Research Paper

Environmental Factors Associated with Dementia: A Systematic Review*

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ABSTRACT

Following the increase in the elderly population, dementia has become a significant challenge in the field of global health. Dementia, as a syndrome, involves progressive impairments in brain function that specifically affect memory, daily activities, and other cognitive abilities such as thinking, reasoning, and judgment. Evidence shows that built and natural environmental factors can improve the lives of people with dementia. This study aims to identify the dimensions and factors that shape the environment for people with dementia and to provide a theoretical framework for a supportive environment that reduces cognitive and behavioral disorders and improves their daily functioning across different urban environments. This study is a systematic review using the PRISMA checklist, conducted by searching the Web of Science, Scopus, and Google Scholar databases for relevant keywords between 2000 and October 2024. Of the 930 identified articles, 27 met the inclusion criteria and were examined using qualitative content analysis. Based on the findings, environmental factors are categorized into four main dimensions: nature, body and activity, meaning and perception, and community. The key factors identified included safety (13 repetitions) and walkability (10 repetitions) in the body dimension, readability (11 repetitions) and familiarity of the environment (9 repetitions) in the meaning dimension, access to parks and green spaces (11 repetitions) in the nature dimension, and social interactions (9 repetitions) in the community dimension. The conclusion is that designing familiar, understandable spaces with clear signs, safe, walkable streets, access to green spaces, and opportunities for social interaction are vital for maintaining the independence and health of people with dementia. This theoretical framework can serve as a basis for dementia-friendly urban design and planning.

Keywords: Health, Dementia, Urban Design, Systematic Review, Theoretical Framework.

1. INTRODUCTION AND PROBLEM STATEMENT

Dementia refers to a decline in cognitive function and level of consciousness (Duong et al. 2017) and is characterized by multiple cognitive deficits, including memory loss. Individuals with dementia become lost even in familiar environments; communication with them is difficult, and they often exhibit inappropriate behaviors. According to the latest report of the World Health Organization (WHO), dementia is the leading cause of disability and the seventh leading cause of death worldwide. Based on the organization's statistics, in 2019, it was estimated that more than 55 million people were living with dementia, 60–70 percent of whom were affected by Alzheimer's disease. This number is expected to nearly double every 20 years, reaching 78 million in 2030 and 139 million in 2050. Most of this increase will occur in developing countries (WHO 2021). Although dementia primarily affects older adults, it is not an inevitable consequence of aging. Research indicates that certain aspects of the built environment can, on the one hand, influence cognitive performance and the risk of developing dementia, and, on the other hand, be designed to support mental health (Mangili et al. 2023).

Despite the breadth of international studies, a review of the research literature within the Iranian context indicates a clear knowledge gap. Domestic studies in this field have mainly focused on fragmented indicator identification or case-based examinations of specific spaces. Although the 2023 study by Sivani and Hakimian represented a step toward developing a conceptual framework for urban design principles, the lack of a systematic study that comprehensively extracts, categorizes, and presents an integrated theoretical framework encompassing all dimensions and environmental factors of the urban environment affecting individuals with dementia remains evident. This fragmentation, along with the absence of a localized systematic review, has hindered the development of a coherent knowledge base for application in urban design and planning in Iran. Therefore, the present study is necessary to conduct a systematic review aimed at developing a comprehensive theoretical framework within the context of Iranian urban neighborhoods.

Some studies indicate that addressing vascular risk factors and engaging in cognitively stimulating activities may delay the onset of cognitive impairment and reduce the progression of dementia. Exposure to neighborhood environments that support physical activity and active living may be one factor that delays cognitive decline. This issue is also related to the concept of "aging-in-place," meaning that an individual "can safely and confidently go wherever and whenever they wish." This characteristic defines the need for continuous access to local shops, healthcare services, public services, and recreational opportunities, and highlights the importance of personal mobility (Clark et al. 2020). Accordingly, attention to independence, social participation, and physical health, and to the role of environments in shaping the quality of life of individuals with dementia—especially older adults—is essential. With the growth of the elderly population, the prevalence of dementia also increases. However, recent assessments show that cities and neighborhoods have not adequately met the needs of these individuals, and there are gaps and limitations in planning, policy, and design related to dementia-supportive environments. Therefore, further research is required to examine how environmental characteristics affect the well-being of individuals with dementia (Biglieri and Dean 2021). Since health is considered one of the fundamental needs of citizens (WHO 2016; Mouratidis 2021), and dementia, as a significant global challenge, severely affects the cognitive and social health of this population, attention to the environmental dimensions influencing this disease is an undeniable necessity. Accordingly, the main objective of this research is to examine, at an intermediate scale (e.g., urban neighborhoods), urban environmental factors related to dementia and to develop a theoretical framework for a dementia-supportive environment.

2. THEORETICAL FOUNDATIONS

Dementia is a complex disease characterized by a significant decline in cognitive abilities that affects an individual's functioning and daily independence. This disease is rapidly increasing and begins with mild memory problems and progresses to severe brain damage. While dementia is most commonly associated with memory loss, this is only one of the potential cognitive impairments that an affected individual may experience. Dementia can also affect mood, sensory perception, language, learning, problem-solving, and other functions, depending on the type of dementia, the most common of which is Alzheimer's disease (Oh 2024; Eshmawey et al. 2023; Javed and Kakul 2023; Quirke et al. 2023). In this cognitive disorder, individuals' intelligence, orientation or wayfinding, perception, attention, judgment, concentration, and social skills are affected. The disease mainly affects individuals over the age of 65; however, growing awareness suggests that younger individuals may also be affected (Blackman et al. 2003).

