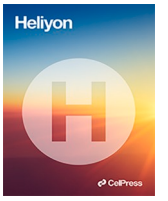
Heliyon 10 (2024) e37676

Contents lists available at ScienceDirect

Heliyon

journal homepage: www.cell.com/heliyon



Research article

Dwelling characteristics and mental well-being in older adults: A systematic review

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ARTICLE INFO

Keywords:
Mental health
Mental well-being
Aged
Systematic review
Dwelling characteristics
House characteristics

ABSTRACT

The increasing prevalence of mental health challenges in older adults underscores the need for a comprehensive understanding of the interplay between dwelling characteristics and mental health outcomes. This systematic review aims to investigate house characteristics associated with mental well-being in older adults. The review meticulously explores existing literature from databases such as PubMed, Scopus, Web of Science, and the Google Scholar search engine. The Newcastle-Ottawa Scale (NOS) was utilized to assess the quality of the included articles. Out of an initial 1182 references, 21 pertinent articles published between 2002 and 2023 were included in the study. While the geographical scope was global, a notable concentration of studies was observed in China. The synthesis of studies reveals that specific attributes of dwelling characteristics, such as high-rise and multi-floor houses, larger house size, high house quality, bathing facilities, and the use of clean fuels for heating and cooking, positively impact mental health outcomes in older adults. However, inconsistent results were found regarding the impact of construction materials on mental health outcomes. Further research is warranted to deepen our understanding of the intricate relationship between construction materials and mental health outcomes. These findings underscore the importance of considering specific dwelling characteristics in designing interventions to enhance the mental well-being of older adults, necessitating targeted strategies for creating age-friendly living environments.

1. Introduction

The older adult population worldwide is experiencing rapid growth, and projections suggest that the population of people aged 60 years or older will exceed 2.1 billion by 2050—more than double the count in 2019 [1]. This demographic shift primarily stems from advances in healthcare and improved living standards, leading to extended life expectancies [2]. However, aging brings forth a spectrum of mental health challenges, including depression, anxiety, and cognitive decline [3], all of which significantly affect an

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https://doi.org/10.1016/j.heliyon.2024.e37676
Received 13 May 2024; Received in revised form 28 August 2024; Accepted 8 September 2024
Available online 10 September 2024

individual's quality of life and societal engagement [4,5].

The home environment stands as a vital indicator of an individual's health and well-being, particularly among older people [6]. Given that older adults spend the majority of their time at home, it functions as a nexus for their identity, life transitions, and family interactions [7]. Prior research has established a positive correlation between favorable housing conditions and improved mental well-being among older adults [8].

The COVID-19 pandemic has highlighted the significance of the home environment as a crucial factor in the well-being of older people, who are particularly vulnerable to its effects and have been advised or mandated to stay at home to minimize their risk of infection [9]. Physical conditions like mobility challenges, chronic illnesses, and cognitive impairments can further curtail older adults' capacity to venture outside their homes and engage in social activities [10,11]. Consequently, the home environment assumes an even more pivotal role in the mental health and overall well-being of older adults who remain at home due to these physical conditions or the pandemic [12]. In this context, architectural design and environmental elements, including lighting, noise levels, and accessibility, gain heightened importance, as they can aid older adults in their daily routines and foster feelings of safety, comfort, and autonomy [13].

The expression 'built environment' pertains to the tangible physical surroundings that are created by human beings to support their daily activities, occupation, and leisure [14]. This construct primarily encompasses various structural components, including housing units such as residences, educational institutions, and workplaces, along with communal spaces like parks, plazas, and recreational venues. Additionally, it encompasses vital infrastructural elements like transportation systems and facilities designated for public services, such as shopping centers, sports arenas, and libraries [15]. Prevailing studies that explored the interconnection among the built environment and mental well-being predominantly centered on the community-level built environment [16]. This specifically pertains to the geographical stratum in closest proximity to residents [17] within the ecological theory framework, considering that the built environment at this level encapsulates direct interactions with inhabitants [18].

