Systematic Review

Impact of the Built Environment on Ageing in Place: A Systematic Overview of Reviews

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Abstract: Background: As the global demographic shifts towards an ageing population, the significance of the built environment in facilitating ageing in place gains prominence. This study addresses the critical question of how a built environment can support older adults' independence and enhance their quality of life. Method: Utilising a systematic review of review papers, this research scrutinises existing literature to uncover the influence of urban planning, physical accessibility, and residential design on the older people's physical and mental well-being. More specially, the study methodically examines existing review articles that span various aspects of the built environment related to ageing in place. Results: The analysis reveals that specific elements of the built environment, notably rational urban planning and accessible urban spaces, as well as adaptable housing designs, significantly impact ageing individuals' health, social engagement, and overall satisfaction with life. It also identifies contradictions in the effects of environmental features on cognitive health and well-being, underscoring areas that warrant further exploration. Conclusions: The study concludes that thoughtful urban and housing designs are pivotal in creating age-friendly environments that support ageing in place. It emphasises the need for future research and policy development aimed at enhancing the living conditions of older adults within their communities.

Keywords: built environment; ageing in place; active ageing; independent living; urban planning; accessibility

1. Introduction

As populations globally witness an unprecedented increase in the number of older adults, the concept of ageing in place—the ability of older individuals to live in their own home and community safely, independently, and with autonomy—becomes increasingly relevant [1]. The significance of the built environment in facilitating ageing in place is profound, as it encompasses various elements like housing, transportation, community design, and public spaces, all of which play crucial roles in the daily lives and well-being of the older people. The intersection of ageing and the built environment has gained considerable research attention in recent decades, underscoring a vital area where public health, urban design, and gerontology intersect. This research contributes to the ongoing debate on how to create age-friendly environments that promote healthy ageing and social inclusion. It addresses the complex interplay between urban planning, public health, and gerontology in the context of rapidly ageing societies worldwide.

The built environment refers to all human-made physical spaces and their arrangement, encompassing the design and layout of cities and neighbourhoods, the construction

and features of individual homes, as well as public spaces and transportation infrastructure [2]. The quality and design of these environments are pivotal in determining the health, mobility, social interaction, and overall quality of life of older adults. For instance, accessible and well-designed spaces can enhance physical activity, reduce the risk of falls, and facilitate access to healthcare services, thereby directly contributing to the physical health and independence of the older people [3]. On the contrary, environments lacking accessibility or safety features can create barriers to mobility, exacerbating health issues and leading to increased dependence [4].

Furthermore, the built environment plays a crucial role in fostering or impeding social interactions and community engagement, which are vital for the mental health and emotional well-being of the ageing population. Features such as community centres, parks, and walkable neighbourhoods encourage socialisation and community participation, while environments that are poorly designed for social interaction or where access to social venues is limited can exacerbate isolation [5]. The adaptability and personalisation of living spaces are also critical aspects to support ageing in place. As individuals age, their needs and abilities change, making it essential for living spaces to be adaptable to these evolving requirements [6]. This adaptability can range from simple modifications like installing grab bars in bathrooms to more significant changes like redesigning living spaces to be more accessible.

The urgency of addressing the relationship between the built environment and ageing in place is heightened by several contemporary factors. Firstly, the rapid ageing of the global population presents unprecedented challenges for urban and rural planners to create environments that support the well-being of older adults. According to the World Health Organization [7], the number of people aged 60 years or older is projected to more than double by 2050, reaching nearly 2.1 billion. This demographic shift demands immediate attention to ensure that the built environment can accommodate the needs of an ageing society. While the pace and scale of population ageing vary across regions, the challenges and opportunities presented by this demographic shift are globally relevant. The findings from this review have implications for urban planners, policy-makers, and healthcare professionals worldwide, as they seek to create environments that support healthy and active ageing across diverse cultural and socioeconomic contexts.

Secondly, the ongoing advancements in technology and urban planning provide new opportunities to innovate and improve the built environment. Smart home technologies, improved urban design practices, and enhanced public transportation systems are increasingly being integrated into the planning of age-friendly cities. Understanding how these innovations can best support ageing in place requires a comprehensive synthesis of existing research.

Thirdly, the COVID-19 pandemic has highlighted the vulnerability of older adults and the importance of their living environments in maintaining health and well-being. Social isolation, access to healthcare, and safe living conditions have become even more critical during this time, underscoring the need for environments that can support the physical and mental health of older adults.

Despite the extensive literature exploring the interaction between the built environment and ageing in place, the existing body of research remains fragmented. Over 20 review papers have been published, focusing on varied facets of how housing, transportation, and community design affect the health, well-being, and social integration of older adults. These individual reviews, while insightful, are diverse in their scope, methodology, and conclusions, suggesting a rich yet dispersed knowledge base that complicates the extraction of clear, actionable insights. This fragmentation indicates the necessity for a systematic review of reviews to consolidate and synthesise these disparate findings, providing a clearer and more comprehensive understanding of the field. The systematic review of reviews was conducted to address these challenges.

The objectives of this systematic review of reviews are threefold as follows: firstly, to consolidate findings from various reviews examining the impact of the built environment

on ageing in place; secondly, to identify consistent patterns, contradictions, and gaps in the existing literature; and thirdly, to offer recommendations for future research, policy formulation, and practice. This endeavour aims to bridge the gaps between individual pieces of research and forge a comprehensive narrative that can guide the creation of age-friendly environments and policies, thereby enhancing the quality of life for the ageing population. This systematic review of reviews represents a novel approach to synthesising the fragmented knowledge in this field. By consolidating findings from diverse studies, it provides a comprehensive and up-to-date overview of the relationship between the built environment and ageing in place. This synthesis is particularly timely and relevant given the urgent need for evidence-based strategies to support healthy ageing in rapidly changing urban environments worldwide.

2. Background

2.1. Built Environment for the Ageing Population

The built environment, encompassing the man-made structures and spaces where people live, work, and recreate, has a profound influence on community health and individual well-being, especially among older adults [8]. Historically, urban development has not always prioritised the needs of ageing populations. However, as demographic trends shift towards an ageing global populace, the imperative to accommodate their needs in urban design has come to the forefront of public health and urban policy discussions [9].

The evolution of urban environments reflects an increasing acknowledgment of the critical role that accessibility and location allocation play in public health outcomes [10]. Age-friendly design principles have emerged, advocating for urban spaces that support ageing individuals in leading healthy, active, and engaged lives within their communities [11]. This encompasses the creation of walkable neighbourhoods, the integration of accessible public transportation, and the provision of amenities that promote social interaction and leisure activities among older adults [12].

Moreover, the built environment's role in fostering community cohesion and intergenerational connectivity is gaining attention. Urban spaces that facilitate encounters and relationships across age groups not only enhance the social fabric of communities but also provide tangible support networks for the older people [13]. Such environments can mitigate feelings of isolation and promote a sense of belonging and purpose, which are crucial for mental health and cognitive resilience as individuals age [14].

In addition to public spaces, the private realm of housing has seen a shift towards 'ageing in place' designs. These include home modifications and smart-home technologies that enable older adults to live independently and safely. The design features range from simple modifications, such as improved lighting and non-slip surfaces, to more complex interventions like sensor systems that monitor health and activity levels [15].

The integration of these elements within the built environment requires a collaborative approach that includes the voices of older adults in urban planning processes. It calls for interdisciplinary research and partnerships between urban planners, architects, gerontologists, and community members to develop environments that are not only physically accommodating but also culturally and socially enriching.

2.2. Ageing in Place

Ageing in place transcends the concept of residing in a familiar environment. It reflects a systemic approach to support the older people in maintaining autonomy, dignity, and continued engagement in their social milieu [16]. This approach acknowledges the complex interplay between personal desires, community support, and the health system's capacity to provide care within the home environment [1].

Critical to ageing in place is the alignment of home environments with the evolving capabilities and preferences of older adults. The ability to age in place is contingent on the adaptability of housing to meet the functional needs of its occupants, which may include the integration of assistive devices and technologies, supportive services, and home

health care [17]. The concept extends to the neighbourhood level, where the availability of resources, such as grocery stores, pharmacies, and healthcare facilities within accessible distances, is crucial [18].

The emotional and psychological dimensions of ageing in place are equally important. The connection that older adults have with their home and community is deeply rooted in their sense of identity and belonging. The familiarity of their environment can offer comfort and cognitive stimulation, which is crucial for their mental health and emotional well-being [19].

Community-based programmes and services are fundamental to the successful implementation of ageing in place. These include adult day care, meal delivery services, transportation services, and home modification programmes, which collectively enable older adults to maintain independence and manage health conditions within their homes [20]. Economic factors also significantly influence the feasibility of ageing in place. The cost benefits of this approach, compared to institutionalised care, make it an attractive option for policy-makers focused on sustainable healthcare models. However, it requires investment in community healthcare infrastructure and services to be a viable option for a broader segment of the population [21].