3. DOMESTIC RESEARCH BACKGROUND

Zabtiyan and Taghvaei (2009), in a study entitled "Indicators for the Adaptation of Elderly-Friendly Urban Spaces Using a Participatory Approach," found that a participatory approach based on interviews and direct interaction with older adults yields the most effective problem diagnosis for identifying indicators to be reflected in urban plans. The indicators derived from this study and the reviewed experiences include

environmental familiarity, legibility, accessibility, recognizability, comfort, and safety. Zandieh (2012), in an article entitled "Adaptation of the Urban Landscape for the Elderly: Case Study of Qeytarieh Neighborhood, Tehran," examined the impact of the urban landscape on the social interaction of older adults and found that this factor plays a significant role in wayfinding and is related to the needs of older people and their visual and cognitive impairments. Moghimi and Alialhesabi (2014), in a study entitled "Presenting Qualitative Environmental Components to Facilitate the Presence of Psychiatric Patients in Urban Spaces (Case Study: Dementia)," concluded that the presence of patients in urban spaces, in addition to enabling the continuation of life in a relatively normal manner, helps prevent depression, increases the sense of independence and self-confidence, and reduces complete dependence on others.

Mansouri et al. (2019), in an article entitled "The Non-Pharmacological Effectiveness of Color, Light Intensity, and the Type and Texture of Environmental Materials on Patients with Alzheimer's-Type Dementia," concluded that the texture of materials, more than affecting the physiological condition of patients, plays a vital role in desirable or undesirable mental and visual perception. The synergistic effect of color, light intensity, and material texture can enhance the meaningful perception of the environment for individuals with dementia and Alzheimer's disease. Additionally, Mansouri et al. (2018), in another article entitled "Explaining the Physical and Neuropsychological Environmental Characteristics in the Environmental Perception of Patients with Alzheimer's-Type Dementia," concluded that physical and neuropsychological environmental characteristics, when considered simultaneously, can play a significant role in creating desirable residential, care, and therapeutic environments for individuals with dementia. Therefore, stronger environmental perception implies greater interaction among different environmental dimensions. Sivani and Hakimian (2024), in an article entitled "Developing a Conceptual Framework for Urban Design Principles Related to Reducing Dementia in the Elderly," found that urban design principles such as safety and security, accessibility to daily activities, wayfinding, permeability, and legibility play an essential role in reducing the burden of dementia among older adults. Based on studies conducted in Iran, it can be concluded that, to date, no significant systematic reviews have been undertaken to identify the dimensions and components of the urban environment that influence the needs of individuals with dementia. Therefore, the absence of a targeted study that presents a broad, comprehensive framework of the dimensions and factors of the urban environment to support individuals with dementia is evident. Accordingly, the present research provides theoretical support for future studies in the subject area of this article.

4. METHOD

A systematic review is a comprehensive examination of the literature that addresses a specific research question. In this type of review, a systematic, transparent method is used to identify, select, and critically evaluate all relevant studies. In addition, data derived from existing studies are collected, analyzed, and utilized (Shannon 2002). Therefore, this method can be used to achieve a comprehensive understanding of environmental factors associated with dementia. In the present study, the PRISMA framework was used to screen articles, ensuring that only those studies that possessed the required and intended characteristics of the research entered the analysis (Fig. 1). The PRISMA framework is a valid method for guiding systematic reviews of scientific literature (Liberati et al. 2009). The systematic literature review in the present study was conducted in four stages, as shown in Figure 1.
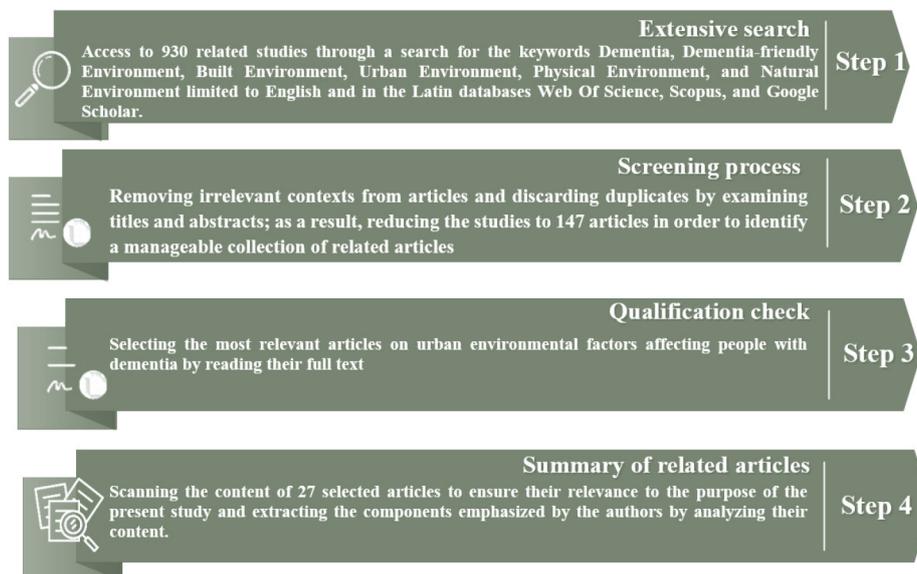