The architectural design and layout of built environments can exert a significant influence on the mental health and overall well-being of older adults, particularly those contending with physical impairments [12]. For instance, buildings with inadequate lighting, high levels of noise, and limited accessibility can contribute to feelings of anxiety, depression, and social isolation among older people [19]. On the other hand, buildings that are well-designed, with ample natural light, green spaces, and accessible features, can promote a sense of security, connection, and independence [20]. Studies have shown that older adults residing in well-designed buildings tend to be more inclined to participate in physical activity, social interactions, and experience better cognitive function [21,22], which all contribute to better mental health outcomes [23,24].

Furthermore, the accessibility and adaptability of a living space play crucial roles in the instrumental activities of daily living (I-ADL) of older adults and can reduce the need for home services [25]. Homes equipped with age-friendly features, such as grab bars, non-slip surfaces, and wheelchair accessibility, can enhance mobility and safety, thereby reducing the risk of accidents and functional limitations [26], subsequently preventing declines in mental well-being [27].

In a recently published Umbrella Review, it was demonstrated that the Built Environment is associated with mental health and social participation [28]. Nevertheless, this review diverges from the previous ones by not exclusively focusing on older adults. Instead, our study encompasses a specific demographic, exclusively examining older adults, in contrast to the mix of adults and older individuals in the previously reviewed studies. Additionally, our review addresses a limitation of the prior study, which did not specifically focus on mental health outcomes. Most of the studies covered in the previous review included various health outcomes including physical aspects of older adults, not solely mental health. To overcome these limitations, our study aims to narrow its focus by exclusively considering studies that involve only older adults and assess their mental health outcomes. Importantly, while the previous reviews predominantly concentrated on the external environment of the house [29,30], our study uniquely directs its attention to dwelling Characteristics.

In the context of this review, an array of distinct measures pertaining to mental health among older adults is examined. These encompass, but are not limited to, dimensions such as depression, stress, self-reported mental health status, and intellectual well-being. The incorporation of these diverse measures contributes to a comprehensive evaluation of older adults' mental well-being across various facets. As such, this review encompasses a range of mental health indicators, each offering unique insights into the psychological and emotional state of this demographic. The ensuing exploration of studies employing these varied measurements offers an opportunity to derive a nuanced understanding of the complex interplay between the dwelling features and older adults' mental health.

Given the significance of exploring the relationship between dwelling Characteristics and the mental health of older adults, a systematic review approach holds particular value in this context. This study aims to conduct a comprehensive and rigorous synthesis of the available evidence on this crucial topic, specifically honing in on the characteristics of living spaces that influence mental well-being in older people. By prioritizing the creation of residences and communities uniquely designed to cater to the mental health needs of older individuals, we seek to not only understand but also contribute to fostering their independence, strengthening social connections, and ultimately enhancing their overall well-being.

2. Methodology

2.1. Registration information

This systematic review and protocol was not registered.

2.2. Search strategy

The present study was initiated in October 2023 with the aim of answering the question, 'What specific characteristics within the living environment are associated with mental well-being outcomes in older people? A comprehensive search was conducted in three major databases, namely PubMed, Web of Science, and Scopus, as well as the Google Scholar search engine. The search strategy integrated several relevant keywords, including "built environment," "housing quality," "older adults," "Housing condition," "mental health," "stress," "mental wellbeing," and "depression," with no limitations on the publication year of the articles, as detailed on Table 1. The searches were performed between October 2023 and November 2023. Subsequently, the search results were transferred to an information management program, namely Endnote, for further analysis. Moreover, the reference lists of the retrieved articles were manually reviewed to identify any other relevant literature. This rigorous approach was taken to ensure a comprehensive and exhaustive search to identify all pertinent studies related to the research question.