The challenges of ageing in place, such as the risk of social isolation and the need for appropriate care, call for an integrative strategy. This strategy must incorporate the design of age-friendly cities, community development practices, and advancements in telehealth and in-home care services. Such a strategy ensures that ageing in place can be a reality for all older adults, regardless of socio-economic status [22].

All in all, ageing in place epitomises a dynamic process that encapsulates the essential elements of independent living, active living, and quality of life, all of which are pivotal for the well-being of older adults [23]. This concept goes beyond the mere act of residing in a long-term home; it represents the ability to live in a personal space autonomously, engage in physical and social activities that foster health and community connection, and maintain a standard of living that reflects personal satisfaction and well-being [24]. It emphasises creating an environment that not only adapts to the changing needs of the ageing population but also actively supports their full participation in life's activities. Through this enriched approach, ageing in place encompasses the very essence of a fulfilled later life, characterised by empowerment, engagement, and a deep sense of personal contentment [25].

3. Materials and Methods

3.1. Search Strategy and Selection

A comprehensive search was conducted to identify studies that examined the impact of the built environment on ageing in place. Searches were carried out across Google Scholar, Scopus, and Taylor and Francis using a predefined set of keywords. These keywords included ("built environment" OR "physical environment" OR "urban environment" OR "man-made environment" OR "artificial environment" OR "constructed environment" OR "anthropogenic landscape") AND ("ageing in place" OR "independent living" OR "quality of life" OR "active ageing" OR "wellbeing" OR "healthy ageing" OR "sustainable ageing" OR "home adaptation") AND ("literature review" OR "review" OR "overview" OR "synthesis" OR "meta-analysis" OR "systematic review" OR "state-of-the-art" OR "critical review" OR "narrative review").

The initial searches resulted in a substantial pool of literature, identifying 283 articles spanning from 2004 to 2023. These articles were subjected to a rigorous screening process based on titles and abstracts to assess their relevance to the research question. The inclusion criteria focused on systematic reviews that examined the relationship between the built environment and ageing in place. Articles were excluded if they did not employ systematic review methodologies or were not directly related to the impact of the built environment on ageing in place.

3.2. Screening and Selection Process

After initial screening, 92 articles were selected for full-text review. Each article was critically examined to ensure methodological soundness and relevance. A final set of 22 systematic reviews met the inclusion criteria and were included in the analysis. These 22 reviews collectively analysed over 1000 primary studies, covering a diverse range of built environment factors and their impacts on ageing in place. The evidence gathered included quantitative data on housing design features, neighbourhood characteristics, and urban planning strategies, as well as qualitative insights into older adults' experiences and preferences. The reviews spanned multiple geographic regions, including North America, Europe, Asia, and Australia, providing a global perspective on the topic. Moreover, 16 review papers were finalised to conduct quantitative analysis due to the comparability of their data. The quantitative analysis focused on quantifiable outcomes such as the number of studies on the positive effects of neighbourhood accessibility, environment aesthetics, or housing design on physical activity, social engagement, or quality of life. This allowed for a statistical synthesis of the evidence, providing more robust conclusions about the strength and consistency of relationships between built environment factors and ageing in place outcomes.

Data extraction involved a detailed review of each included article to identify key findings, methodologies, and evaluation measures. The extracted data focused on elements such as the types of built environment factors studied, the ageing in place factors examined, and the relationships between them. The synthesis of the data followed a qualitative approach, where findings from individual reviews were integrated to identify consistent patterns, contradictions, and gaps in the literature. The synthesis also involved a quantitative component, where the frequency and nature of relationships between built environment factors and ageing in place outcomes were tabulated.

The systematic review of reviews methodology was chosen for its ability to consolidate findings from multiple reviews, providing a higher-order synthesis that reveals consistent patterns, contradictions, and gaps in the literature. This approach was deemed appropriate given the fragmented nature of existing research on the built environment and ageing in place. It allows for a comprehensive overview of the field while minimising the risk of bias that might occur in analysing individual primary studies. The choice of PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) as the reporting standard was driven by its widespread acceptance and comprehensive guidelines for conducting systematic reviews. PRISMA consists of a 27-item checklist and a four-phase flow diagram, designed to improve the transparency and quality of systematic reviews and meta-analyses. It provides a clear framework for ensuring transparency and replication in systematic reviews, which was crucial for this study. PRISMA guided the process in screening, selection, and data extraction, enhancing the methodological rigour of the review. The flowchart is shown in Figure 1.
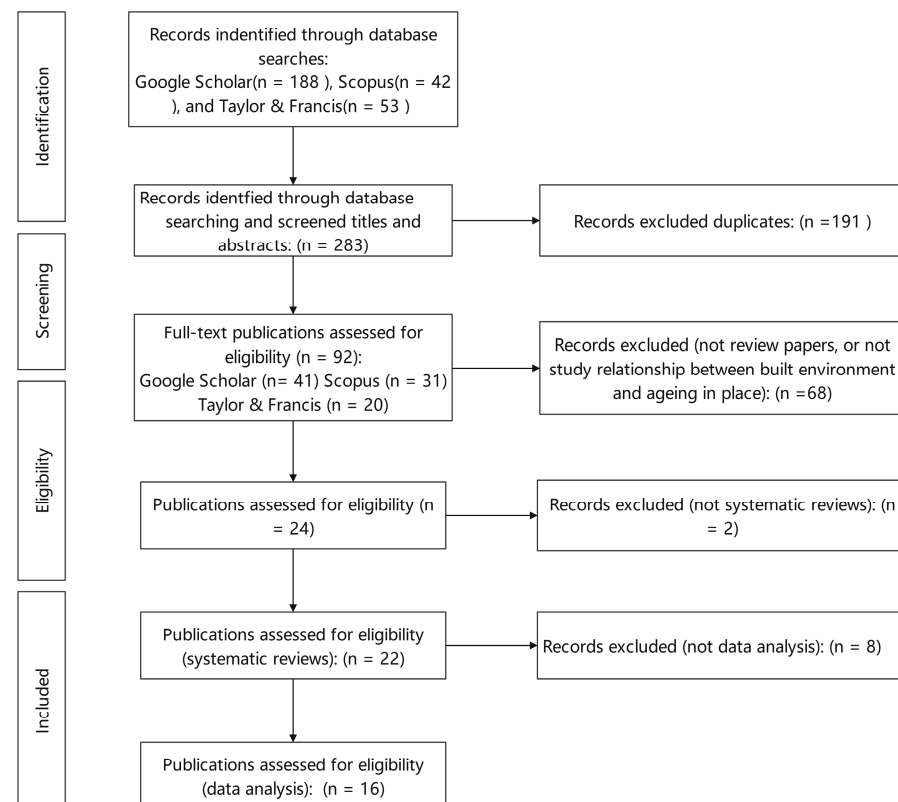
Figure 1. PRISMA 2020 flow diagram of the literature search on the impact of built environment and ageing in place.

4. Results

Spanning from 2004 to 2023, a total of 22 literature review studies were critically examined, highlighting several key built environmental factors that influence ageing in place (AIP). These 22 articles were all systematic reviews of the built environment and their influence on ageing in place-related factors including independent living, active living, quality of life and well-being, etc. Table 1 lists the detailed information and key findings of the articles.

The influence of urban design on life satisfaction, safety, and overall well-being of older people stands out as a significant research theme. For example, the role of urban design in promoting physical activity was emphasised in studies by Cunningham and Michael [26] and Barnett, Barnett et al. [27], where walkability and accessible neighbourhoods were linked to enhanced physical activity among older adults. The significant impact of the built environment on the physical and mental health of the older adults was demonstrated in studies by Garin, Olaya et al. [28] and Xu, Nordin et al. [29].

Tailored design interventions for specific groups, such as those with dementia, are highlighted in studies by Pettersson, Malmqvist et al. [30], indicating the necessity of diverse and inclusive urban solutions. The importance of both home and neighbourhood settings in facilitating ageing in place was highlighted by Trecartin and Cummings [31] and Chen, Lee et al. [32], emphasising the role of these environments in supporting the older people. The role of cultural aspects and community connectivity in urban planning was brought forward in studies by Engelen, Rahmann et al. [33], suggesting the need for culturally sensitive and community-focused designs.

The link between environmental factors (like green spaces) and health outcomes was explored in studies by Bonaccorsi, Milani et al. [34] and Azim, Ariza-Vega et al. [35], showing the impact of these elements on aspects like obesity, sleep quality, and overall well-being. The collective findings of these studies, including García Sánchez and Torres

Barchino [36], called for thoughtful urban planning and policy development that cater to the ageing population's unique needs to create supportive, age-friendly environments.