Extensive search
Access to 930 related studies through a search for the keywords Dementia, Dementia-friendly Environment, Built Environment, Urban Environment, Physical Environment, and Natural Environment limited to English and in the Latin databases Web Of Science, Scopus, and Google Scholar.
Step 1

Screening process
Removing irrelevant contexts from articles and discarding duplicates by examining titles and abstracts; as a result, reducing the studies to 147 articles in order to identify a manageable collection of related articles
Step 2

Qualification check
Selecting the most relevant articles on urban environmental factors affecting people with dementia by reading their full text
Step 3

Summary of related articles
Scanning the content of 27 selected articles to ensure their relevance to the purpose of the present study and extracting the components emphasized by the authors by analyzing their content.
Step 4

Fig. 1. Stages of the Systematic Review of the Research Literature

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- Data Sources and Search Strategy

PRISMA is one of the internationally recognized standards for reporting the results of review studies. The initial form of this statement was developed in 2009 by a group of international researchers from various disciplinary fields to evaluate the full content of systematic reviews and meta-analyses (Moher et al., 2009). The PRISMA checklist is used as a design guideline to improve the quality of reporting in systematic reviews. Accordingly, authors of scientific articles use the PRISMA guidelines to assist in preparing and publishing systematic reviews (Hutton et al. 2015). The PRISMA reporting guidelines include essential points for conducting detailed, transparent research. In addition to helping authors as a writing tool, these guidelines can greatly assist reviewers in evaluating manuscripts. The purpose of the PRISMA statement is to help authors succeed in reporting systematic reviews and meta-analyses. In general, PRISMA can also serve as a foundation for reporting other types of review studies (Dijkers et al. 2011). Table 1 presents the search strategy and the frequency of this topic across the selected databases.

Table 1. Search Strategy in Selected Databases

Search Date	October 17, 2024	
Article Type	Primary study (research articles) and secondary study (review articles)	
	Search databases	Count
Scopus	Article title, Abstract, Keywords: (Dementia OR "Dementia-friendly Environment") AND ("Built Environment" OR "Urban Environment" OR "Physical Environment" OR "Natural Environment")	408
Web Of Science	Topic: (Dementia OR "Dementia-friendly Environment") AND ("Built Environment" OR "Urban Environment" OR "Physical Environment" OR "Natural Environment")	473
Google Scholar	(Dementia OR "Dementia-friendly Environment") AND ("Built Environment" OR "Urban Environment" OR "Physical Environment" OR "Natural Environment")	49
	Total studies from the initial search	930

During the systematic review process, after collecting the initial sources, a total of 930 articles were identified as related in various ways to the main structure of the research field and extracted from the selected databases. In the first stage of the screening process, duplicate documents and studies from unrelated fields, such as medicine, cognitive sciences, psychology, indoor environmental care, and related areas, were excluded, reducing the number of articles to 147. Ultimately, 27 articles were included in the main study (Fig. 2). These articles were relevant to the present research and influenced the final theoretical framework.
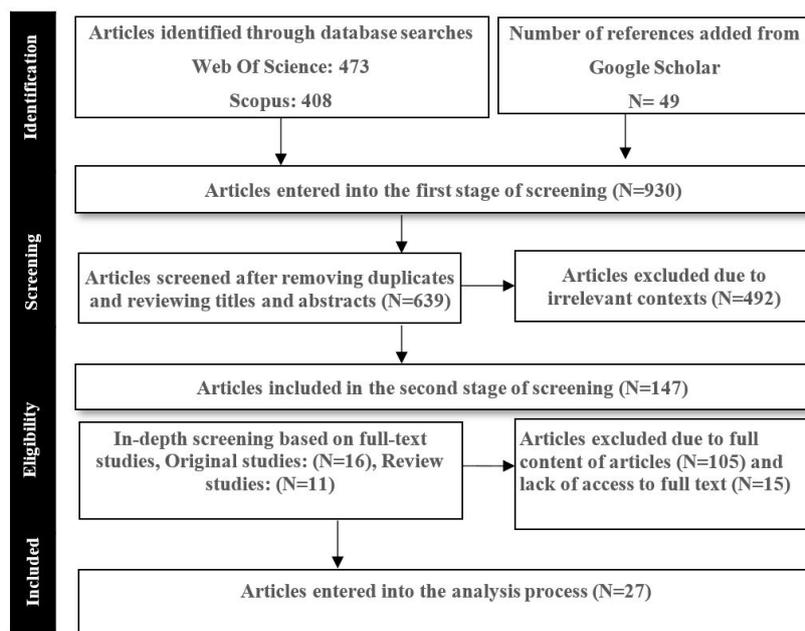

Fig. 2. Process of Screening Studies in a Systematic Review (based on the PRISMA Checklist)

During the systematic review process, after collecting primary sources, a total of 930 articles were identified as related to the main structure of the research field in various ways and extracted from selected databases. In the first stage of the screening process, documents that were repetitive or contained unrelated fields, such as medicine, cognitive sciences, psychology, indoor environment care, etc., were excluded from the articles, reducing the number to 147. Finally, 27 articles were included in the main study (Fig. 2). These articles relate to the present study and influence the final theoretical framework. During the second stage, articles from unrelated fields were excluded, and only studies related to the aim and subject of this article in the field of urban environments and residential neighborhoods were reviewed. Of the total number of articles reviewed, 105 were excluded from the list of references for this study, even though their titles contained keywords related to this research, due to their content not being in accordance with the subject of the article and their connection to different scientific fields. Table 2 lists the inclusion criteria for including or excluding the studies obtained.