2.3. Inclusion and exclusion criteria

The systematic review aimed to identify studies investigating the relationship between dwelling characteristics and the mental well-being of older people. For inclusion in the review, studies had to meet several inclusion criteria. Firstly, the studies needed to involve human participants who were in the old age period (aged 60 and above, or with a mean age of at least 60). Secondly, this review only included original, peer-reviewed studies that reported the quantitative association between dwelling features and mental health outcomes in older adults. Thirdly, studies that exclusively focused on mental health outcomes (depression, stress, mental well-being, intellectual well-being, and quality of life) were included. Additionally, to ensure a comprehensive examination of dwelling characteristics, examples of such characteristics could include but are not limited to: architectural design, lighting, noise levels, accessibility, and adaptability of the living space. Finally, the review only included studies written in English. These criteria were established to ensure that the studies selected for the review were relevant to the research question and met certain methodological standards.

Any studies categorized as review studies, research letters or commentaries, replication studies, or studies in a language other than English were excluded from our review in accordance with our exclusion criteria.

2.4. Study selection

The selection process for this study adhered to the guidelines set forth by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) [31]. Duplicate studies retrieved from different search databases were omitted from the study. Initially, the articles underwent screening through the assessment of their titles and abstracts to verify compliance with the inclusion criteria. Subsequently, the full text of the articles underwent a review process in accordance with the inclusion and exclusion criteria, with any irrelevant studies being excluded. To ensure the consistency and accuracy of the results, two separate authors (S.Sh, K.B) handled all phases of data analysis and extraction. If there were discrepancies between the researchers, a third reviewer was consulted to resolve them.

2.5. Quality assessment

Our research team used the Newcastle-Ottawa Scale (NOS) to evaluate the quality of all articles included in the analysis [32]. Two reviewers evaluated cross-sectional and longitudinal studies independently following modified NOS items including three domains: selection, comparability, and exposure. A study can be scored a maximum of three points for items in selection, a maximum of two points for items in comparability, and a maximum of two points for outcome items. The total score ranged to seven for the high-quality studies.

Simultaneously, quality appraisal for experimental studies has done by two independent authors using the Consolidated Standards of Reporting Trials (CONSORT) tool [33]. Included papers quality was valued in terms of the random sequence generation, allocation concealment, Blinding, incomplete outcome, and selective outcome reporting (reporting bias).

2.6. Certainty assessment

Two scholars assessed the quality of mental health outcomes using the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) framework [34]. This approach entailed a thorough assessment of various factors, including study design,

Table 1
Database search terms.

	Search terms
Exposure/Risk factor	"built environment" OR "housing quality" OR "Housing condition," OR "built" OR "house" OR "home*" OR "residence*" OR "dwelling*" "interior design*" OR "interior decor*"
Outcome	"mental health" OR "stress" OR "mental wellbeing" OR "depression" OR "psychological well-being" OR "depressive symptoms"
Population	"older adults" OR "older people" OR "aged" OR "elderly" OR "seniors" OR "aging population"

risk of bias, result consistency, evidence directness, and estimate precision. The certainty assessments' results, classified into levels of high, moderate, low, or very low certainty, are detailed in a designated section within this review. These evaluations help convey the level of confidence in the research findings, aiding in the interpretation of evidence and guiding future recommendations.

2.7. Data extraction

For data extraction, two scholars utilized a predefined checklist covering multiple factors, such as the primary author's identity, publication year, study location, sample size, and age group of participants, characteristics of the house under review, assessment tools used to evaluate mental health, along with a summary of the noteworthy findings. Due to the significant heterogeneity among the varying definitions and measures of dwelling characteristics, mental health assessed, and analytical methodologies employed in the selected studies, a meta-analysis was considered inappropriate for drawing substantial conclusions, following the guidelines outlined in Section 9 of the Cochrane handbook. Thus, a narrative synthesis of the findings was undertaken, entailing a systematic and thorough overview of the results from the included studies. The effect size of each study was gathered and organized separately. Subsequently, a visual representation of these effects was created using Stata 17 software, and they were presented in a forest plot.