In conclusion, these studies offered a comprehensive view of the relationship between the built environment and ageing in place, stressing the importance of integrated and inclusive urban design and policy initiatives to enhance the quality of life for older adults.

Table 1. Summary of studies that investigated key findings and variables of built environment and ageing in place.

	Authors	Year	Journal	BE Var.	AIP Var.	Key Findings
1	Cunningham and Michael [26]	2004	*American Journal of Health Promotion*	Built Environment	Physical Activity	• The environment plays a significant role in senior physical activity. • Safety and aesthetics are key, while the value of design details and facility access varies. • Research is key for health interventions aiding senior independence and ageing in a place. • Interventions should integrate environmental factors, not just individual behaviour.
2	Garin, Olaya et al. [28]	2014	*Clinical Practice and Epidemiology in Mental Health*	Built Environment	Physical health, Mental health, and Life satisfaction	• The built environment impacts older people's health, affecting areas like preventive care and mobility. • Elements like housing quality, walkability, noise, and lighting connect to health issues such as injuries. • Green spaces and comfortable temperatures are linked to longer life and lower death rates. • Social and emotional well-being, influenced by the environment, affect physical health. • Calls for a health model that integrates environmental impacts to better understand their effects on health.
3	Joseph, Choi et al. [37]	2016	*Environment and Behavior*	Physical Environment	Safety and Quality of life	• Design aspects such as layout and natural elements critically shape RHCSF environments. • Unit layouts influence resident well-being and staff productivity. • Room organisation is key to RHCSFs' care quality. • Lighting quality affects both residents' and staff's comfort. • Furniture choices impact safety and comfort for residents. • Interior materials affect the overall quality of the environment and experience. • Environmental factors like cleanliness and stable conditions are essential for well-being.
4	Barnett, Barnett et al. [27]	2017	*International Journal of Behavioral Nutrition and Physical Activity*	Built Environment	Physical activity and Walking	• Strong evidence shows that walkable areas, nearby services, recreational spots, and safety are key to seniors' physical activity. • Safe, accessible, attractive neighbourhoods boost seniors' activity levels. • The link between activity and environment varies with different measurement methods. • More in-depth, long-term studies are needed to understand these variations.
5	Hwang [38]	2017	*Housing and Society*	Built Environment	Walking	• Older adults increasingly desire to age in place. • Local governments aim for age-friendly, independent living environments. • Walkability is a key metric for active ageing environments. • Future research should refine walkability measurements and consider diverse contexts.
6	Tuckett, Banchoff et al. [39]	2017	*International Journal of Older People Nursing*	Built Environment	Health of older people	• The built environment significantly impacts older people's health. • The "Our Voice" framework empowers older individuals as citizen scientists. • Ageing-friendly strategies are crucial for optimal older people's health outcomes. • Older people's insights are vital in shaping environment-related health policies.

Table 1. *Cont.*

	Authors	Year	Journal	BE Var.	AIP Var.	Key Findings
7	Van Cauwenberg, Nathan et al. [40]	2018	*Sports medicine*	Physical Environment	Leisure-time physical activity (LTPA)	• Walkability, access to mixed land use, and pleasing aesthetics enhance leisure-time walking. • Leisure-time walking within neighbourhoods is positively linked to mixed land use and public transit access. • Barriers to walking/cycling negatively impact leisure-time walking within neighbourhoods. • Overall leisure-time physical activity (LTPA) increases with access to recreational facilities and parks/open spaces.
8	Trecartin and Cummings [31]	2018	*Journal of Gerontological Social Work*	Physical home environment	Psychological well-being	• The home setting can both help and hinder engagement for seniors with disabilities. • Being sidelined from daily activities can harm seniors' mental health. • Links between home settings, disability, and mental health are recognised. • Home environment impacts mental health both tangibly and perceptually. • A senior's abilities influence how their home setting affects their mental state.
9	Gharaveis [41]	2020	*Facilities*	Built Environment	Physical activity	• Design interventions can elevate physical activity levels for the older people both inside and outside long-term residential facilities. • Increasing walkable spaces and reducing physical barriers are pivotal for promoting older people's physical activity. • Corridor design and ergonomic considerations within interiors are significant design factors. • Accessibility to outdoor walkable spaces is essential to encourage moderate levels of physical activity among the older people. • Environmental design plays a unique role in enhancing activity levels in the older population.
10	Pettersson, Malmqvist et al. [30]	2020	*Journal of Aging and Environment*	Physical Environment	Enablers and Barriers	• Accessibility problems in ordinary housing include barriers such as thresholds, narrow doors, and the absence of an elevator. • Accessibility problems are exacerbated for persons with dementia due to challenges like difficulties in recognising and using objects or spaces. • The physical environment can either support or restrict a person's ability to perform activities, impacting their autonomy and participation. • Solutions like using contrasts and lighting can aid in making spaces more dementia-friendly.
11	Valipoor, Pati et al. [42]	2020	*Journal of Aging and Environment*	Built Environment	Falls	• Falls are a leading cause of morbidity and mortality among older adults. • Interior elements, such as flooring materials, furniture, lighting, and spatial configurations, play a crucial role in fall risks. • Proper lighting is essential, as inadequate lighting can lead to misjudgment of space and obstacles. • Furniture positioning and type can influence navigation and balance. • Flooring materials can either mitigate or exacerbate fall risks, with some materials posing greater slip risks. • Bathrooms and bedrooms are frequently identified as high-risk fall areas. • Adaptable designs that cater to individual needs can reduce fall risks.

Table 1. *Cont.*

	Authors	Year	Journal	BE Var.	AIP Var.	Key Findings
12	Peters, Muellmann et al. [43]	2020	*International Journal of Health Geographics*	Neighborhood environment	Physical activity	• There is a significant association between both objective and perceived neighbourhood environments and physical activity. • Individual perceptions of the neighbourhood often align with objective environmental measures. • Both perceived and objective measures of the environment can independently influence physical activity levels. • Considering both objective and perceived factors is crucial for a comprehensive understanding of how the neighbourhood environment impacts physical activity.
13	Chen, Lee et al. [32]	2021	*Social Science and Medicine*	Built Environment	Cognition and dementia	• Local environments play a key role in maintaining cognitive health for older adults. • Being around neighbourhood amenities and greenery often boosts cognitive health. • These environments are closely linked to cognition and dementia in seniors. • Physical activity is a key link between local environments and cognitive function. • Built environments have a stronger cognitive impact on older women, the disabled, and the less wealthy.
14	Gao, Dupre et al. [44]	2021	*Ageing and Society*	Neighbourhood environment	Health and well-being	• The neighbourhood environment significantly impacts the health and well-being of older Chinese immigrants. • Walkability, safety, and social cohesion in the neighbourhood play crucial roles. • These environmental factors are integral in influencing the physical activity levels of older Chinese immigrants. • The neighbourhood environment also affects social interactions among this demographic.
15	Engelen, Rahmann et al. [33]	2022	*Building Research & Information*	Built Environment	Health ageing and Quality of life	• Socio-economic status, laws, and health issues could impact design and well-being more than national differences. • The design of indoor and nearby spaces affects seniors' physical, social, and mental health, aiding healthy ageing. • A well-designed environment can lead to a high quality of life (QoL). • Thoughtful design changes can boost QoL and promote healthy ageing. • Strong evidence exists for biophilia (love of life and the living world) in promoting healthy ageing.
16	Yang, Ismail et al. [45]	2022	*International Journal of Environmental Research and Public Health*	Housing security, Home environment, and Neighborhood environment.	Physical health, Cognitive health, and Mental health	• Connections were made between the built environment and older adults' sleep quality. • Factors like affordability, lighting, noise, climate control, air flow, air purity, safety, community ties, ease of walking, parks, and access to nutritious food may affect sleep. • Addressing sleep issues in seniors and how their environment affects sleep is crucial.
17	Padeiro, de Sao Jose et al. [46]	2022	*Research on Aging*	Physical environment,	Well-being	• Natural areas in neighbourhoods and a sense of community have the most positive impact on well-being. • Transit-related variables, urban furniture, and access to healthcare are also positively related to well-being. • Neighbourhoods can enhance well-being more effectively by considering the mentioned positive attributes.