Table 2. Inclusion and Exclusion Criteria for Research Sources

Inclusion Criteria	Exclusion Criteria
Articles focused on the urban environment and its impact on dementia.	Studies that did not address the relationship with the urban environment (e.g., at the indoor/environmental scale, nursing homes, dementia care centers, etc.).
Articles that presented dimensions and components related to the subject of the present research.	Studies that did not consider dementia as the dependent variable.
Authentic research and review articles in English	Studies primarily focused on medical and psychiatric domains.

- Qualitative Content Analysis Process
This study analyzed the data using a qualitative content analysis method, employing an interactive, collaborative approach among the authors. The qualitative approach, rather than focusing solely on the quantity of studies, enabled a deeper understanding of the concepts, contexts, and relationships in the selected texts. The analysis process in the present research was conducted manually, based on inference and joint discussion among the researchers, and without the use of qualitative data analysis software.
Coding and Analysis Stages. The analysis process was carried out in three main phases and interactively among the researchers:

Phase One: Open Coding
At this stage, the authors studied the full text of each of the 22 selected articles line by line. The aim was to identify and extract any statement, concept, or factor that in some way referred to the relationship between the urban environment and dementia. These concepts were extracted as "initial codes" and recorded in separate text files for each article. To ensure comprehensiveness, the researchers independently conducted the initial coding. For example, initial codes such as "access to parks," "density of street intersections," "sense of safety in nighttime walking," "presence in public spaces to maintain social interactions," and "familiarity with neighborhood landmarks" were extracted from the texts of the articles. By the end of this phase, the research team had collected more than 150 dispersed initial codes.

Phase Two: Formation of Categories and Themes
In this step, the researchers jointly reviewed and compared the initial codes for semantic and conceptual similarity across multiple discussion sessions. This collaborative process led to the integration of similar codes and the formation of categories. For instance, the codes "access to parks," "presence of green space," and "distance to green space" were all classified under a broader category titled "interaction with nature." Subsequently, through the comparison and integration of these categories, broader themes emerged. This stage was iteratively repeated until consensus among the researchers was achieved.

Phase Three: Redefinition and Final Naming
After forming the initial thematic structure, the final stage of refinement and precise definition began. In this phase, an operational definition was written for each of the main themes and their constituent subcategories to delineate the boundaries of each concept. This process greatly facilitated a shared and unified understanding of the concepts among the authors and prevented overlap or ambiguity in the interpretation of the findings. Ultimately, the research's theoretical framework—comprising four main themes (nature; physical form and activity; meaning and perception; and society)—was finalized and developed.

- Ensuring Validity and Reliability
In qualitative studies, where the researcher plays a central role as the primary instrument for data collection and analysis, the concepts of validity (credibility) and reliability (dependability) take on a different nature than in quantitative research. This difference is mainly due to the active and interpretive role of the researcher and the inevitable influence of their worldview and presuppositions in the research process. To ensure the credibility, dependability, and accuracy of the findings, the entire process—from initial coding to theme formation—was based

on discussion, comparison, and consensus-building among the authors. Differences of opinion were examined in discussion and exchange sessions and continued until final agreement was reached. In addition, the researchers independently coded the articles; their codes were then compared, and a high level of agreement was observed, confirming the dependability of the manual coding process. After the initial thematic framework was formed, the researchers returned to the raw data (the original texts of the 27 articles) to ensure that the proposed framework fully and accurately reflected the articles'

content and that no key concept or relationship had been overlooked. This final step strengthened the internal validity of the findings.

5. FINDINGS

Systematically reviewing the literature and using their qualitative results coherently enabled analysis of the research findings, the components of the urban environment, and the concepts and components they presented related to dementia, as summarized in Table 3.

Table 3. Factors Extracted from Studies Focusing on the Relationship Between Urban Environment and Dementia

Row	Authors	Year	Factors Mentioned in the Research
1	Cavuoto et al.	2024	Distance to greenspace/ Natural environment/ Walkability/ Socioeconomic status/ Crime rate/ Street intersection density/ Physical activity/ Safety/ Accessibility/Social interaction/ Air pollution
2	Innes et al.	2024	Outdoor Activities/ Natural environments/ Natural Elements/ Transportation/ Access to walking areas/ Accessing leisure services
3	Song et al.	2024	Destination accessibility/ Public transportation distance/ Population density/ Street connectivity/ Walkability/ Number of public transportation stops around the residence/ Land use mix/Green space.
4	Gan et al.	2024	Public space participation/ Social support/ (Walkability/ Wayfinding/ Recreational facilities/ Nature areas/ (Public facilities/ Distinctive places/ Socioeconomic status/ Meaningful landmarks/ Legibility
5	Craig et al.	2024	Sense of security/Social engagement/ Community ties/ Accessible meeting places
6	Ho et al.	2023	Greenery/ walkability/ Accessibility/ Leisure facilities/ Transportation facilities/ Health facilities/ Land use mix
7	Quirke et al.	2023	Safety/ human scale/ Link to the community/ familiar place/ movement and engagement/ wayfinding/ thermal comfort/ lighting and visual comfort/ temperature changes/ air quality/comfort
8	Mangili et al.	2023	Social connection/ Accessibility/ Spaces Flexibility/ Promote Physical activity/ Safety/ Wayfinding
9	Röhr et al.	2022	Social participation / Inclusion/ Social contact/ Social housing/ Intergenerationality/ Proximity and accessibility to means/ Cultural events/ Access to health care/ Mobility/ Public toilets/ Local recreation and wellbeing/ Safety in traffic/ Security after dark/ Public gardening/ Cleanliness and environmental protection/ Urban greenery/ Climate change and heat waves/ Outdoor physical activity
10	Gan	2022	Familiarity with landmarks/ legibility/ Wayfinding/ social connections
11	Brittain and Degnen	2022	Safety/ Familiarity/ Accessibility/ Known places/ Atmospheric qualities/ Social inclusion/ quiet areas/ Clear paths/ proximate seating
12	Menéndez and García	2022	Accessibility/ habitability/ Green areas/ Legibility/ Iconic landmarks/ Signposts Integration and inclusion
13	Sturge et al.	2021	Connection to society/ Interaction with natural environments/ Access to public space/ Familiarity
14	Biglieri and Dean	2021	Familiar places/ Comfort/ Mixed-use/ Safety/ Perception of crime/ Green space/ Walkability/ Access amenities/ Wayfinding signage
15	Crous-Bou et al.	2020	green spaces/ air pollution/ traffic noise/ Socioeconomic status/ Physical activity
16	Ho et al.	2020	urban compactness/ urban greenness/ air pollution/ traffic/ air temperature/ social engagement/ social cohesion/ accessibility of local facilities/ multifunctional land use/ air quality

