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Review article

Older people perceptions on the built environment: A scoping review

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ABSTRACT

As the world ages, the built environment requires special attention to assist this growing part of society and therefore the update of urban design guidelines and urban policies is required. The goal of this study is to provide an overview of existing literature regarding emotions and perceptions from older people related to the outdoor built environment. A scoping review was performed using empirical studies in 12 scientific databases in a fourteen-year period (2007–2021) involving people at least 60 years old and outdoor built environment perceptions. Collected evidence identified 52 papers following the PRISMA procedure. Studies reported basic emotions (e.g., fear, joy) and space perceptions (e.g., walkability, accessibility) regarding the outdoor built environment as sidewalks, streets, and greenery. Our study reinforces the importance of analyzing older people perceptions regarding the outdoor built environment so that architects, urban planners, and decision makers have information to design solutions that fit older people needs.

1. Introduction

The world is ageing. United Nation Population Fund (UNFPA, 2019) predicts that people aged 60 and older, currently accounting for 12.3% of the global population, will rise to almost 22% in 2050.

This longevity increase requires a readjustment of the outdoor built environment, to promote an aging friendly environment. In 2007, the World Health Organization (WHO) released the ”Age-friendly Cities Global: A Guide” (WHO, 2007a), with recommendations for life quality, safety, and access to the built environment, as a clear call for cities to assist older people requirements. Cities shall encourage the inclusion of all citizens and promote older people wellbeing and a healthy and active ageing.[1] The application of the ageing in place concept, enables older people to live in their homes and community safely, independently, and comfortably for as long as possible.

As the urban areas grow and become more densely populated, age-friendly cities emerge as a concept of great importance. The share of older people in urban communities in developed countries will multiply 16 times from about 56 million in 1998 to over 908 million in 2050 (WHO, 2007a). UN released in 2007 the “Checklist of Essential Features of Age-Friendly Cities”(WHO, 2007b), strengthening the idea of older people as actors to adjust and conceive the cities as more inclusive places. Due to the multidisciplinary nature of the age friendly concept, WHO coined it as the city that promotes active aging, defined as the process of optimizing opportunities for health, participation, and security in order to enhance quality of life as people age. Moreover, the recent initiative of the European Commission - New European Bauhaus - connects the European Green Deal to our living spaces and experiences. This initiative points out creating more inclusive Europe as one of its three main goals focused on making cities more beautiful, more sustainable, and more inclusive.

The role of the built environment in the ageing process is crucial and has been explored by several authors (e.g. (König et al., 2019; Maciel et al., 2016)). Studies point to the fact that the built environment can leverage or hinder the well-being of older people (e.g. (Therrien and Desrosiers, 2009)). Older people have special requirements due to health and mental issues. As the years pass by, frailty in several dimensions may become more evident. The outdoor built environment should be prepared and reframed for this new and challenging scenario. The importance of the connection between frailty and built environment is clearly set forth in studies invoking the necessity to understand mobility issues (e.g. (Cramm and Nieboer, 2013; Domènech-Abella et al., 2020)). Inclusive architectural solutions can provide confidence to older people integrating their ordinary activities as walking, going out,

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[1] WHO defines active ageing, as the process of optimizing opportunities for health, participation, and security in order to enhance quality of life as people age (WHO, 2007a).

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doing sports, and relaxing. Thus, it is important to effectively transfer this knowledge to architects, urban designers, and policy makers who are responsible to design and approve solutions for new public places and retrofit existing ones providing a good quality of life.

Ergonomics, the design and engineering of human-machine systems for the purpose of enhancing human performance (Dempsey et al., 2000), is a discipline that brings key tools to realize and evaluate the quality of life of older people while using the built environment.

The approaches and strategies to assess the usability of the built environment by older people request the adoption of cross-disciplinary approaches and the development of diverse measurement and evaluation tools for large-scale field studies.

The outdoor built environment should be inclusive to older people by using design strategies aiming to provide appropriate wayfinding, accessibility, and walkability. The urban fabric should support harmony between the individual and neighborhood, intertwined with concepts, such as social cohesion (Yu et al., 2019), wellbeing (Burton et al., 2011) and mental health (Gale et al., 2011). Well-designed public spaces and neighborhoods contribute for an active ageing and a better quality of life.

The current literature about this theme is disperse due to the complexity and heterogeneity of the topics involved. Due to this dispersity, it is difficult to identify the main results achieved by these studies as well as the methods used. In order to summarize the research findings and identify the extent of existing research, we synthesize in the current study the evidence referring the perceptions and emotions related to the use of outdoor spaces by older people and the main research methods associated. The purpose of this paper is to provide a scoping review of the existing literature in empirical research regarding analysis of emotions and perception from older people related to the outdoor built environment. The two specific objectives of this scoping review are (1) to map the evidence that demonstrate older people's perceptions and emotions regarding the outdoor built environment (2) examine the instruments that have been used as the main means to collect and assess perceptions, behaviors, and emotions regarding the outdoor built environment by older people within empirical studies. The results of this study enable to identify gaps in the existing body of literature and support future studies considering older people perceptions and outdoor built environment.