Table 1. *Cont.*

	Authors	Year	Journal	BE Var.	AIP Var.	Key Findings
18	Xu, Nordin et al. [29]	2022	*International Journal of Environmental Research and Public Health*	Spatial, Green and Gray Characteristics	Well-being	• Green space characteristics like size and accessibility affect well-being. • The richness of plants, water features, and biodiversity in green spaces matter. • Amenities in these areas, like parking and lighting, also affect well-being. • An individual's demographics alter how green spaces are perceived and their impact on well-being. • Urban green spaces play a crucial role in the well-being of the older adults, with the benefits influenced by both the spaces' features and the seniors' characteristics.
19	Bonaccorsi, Milani et al. [34]	2023	*Annali di Igiene, Medicina Preventiva e di Comunita*	Built Environment	Mental health, Well-being, and Social participation	• Most built environment aspects positively correlate with health outcomes. • Green spaces greatly benefit mental health; access, variety, and gardening activities enhance this. • More local green space improves life satisfaction. • Older adults prefer green spaces with facilities like seating and water features. • Green spaces have a stronger tie to mental health compared to other environmental aspects.
20	Azim, Ariza-Vega et al. [35]	2023	*Canadian Journal on Aging*	Campus, Building and Fixtures	Physical activity	• Indoor features positively impact seniors' physical activity. • Indoor environments are split into campus (shared spaces), buildings (in-home), and fixtures (like elevators). • Post-renovation, seniors engaged more in leisure activities and rested less.
21	Verderber, Koyabashi et al. [47]	2023	*Health Environments Research and Design Journal*	Built Environment	Well-being	• Community-focused housing is key for seniors, highlighting the need for walkable areas and nearby amenities. • Proximity to walkable and transit-friendly locations is important for residences. • Private rooms in long-term care offer more safety, privacy, and autonomy. • Forced relocations have negative effects. • The healing benefits of nature in living environments are recognised. • Managing infections, especially with COVID-19, is essential in senior housing.
22	García Sánchez and Torres Barchino [36]	2023	*Journal of Aging and Environment*	Built Environment	Quality of life	• The built environment significantly affects seniors' quality of life at home. • Age-friendly universal design should guide housing and neighbourhood planning. • Smart-home tech could improve senior well-being; this is mostly theoretical so far. • Professionals in social services, health, architecture, and planning must work together to adapt the built environment for seniors.

Of the 22 systematic reviews above, 16 articles were eligible for data analysis, aimed at examining relationships between various built environment factors and ageing in place factors. As shown in Table 2, the built environment factors were categorised into several sub-categories, and their relationships with the ageing in place factors were marked as positive (+), negative (−), no significance (N), or associated but no clear positive or negative relationship (A).

From the 16 analysed articles, the built environment was initially categorised into over two hundred distinct factors. Through a two-tier classification process, these factors were ultimately consolidated into the following nine major categories: Safety from Traffic/Accidents, Accessibility and Walkability in Neighbourhoods, Safety from Crime, Accessibility to Social and Leisure Venues, Accessibility to Parks and Outdoor Spaces, Accessibility to Public Transportation, Accessibility to Places of Basic Needs, Environment

Quality and Aesthetics, and Housing Environment. Meanwhile, the concept of ageing in place was represented through various factors, which include active ageing, quality of life, daily activities, life satisfaction, well-being, physical health, overall health condition, mental health, social health, and cognition.

Table 2. Integrated built environment factors and ageing in place with the number of studies involving the association between them.

Category	Ageing in Place			
	+	N	−	A
Safety from Traffic/Accidents	12	18	5	1
Accessibility and Walkability in Neighbourhoods	119	175	22	10
Safety from Crime	2	7	1	0
Accessibility to Social and Leisure Venues	20	21	0	3
Accessibility to Parks and Outdoor Spaces	62	18	3	138
Accessibility to Public Transportation	21	17	1	0
Accessibility to Places of Basic Needs	26	12	0	11
Environment Quality and Aesthetics	24	31	7	9
Housing Environment	110	32	14	210

Table 3 presents a quantitative synthesis of the literature on various built environment categories and their association with ageing in place. Among the nine built environment categories analysed, "Accessibility and Walkability in Neighbourhoods" garnered the most considerable attention, with 326 occurrences of research exploring its connection with ageing in place. Following closely is "Housing Environment", which has been studied 366 times for its relationship with various ageing in place factors. The third most examined category, "Accessibility to Parks and Outdoor Spaces", was the subject of 221 studies, indicating a robust interest in understanding its role in the ageing process.

The subsequent discourse would concentrate on those associations between built environment factors and ageing in place factors. Table 4 tabulates the relationships that have been discussed in a combined total of more than ten articles, and the table breaks down the variables under each built environment sub-category into specific built environment factors, which allows for a clearer understanding of the relationship and number of times specific built environment factors have been examined in relation to ageing in place factors. This focused approach could provide a more in-depth exploration of the most frequently discussed relationships.

Cognition: In examining the impact of the built environment on cognition, studies present a mixed picture. While a notable number of research efforts suggest a positive correlation between urban planning and cognitive function, indicating that diverse and well-planned urban environments may promote cognitive health, there are equally many studies that report no significant relationship. Similarly, in the area of road network accessibility, the bulk of research does not demonstrate a clear connection to cognitive outcomes, with findings skewed towards non-significant results, although there are instances of both positive and negative associations. As for physical accessibility, the majority of studies do not provide conclusive evidence of an impact on cognition, suggesting that while it is an area of interest, its direct relationship with cognitive health remains unclear. These outcomes highlight the need for further investigation into how and to what extent different aspects of the built environment contribute to cognitive ageing.

Table 3. Category of built environment factors and ageing in place factors and number of articles involving the association between them.

Built Environment Category	Sub-Category	Active Ageing				Quality of Life				Daily Activities				Life Satisfaction				Well-Being				Physical Health				Overall Health Condition				Mental Health				Social Health				Cognition			
		+	N	−	A	+	N	−	A	+	N	−	A	+	N	−	A	+	N	−	A	+	N	−	A	+	N	−	A	+	N	−	A	+	N	−	A	+	N	−	A
Safety from Traffic/Accidents	Animal Control																					1	1	1																	
	Exercise Safety																		1			3	1				1														
	Traffic Safety						1															2	4	1														5			
	Traffic Volume																					1	6	3	1	1		1							1						
Accessibility and Walkability in Neighbourhood	Accessibility Problems		1	1										1				1	1				3			2				1		1							5	1	
	Challenging Terrain																					2	5	5		1									1					1	
	Neighbourhood Environment Evaluation														2			4	1	1		1	2							2	1							2	4		
	Physical Accessibility	2						1						1				5	5	6		11	11			1		1		3		5		2		2		4	11		
	Recreational Accessibility	1																				1	1									1						4	3		
	Service Accessibility																	1				8	5	1		1															
	Road Network Accessibility					1	1			1				1				1				4	7	1						2		3		2		2		5	17	2	
	Urban Planning						1				1			1				1		7	2	9	14	3	1	1				2	4	1		2		2		19	20	4	
	Visual Accessibility						2								2				2			3	5							2	4			4	4						
Safety from Crime	Crime Incidence																					3	1																		
	Personal Safety																					2	2																		
	Social Disorder																						2																		
Accessibility to Social and Leisure Venues	Cultural and Religious Venues																						2																		
	Educational Facilities																						2												1						
	Recreational Venues																					7	12	2											1						
	Social Venues	1						1										2		3		1	2															1	6		

Table 3. *Cont.*

Built Environment Category	Sub-Category	Active Ageing				Quality of Life				Daily Activities				Life Satisfaction				Well-Being				Physical Health				Overall Health Condition				Mental Health				Social Health				Cognition			
		+	N	−	A	+	N	−	A	+	N	−	A	+	N	−	A	+	N	−	A	+	N	−	A	+	N	−	A	+	N	−	A	+	N	−	A	+	N	−	A
Accessibility to Parks and Outdoor Spaces	Active Spaces																					1	3																		
	Facilities for Specific Groups																																					1	3		
	Outdoor Pavement and Buildings																	1	13																						
	Natural Elements	1					3		1						1	2		4	7	1		3	3		1	1				4	7	3	1	5	5			3	6	2	2
	Parks and Trails	1					3	1							2			2	2			1	8	3		1				1	1			1	1			1	6	2	
	Recreational Facilities																		11																						
	Supporting Facilities																		17																						
Accessibility to Public Transportation	Public transportation	1					1	1						1	1			9	4	1		6	4			3								1	1			2	3		
Accessibility to Places of Basic Needs	Commercial and Retail																					5	1		2					1				1							
	Government and Financial Services																							2																	
	Healthcare Services															1			6	1		3																			
	Social Services											1						1	9	3				5				1		1	1			2	1			1			
Environment Quality and Aesthetics	Environmental Aesthetics							1											2			1	11	3	2	1				1	1			2	1	1		1	3	5	
	Neighbourhood Aesthetics															1			3			1									1									2	
	Pollution							1		1		1						1	14	4				2		1	1	1													