3. Results

3.1. Characteristics of the studies

Initially, 1182 articles were identified and managed using EndNote software. During the selection stage, 140 articles were excluded due to duplication, leaving a final set of articles for further analysis. Following this, the title and abstract of the remaining articles were assessed against the inclusion and exclusion criteria, leading to the exclusion of 1011 articles from the review. During the phase of comprehensive review, a total of 31 studies were subjected to assessment. From this pool, 10 articles were excluded on account of non-conformance to the predetermined inclusion and exclusion criteria: specifically, 3 articles were omitted due to employment of an inaccurate outcome measure, while 7 articles were eliminated for focusing on an unsuitable population. Following the completion of

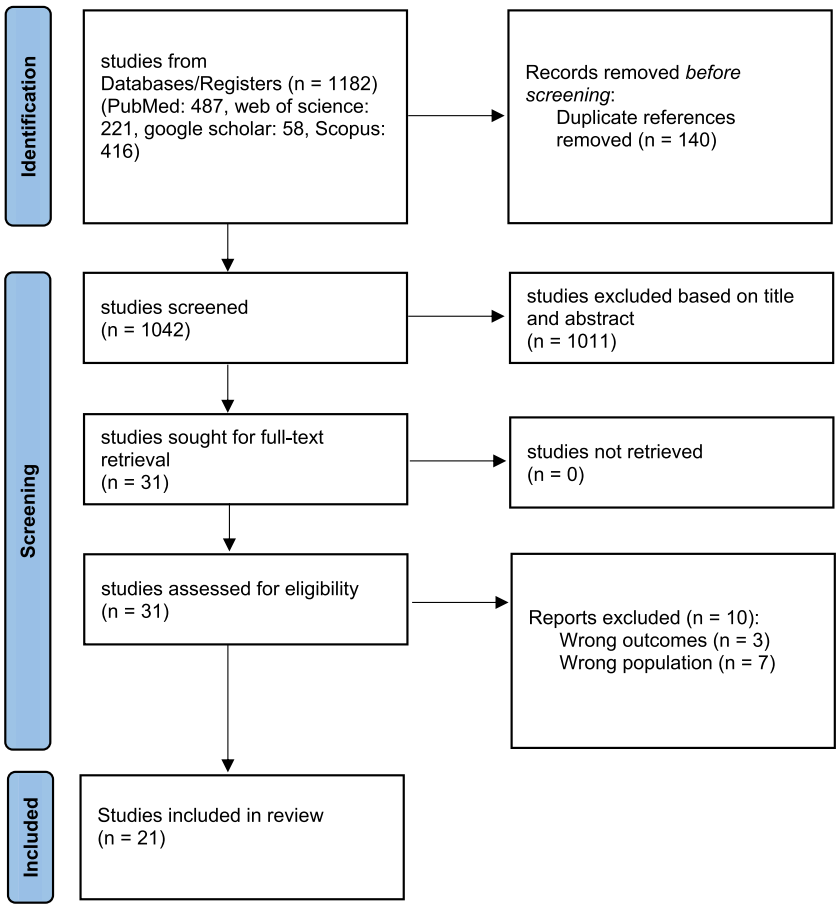

Fig. 1. The flowchart on the stages of including the studies in the systematic review (PRISMA 2020).

the selection process, 21 articles were deemed eligible for the final evaluation stage. The search and selection procedures are outlined in detail in the PRISMA flowchart, depicted in Fig. 1. Additional information regarding these 21 articles is available in Table 2, which includes details such as the primary author's identity, year of publication, study site, sample size, age cohort of participants, examination instruments utilized for assessing the built environment, assessment tools employed for evaluating mental health, as well as a summary of the significant outcomes.

