	#3 AND #4	43310
6	(Review[ptyp] OR systematic[sb] OR Meta-Analysis[ptyp])	2544893
7	#5 AND #6	3570
8	"aged"[MeSH Terms]	2906045
7	# 7 AND # 8	2319
8	("last 10 years"[PDat])	10090278
9	#7AND #8	1039
10	(frail * OR fall OR hospital OR dwelling OR pharmacol* OR therapy)	13727617
11	#9 NOT #10	267

### Appendix A.2. Pubmed database (2)

1	((("Environment"[Mesh]) OR "Social Environment"[Mesh]) OR "Environment Design"[Mesh]) OR "Environment and Public Health"[Mesh]) OR "Built Environment"[Mesh] OR environment OR "built environment" OR "environment design" OR "social environment" OR "walkable environment" OR neighborhood OR "neighborhood design"	8258056
2	well-being OR (social AND participation OR "social participation ") OR (mental AND health OR "mental health" OR mental health [Mesh]) OR ("social interaction" OR social AND interaction) OR (depression OR depression [Mesh]) OR loneliness	741683
3	#1 AND #2	369651
4	older* OR senior* OR elder* OR adult*	5894928
5	#3 AND #4	225823
6	(Review[ptyp] OR systematic[sb] OR Meta-Analysis[ptyp])	2544893
7	#5 AND #6	10980
8	("last 10 years"[PDat])	10090278
9	#7 AND #8	5911
10	NOT frail * NOT fall NOT hospital* NOT dwelling* NOT therapy NOT adolescent* NOT young* NOT youth* NOT internet NOT child* NOT disease* NOT dementia NOT cost-effectiveness NOT illness NOT pharmacol* NOT student* NOT suicide NOT diabet* NOT nurse* NOT rehabilitation	
11	#9 NOT #10	408

**Appendix A.3. SAGE journals database**

1	(built environment OR neighborhood) AND (well-being OR mental health) AND (old* OR elder* OR adult*) NOT adolescent* NOT therapy NOT fruit NOT child* Limiti: 2019-2004 e review article	106
2	[All built] AND [[All environment] OR [All neighborhood]] AND [[All well-being] OR [All mental]] AND [All health] AND [[All old*] OR [All elder*] OR [All adult*]] AND NOT [All adolescent*] AND NOT [All therapy] AND NOT [All fruit] AND NOT [All child*] AND [Title review] Limiti: 2019-2004 research article	52

**Appendix A.4. Health Evidence database**

1	Built environment AND adult*	32 of which 3 related but 2 doubles
2	Built environment AND well-being	10 of which 3 related but already present in the previous strings
3	built environment AND mental health	18 of which 3 related but already present in the previous strings
4	built environment AND old*	10 relevant

**Appendix A.5. Cochrane Library database**

1	Built environment	2 of which 1 related and already found
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**Appendix A.6. EMBASE database (1)**

1	Built environment	6,642
2	aging	666,707
3	#1 AND #2	216
4	well-being	72,452
5	#3 AND 4	18
6	([systematic review]/lim OR [meta analysis]/lim) AND [cochrane review]/lim	9,837
7	#5 AND #6	2
8	[2009-2019]/py	13,977,698
9	#7 AND 8	11

**Appendix A.7. EMBASE database (2)**

1	Built environment	6,642
2	aging	666,707
3	#1 AND #2	216
4	Mental health	406,535
5	#3 AND 4	11
6	([systematic review]/lim OR [meta analysis]/lim) AND [cochrane review]/lim	9,837
7	#5 AND #6	1
8	[2009-2019]/py	13,977,698
9	#7 AND 8	1 must have

**Appendix A.8. EMBASE database (3)**

1	Built environment	6,642
2	aging	666,707
3	#1 AND #2	216

4	Social participation	6965
5	#3 AND 4	10
6	([systematic review]/lim OR [meta analysis]/lim) AND [cochrane review]/lim	9,837
7	#5 AND #6	2
8	[2009-2019]/py	13,977,698
9	#7 AND 8	2

#### Appendix A.9. Avery Index database

1	Built environment OR neighborhood	17
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#### Appendix A.10. SCOPUS database

1	built environment AND aging AND well-being limite review e 2009-2019	2
2	built environment AND aging AND mental health limite review e 2009-2019	5
3	built environment AND aging AND social participation limite review e 2009-2019	5