Table 3. *Cont.*

Built Environment Category	Sub-Category	Active Ageing				Quality of Life				Daily Activities				Life Satisfaction				Well-Being				Physical Health				Overall Health Condition				Mental Health				Social Health				Cognition			
		+	N	−	A	+	N	−	A	+	N	−	A	+	N	−	A	+	N	−	A	+	N	−	A	+	N	−	A	+	N	−	A	+	N	−	A	+	N	−	A
Housing Environment	Accessibility Challenges													7	1		4				2	3		16	3		1	2			3	5									
	Home Accessibility Improvements													1	2	1						6		2	2	1						2				2					
	Amenities and Facilities													1	3		2				1	4			1							1				1					1
	Biology and Environment																		2		1	1			1							3				1					2
	Comfort and Usability	1							1					3	1	1		1						2		1	1					2									
	Design and Aesthetics																								4				1				2				5				3
	Environmental Control and Sensory Experience												1				3			1	4	5	2	1	7	4	3	1	3			1	15				4				3
	Facilities and Equipment								1						1	1						4		1	1	1	5	1								1					1
	General Housing Characteristics	1					2	2		3				4	2			5	2			5	4	1	2	2	1	3	1	1			11				12				2
	Interior Living Conditions													2						2	3					2	3	1				1	2								1
	Outdoor Setup						2						1	4							1	4		1	1						4	1				1	2				1
	Private and Public								1					1						2	1	1	1					1				1				1	2				1
	Size and Space													2	1	2	1	2	1			1	1													4	2	5	1		3
	Housing Disrepair	1														2				2	3			1	7	1		1		1	1	1					2				

Note: '+': Positively associated; 'N': No significance; '−': Negatively associated; 'A': Associated but no clear positive or negative relationship. The number represents the number of articles presenting this relationship.

Table 4. The relationship between BE factor and AIP factor that was studied for a total of more than ten articles.

AIP Factors	BE Sub-Category	BE Factors	+	N	−	A
Cognition	Urban Planning	Land-Use Diversity	7	10		
		Community size	7		2	
		Population density/urbanisation	4	6		
		Destination density	1	4	2	
Well-being	Supporting Facilities	Recreational Facility				10
		Sports Facility				6
		Car Parking Facility				5
		Resting Facility				13
		Sanitary Facility				10
		Lighting Facility				9
		Security Facility				9
		Directional Facility				6
		Landscape Facility				4
		Management Buildings				10
		Accessible Facility				11
Cognition	Road Network Accessibility	Street connectivity	3	8		
		Stree intersections		6	1	
		Street integration	1	3	1	
		Physical environment	1			
Physical Health	Accessibility Challenges	Narrow doors				3
		Steep stairs				1
		Lack of wheelchair accessibility				1
		Inappropriate handrails				1
		Unsafe flooring				1
		Physical restraints				1
		Stairs at front entrance				2
		Access to garbage disposal				1
		High difference in threshold or steps				2
		Uneven floor/ground inside/outside				2
		Narrow stairs with no handrails				1
		Unable to access some (e.g., basement)				1
		Indoor thresholds				1
		Housing on the second floor or above	1			
		Housing with stairs	1			
		Steep ramps				1
		Ramps	1			
Mental Health	Environmental Control and Sensory Experience	Ambient environment (light)				3
		Lighting glare				1
		Lighting type/quality		1		7
		Rooms have good daylight				1
		Appropriate temperature				3
Physical Health	Urban Planning	Land-Use Diversity	2	6		
		Population density/urbanisation	4	8	2	
		Density of places of employment	1			
		Residential neighbourhood	2	1	1	
Physical Health	Pollution	Excessive noise	1	4	3	
		Trash/litter		3		
		Air pollution		5	1	
		Sewer pollution		2		
Well-being	Infrastructure	Pavement Condition				13
		Outdoor spaces/buildings		1		
Physical Health	Recreational Venues	Golf course		1		1
		Gym	2	1		
		Food outlets		2		
		Recreational facilities	2	1		
		Social recreational facilities		2		
		Swimming pool		3		
		Entertainment		1		
		Attractive recreational facilities	2	1		1
		Clubhouse	1			
Social Health	General Housing Characteristics	Room occupancy type				1
		Overall environmental quality				1
		Housing location				3
		Floor plan				2
		Type of dwelling (>3 rooms)				4
		Housing grade (number of rooms and public vs. private)				1
Well-being	Recreational Facilities	Recreational Facility				10
		Sports Facility				6
Physical Health	Environmental Aesthetics	Aesthetics of environment	11	1	1	
		Vegetation index		2		
		Urban/rural			1	
Physical Health	Physical Accessibility	Overall access to cycle/walk-friendly infrastructure		2		
		Infrastructure for walking/cycling		2		
		Sidewalks present	2	4		
		Walkability	8	3		
		Street without barriers	1			
Cognition	Physical Accessibility	Infrastructure for walking/cycling		7		
		Walkability	4	2		
		Handicapped access		2		
Mental Health	General Housing Characteristics	Ground-floor parking		1		
		Room occupancy type				4
		Overall environmental quality				2
		Housing layout				1
		Housing location				1
		Floor plan				2
		Type of dwelling (>3 rooms)	1			
		Housing tenure				1

Note: '+': Positively associated; 'N': No significance; '−': Negatively associated; 'A': Associated but no clear positive or negative relationship. The number represents the number of articles presenting this relationship.

Well-being: The relationship between well-being and built environment factors, specifically supporting facilities, infrastructure, and recreational facilities, is broadly affirmed across the literature. The consensus acknowledges that these elements are indeed related to the well-being of individuals as they age. However, the directionality of these relationships remains indeterminate. Studies collectively recognise the influence of features such as recreational, sports, and car parking facilities; resting, sanitary, lighting, and security installations; as well as the overall condition of pavements and accessibility to outdoor spaces. These aspects are consistently associated with well-being, yet the literature stops short of conclusively categorising these associations as either positive or negative. This suggests a complex interplay where the impacts on well-being are acknowledged but not fully characterised, highlighting the nuanced manner in which the built environment intersects with the quality of life for ageing populations.

Physical Health: The exploration of physical health within the context of the built environment reveals varied interactions with several factors. Accessibility challenges, such as narrow doors and steep stairs, are predominantly associated with negative health outcomes, suggesting that barriers within the living environment can detrimentally affect physical health. When considering urban planning, there is a mix of outcomes. Some studies point to a positive relationship, where thoughtfully designed urban spaces correlate with better physical health. However, other studies find no significant impact, indicating that the influence of urban planning on health is not consistent across different settings. Regarding pollution, the bulk of the literature reports no significant relationship with physical health. This could imply that the expected negative health effects of pollution, such as from noise or air quality issues, may not be as straightforward as traditionally perceived or may be influenced by other mediating factors. Recreational venues also show a mostly non-significant relationship with physical health. While these spaces are essential for leisure and social engagement, their direct influence on physical health appears limited within the studies examined. Conversely, environmental aesthetics, such as the visual design of surroundings, are frequently associated with positive health outcomes, suggesting that pleasant and well-maintained environments can promote physical health and encourage active lifestyles. Finally, the link between physical accessibility and health is split; there is an equal number of studies showing positive associations—where accessible environments promote physical health—and those indicating no significant relationship. This highlights a complex relationship where the degree of physical accessibility may not uniformly translate to health benefits.

Mental Health: When studied in relation to the built environment, exhibits consistent associations with environmental control, sensory experience, and general housing characteristics. The literature widely supports the notion that these factors are interconnected with mental well-being, though it refrains from defining these relationships as either predominantly positive or negative. In the realm of environmental control and sensory experience, factors such as lighting quality, ambient light, and temperature control within housing have been identified as significant. These elements are recognised for their potential impact on mood and psychological comfort. Nevertheless, the studies do not distinctly categorise the nature of these impacts, suggesting that while the control and quality of the environment are important for mental health, the specific outcomes may vary based on individual perceptions, needs, and preferences. Similarly, general housing characteristics, including aspects such as room occupancy type, overall environmental quality, housing layout, location, and floor plan, are all associated with mental health in the body of research. These characteristics encompass the physical and functional attributes of living spaces that can influence residents' mental health. The absence of a clear direction in the findings may indicate that the implications for mental health are influenced by a combination of these factors rather than isolated characteristics, and that personal circumstances and contextual factors play a significant role in shaping these outcomes.

Social Health: In the examination of social health's correlation with general housing characteristics, the bulk of the literature concurs that there is an association, yet it does

not conclusively state whether these associations are positive or negative. The aspects considered under general housing characteristics include room occupancy type, overall environmental quality, housing location, floor plan, type of dwelling, and housing grade. These elements are fundamental in shaping the interactions and social fabric of residents' lives. The general consensus is that the configuration and quality of housing play a substantial role in the social engagement and community integration of individuals. For instance, the layout of a house or apartment may foster or hinder social interaction is recognised, but whether this impact is beneficial or detrimental is not definitively reported. Similarly, the location of housing can influence access to community resources and social networks, which are crucial for social health, but the studies stop short of classifying these effects as consistently positive or negative.