Within the framework of this comprehensive systematic review, a total of 21 studies were meticulously incorporated, encompassing a diverse array of research designs. Notably, the majority of studies—15 in total—adopted a cross-sectional approach. One study employed an experimental methodology. Additionally, four studies followed longitudinal designs, while one adhered to a cohort study approach, contributing longitudinal perspectives to the overall synthesis. Geographically, the included studies exhibited a wide distribution, with three originating from the United States, ten from China, two from Germany, and one each from Korea, Canada, India, the United Kingdom, Brazil, and Taiwan. In terms of outcome measures, the studies incorporated various scales: 9 studies utilized the CES-D (Center for Epidemiologic Studies Depression Scale), 1 employed the PHQ-9 (Patient Health Questionnaire-9), 1 used the GDS (Geriatric Depression Scale), and 2 focused on life satisfaction.

3.2. Quality assessment

The evaluation results of methodological quality appraisal is available in Table 3. The risk of bias of included papers assessed by two authors independently, and the mean of two scorings was considered as the rate of quality when there were disagreements. Among the 21 included studies, 17 were assessed as having high to moderate quality, while the remaining 4 were considered to be of low quality. Overally, most of the selected articles gained high quality scores which determined a low risk of bias.

3.3. Fuel role in mental health of older adults

Four studies in this systematic review reported a significant association between home fuel types and mental health in older adults (Fig. 2). The use of clean fuels for heating and cooking showed a significant association with improved mental health in older adults [35]. Polluting fuels (coal, wood, straw) were consistently linked to mental health problems, especially depression [36–38]. In one study, a significant relationship between fuel and mental health was observed, particularly among older women [37].

3.4. Bath facilities and toilets

Houses with working showers were significantly associated with improved mental health in older people [39]. Additionally, three other studies indicated that the presence of bath facilities is correlated with improved mental health, particularly in relation to depression [37,38]. Concerning home toilets, the absence of seats is associated with an increased likelihood of psychological problems [37,38]. Conversely, the presence of flush toilets is linked to a decreased likelihood of depression [40].

3.5. House quality & mental health

The quality of a house usually refers to the presence or absence of amenities such as bathroom facilities, toilets, cabinets, etc., and support equipment such as handrails and the proper structure of the house. In the study of Liang et al. (2020), it was shown that a high quality of house is associated with a reduced risk of depression [41]. In this regard, Liu et al.'s (2017) study also showed that good quality houses are significantly related to better mental health [8]. Also, three other studies have confirmed the same significant relationship among the quality of house and mental health [42–44]. However, unlike these studies, Kim et al.'s (2021) study showed that there is no significant relationship between the house quality and mental health in older adults [12].

3.6. House height and area

Larger living spaces exceeding 80 square meters showed a significant association with improved mental health in older people [39]. A significant relationship between apartment size and mental health was also noted [45]. Conversely, smaller home environments were associated with an increased risk of depression [46].

Turning to the height of the house, Li et al.'s study in 2020 showed that residing in multi-story houses is significantly related to a lower risk of depression [40]. Additionally, Cheng et al.'s study in 2014 indicated that living in high-rise buildings is associated with an improvement in the mental health of older people [47]. Also, Liang et al.'s (2020) study revealed that living in multi-floor houses was associated with a lower risk of depression in older adults [41].

3.7. Diverse housing features & mental health in older adults

A study has demonstrated a significant association between structural problems at home and indoor noise pollution with depression [19]. Another study found that having a sewer system and more days with electricity is linked to a reduced risk of depression in older adults [48]. Additionally, a study revealed that installing sports equipment and energy-efficient systems at home improves the mental health of older adults [49].

In one study, results indicated that concrete and metal houses are associated with a lower risk of depression [40]. However, another

Table 2
Summary of characteristics of included studies.