2. Methodology

2.1. Search strategy and eligibility criteria

Following the guidelines for Scoping Reviews (Peters et al., 2020), in accordance with the Joanna Briggs Institute (JBI), we elaborated a protocol in a prospective way. The protocol can be found in Open Science Framework (OSF) and was publicly released through registration with the OSF platform (https://osf.io/hx8tn/).

The studies that were collected for this review meet to the following criteria: i) Studies focusing older people in outdoor built environment; ii) Studies where older people perceptions and emotions were collected; iii) Studies published after 2007, year of the publication of "Global Age Friendly Cities: A Guide" by WHO (2007a); iv) Empirical studies, defined as selection and analysis of primary data based in experiences in field or observation.; v) Full text available in English, Portuguese, or Spanish. All inclusion and exclusion criteria are specified and listed in Supplementary Material Table S1. The age from 60 years was considered as older people, following the age classification of WHO. However, studies that have younger participants and a clear division for older participants, i.e., +65, +70, etc., were also included, as it was possible to identify the results obtained from older people.

2.2. Study selection

This scoping revision involved 12 electronic databases, with academic and grey literature, which were searched from 01/01/2007 up to 31/03/2021: Scopus, PubMed, Webofscience, PsycINFO, IEEE Explore, EBSCO Discovery Services, Epistemonikos, Arts & Humanities Citation Index, Global Index Medicus, Campbell Collaboration, Greylit and Opengrey. Our string is presented in the section of Supplementary Material Table S2.

The publications collected from the indicated databases (n = 8172) was gathered in RAYYAN online platform (https://www.rayyan.ai/), a web-based tool created to assist scoping and systematic review process, to eliminate duplicate and irrelevant references. After this initial process, the remaining publications (n = 5149) were transferred to COVIDENCE web-based platform (https://www.covidence.org/) to carry out the next stages of the scoping review (Kellermeyer et al., 2018).

The screening process started by a first pilot considering the criteria of inclusion and exclusion, namely for title, abstract and keywords, for a sub-sample of 10 references. Two reviewers (MF, LD) executed this first pilot, and the results presented a Cohen's Kappa of 0.44, considered as a moderate agreement. Disagreements were resolved with the help of an independent third reviewer (SE or SM). Both reviewers (MF, LD) conducted additional 1501 titles and abstracts, and the percentage of inter-rater agreement was 91.03%. Conflicts were solved by one of two reviewers (SE or SM), assigned randomly. The remaining 3638 titles and abstracts were assessed by only one reviewer (MF).

The number of references selected after title and abstract screening process was 226. Those full texts were added to COVIDENCE platform. For the texts that were not available online, we reached the authors to requested for a copy (MF). In this phase each full text was assessed in line with the exclusion criteria. An initial assessment of 10 references was done by a pair of reviewers (MF, LD) and the inter-rater agreement in this process was 50%, considered as moderate. Disagreements were resolved with the help of an independent third reviewer (SE or SM). The remaining 216 references were assessed by one reviewer (MF). If a publication was excluded, the exclusion reasons were registered and in case of conflicts or doubts, one of two reviewers intervened (SE or SM) and was requested to decide. The final number of 52 publications was reached. In Fig. 1, search and selection procedures are presented.

2.3. Data analyses

The form used for data extraction was defined together by the authors. After some adjustments, the final extraction form included the following fields: publication details (Supplementary Material Table S3: authors, year, country, title and keywords); study and sample characteristics (Supplementary Material Table S4: age, gender and study duration), methodology and data collection (Supplementary Material Table S5: data collection methods, self-reported or objective measures and immersivity); and outdoor built environment features. The tables can be viewed in the section supplementary materials.

Given the heterogeneity of the studies included in this review, we decided to summarize the main findings using a narrative synthesis procedure. In our synthesis, the perceptions, spaces, and ergonomics analyzed were organized as detailed in Table 2.

The raw data collected in this study is available at GitHub (https://github.com/istar-iscte/scopingreviewolderpeople).

3. Results

3.1. General results

The 52 selected publications are divided in 48 articles published in journals, two book chapters and two master's dissertations.

Regarding the countries where the data was collected, United States of America (n = 9; 17.30%), is the country from where there is the highest number of studies. United Kingdom and Netherlands are the following countries where more studies were published with five studies each (n = 5; 9.61%). Researchers from Hong Kong published four studies

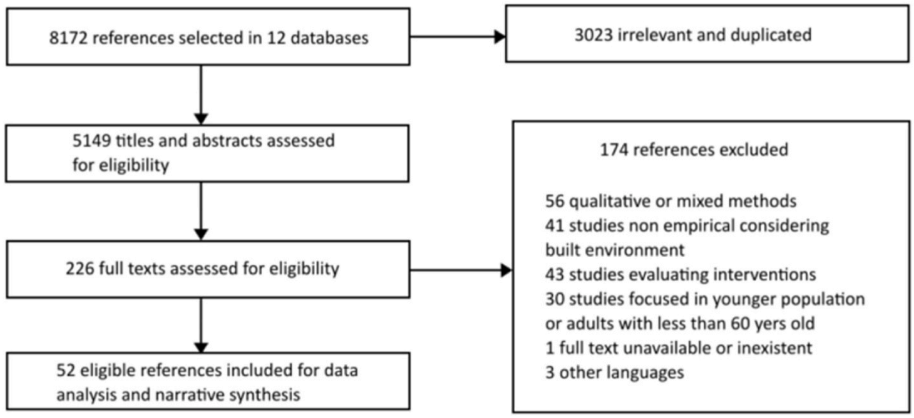

Fig. 1. PRISMA flow diagram.