These findings collectively demonstrate that while some aspects of the built environment, such as physical accessibility and urban planning, have a clear linkage to ageing in place factors like physical health and cognition, others, like general housing characteristics and recreational facilities, present a more complex picture, with associations indicated. This suggests a nuanced interplay between the built environment and the health and well-being of the ageing population, warranting further study to fully understand and leverage these relationships for optimal ageing in place outcomes.

5. Discussion

5.1. Safety from Traffic/Accidents

The investigation into the influence of the "Safety from Traffic/Accidents" category (including primarily the intersection of traffic volume, traffic safety, animal control, and exercise safety) on the "health" and "cognition" of older adults reveals a profound narrative about the broader implications of traffic environments on ageing. The body of research in this area, through its diverse findings, highlights not just the direct impacts of traffic on physical health and safety but also reflects the broader living experience of the ageing demographic.

The mixed findings regarding the impact of traffic volume on physical health hint at a complex relationship. While higher traffic volumes might be associated with urban vitality, potentially encouraging outdoor activities, they also bring challenges such as noise and air pollution and the risk of accidents. The negative association found in some studies underscores the potential stressors associated with high-traffic environments, which could adversely affect physical health. This paradox suggests that the health implications of traffic volume are contingent on a balance between the positive aspects of urban liveliness and the negative effects of traffic-related stressors [26].

The findings on the relationship between traffic safety and physical health reflect the significance of perceived and actual safety in encouraging physical activity among older adults. The positive impact of traffic safety on physical health suggests that safer traffic environments might foster a more active lifestyle. However, the lack of significant correlation with cognitive health indicates that traffic safety's role in cognitive well-being is less direct.

The positive association between exercise safety and physical health emphasises the importance of creating safe environments for physical activity, particularly for older adults. This finding is crucial for urban planning and public health, as it suggests that ensuring safe spaces for exercise can significantly contribute to the physical health of the ageing population. It also reflects the broader need for age-friendly urban designs that accommodate the mobility and safety needs of older adults [48].

Overall, the research related to the "Safety from Traffic/Accidents" category points to the critical role of urban traffic environments in shaping the health and well-being of older adults. The findings highlight the need for comprehensive urban planning strategies that consider the multifaceted impacts of traffic volume, safety, and exercise environments on the ageing population. This involves not only addressing the direct safety concerns related to traffic but also creating supportive, age-friendly urban spaces that promote physical

activity and well-being. Future research should further explore these dynamics, focusing on how to optimise urban environments to support the health, safety, and quality of life of older adults. This approach is essential in developing inclusive, sustainable cities that cater to the needs of an ageing population.

5.2. Accessibility and Walkability in Neighbourhood

The exploration of "Accessibility and Walkability in Neighbourhood" in relation to ageing in place delves into a profound narrative about how urban environments influence the ageing process, particularly in terms of cognitive and physical health. This research presents a complex picture of how urban planning and infrastructure intersect with the multifaceted aspects of ageing.

The findings regarding the influence of urban planning on cognition reflect a deeper, nuanced understanding of the cognitive needs of ageing populations. While certain studies do not find a direct correlation, others highlight a positive impact, suggesting that elements like land-use diversity and community size can create stimulating environments conducive to cognitive health [49]. This divergence may be rooted in the diverse methodologies and urban contexts of the studies, indicating that cognitive benefits from urban planning might be context-specific and dependent on individual interactions with the environment.

The mixed results in the relationship between urban planning and physical health reveal the complexity of how urban elements influence health. While some aspects of urban planning may not directly impact physical health, others may contribute to more active lifestyles. This suggests a need for urban planning that not only considers physical structures but also how these structures encourage healthy behaviours and lifestyles among older adults [50].

The lack of significant impact of urban infrastructure on cognition as observed in the majority of studies points towards a potential underestimation of the cognitive aspects of urban design. It suggests that while physical infrastructure is critical, its role in supporting cognitive health might be more indirect, possibly facilitated through social interactions and community engagement that such infrastructure enables [51].

The strong association between physical accessibility and physical health emphasises the importance of designing neighbourhoods that are navigable and safe for older adults. However, the discrepancies in findings also highlight the variability in how physical accessibility is experienced by different individuals. In terms of cognition, the lack of a direct impact suggests that other factors beyond physical accessibility, such as social and cognitive engagement, might play more significant roles in cognitive health.

In summary, "Accessibility and Walkability in Neighbourhoods" play an essential role of urban design and infrastructure in supporting the health and well-being of the ageing population. The findings underscore the importance of considering both the physical and cognitive dimensions of ageing in urban planning and policy-making. Future research should continue to explore these relationships, employing diverse methodologies and considering the heterogeneity of urban environments and ageing populations. This nuanced understanding is crucial for developing age-friendly urban spaces that cater to the diverse needs of older adults, promoting both their physical and cognitive health.

5.3. Safety from Crime

The exploration of the connection between "Safety from Crime" and the physical health of older adults extends beyond the superficial understanding of crime statistics and personal safety perceptions. This body of research, with its varied findings, delves into the intricate ways in which safety, or the lack thereof, influences the lifestyle, behaviour, and overall well-being of older adults in urban settings.

The predominantly non-significant relationship between crime incidence and physical health, with a few studies suggesting a negative impact, hints at a complex interaction between external safety conditions and internal health responses. The lack of a direct correlation in most studies suggests that older adults may adapt their behaviour or develop

resilience to crime in their neighbourhoods, mitigating its potential impact on physical health. However, the negative association noted in some research indicates that high crime rates can lead to increased stress and restricted outdoor activities, thereby indirectly affecting physical health. This duality underscores the importance of considering both the objective crime rates and the subjective experience of safety among older adults [52].

The mixed results concerning the impact of personal safety on physical health reveal the subjective nature of safety perceptions and their influence on health behaviors. The positive associations found in some studies highlight that a sense of personal safety can encourage physical activity, leading to better health outcomes. Conversely, the lack of significant findings in other studies suggests that the relationship is not uniform and may depend on various factors, including the individual's previous experiences, the severity of safety concerns, and the presence of community support networks. This indicates a need for a holistic approach to urban safety, one that goes beyond crime reduction to fostering a sense of security and trust within communities [53].

The absence of a significant relationship between social disorder and physical health in most studies points to the adaptability and resilience of older adults in the face of social challenges. It suggests that while social disorders may impact the aesthetic and social fabric of a neighbourhood, their direct influence on the physical health of older adults may be limited, possibly due to coping strategies and the support of social networks. This finding calls attention to the potential buffering effects of community cohesion and social support in mitigating the negative impacts of social disorder [54].

Overall, the "Safety from Crime" category highlights the nuanced and multifaceted nature of safety and its impact on the ageing population. The findings emphasise the need for comprehensive urban safety strategies that address both crime prevention and the enhancement of subjective feelings of safety. Such strategies should consider the diverse needs and perceptions of older adults, ensuring that urban environments are not only objectively safe but also perceived as such by this vulnerable population. Future research should further explore the complex dynamics between safety, health behaviours, and community factors, aiming to inform urban planning and public policies that foster safe, inclusive, and health-supportive environments for older adults.

5.4. Accessibility to Social and Leisure Venues

The investigation into "Accessibility to Social and Leisure Venues" and their impact on the ageing population underscores a deeper narrative about the role of communal and recreational spaces in fostering health and well-being. This body of research reveals the intricate ways in which these venues extend beyond their primary functions to influence various aspects of ageing, including physical health, social health, active ageing, and overall quality of life.

The lack of a significant relationship between cultural and religious venues and physical health suggests that the benefits of these spaces may lie in realms other than the physical. These venues often serve as centres for community gathering, spiritual solace, and cultural engagement, offering psychological and emotional support rather than direct physical health benefits. This highlights the importance of considering the holistic well-being of older adults, acknowledging that spiritual and cultural engagement plays a crucial role in their overall quality of life [55].

The positive association of educational facilities with social health, but not physical health, points to the critical role these spaces play in fostering social connections, community involvement, and intellectual engagement. The findings suggest that educational activities and environments offer significant opportunities for social interaction and mental stimulation, which are essential for maintaining social well-being in older age. However, their indirect influence on physical health may emerge through the promotion of an active and engaged lifestyle [56].