Study	Participants	Design	Features/modification of house	Mental health Outcome Measures	Results
Breysse et al., 2015 [49], Usa	N = 22 Median age: 72 years	Quasi-experimental study	Intervention: Green renovation, including improving the building envelope, installing new energy-efficient systems and appliances, abating asbestos and mold, and enhancing exercise facilities.	the Veterans RAND 12-Item Health Survey (VR-12)	In the all-ages study group, there was a significant improvement in mental health compared to the comparison group. This is evident from both the mean number of good mental health days in the past month ($p = 0.026$) and the mean VR-12 mental component score ($p = 0.023$).
Chen et al., 2023 [35], china	N = 7959 Aged 50 years and older	Cross sectional study	Household clean fuel combustion for heating and cooking	The Center for Epidemiological Studies Depression Brief Scale (CES-D)	Household clean fuel combustion (HCFC) is associated with favorable outcomes for the health of older adults, particularly contributing to the enhancement of their psychological well-being.
Liu et al. 2020 [36], china	N = 9107 Mean age = 62.59 (SD 9.32)	Cross sectional study	Cooking fuel categorized as clean (liquefied gas, natural gas, and electricity) and solid (coal, biomass charcoal, wood, and straw).	Depressive symptoms measured using the 10-item Center for Epidemiologic Studies Depression (CES-D) scale.	Current solid fuel users had a higher CES-D score of 0.59 (95 % confidence interval [CI]: 0.31, 0.89) than clean fuel users.
Chen et al., 2021 [39], china	N = 938 Aged ≥60 years	Cross sectional study	Housing environment assessed using a self-assessment instrument	15-item Geriatric Depression Scale (GDS)	Participants who reported having a residence with sufficient sunlight exposure, adequate ventilation, living areas greater than 80 m^2, and a functional shower exhibited a significantly lower prevalence of high depressive symptoms compared to others.
Fang et al., 2019 [37], china	n = 4585 age ≥60	Survey design	Physical Environment (housing materials, cooking fuel, housing facility)	10-item Center for Epidemiologic Studies Depression Scale (CES-D)	Toilets without seats and lack of bathing facilities were linked to depression in men, while the use of polluting fuels was linked to depression in women.
Fang et al., 2019 [38], china	n = 4585 age ≥60	Cross sectional study	Physical Environment (housing materials, Cooking fuel, housing facility)	10-item Center for Epidemiologic Studies Depression Scale (CES-D)	polluting cooking fuel, toilet without seat, and no bathing facility were associated with higher depressive symptoms
Firdaus, 2017 [19], india	N = 1896 Age 60 years or above	Cross sectional study	Built environment (Household factors, neighborhood quality)	Rand Mental Health Inventory Survey Instrument.	Overcrowding, structural problems in the house, and exposure to indoor noise pollution were linked to depression.
Wang et al. 2018 [48], china	N = 6,548 Mean age = 68.50. 49.65 % were women	Longitudinal Study	Housing measured by the presence of a sewer system (1 = yes), waste management (1 = yes), indoor toilets (1 = yes), and the number of days with electricity (0–366 days).	Depressive symptoms measured by a 10-item short form of the Center for Epidemiologic Studies Depression scale (CES-D 10).	Having a sewer system ($b = -0.64$, $SE = 0.28$) and more days with electricity ($b = -0.01$, $SE = 0.004$) decreased older adults' depressive symptom scores.
Kim et al., 2021 [12], South Korea	N = 2,077 age 60 and older	Survey design	- Quality of housing environment (house structure and materials, sound insulation, ventilation, lighting, and heating, noise, odors, and air pollution), home accessibility	Depressive symptomatology, stress, Suicidal ideation	Accessible and useable houses are important for health and well-being, but the quality of the housing environment was not significantly related to health outcomes.
Li and Zhou, 2020 [40], china	N = 9143 age 45 and older	Longitudinal Study	External building characteristics, indoor space layout, household facilities, internal building environment	10-item short form of the Center for Epidemiologic Studies Depression scale (CES-D10)	Concrete and steel buildings were associated with lower depressive symptoms. Living in multi-story buildings was linked to a lower depression risk, while compound buildings were associated with

(*continued on next page*)

Table 2 (*continued*)