and from Portugal, Australia, and Italy three studies were published from each country. Fig. 2 presents a visual description of the studies per country, and in Table S3 all data is given.

34.61% of the studies were published during 2019 and 2020, being these years when more studies were published (n = 9; 17.30% in each year). 2010 and 2015 were the second group of years in which the most publications occurred (n = 6 publications, 11.53% per each country). In Fig. 3 the number of publications per year is presented.

The keywords from 47 studies were analyzed (five studies did not include keywords). For that we used a web-based tool named Voyant Tools (https://voyant-tools.org/), where all the keywords were added and the words that appear most often are: environment (18); social (18); older (17); aging (10); adults (9) and age (7). Fig. 4 presents a word cloud with the most mentioned keywords.

The duration of the studies data collection was identified and analyzed. From the studies that mentioned their duration (n = 33; 63.46%), the results were: 11 (33.34%) lasted between one to three months; 5 (15.15%) lasted between three to six months; 8 (24.24%) lasted between seven to 12 months; and 9 (27.27%) used more than 12 months to be developed.

The dominant gender of the experimental subjects involved in the studies is female (n = 29; 55.76%). Five studies (n = 5; 17.30%) had equal distribution and eight studies (n = 8; 13.46%) did not mention the gender distribution of the sample.

Regarding the age of the experimental subjects, most of the studies (n = 39; 75%), considered only people with 60 years or older. Seven studies (n = 7; 13.46%) considered middle-aged adults, with 30 years old or more and older people and six (n = 6; 11.53%) reached all the ages. It is important to mention that in the studies that encompassed ages different from +60, only the older adults' groups results were analyzed.

The number of participants involved varied from smaller sample sizes (e.g., photovoice studies) to large national surveys or databases from a certain area or region, reaching hundreds or thousands of people.

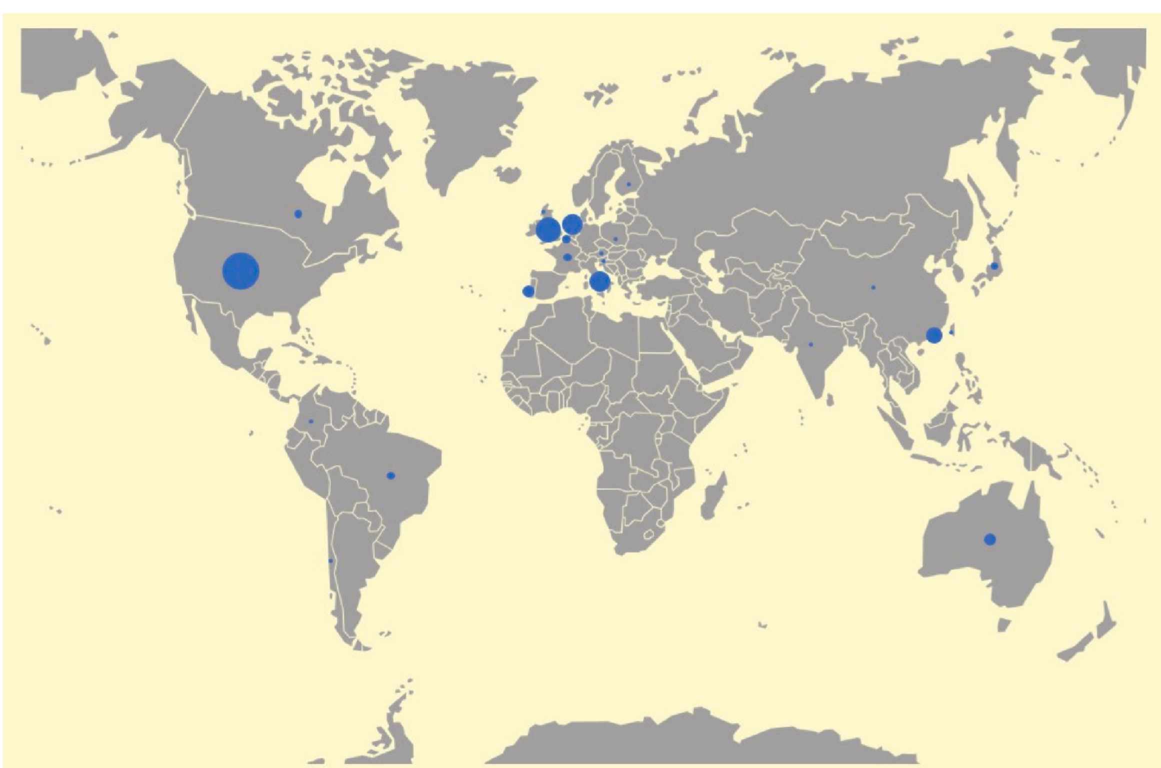

Fig. 2. Geographic distribution of the references included in this scoping review.