The varied impact of recreational venues on physical health, with some studies showing a positive relationship and others showing no significant impact, indicates that the

health benefits of recreational activities are likely dependent on their nature, accessibility, and alignment with the needs and preferences of the older adults. Recreational venues that offer age-appropriate, accessible, and enjoyable activities can encourage physical activity and social interaction, contributing positively to both physical and social health. The presence of these venues can create an environment conducive to an active lifestyle, which is crucial for the physical and social well-being of older adults [40].

The positive correlation of social venues with active ageing, quality of life, and social health underscores their importance in the lives of older adults. These spaces provide opportunities for socialisation, community engagement, and leisure activities, which are integral to maintaining an active, fulfilling life in older age. The mixed results regarding their impact on physical health and well-being suggest that while social venues are vital for social and emotional aspects of ageing, their influence on physical health is likely mediated by individual lifestyle choices, mobility, and access to these venues [57].

In essence, "Accessibility to Social and Leisure Venues" plays a multifaceted role in supporting the well-being of the ageing population. They are not merely places for activities but are integral to fostering a sense of community, engagement, and fulfilment among older adults. This understanding calls for urban planning and policy-making that prioritise the creation and maintenance of diverse, accessible, and age-friendly social and leisure venues. Future research should further explore how these spaces can be optimised to support the comprehensive well-being of older adults, facilitating not just physical health but also social, emotional, and cognitive well-being.

5.5. Accessibility to Parks and Outdoor Spaces

Despite revealing a correlation between various park facilities and infrastructure and older adults' well-being, the investigation into "Accessibility to Parks and Outdoor Spaces" navigates uncertain terrain. This body of research, encompassing diverse elements such as supporting facilities, infrastructure, and recreational amenities, underscores a fundamental but not fully elucidated connection between the physical environment of parks and the subjective experience of ageing.

The ambiguity in the relationship between supporting facilities in parks, such as car parking, resting areas, and sanitary facilities, and the well-being of the older adults suggests a deeper, more nuanced interplay. While these amenities undeniably contribute to the usability and enjoyment of parks, their direct impact on well-being might be influenced by broader contextual factors. For instance, the presence of these facilities could enhance the sense of security and comfort, thereby indirectly contributing to well-being. However, their effectiveness in improving well-being could be contingent upon other variables such as the overall park design, the natural environment's quality, and social aspects of park use.

Similarly, the infrastructure of parks, notably the condition of pavements, presents an interesting aspect of study. While recognised as crucial for accessibility, particularly for the ageing population, the lack of definitive evidence on its impact on well-being hints at an underlying complexity. It raises questions about how physical accessibility intersects with psychological and social elements of well-being. The physical design may facilitate physical access, yet the contribution to emotional and social well-being could be mediated by personal factors such as health status, mobility, social networks, and even past experiences with outdoor spaces [58].

The investigation into recreational facilities within parks and their link to well-being further illustrates this intricate relationship. The presence and quality of these amenities are undoubtedly central to the recreational value of parks. However, the absence of a clear positive or negative correlation with well-being suggests that the utility and impact of these facilities are likely dependent on individual preferences, physical capabilities, and the social environment within the park [59].

These findings collectively point to a broader conceptual understanding that the relationship between park environments and the well-being of older adults extends beyond mere physical accessibility or the availability of facilities. It encompasses a complex matrix

of individual, social, and environmental factors. The well-being derived from parks and outdoor spaces may be as much about the social interactions, sense of community, and personal relevance of these spaces as about the physical amenities they offer.

This nuanced understanding has significant implications for urban planning and public policy. It suggests that designing parks for older adults requires a holistic approach that goes beyond physical infrastructure to consider the social and psychological aspects of park use. Future research in this area could benefit from a multidimensional approach, incorporating qualitative methods to capture the subjective experiences and perceptions of older adults regarding parks and outdoor spaces. Such comprehensive insights would be invaluable in creating age-friendly outdoor environments that cater to the diverse needs and preferences of the ageing population, ultimately enhancing their overall quality of life.

5.6. Accessibility to Public Transportation

The academic exploration of "Accessibility to Public Transportation" in relation to the ageing population unveils a layered interplay between urban mobility systems and various aspects of older adults' lives, including well-being, physical health, overall health condition, cognition, etc. This body of research not only highlights the functional role of public transportation but also its broader implications for ageing in place.

The positive correlation between public transportation and the well-being of older adults in many studies underscores the profound impact of mobility on social and psychological aspects of ageing. Access to reliable public transportation extends beyond mere movement from one place to another; it represents a vital link to community engagement, social interaction, and independence. These factors are integral to maintaining a sense of purpose and connectedness, which are key components of well-being in later life. However, the absence of a significant relationship in some studies suggests that the mere availability of transportation might not suffice. The quality, accessibility, and alignment of transportation services with the specific needs and preferences of the ageing population are critical determinants of its impact on well-being [60].

The association between public transportation and physical health, predominantly positive, reveals an important dimension of ageing in urban environments. The physical activity involved in accessing and using public transportation, such as walking to bus stops or subway stations, can contribute significantly to maintaining physical health in older adults. However, the lack of a significant relationship in several studies indicates potential barriers that might limit this positive impact, such as issues related to the physical accessibility of transit systems or safety concerns, which might deter older adults from using these services [60].

The lack of a significant correlation between accessibility to public transportation and overall health conditions posits that the role of transportation in broader health outcomes might be indirect or overshadowed by other more dominant health determinants like medical care, lifestyle, and socio-economic factors [61]. The mixed findings regarding cognition highlight the cognitive engagement and stimulation that navigating public transportation can entail. While for some, the complexity of using public transportation might enhance cognitive functioning, for others, especially those with cognitive impairments, it may not offer the same benefits [62].

These insights into "Accessibility to Public Transportation" and its multifaceted impact on ageing reflect the essential role of urban mobility systems in supporting the diverse needs of the ageing population. The evidence suggests that while public transportation can be a crucial factor in enhancing certain aspects of health and well-being, its effectiveness and impact are contingent upon a range of factors, including the quality and accessibility of transportation services, individual health and mobility, and the broader urban context. This understanding highlights the importance of designing inclusive and accessible public transportation systems that cater to the unique needs of older adults, thereby supporting their health, well-being, and active participation in society. Future research should continue to explore these relationships, employing diverse methodologies to capture the complex

dynamics at play and inform the development of age-friendly transportation policies and practices.

5.7. Accessibility to Places of Basic Needs

The investigation into the "Accessibility to Places of Basic Needs" category, focusing on social services, healthcare services, and commercial and retail spaces, underscores a deeper, multifaceted impact on the ageing population's well-being and physical health. The body of research in this area reveals not just the functional importance of these services and spaces but also their broader role in shaping the quality of life for older adults.

The prevalence of studies indicating a positive correlation between social services and well-being highlights the critical role these services play in supporting the mental and emotional aspects of ageing. Social services, by addressing social isolation, providing support networks, and facilitating engagement in community life, significantly contribute to enhancing life satisfaction among the older adults [63]. However, the existence of studies with no significant findings and those merely indicating an association suggests that the impact of social services is not uniform and may depend on their alignment with the specific needs and circumstances of the older population. This variability points to the need for personalised and context-sensitive social services that resonate with the diverse experiences and expectations of older adults.

The generally positive association between healthcare services and well-being emphasises the importance of accessible and quality healthcare in maintaining overall well-being in later life. However, the lack of a significant relationship between healthcare services and physical health is an intriguing finding. It may indicate that while healthcare services are essential for managing health conditions, other factors like lifestyle choices, environmental conditions, and social determinants play a more dominant role in shaping physical health outcomes in older adults [64]. This finding calls for an integrated approach to healthcare that not only addresses medical needs but also considers the broader lifestyle and environmental factors influencing older adults' health.

The mostly positive impact of commercial and retail spaces on physical health underscores the role of these spaces in promoting physical activity and providing access to healthful products and services. However, the mixed results in some studies ($n = 1$ for no significant relationship and $n = 2$ for a general association) highlight that the mere presence of these spaces is not a panacea. The effectiveness of commercial and retail spaces in promoting physical health likely depends on their accessibility, the variety of services and products they offer, and how they are integrated into the daily lives of older adults [46].

In essence, the "Accessibility to Places of Basic Needs" category reflects the interconnectedness of physical, social, and environmental factors in the ageing experience. This comprehensive understanding emphasises the need for holistic urban planning and policy frameworks that not only ensure the availability of basic services and facilities but also prioritise their quality, accessibility, and integration into the community fabric. Future research should continue to explore these dynamics, focusing on how the design and implementation of these essential services and spaces can be optimised to support not just the physical but also the social and emotional well-being of the ageing population. This approach is pivotal in creating age-friendly environments that enhance the overall quality of life for older adults.