Study	Participants	Design	Features/modification of house	Mental health Outcome Measures	Results
					a higher depression risk. Private balconies, heating and bathing facilities, and flushable toilets were also linked to a lower depression risk.
Liang, 2020 [41], china	N = 5982 mean age: 66.9	Longitudinal Study	Housing characteristics: Housing ownership, Housing space, Housing floor type, Construction materials, Housing quality	10-item Center for Epidemiological Studies Depression Scale (CES-D)	Stable residence in high-quality, multi-floor houses is linked to lower depression risk, but living space is not linked to psychological well-being. The construction material of the house was not linked to depression.
Liu et al., 2017 [8], china	N = 1035 age 60 and older	Survey design	Housing quality measured by high-rise and mid-rise residential buildings in Shanghai, known for better housing facilities, sanitation, and neighborhood amenities compared to low-rise traditional and rural houses.	Mental health assessed in terms of cognition, interpersonal activities, sleep and energy, affect, and depression.	Good housing quality was significantly linked to better mental health ($\beta = 0.770$, $p < 0.001$).
Qiu et al., 2020 [70], china	N = 5090 aged 60 years or more	Cross sectional study	living in a cottage or an apartment, The gross area of the house	Depression assessed using the Patient Health Questionnaire (PHQ-9)	Residing in a cottage was linked to a lower risk of depression, while a smaller home area was associated with a higher risk of depression. A majority of individuals experiencing depression in terms of living space per person had an area of 30 square meters or less.
Gan et al. 2022 [44], Canada	N = 14301 Mean age = 74.5 (SD 6.6)	Longitudinal Study	Housing quality measured with two items — the first assessing problems with electrical wiring, plumbing, heating, condensation, leaking, maintenance, infestations, and noise. The second item gauges satisfaction with current housing on a 4-point Likert scale.	Depressive symptoms assessed using nine items from the short form of the Center for Epidemiologic Studies—Depression scale.	A significant relationship was observed between housing quality and depressive symptoms.
Sarkar et al. 2013 [50], Uk	N = 687 older men Mean age = 73.5 years (SD = 4.3)	Cross sectional study	13 measures of built environment morphological metrics under three categories: dwelling level, land use, and street-network accessibility variables.	Psychological distress measured using the 30-item General Health Questionnaire (GHQ-30).	Living in a terraced dwelling (OR = 0.48, p = 0.03) and having higher land-use mix (OR = 0.42, p = 0.03 for high tertile) were linked to reduced psychological distress.
Brown et al. 2009 [51], Usa	N = 273 mean age = 78.5 years (*SD* = 6.3)	Cross sectional study	Built environment measured using the University of Miami Built Environment Coding System (Above grade, Stoop, Porch, Ground floor parking, Window area, Low sill height windows, Setback).	Psychological distress measured by self-reported anxiety and depressive symptoms (Spanish version of the Center for Epidemiological Studies–Depression scale).	Perceived social support mediated the relationship between built environment variables and psychological distress.
Cheng et al. 2014 [47], Taiwan	N = 250 Mean age = 75.35 (SD 8.65)	Prospective cohort study	High-rise residence (from the fourth to the eighth floor) vs. ground-level housing	World Health Organization Quality of Life (WHOQOL-BREF)	Moving to a high-rise apartment improved psychological well-being compared to those who remained in ground-level housing.
Evans et al. 2002 [42], Usa	N = 497 Mean age = 72.5 32 % were women	Cross sectional study	Housing quality: infrastructure (e.g., home in good repair), amenities (e.g., presence of custom cabinets), support for mobility	Psychological well-being (Standardized instrument assessing positive affect in healthy, elderly adults)	Housing quality was significantly related to positive affect, with a partial b = 0.32, t (489) = 3.65, $p < 0.001$.