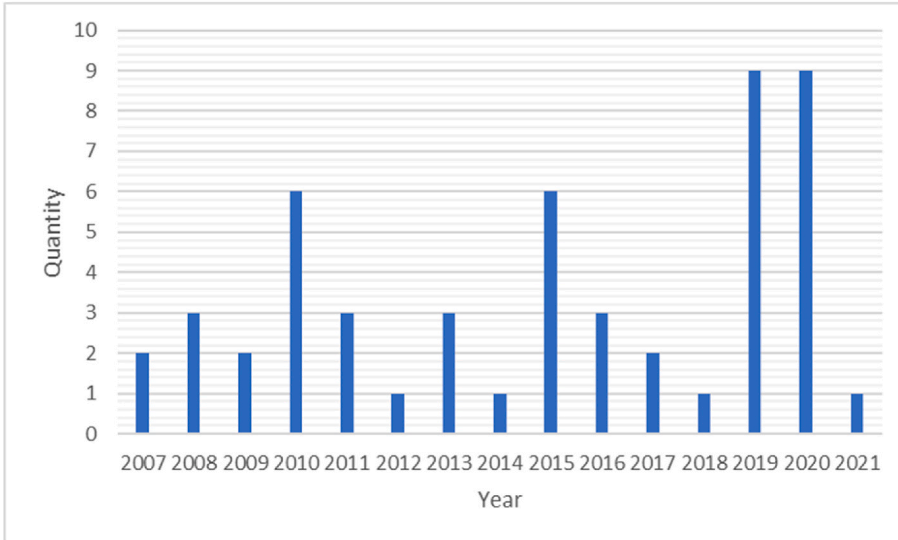

Fig. 3. The number of publications per year.

Fig. 4. Word cloud representing the keywords.

The size of samples was divided in three groups and presented in Table 1.

3.2. Specific results

We analyzed the main results of the papers taking in consideration two main categories. The first main category is related with the contents explored in the papers and we considered: i) main emotions and perceptions, ii) types of outdoor built environment, and iii) ergonomic factors explored. Table 2 presents a summary of the main findings for all the 52 publications identified. The second category is methodological listed, containing: iv) objective/subjective methods; v) specific measures (e.g., scales) and; vi) devices for data collection.

Table 1
Distribution of the number of participants in the studies.

Number of participants	Percentage of studies (%)
1–50	15.38
51–500	46.15
+501	38.46

3.2.1. Emotions and perceptions

Main emotions and perceptions referenced in the 52 papers were categorized in accordance with three categories: basic emotions, spatial perceptions, and general perceptions.

Basic emotions were classified in accordance with Ekman (1992, 1999). The basic emotion that was most mentioned was fear (n = 13; 25%), followed by happiness and sadness (n = 2; 3.80%) and anger and disgust (n = 1; 1.90%).

Spatial Perceptions were considered as the ones related specifically

Table 2
The 52 publications and their main characteristics.