5.8. Environment Quality and Aesthetics

The exploration of "Environment Quality and Aesthetics" in relation to the health and cognition of the ageing population uncovers a layered narrative that transcends the conventional understanding of environmental impact. The research, particularly focusing on pollution and environmental aesthetics, reveals a complex interplay between external environmental factors and the internal health dynamics of individuals.

The predominant lack of significant findings in studies exploring the relationship between various types of pollution and physical health invites a reevaluation of the perceived

impact of environmental pollutants on older adults. Traditional assumptions regarding the adverse effects of noise, trash, sewer pollution, and air quality on health are not as straightforward as previously thought. However, the presence of studies showing both positive and negative associations suggests that the relationship might be more nuanced. It points towards the possibility that the health impacts of pollution are dependent on variables such as the intensity and duration of exposure, individual health status, age-related susceptibility, and perhaps the presence of social and community support structures that might buffer against these environmental stressors [65].

The positive association between environmental aesthetics and physical health underscores the potential of well-designed, aesthetically pleasing environments in promoting physical activity and mental well-being. Aesthetic surroundings may encourage older adults to engage more in outdoor activities, thereby enhancing physical health. The mixed findings, with some studies showing no significant or negative correlations, suggest that the health benefits of aesthetics are not universal and may depend on individual perceptions and the functionality of the environment in promoting health-promoting behaviours [66]. In terms of cognition, the positive association observed in some studies hints at the potential cognitive stimulation provided by aesthetically engaging environments. However, the majority of studies reporting no significant relationship imply that cognitive health in ageing is influenced by a constellation of factors beyond environmental aesthetics, including genetic, lifestyle, and socio-economic factors [32].

These insights reveal that the impact of environmental quality and aesthetics on ageing is intricately woven into a fabric of individual, social, and contextual factors. The findings suggest a need for a more holistic approach in urban and environmental planning, one that considers not only the physical dimensions of the environment but also its psychological and social implications for ageing populations. Future research should aim to disentangle these complex relationships, exploring how individual differences in health, lifestyle, and social context interact with environmental factors to influence health and well-being. Such nuanced understanding is crucial for creating supportive, health-promoting environments that cater to the diverse needs of the ageing demographic.

5.9. Housing Environment

The scholarly exploration of the "Housing Environment" and its influence on the ageing population brings to light a profound understanding that extends beyond the physical aspects of housing. This body of research, examining the relationship between housing characteristics and health outcomes, underscores the intricate ways in which the living environment interplays with the physical, mental, and social aspects of ageing.

The negative association found between certain accessibility challenges and physical health highlights a critical aspect of ageing in place. Inaccessible housing features such as narrow doors, steep stairs, and uneven floors not only pose direct physical hazards like falls and accidents but also symbolise barriers to independence and mobility. The implications of these findings are far-reaching, suggesting that age-friendly housing design is not merely a matter of convenience but a crucial determinant of health and autonomy in older age. This necessitates a shift in housing design and policy to prioritise accessibility and safety, ensuring that homes can accommodate the changing needs of individuals as they age [35].

Environmental Control and Sensory Experience and Mental Health: The association, though ambiguous, between environmental control and sensory experience and mental health reveals the profound impact of the living environment on psychological well-being. Factors such as lighting and temperature control are not simply comfort features; they play a significant role in shaping mood, behaviour, and cognitive function. This suggests that the sensory and perceptual qualities of housing can profoundly influence mental health, pointing to the need for housing designs that offer a supportive sensory environment tailored to the psychological needs of older adults [67].

The nuanced relationship between general housing characteristics and social and mental health underscores the multi-dimensional role of housing in fostering social connections

and mental well-being. While the physical structure and location of housing impact social interactions and networks, this influence is embedded within a larger social and cultural context. Similarly, mental health outcomes, while influenced by housing characteristics, are also shaped by a complex interplay of personal, social, and environmental factors. This points to the importance of considering housing not just as a physical space but as a social and psychological environment that can either facilitate or hinder healthy ageing [68].

In summary, the "Housing Environment" category elucidates the critical role of housing in the overall health and well-being of the ageing population. The insights from this research advocate for a holistic approach to housing design and policy, one that encompasses the physical, sensory, social, and psychological dimensions of living spaces. Future research should continue to investigate these relationships, emphasising the development of integrated housing solutions that support not only the physical safety and comfort of older adults but also their social connectivity and mental health. This comprehensive understanding is vital in creating age-friendly living environments that enhance the quality of life for older individuals.

The findings of this review are exemplified by real-world initiatives such as the Age-Friendly Neighbourhood Spaces in Copenhagen and Singapore's Kampung Admiralty development. These case studies demonstrate the practical application of evidence-based interventions in the built environment to enhance ageing in place. The Copenhagen case, involving older residents in co-designing new neighbourhood spaces, resulted in improved accessibility and social engagement through simple yet effective measures like strategically placed benches and intergenerational community gardens [69]. Similarly, the Kampung Admiralty project in Singapore showcased the benefits of integrated development, combining housing with essential services, leading to improved quality of life and increased social interactions for older residents [70]. These examples underscore the importance of holistic approaches to urban planning and community design that consider the multifaceted needs of older adults. They also highlight the potential for innovative solutions when policymakers, urban planners, and older adults collaborate. As we move forward in creating age-friendly environments, it is crucial to continue learning from such successful initiatives, adapting them to diverse cultural and socioeconomic contexts, and addressing the gaps and challenges identified in this review. By doing so, we can work towards creating built environments that truly support and enhance the experience of ageing in place for older adults worldwide.

6. Conclusions

This systematic review of reviews has comprehensively addressed the research question of how the built environment impacts ageing in place. The findings reveal that various aspects of the built environment, including Safety from Traffic/Accidents, Accessibility and Walkability in Neighborhoods, Safety from Crime, Accessibility to Social and Leisure Venues, Accessibility to Parks and Outdoor Spaces, Accessibility to Public Transportation, Accessibility to Places of Basic Needs, Environment Quality and Aesthetics, and Housing Environment, significantly influence older adults' ability to age in place successfully. However, this process also revealed key contradictions, such as the varied impacts of urban design on cognitive health and the ambiguous relationship between recreational facilities and well-being.

The results highlight a multifaceted relationship between the built environment and ageing in place. Key elements like urban planning, infrastructure, housing, and community design profoundly influence the physical and mental health, social interaction, and overall quality of life of older adults. While some aspects like physical accessibility and urban planning showed clear linkages to factors like physical health and cognition, others presented a more complex picture, with varying impacts and unclear directionality. The review has successfully identified significant gaps in the current research, including a lack of longitudinal studies and an insufficient exploration of the combined effects of multiple built environment factors. By addressing these patterns, contradictions, and gaps, the

review paves the way for formulating informed recommendations that are pertinent to future research, policy development, and practical application in the realms of urban design and ageing in place. These findings have significant implications for the global context of population ageing. As the world faces an unprecedented increase in the older population, understanding and optimising the built environment becomes crucial for supporting healthy and active ageing. The results underscore the need for integrated approaches to urban planning and policy-making that consider the diverse needs of ageing populations across different cultural and socioeconomic contexts.

This research invites researchers to reconsider the relationship between the built environment and ageing in place as a complex, dynamic system rather than a series of isolated factors. It challenges the notion of one-size-fits-all solutions, highlighting the need for context-specific and adaptable approaches to creating age-friendly environments. Moreover, it emphasises the importance of interdisciplinary collaboration in addressing the multifaceted challenges of ageing in place. For academics, the findings highlight critical research gaps and methodological considerations for future studies, particularly the need for longitudinal research and more comprehensive analyses of combined environmental factors. Policy-makers can use these insights to develop more holistic and evidence-based strategies for creating age-friendly cities and communities. For practitioners in urban planning and design, the results provide a nuanced understanding of how different environmental elements impact older adults, guiding more informed and effective interventions in the built environment.

The limitations of this systematic review are multifaceted. Firstly, it focuses on summarising existing review articles, meaning original studies not included in previous reviews are not covered in this analysis. This approach, while comprehensive, may overlook recent developments not yet synthesised in review papers. Secondly, the review only incorporates literature where systematic data were accessible, potentially overlooking relevant studies with limited data availability, particularly from non-English language sources or developing countries. Thirdly, discrepancies in findings across different studies about the same built environment factors and their impact on ageing in place were not individually analysed but rather taken from previous reviews, which may obscure nuances in the data. Fourthly, this review did not yield substantial findings specifically related to gender differences in the impact of the built environment on ageing in place, representing a gap in the current literature. Finally, due to the vast scope of data, this study selectively discussed representative data. These limitations point to remaining uncertainties, particularly in understanding regional variations, gender-specific needs, and the applicability of findings across diverse cultural and socioeconomic contexts. A more comprehensive and in-depth analysis of these topics, constrained by the scope of this paper, is identified as an area for future detailed research.

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