#### Appendix A.11. Web of Science database

1	(built environment OR neighborhood) AND (aging OR adult OR old OR elder) AND (well-being OR mental health OR depression) limite review e 2009-2019	77
2	(built environment OR neighborhood) AND (aging OR adult OR old OR elder) AND social participation limite review e 2009-2019	18

### Appendix B: Description of the studies included: built environment and health outcomes measurement

Author(s) (Year)	Environmental factors	Built environment measurement	Health Outcome	Health outcomes measurement
Garin, 2014 [38]	Traffic, public transport accessibility, road conditions, road safety.	<p><b>*Objective:</b> 42%</p> <ul style="list-style-type: none"> <li>- Geographic measures, census tracts or similar database</li> <li>- Interviewers acting as observers</li> <li>- Tools: Walkability Index of Walkable and Bikeable Communities Project (WBC); University of Miami Built environment coding system UMBECS; Systematic Social Observation System.</li> </ul> <p><b>Self-reported:</b> 40%</p> <ul style="list-style-type: none"> <li>- NEWS</li> <li>- Not standardized, item Likert scale and dichotomic scales.</li> </ul> <p><b>Both:</b> 19%</p> <ul style="list-style-type: none"> <li>- Housing enablers</li> </ul>	<p>Mental health (and well-being)</p> <ul style="list-style-type: none"> <li>- Depression</li> <li>- Psychological distress</li> <li>- Minor psychiatric morbidity</li> </ul> <p>QoL, interpersonal interactions, Life satisfaction, Successful and healthy aging</p>	<p><b>Mental Health:</b> 17%</p> <ul style="list-style-type: none"> <li>- Objective: 63%;</li> <li>- Self-rated: 37%.</li> </ul> <p><b>Life Satisfaction and Related Variables:</b> 21%</p> <ul style="list-style-type: none"> <li>- Objective: 20%;</li> <li>- Self-rated: 30%;</li> <li>- Mixed: 50%.</li> </ul>



<p>Houlden, 2018 [39]</p>	<p>Green spaces</p>	<p><u>Amount of local area green space</u>: 44%                  - Land cover map: 15%;                  - Land-use database: 20%;                  - GIS: 25%;                  - On-street audit: 5%;                  - Normalized Difference Vegetation Index (NDVI): 15%.  <u>Greenspace types</u>: 20%                  - Land cover map or similar: 78%;                  - GIS: 44%;                  - Advanced Land Observation Satellite: 1%;                  - Field survey: 1%.  <u>Views of greenspace</u>: 4%                  Self-reported: 100%.  <u>Visits to greenspace</u>: 31%                  - Objective: 21%                  - Self-reported: 64%                  - Land-use database: 21%                  - GIS: 7%                  - Urban atlas: 7%  <u>Greenspace accessibility</u>: 13                  - Land-use database: 33%                  - Normalized Difference Vegetation Index (NDVI): 33%                  - GIS: 17%                  - Self-reported: 17%                  - Urban atlas: 17%  <u>Subjective connection to nature</u>: 11%                  - Self-reported: 100%                  - Connectedness to Nature Scale (CNS): 29%                  - Single-item version of CNS (CNS-SI): 14%                  - Nature exposure: 14%                  - Nature Relatedness Scale: 29%                  - New Ecological Consciousness Scale: 14%                  - Inclusion of nature in self: 14%                  - Engagement with natural Beauty Scale: 14%</p>	<p>Psychological distress                  Life Satisfaction                  Mental Health                  QoL                  Hedonic well-being                  Vitality                  Happiness                  Attention                  Affect</p>	<p>Using only validated measures:                  - Warwick-Edinburgh Mental Well-Being Scale (WEMWBS) or Shortened (SWEMWBS): 13 %                  - Personal well-being ONS4: 2%                  - WHO-5 Well-Being Index: 4%                  - WHO QoL-BREF (WHOQOL-BREF): 4%                  - 36-Item Short-Form Health Survey (SF-36): 7%                  - SF-36 Mental Component Summary (SF-36, MCS): 11%                  - SF-36 Vitality Component Survey: 2%                  - Single-item Life Satisfaction: 13%                  - Satisfaction With Life Scale (SWLS): 9%                  - One question about happiness: 7%                  - Attentional Functioning Index (AFI): 2%                  - Positive and Negative Affect Scale (PANAS): 13%                  - General Health Questionnaire (GHQ): 29%.</p>
<p>Kabisch, 2017 [8]</p>	<p>Green and blue spaces</p>	<p>x</p>	<p>Better self-reported general and mental health conditions</p>	<p>Self-reported: 100%</p>