Author name (year)	Basic emotions	Spatial perceptions	General perceptions	Outdoor built environment	Ergonomic
Ahrentzen (2010)	FEA	WAL, WAY	SAF, SCA	GRE, NEI, SHA, SID	COG
An and Yoshida (2013)	FEA		SAF, SEC	GRE, ROA, SID, STR, TRA	COG, ORG
Benoit et al. (2015)			ANX, SEC	IMM	COG
Bilotta et al. (2010)		ACC	DEP, QOL, SCA, WEL	NEI	COG
Bojan (2019)	FEA		SAF	FUR, LIT, NEI, NOI	COG, ORG
Bowling and Gabriel (2007)			SAF, QOL	NEI, FUR	COG, ORG
Burton et al. (2011)			SAF, WEL	GRE, NEI, NOI, PRO, ROA, SET, STR, TOP, TRA	COG, PHY, ORG
Cain et al. (2018)			SAF, SCH, SCA	ABAN, NEI	COG
Chen et al. (2020)		WAL	MOO	GRE, LIT, ROA, SID, UBS	COG, PHY, ORG
Cramm and Nieboer (2013)			SAF, SCH, SEC	NEI	ORG
de Donder et al. (2013)		ACC, MOB	QOL, SAF	ACC, ENV, FUR, GRE, LIT, NEI, ROA, TRA	COG, PHY, ORG
Distefano et al. (2021)	FEA	WAL	SAF	NEI, ROA, SID, TRA	COG, PHY, ORG
Domènech-Abella et al. (2020)		MOB, WAL	LON, SAF, SCH, SCA	ACC, NEI, TRA	COG, PHY, ORG
Dryjanska (2015)	SAD		MOO	CUL, NEI, GRE	ORG
Fabisiak et al. (2020)	FEA		MEN	FUR, UBS	COG
Firdaus (2017)	FEA		DEP, MEN, WEL	ACC, GRE, NEI, NOI	COG, ORG
Gaber et al. (2020)	FEA	ACC	STR	NEI, UBS	COG
Gale et al. (2011)			SCH, WEL	LIT, NEI	COG
Gómez et al. (2010)			SAF	NEI, ENV, ROA, GRE, SID, TRA	COG, PHY, ORG
Greenberg (2009)			SCH, SCA	ABAN, LIT, NEI, NOI, TRA	COG, ORG
Herrmann-Lunecke et al. (2021)	ANG, DIS, FEA, FRU, HAP	MOB, WAL	SAF, SEC, STR, WEL	GRE, SID	COG, PHY
Ivey et al. (2015)		WAL	DEP, MEN, SAF, SCA	ACC, NEI, TRA	COG, ORG
Kemperman et al. (2019)	FEA		LON, SAF, SCH, SCA	FUR, GRE, NEI	COG, PHY, ORG
König et al. (2019)		WAL	SAF	NEI, FUR, GRE, SID, LIT	COG, PHY, ORG
Lager et al. (2021)		ACC, MOB, WAL	SCH, WEL	NEI, SID	COG
Largueiras (2020)		MOB, SEN	SAF, SCH, WEL	ENV, GRE, ROA, SID, TOP	COG, PHY, ORG
Low and Molzahn (2007)			QOL	NEI	COG
Lucchesi et al. (2020)		WAL	SAF, SEC, WEL	ACC, NEI, ROA, SID	COG, PHY, ORG
Machado (2016)		ACC, MOB, WAY	ANX, DEP, QOL, SAF, WEL	GRE, PRO	ORG
Mahmood et al. (2012)		ACC, WAL, WAY	MEN, SAF, SCH, SEC, STR	ACC, ENV, FUR, GRE, NEI, SID	COG, PHY, ORG
Menant et al. (2010)			ATT	AOB	PHY
Montuwy et al. (2019)		WAY	ATT, SAF	ENV, STR	COG
Moorman et al. (2017)			SCH, WEL	NEI	COG
Neale et al. (2017)		MOB, WAY	ENG, EXC, FRU, RES	GRE, NOI, SID, TRA, UBS	COG
Phillips et al. (2010)			QOL, SAF, SCA, WEL	ACC, NEI, NOI	COG, PHY, ORG
Qian et al. (2019)		ACC	SAF	NEI, FUR, GRE, UBS	COG, PHY, ORG
Quine and Morrell (2008)			SAF	NEI	COG
Rantakokko et al. (2010)	FEA, SAD	MOB, SEN	SEC	ACC, ENV, FUR, NEI, NOI, ROA, STR, TRA	PHY, ORG
Ribeiro et al. (2015)		WAL	SAF	GRE, NEI, ROA	ORG
Ronzi et al. (2020)			FIC, WEL	FUR, GRE, SID	PHY, ORG
Rubenstein et al. (2011)	FEA	ACC, MOB	DEP, MOO	SID	PHY
Sallis et al. (2015)	FEA		SCH, SEC	FUR, GRE, NEI, ROA, SID, SET	PHY, ORG
Siu (2019)		ACC, WAL		ACC, SID, NEI, UBS	PHY, ORG
Strohmeier (2016)	FEA	MOB, SEN, WAL	QOL, SAF	ENV, PRO, ROA SID, STR, TRA	COG, PHY, ORG
Therrien and Desrosiers (2009)		MOB	SEC, SCA	ACC, NEI	COG, PHY
van den Berg et al. (2016)		ACC, MOB	LON	ACC, NEI	COG, PHY, ORG
van Haastregt et al. (2008)			ANX, DEP		COG
Vitorino et al. (2019)			SAF	NEI	COG, ORG
Wood et al. (2008)			SAF, SCA	ACC, GRE, TR	COG, ORG
Yanagihara et al. (2014)		ACC		ENV, SID, TRA	PHY, ORG
Yu et al. (2020)			ATT, MOO, RES	GRE, NOI, ROA, TRA	COG
Yu et al. (2019)	HAP		MEN, SCH, WEL	NEI	COG

Note: Spatial Perceptions: ACC– accessibility; MOB– mobility; SEN– sensorimotor; WAL– walkability; WAY– wayfinding.
Basic Emotions: ANG– anger; DIS– disgust; FEA– fear; HAP– happiness; SAD– sadness; SUR - surprise.
General Perceptions: ANX– anxiety; ATT-attention; DEP– depression; ENG-engagement; EXC– excitement; FIC- feeling of inclusion; FRU– frustration; LON– loneliness;