Row	Authors	Year	Factors Mentioned in the Research
17	Liu et al.	2019	Accessible environmental resources/greenery/ mixed land use/ Playgrounds and sport venues Community centers/ Availability of neighborhood spaces for recreational activities/ social interactions/ physical activity
18	Ferdous	2019	Accessibility/ Legibility/ familiarity/ connection to nature/ wayfinding/ social activity/ natural settings/ social interaction
19	Woodbridge et al.	2018	Orientation/ Familiar cues/ Accessibility of spaces/ participation/ Visual contrast
20	Besser et al.	2018	Social destination density/ walking destinations/ intersection densities/ air pollution/ Proportion land residential/ Proportion land retail
21	Wu et al.	2017	Land use mix/ Natural environment availability
22	Fleming et al.	2016	familiar environment/ social interaction/Link to the community/ visual access/ Safety/ walking
23	Wu et al.	2015	Socioeconomic status/ Green space/ Safety and security/ Crime/ Accessibility to health care/ walkability/ Transport/ Street connectivity/ recreation centre/ playgrounds/ Public toilet/ Residential density
24	Cassarinoa and Setti	2015	Socioeconomic status/ Physical activity/ Social engagement/ Walkability/ Accessible services
25	Marquardt et al.	2014	Orientation/ Visual cues/Signage/ Safety
26	Keady et al.	2012	Safety/ Way-finding/ Legibility/ Accessibility of public spaces/ Outside facilities
27	Mitchell et al.	2003	Familiarity/ Legibility/ Distinctiveness/ Accessibility/ Comfort/ Safety

The review and classification of the aforementioned studies show that, although there are similarities and common features in the expression of the factors presented by experts, a comprehensive theoretical framework for the dimensions and components of the urban environment affecting people with dementia has not yet been developed. Therefore, these factors are summarized in Table 4.

Table 4. Environmental Factors Related to Dementia Extracted from Selected Articles

	Factor	Cavuoto et al., 2024	Innes et al., 20	Song et al., 2024	Gan et al., 2024	Craig et al., 2024	Ho et al., 2023	Quirke et al., 2023	Mangili et al., 2023	Röhr et al., 2022	Gan et al., 2022	Brittain and Degnan, 2022	Menéndez and García, 2022	Sturge et al., 2021	Biglieri and Dean, 2021	Crous-Bou et al., 2020	Ho et al., 2020	Liu et al., 2019	Ferdous, 2019	Woodbridge et al., 2018	Besser et al., 2018	Wu et al., 2017	Fleming et al., 2016	Wu et al., 2015	Cassarinoa and Setti, 2015	Marquardt et al., 2014	Keady et al., 2012	Mitchell et al., 2003	Number of repetitions of each factor
Natural	Parks and Green Space	*		*			*						*		*	*	*	*								*			9
	Air Quality and Thermal Comfort	*						*		*		*				*	*				*								7
	Interaction with Nature	*	*		*										*		*					*							6
	Natural Elements		*		*																								2
	Distance to green space	*															*												2
Physical	Safety and Traffic Volume	*					*	*	*		*				*	*	*							*	*	*	*	*	13
	Walkability	*	*	*	*		*								*						*			*	*	*			10
	Land Use Mix and Retail Ratio			*	*										*	*	*				*	*							7
	Accessibility	*		*			*	*	*			*	*				*										*		9
	Access to Recreational Services		*		*		*			*							*								*				6