Lavasseur, 2015 [40]	Products and technology Natural environment and human-made changes to environment	* Neighborhood measures: - Subjective: 68% - Objective: 14 % - Both:18%	Social participation	Self-reported: 100%
Moore, 2018 [44]	Transport infrastructure modifications Improve walking and cycling Urban regeneration Improving Urban Green Spaces	x	Mental health Well-being QoL, Social inclusion or isolation Social capital, fear of crime (anxiety, depression, stress)	<u>Single survey questions</u> : 21 % <u>Validated multi-item scales</u> : - the mental component scales of the 12-item short-form QoL scale (SF-12 MCS) 7% - the 36-item SF-36 (MCS): 7% - Mental Health Inventory 5 (MHI-5): 14% - the 12-item general health questionnaire (GHQ-12): 21% - 28-item GHQ (GHQ-28): 7% - Health Satisfaction scale: 7% - Warwick–Edinburgh Mental Well-being Scale (WEMBS): 7% - Revised Clinical Interview Schedule (CIS-R) 7%
Vaughan, 2016 [41]	- Land-use diversity and planning - Perceived social support - Neighbourliness - Street connectivity and walkability - Living with or near family and friends - Transportation services - Civil protection services (for example, crime/safety)	<u>Perceived</u> : 92 % - Interpersonal Support Evaluation List: 8%; - U.K. national survey: 8% - Individual questions (self-report): 25% - ENABLE-AGE survey study questionnaire: 8% - Walkability Survey: 8%; - Medical Outcomes Study Social Support Survey: 8% - Various item scale/questionnaire: 33% - Home and Community Environment survey: 8% - Perceived Accessibility to Key Resources for Older Adults scale: 17% <u>Perceived + objective</u> : 8% - 10-item structured questionnaire + New York City Mayor's Management Report	Community participation	Self-report: 100% - Elderly Activity Inventory Questionnaire and Statistics Canada's Participation and Activity Limitation Survey: 25% - Assessment of Life Habits: 17% - Questions on the long form of the 2000 U.S. Census: Q18c asking about disability affecting going outside home: 8% - Frequency of social contacts: 8% - Craig Handicap Assessment and Reporting Technique (CHART): 8% - Nottingham Leisure Questionnaire: 8% - ENABLE-AGE survey questionnaire: 8% - Keele Assessment of Participation: 8% - Late Life Disability Instrument: 8% - Activity Limitation Survey: 8% - Individual question of self-rated community involvement 8%.

<p>Won, 2016 [42]</p>	<p>Overall/general neighborhood safety Crime-related safety Traffic-related safety proxies</p>	<p>* <b>Subjective:</b> 59 % Mostly based on surveys from validated questionnaires, including the NEWS and Behavioral Risk Factor Surveillance System (BRFSS) + general questions (safe from crime, traffic) or specific neighborhood conditions <b>Objective:</b> 22% Violent crime records obtained from state public safety or local police departments as data sources + walking audits for crime safety and for traffic safety. The number of traffic collisions and traffic volume were measured using the Geographic Information Systems (GIS) <b>Both:</b> 19%.</p>	<p>Mental health, QoL, depression.</p>	<p>Mental health: Subjective 100%</p>
<p>Yen, 2009 [43]</p>	<p>- Physical environment and resources (traffic, trash or litter, safety/crime, access to or quality of commercial or public services, housing density, land-use diversity, availability of services that promotes social cohesion) - Social environment (accessibility and availability of service, perceived social cohesion, etc.)</p>	<p>- Socioeconomic composition (administrative data): 73% - Racial composition: 47% - Demographics: 40% - Perceived resources and/or problems (from survey data): 7% - Physical environment (Direct observations + administrative data): 40%, telephone directory listings of commercial services, direct observations of traffic or trash + neighborhood design such as housing density and land-use diversity) - Social environment (Perceived + administrative data): 20%, perceived measures such as perceived social cohesion/support, collective efficacy, and neighborliness + administrative data describing the availability of services that promote social organization.</p>	<p>Self-rated health/ QoL Morbidity/ mortality Diagnosable mental health or mental disorders Physical activity Physical function Cognition</p>	<p>x</p>

\* Limits in data extraction because it was not possible to isolate information of our interest (about older people and health outcomes)