MEN - mental health; MOO– mood; QOL-quality of life; RES– restoration; SAF- safety; SCH- social cohesion; SEC– security; SCA-social capital; STR– stress; WEL– wellbeing.
Outdoor built Environment: ABAN– abandoned housing; ACC– access/distance from stores; AOB– artificial obstacles; CUL– cultural heritage; ENV– environmental barriers; FUR– urban furniture/amenities; GRE – green environment/trees/parks/blue spaces/gardens; IMM– immersive environment.
LIT-litter/garbage/trash; NEI– neighborhood; NOI– noise; PRO– prosthetic devices; ROA– road crossing/design; SET– setbacks; SHA– shading; SID– sidewalks/pavements; STR– streets; TOP– topography; TRA– traffic/danger; UBS– urban busy spaces/public spaces.
Ergonomic: Cognitive; Physics; Organizational.

with the characteristics of the outdoor built environment (Barhorst--Cates et al., 2020; Wang and Zhou, 2019). The most indicated perceptions were walkability (n = 14, 26.92%) and mobility (n = 12; 23.07%). Accessibility was cited 10 times (n = 10; 19.23%), while wayfinding (n = 6; 11.53%) and sensorimotor (n = 3; 5.77%) were less mentioned.

Finally, we identified a group we named General Perceptions, considering global concepts not specifically related neither to basic emotions nor to specific spatial perceptions. In the studies we identified 18 relevant general perceptions. The most explored general perception was safety (n = 28; 53.84%), followed by wellbeing (n = 15; 28.84%) and social cohesion (n = 11; 21.15%). Social capital and security had 10 mentions each (n = 10; 19.23%). Quality of life was indicated five times (n = 5; 9.61%), while mental health and mood had four mentions (n = 4; 7.69%).

3.2.2. Outdoor built environment

Built environment is a broad concept that can be associated with all the structures built by men to support human activity. This term comprises everything that is physically part of a city, a town, or a village, such as buildings, roads, squares, parks, sidewalks, commercial signage, street furniture, and so on (Portella, 2014). As a complex social-ecological system, the built environment, involves physical forms with characteristics such as land, housing, scale, construction details and others (Moffatt and Kohler, 2008).

We classified the studied outdoor built environment in 20 categories. Seven categories are sets of related environmental elements have more than one terminology associated, e.g., litter, trash, and garbage. All the descriptions and aggregated terminologies are available in the notes of Table 2. The results highlight that the most indicated outdoor built environment was “neighborhood” (n = 35; 67.30%). The category “green environment/trees/parks/blue spaces/gardens” had 21 mentions (n = 21; 40.38%). “Sidewalks/pavements” (n = 17; 32.69%) and “road crossing/road design” (n = 13; 25.00%) were the following mentioned categories. Another referenced outdoor built environment was “access/distance from stores” (n = 11; 21.15%), “noise” (n = 8; 15.38%) and “environmental barriers” (n = 8; 15.38%). Less mentioned were “streets” (n = 6; 11.53%), “urban busy spaces/public spaces” (n = 6; 11.53%), “litter/trash/garbage” (n = 6; 11.53%) and “setbacks” (n = 4; 7.69%).

3.2.3. Ergonomic

Ergonomics is about the understanding and design for the interactions not the components (Wilson, 2012) and thus, the association between older people (users) and the built environment is of relevance in our study. We used the International Ergonomics Association (IEA) (2015) classification, namely cognitive, physical, or organizational. According to (Salvendy, 2012) physical ergonomics is concerned with human anatomical, anthropometric, physiological, and biomechanical characteristics such as working postures. IEA summarizes cognitive ergonomics as concerned with mental processes such as perception, memory, reasoning, and motor response, as they affect interactions amongst humans and other elements of a system. Also, IEA states that organizational ergonomics is related to the optimization of socio-technical systems, including their organizational structures, policies, and processes.

Most of the studies (n = 41; 78.84%) mentioned cognitive ergonomics in their research. Organizational ergonomics was present in 31 studies (n = 31; 59.61%) and physical ergonomics had 25 mentions (n = 25; 48.07%). Thirty studies (n = 30; 57.69%) considered more than one ergonomic aspect. A detailed identification of the ergonomics analyzed in the studies is indicated in Table 2.

3.2.4. Objective and self-reported measurements

Our study also investigated if measurements were done subjectively or objectively (Xu et al., 2022) in Table 3. We considered subjective measures as self-reported perceptions based on interviews. Subjective measures included fear perceptions and well-being measures, for instance. We considered objective measurements as the ones not related with people’s perceptions or consciousness (Gaillard et al., 2014). Objective measures included, e.g., distance from stores, street patterns, heart rate and electrodermal activity. Measurements were grouped in three sets, objective, self-reported or both, as some studies used the two, identified as well.

3.2.5. Specific measures used (i.e. scales)

There were studies that used more than one scale in the methodology. Our focus is on scales that had relation to the outdoor built environment. There were nine studies that did not use scales (n = 9; 16.98%). We sorted out 35 different methodologies and the most used were Neighborhood Environmental Walkability Scale (NEWS), Built Environment Site Survey Checklist (BESSC), Health Aging Research Network (HAN) and Warwick-Edinburgh Mental Well-Being Scale (WEMWBS), used two times each (n = 2; 3.84% each one). In Supplementary Materials Table S4 the scales are indicated.