Environmental Factors / Factor	Cavuoto et al., 2024	Innes et al., 20	Song et al., 2024	Gan et al., 2024	Craig et al., 2024	Ho et al., 2023	Quirke et al., 2023	Mangili et al., 2023	Röhr et al., 2022	Gan et al., 2022	Brittain and Degnan, 2022	Menéndez and García, 2022	Sturge et al., 2021	Biglieri and Dean, 2021	Crous-Bou et al., 2020	Ho et al., 2020	Liu et al., 2019	Ferdous, 2019	Woodbridge et al., 2018	Besser et al., 2018	Wu et al., 2017	Fleming et al., 2016	Wu et al., 2015	Cassarinoa and Setti, 2015	Marquardt et al., 2014	Keady et al., 2012	Mitchell et al., 2003	Number of repetitions of each factor
Physical																												
Navigation			*				*	*		*			*						*						*	*		8
Access to Services								*			*		*		*										*	*		6
Access to Public Space				*	*								*	*					*							*		6
Distance to Public Transport	*	*				*																*						4
Street Connectivity	*	*																		*					*			4
Health Facilities (Public Toilets, etc.)					*				*																*			3
Residential Density		*																		*					*			3
Non-Physical																												
Social Interactions	*						*	*		*	*		*				*	*			*							9
Familiarity							*				*	*	*	*			*	*			*						*	9
Socio-Economic Status	*		*												*										*	*		5
Social Participation				*	*					*						*			*			*						6
Safety and Crime Rate	*		*							*										*	*							5
Legibility			*								*	*							*							*	*	6
Connection with the Local Community				*			*	*			*	*	*								*							7
Distinctiveness			*										*						*						*		*	5
Neighborhood Goals and Community Centers, Social Activity																	*	*		*								2

Based on the findings in Table 4, several urban environmental factors are associated with dementia. In the process of qualitative content analysis, coding, and categorization, these findings were classified into a theoretical framework and four general groups, as shown in Table 5. Some of the factors mentioned in the aforementioned studies, mobility, walking, and physical activity, were non-physical factors that act either as an intervening variable or a mediating variable. Since these factors, as components of the urban environment, cannot affect people with dementia and are not at the same level as the other factors mentioned, they were not included in the summary table. However, they were not excluded from the studies and are considered in Tables 3 and 4. It should be noted that items with low frequency, including residential density, cultural events, intergenerational interaction, social cohesion, visual amenity, urban compactness, flexibility, inclusiveness, human scale, cleanliness, habitability, and quiet and low-noise areas, are not included in the table.

According to the proposed theoretical framework, the environmental factors obtained differ in nature and can be classified into four dimensions or groups: 1-Nature, 2-Body and Activity, 3-Meaning and Perception, and 4-Society.

1. Nature dimension refers to the natural environment and elements of the natural environment and their impact on people with dementia. This dimension includes three factors: parks and green spaces, air quality, and thermal comfort and interaction with nature and its elements, of which the factor of parks and green spaces has the highest frequency in studies, at 11, and plays an essential role in improving the quality of life of citizens as vital elements in cities. Parks and green spaces not only act as the city's respiratory lungs but also improve people with dementia's physical and mental health through their impact on air quality, thermal comfort, and interactions with nature.

2. The physical and activity dimension focuses on the form, layout, and activity characteristics of the physical environment. This dimension includes key qualities that are associated with dementia. Accessibility to

various destinations (with a frequency of 34), such as public transportation (promoting independence), neighborhood services and facilities, especially dementia care and treatment services, public and recreational spaces, was emphasized by many studies. Safety and walkability (with frequencies of 13 and 10, respectively) are critical environmental features that help people with dementia better interact with their living environment. Mixed-use and street connectivity (with frequencies of 7 and 4, respectively) are other essential qualities that help people with dementia live comfortably and efficiently.

3. The dimension of meaning and perception is one of the key aspects of the environment that is closely related to dementia. Due to the decline in cognitive function in people with dementia, the quality of being familiar with the environment had the highest frequency of repetition (9) among the studies. Familiarity with places and the neighborhood environment enables their independent presence and effective communication in the urban environment. The quality of wayfinding (with a frequency of 8) prevents the fear and stress of getting lost in the neighborhood. The readability of the environment (with a frequency of 6) helps form a clear cognitive map of the neighborhood environment in people's minds. It plays an important role in better understanding the neighborhood environment and in preventing anxiety and promoting mental peace.

4. The social dimension is critical because dementia is also considered a social disability. Social interactions (with a frequency of 9) were the most frequent factor in this dimension, which significantly contributes to the empowerment and acceptance of these people within the community and the neighborhood social network. Connection with the local community is abundant, 7 through two environmental factors: planning and creating social activities and neighborhood centers, which contribute to the presence and activity of these individuals. Social participation among these individuals is considered an occupational activity that can be used as a non-pharmacological therapeutic approach to prevent or control dementia. Socio-economic status was also a factor that has been associated with dementia in many studies, along with physical and natural environmental factors.

Table 5. Theoretical Framework of Urban Environmental Factors Related to Dementia

Dimension	Factor	Components	Frequency
Nature	Parks and Green Spaces	Presence of parks or green spaces; distance to green spaces; accessibility	11
	Air Quality and Thermal Comfort	Air quality; air pollution; temperature; thermal comfort	7
	Interaction with Nature and Its Elements	Interaction and connection to nature; natural elements such as water, plants, etc.	8
Physical Form & Activity	Accessibility to Destinations	Destinations including public transport, recreational services, local services and facilities; healthcare facilities; public spaces (accessible gathering areas)	34
	Walkability	Quality of sidewalks; existence of pathways; easy access	10
	Safety	Safety; street traffic	13
	Land Use Mix	Diverse land uses	7
	Street Connectivity	Number of intersections; block lengths	4
Meaning & Perception	Wayfinding	Understandable signage; grid patterns; orientation	8
	Legibility	Legibility; distinctiveness of places (visual distinction)	11
	Familiarity	Familiar places and landmarks; meaningful signs; visual cues; iconic points	10
	Security	Perceived safety; crime rates	5
Society	Social Interaction	Social interactions; engagement with neighbors	9
	Connection to Local Community	Social programs, community activities, and the presence of neighborhood centers	7
	Social Participation	Participation in community activities; non-pharmacological therapy approaches	6
	Socioeconomic Status	Individual or household socioeconomic conditions	4

6. DISCUSSION

Dementia is a disease that affects an individual's physical, psychological, and social dimensions. The main problems and challenges faced by people with this condition can be categorized into three groups: cognitive problems, physical and mobility issues, and communication and social interaction difficulties. The proposed theoretical framework addresses these dimensions through four components (Fig. 3).

- The meaning and perception dimension focuses on cognitive problems and decreased brain function. This disease is accompanied by symptoms such as memory loss, mood changes, and communication problems. It is progressive: the brain's cognitive function gradually deteriorates, and the person's powers of logic, understanding, and perception decrease. In these people, the ability to remember names, places, and navigate the environment decreases, and the likelihood of getting lost in the neighborhood and outside the home increases. These people rely more on old information from the environment and familiar places. Therefore, the meaning and perceptual-cognitive aspects of the environment are essential dimensions of environments that support people with dementia.

- The body and activity dimension focuses on physical problems and mobility. People with dementia are generally old, which in turn causes low mobility and mobility problems, and reduced vision and hearing. These cases contribute to the lack of independence of these people in meeting their daily needs and in passing, browsing, and being in the neighborhood. Therefore, the physical layout and activities of the environment that allow for the continuity of paths and walking, along with creating a lively and safe environment, are other key dimensions of environments that support people with dementia.

- The community dimension considers social-communication problems. Dementia is a disease that, due to cognitive and psychological difficulties, changes the pattern of interactions and communications, and the individual's connection with the surrounding environment and other people decreases. Therefore, people with dementia move away from the local community and gradually lose their presence and social role. The social environment provides opportunities to empower and rehabilitate these people by increasing social interactions and connections with the local community and by encouraging their participation.

- The dimension of nature as a common ground for all dimensions of health is emphasized by the majority of health studies, especially studies related to dementia. Therefore, this dimension, separate from the city's physical and activity environments, plays an important role in preventing or halting the progression of dementia.

It is important to note that due to the various aspects of dementia, the approach adopted to form a theoretical framework is comprehensive, and a purely medical or psychological view of this disease or a mere attention to the role of the social environment in empowering these individuals is not adequate. Therefore, in addition to the physical and semantic dimensions of the environment, two social and natural dimensions have also been included in this framework to coordinate with the comprehensive approach.
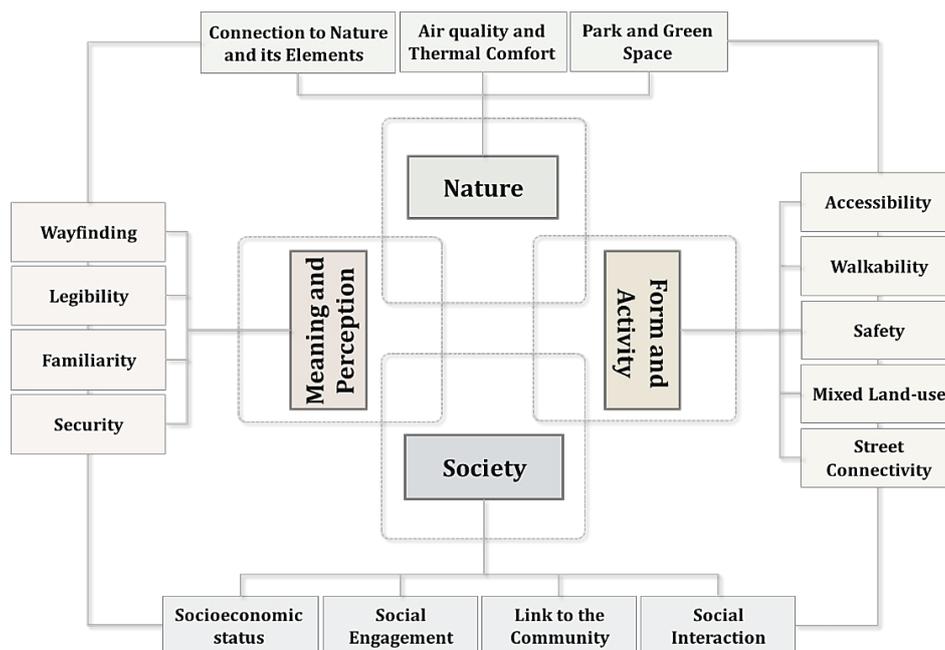
Fig. 3. Diagram of the Research Theoretical Framework

The proposed theoretical framework of this study is applicable at an intermediate scale, within urban environments and residential neighborhoods, and can provide a theoretical basis for cross-sectional or longitudinal research in urban settings and neighborhoods by designers and urban planners. Based on the authors' literature review, most studies have focused on the roles of architecture and internal building factors in dementia among building users, particularly in elderly care centers, and on tools for evaluating such spaces. Developing tools for assessing urban environmental factors specifically related to dementia remains one of the main challenges in urban studies, and this model can serve as a reliable foundation for initiating studies to develop measurement instruments and audits for urban environments and residential neighborhoods related to dementia.