3.2.6. Data collection methods

The most used modality for data collection was face-to-face interviews (n = 31; 59.61%), followed by pencil/postal/email surveys (n = 11; 21.15%). There are studies that used two data collection methods (n = 15; 28.84%) and three methods (n = 2; 3.85%). Studies using technologies as virtual environments (n = 2; 3.85%), photovoice (n = 2; 3.85%) or sensors (n = 3; 5.77%) are less frequent. In Fig. 5, data collection methods and frequencies are represented.

4. Discussion

This scoping review had the goal to identify the main emotions and perceptions of older people in relation to the outdoor built environment. Moreover, we also aimed to examine the main methods and instruments for data collection used in studies in this domain. Considering a period of fourteen years, we identified 52 studies exploring different perceptions and methods. An analysis of the characteristics of the studies revealed a varied pattern of studies regarding the geographical location, sample size and type of methodologies used. Although a significant percentage of the studies were conducted in the United States (17.30%), we found a large geographic distribution of studies conducted across the world, in European and Asian countries, reflecting diversity regarding the geographic representation. In the same manner, we also found studies

Table 3
Types of measurements used.

Measurements	Quantity	Percentage of studies (%)
Self-reported	25	48.07
Objective	8	15.38
Both	19	36.53

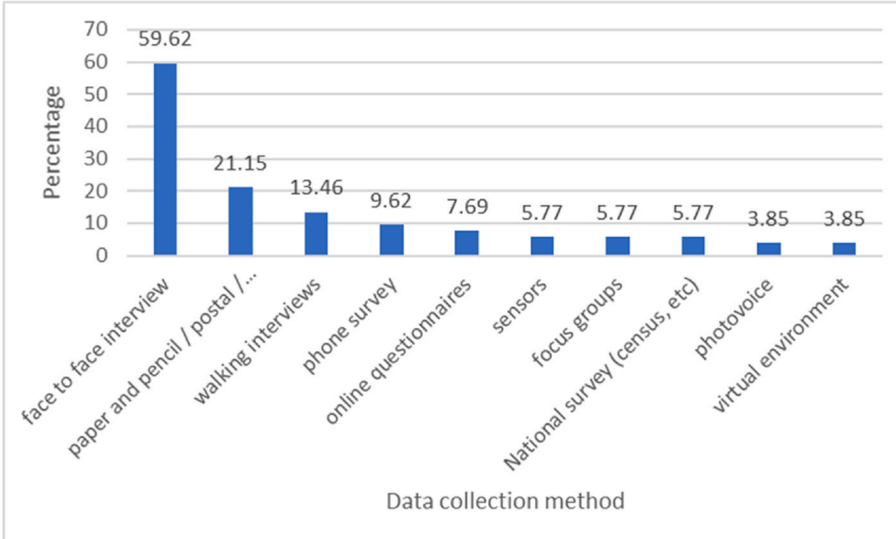

Fig. 5. Data collection methods.

conducted with small (e.g., photovoice studies with 26 participants (Ronzi et al., 2020)) and very large sample sizes (e.g., census from national studies (Moorman et al., 2017)). As expected, most of the studies included in this review considered only older participants. However, some of them also considered other age groups.

The main findings on basic emotions show that fear was referred more times than other basic emotions like happiness or sadness, which are scarcely mentioned (Dryjanska, 2015; Herrmann-Lunecke et al., 2021). Although fear, and especially fear of falling, is an important emotion, often linked with crucial health outcomes for older people's health (van Haastregt et al., 2008), the emphasis put on this emotion over others may indicate the prevalence of a narrow and stereotypical view on older people are disabled people due to their cognitive or physical fragility, while ignoring the heterogeneity in health conditions among this age group.

Half of the studies reported spatial perceptions and provided compelling evidence to further research. Walkability, mobility, and accessibility were tracked extensively in our review in complete alignment with age-friendly cities recommendations (WHO, 2007a). In fact, outdoor built environment should invite its users to a pleasant experience and inadequate built environment conditions such as bad walkability, deficient mobility, lack of accessibility contributes to stressing and harmful lifestyles and limited or none participation in the social life of a given community.

Moreover, several studies also involved the assessment of more general perceptions such as safety, well-being, social cohesion and social capital, once again clearly in line with the broader conceptualization of age inclusive cities (WHO, 2007a). Urban spaces need to be shaped in order to provide a restorative and safe context for users' daily life and to tackle practices such as loneliness (Domènech-Abella et al., 2020) and unsafety (de Donder et al., 2013). Neighborhood, the most indicated built environment in the studies, plays a crucial role in age friendly cities, as ageing in place has been adopted as a key strategy for coping with the challenges of longevity (Burton et al., 2011). Also, the green and blue structure of the city (i.e., trees, parks, gardens, lakes, rivers) is often referred, thus associating streets with the green as wellbeing promoter. Age friendly green spaces should be safe, well maintained and provide resting and comfortable places (WHO, 2007a).

Regarding ergonomic aspects, it is relevant that most of the studies mentioned cognitive ergonomics and much less physical ergonomics. Although cognitive ergonomics is of main relevance to architecture, studies that focus on physical ergonomics and findings on the immediate level of physical use of the built environment are lacking.