- Comparison of Findings with Similar Global Frameworks

The proposed theoretical framework shows both similarities and differences with previous studies. One of the earliest and most influential works in this field is the study by Mitchell et al. (2003), which introduced six qualities: "familiarity, legibility, distinctiveness, accessibility, comfort, and safety." These qualities focused mainly on the semantic-perceptual dimension and on part of the built environment dimension, forming the foundation for many subsequent studies. The present framework, by integrating these qualities into the "Meaning and Perception" and "Built Environment and Activity" dimensions, not only validates them but also goes further by adding the "Nature" and "Social" dimensions. This indicates that while these qualities are necessary, they are not sufficient to fully address the range of needs of individuals with dementia at an urban scale. Since 2012, studies have become broader and focused on more quantifiable factors. For instance, Mangili et al. (2023) examined features of elderly care and dementia facilities, identifying three aspects—physical, cognitive, and social—along with seven criteria (Mangili et al. 2023). These three aspects correspond to three dimensions of the proposed theoretical framework. The main difference is the inclusion of the "Nature" dimension as a critical urban factor affecting dementia. In contrast, the constituent criteria of each dimension differ due to the larger spatial scale and the urban and neighborhood context compared to the mentioned study. Some contemporary frameworks, such as the model presented by Quirke et al. (2023), focus on the design of internal and residential environments and measure "physical, cognitive, and social" dimensions (Quirke et al. 2023). Although these three dimensions superficially resemble the current framework, their scales and content are fundamentally different. Quirke's framework operates at the building and residential-unit scales. In contrast, the present

study's framework targets the intermediate scale of neighborhoods and cities through factors like "land use mix," "intersection density," "access to public transport," and "link to the local community," which cannot be defined at the micro scale. Therefore, the added value of this framework lies in generalizing and adapting dementia-supportive principles to a broader scale in urban planning and design. A more integrated framework by Gan et al. (2024) also emphasizes the complex interaction of the individual with the environment. However, its holistic perspective, which considers health systems and care alongside psychological and built environments, gives it a broader scope within which the present framework can be situated (Gan et al. 2024).

7. CONCLUSION

Research on environmental factors related to dementia is a key topic in urban health, especially given the growing elderly population and the undeniable impact of urban environments and residential neighborhoods on their daily lives. Therefore, this study aimed to systematically examine the relationship between urban environmental factors and dementia at the neighborhood scale. The study reviewed sources and articles published in reputable international journals and, using qualitative content analysis, precisely examined the various dimensions related to the study's objectives. This research synthesized and analyzed findings from 27 studies, including 16 original and 11 review studies, focusing on the relationships among social, natural, and built urban environments and the well-being of individuals with dementia. According to the proposed theoretical framework, a supportive environment for individuals with dementia can be defined through four dimensions: Built Environment and Activity, Meaning and Perception, Nature, and Social. Supportive environments play a critical role in determining the identity of individuals with dementia and guiding them toward self-awareness through sensory stimuli, spatial experiences, engagement in activities, and interaction with different levels of their environment.

This theoretical framework can be localized and applied in future research across neighborhoods with different cultural and geographic contexts. Moreover, future studies can develop and validate multidimensional environmental assessment tools, enabling more objective evaluations of the effectiveness of urban environments in slowing dementia progression. Longitudinal studies focusing on the impact of socio-spatial interventions, as well as interdisciplinary approaches combining neuroscience, innovative technologies, and urban design, can provide deeper insights into the mechanisms of environmental interaction and cognition. Additionally, participatory methods for capturing individuals with dementia's lived experiences can lead to comprehensive,

context-sensitive strategies at both policy and design levels. Identifying clear links between dementia and urban environmental factors can effectively inform urban policies and designs to support dementia care and enhance the mental and social health of this population. To translate this theoretical framework into practical actions, the following recommendations are proposed at the macro and micro levels:

Policy Recommendations for Urban Management (Macro Scale):

- Develop "special design regulations for dementia-friendly neighborhoods," including dedicated clauses in comprehensive, detailed urban plans.
- Implement "community awareness and empowerment programs," including educational campaigns for shopkeepers, residents, and municipal staff.
- Establish a "monitoring and evaluation system" and develop a neighborhood assessment tool (audit checklist) based on the proposed four-dimensional framework.

Practical Recommendations for Landscape Architects, Designers, and Urban Planners (Micro/ Neighborhood Scale):

- Create "familiar and safe pathways" by identifying and designing main pedestrian routes connecting key points such as local shopping centers, parks, clinics, and social hubs.

- Design "therapeutic-cognitive parks" by dedicating parts of local green spaces to parks with features aimed explicitly at sensory and cognitive stimulation.
- Enhance "legibility" in neighborhoods, intersections, and local squares through redesigning key public spaces to reduce disorientation.

In conclusion, this proposed framework can transform from a purely theoretical model into an operational agenda. Modifying cities to become safe, familiar, vibrant, and equitable places for the growing population of individuals with dementia requires cross-sector collaboration among designers, planners, policymakers, and the community. Implementing these recommendations can be a practical step toward achieving aging-friendly environments that ensure dignity and relative independence for citizens with dementia and their families.

CONFLICT OF INTEREST

The authors have no conflicts of interest to declare.

MORAL APPROVAL

The authors commit to observe all the ethical principles of the publication of the scientific work based on the ethical principles of COPE. In case of any violation of the ethical principles, even after the publication of the article, they give the journal the right to delete the article and follow up on the matter.

PARTICIPATION PERCENTAGE

The authors state that they have directly participated in the stages of conducting research and writing the article.

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