Another aspect that is interesting to highlight is that in 34 of the 52 studies included in this review different measures were used. In fact, only 10 studies used the same scales. These numbers show the dispersity of the field and reveal approaches probably coming from several disciplines with different scientific background. Regardless of those measures' relevance, our study supports further investigations on whether it is possible to provide a common framework to assess perceptions of the outdoor built environment.

Older people perceptions and emotions were assessed in several different ways. Self-reporting was the most common way to measure perceptions and emotions. New devices and sensors were explored in only a limited number of studies, e.g., 360° cameras (An and Yoshida, 2013), sensors (Neale et al., 2017), augmented reality (AR) glasses (Montuwy et al., 2019) and head mounted displays for virtual reality (VR) (Yu et al., 2020). This scoping review revealed that there are few studies using these new technologies and only more recently they have been used. These tools allow to new types of studies that should be further pursued in the future.

4.1. *Strengths and limitations of the research done in the field*

Several positive aspects can be highlighted regarding the research that has been carried out: i) a relevant number of papers is already published on the topic (52); ii) these papers report broadly geographically distributed studies; iii) several studies were developed using large samples of participants enabling the generalization of results; iv) relevant concepts for public policies for age-friendly cities are frequently mentioned, such as walkability, mobility and accessibility; v) special attention to the neighborhood where older people live is noticeable.

Despite these strengths, this body of research also presents some relevant limitations: i) it focuses primarily on negative emotions (e.g., fear) and less on positive, global aspects, such as well-being and quality of life; ii) it does not focus on specific architectural aspects (e.g., street design); iii) it uses primarily self-reported measures.

The lack of research on positive indicators, such as wellbeing, inclusiveness and quality of life, shows that research focuses on older people's perception is primarily based on the perception of ageing as a problem and not as a positive and enjoyable period of life.

Regarding the outdoor built environment, although some studies investigate specific elements such as streets, sidewalks and pavements (An and Yoshida, 2013; Yanagihara et al., 2014), they often do so in a broader manner (i.e., fear of falling in the streets), without consideration for more specific features such as different street design or architectural elements. In fact, there is a lack of research regarding the design of the outdoor built environment like streets and gardens and their facilities (e.g., pavements, crossings, benches, light), reinforcing future studies using the results of this paper as a reference. This limits the impact that this research could have for urban design.

Most of the studies used self-reports as measurements and focused on the same dimensions of negative emotions, emphasizing older people's cognitive and physical frailties and reinforcing an ageist bias. Therefore, additional research should be done using objective measures, such as data from biometric sensing, to support existing results.

4.2. Strengths and limitations of the present scoping review

One core strength of this scoping review is the focus on literature that includes the perspective of older people and their emotions and perceptions of the outdoor built environment. This is relevant since this societal group is increasing in number in most developing countries, and cities still fail to find proper solutions for being ageing friendly. Another strength of this study is that it offers designers and architects information on the impact of the outdoor places they design. Moreover, public policies and decision-makers can use this study to drive discussions and policies regarding the growing silver economy.

Regarding the limitations of the review. First, related to the essence of a scoping review, although the list of scientifically and grey literature databases is vast, it is likely that not all publications were identified. In addition to this, differently from systematic reviews, scoping reviews does not assess the quality of the articles. Second, we focused on English, Portuguese and Spanish peer-reviewed literature which omits studies published in other languages that could bring additional perspectives on the topic. Also, one can notice that a major part of the research included in this review is originated from affluent countries and can narrow the coverage of the findings. The results showed in this review provides insight into the experiences of older people when accessing outdoor built environments and does not involve those restricted to indoors.

5. Conclusions

The present scoping review departures from the understanding that the outdoor built environment is one of the main areas that impacts an active ageing in contemporary age-friendly cities. This review supports the efforts to create age-friendly cities by identifying the main aspects that have been studied and consequently the ones that have been absent from research. The evidence we present in this review identifies that fear is by large the emotion more studied, and positive emotions such as happiness, joy, and trust are much less studied. Additionally, related to the outdoor built environment, we identified that most studies focus on abstract concepts of space as neighborhood, green environments, and gardens and much less on concrete design solutions such as textures of pavements, design of streets, the existence of benches and so on. Another finding was that most studies were based on direct experimentation of the real space and much less on simulated future environments. These findings give concrete data to researchers to decide on which topics are needed for future work for age-friendly cities considering the well-being and life quality for older people.

Improving the living areas of the city is a priority for policy makers together with urban planners and architects and the aim of scientists is to direct their attention to the most promising solutions, determining the directions of the changes. As technology offers devices and sensors for novel approaches, at personal and collective levels, researchers can advance the assessments of the built environment impact on older people studying phenomenon that were not studied before such as the objective impact of the outdoor built environment on users by using biometric data. Smarter and more inclusive cities demand alternative approaches to respond to an ageing society, supporting the social inclusion and improving autonomy for this vulnerable group. Simultaneously we aimed at empowering further research bridging the research gaps that our integrated analysis of the literature highlighted.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.apergo.2022.103951.

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