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Table 2 (*continued*)

Study	Participants	Design	Features/modification of house	Mental health Outcome Measures	Results
			impairment (e.g., handrails in the main hallway), and spatial requirements (e.g., kitchen space adequate for meal preparation).		
Oswald et al. 2003 [43], Germany	N = 412 Mean age = 65.3 (SD 5.5)	Cross sectional study	Housing amenities (13 features, e.g., inside toilet, central heating, phone, barrier-free apartment, garage, balcony, etc.)	Subjective well-being measured by a 4-item subscale (General Life Satisfaction) of the Philadelphia Geriatric Center Morale Scale.	Housing amenities played a crucial role in predicting life satisfaction, particularly in the east area.
Oswald et al. 2011 [45], Germany	N = 381 Mean age = 77.3 (SD 7.8)	Cross sectional study	Indoor Housing (Number of available rooms at home and apartment size in square meters)	Life Satisfaction assessed using an 11-point Likert-type single-item self-evaluation rating scale from 0 (totally unsatisfied) to 10 (totally satisfied)	Apartment size was positively related to life satisfaction in the young–old but negatively related in the old–old.
Blay et al. 2015 [71], Brazil	N = 6,963 Aged 60 and above, 66.0 % were women	Cross sectional study	House environment: Presence of an indoor shower or toilet (yes/no), indoor electric supply with meter (yes/no), proper sleeping arrangements (alone or with spouse/with children, grandchildren, or other people), and type of physical residence (house-apartment/room-slum).	Depression measured with the Brazilian version of the Short Psychiatric Evaluation Schedule.	The study found a significant association between a high Built Environment Index (BEI) and depression [OR 1.35 (95 % CI: 1.08–1.69, P = 0.01)].

study suggested that the construction materials of the house do not have a significant relationship with depression [41].

In a study conducted in UK, living in terrace houses was associated with reduced depression [50]. Concurrently, another study in China found that living in homes with private balconies is linked to decreased depression in older adults [40]. Also, in a study, it was found that living in a cottage is associated with a lower risk of depression [46].

3.8. Moderators and mediators in the relationship between dwelling features and mental well-being

In Gan et al.'s study (2022), it was revealed that the impact of quality of house on depression is significantly mediated by social support [44]. Brown et al. (2009) found that social support mediates the relationship between residing on the ground floor and mental health [51]. Evans et al.'s study (2002) demonstrated that place attachment serves as a complete mediator of the relationship between house quality and mental health [42].

Liu et al.'s study in 2020 indicated that the connection between solid fuels and mental health is more pronounced in individuals with chronic diseases, women, and those with lower literacy levels [36]. Similarly, Liang et al., 's 2020 study showed that the mental health benefits of high-quality homes for older adults are more prominent among individuals with less education in rural areas [41]. Conversely, Chen et al.'s study in 2023 demonstrated that the relationship between clean fuel consumption and mental health is stronger in elderly individuals under 75 years old, particularly those with chronic diseases and higher education levels [35].

3.9. Certainty assessment

Due to the limited availability of studies exploring various characteristics of housing in relation to the mental health of older adults, the certainty assessment was specifically conducted for the features of fuel, toilet, bathroom facilities, house quality, height of the house, and area of the house. The detailed results of this assessment can be found in Table 4. In terms of consistency, results demonstrated uniformity across the majority of studies. The directness of the findings was generally apparent. Precision was evident, as reflected in the small confidence interval of the effect size, suggesting a higher level of certainty. However, with respect to publication bias, while the majority of studies reported consistent findings, there were a few studies with divergent results, indicating a possible publication bias. In summary, a moderate level of certainty was assigned to the examined results.

4. Discussion

This systematic study aimed to determine the relationship between dwelling characteristics and mental well-being in older people. Previous reviews have primarily focused on the surroundings and environment of the house concerning mental health, such as the presence of parks, green spaces, or religious and cultural places nearby [29,30]. However, this systematic review emphasizes various house and interior features positively associated with promoting mental health in older people. One notable feature identified in this study, corroborated by multiple sources, is the type of fuel used at home. Using clean fuels for heating and cooking has been linked to

Table 3
Quality and risk of bias assessment.

Study (cross – sectional)	Selection			Comparability	Outcome		Total score (7)
	Representativeness of the exposed sample	Selection of the non-exposed sample	Ascertainment of exposure	Comparability of outcome groups on the basis of design or analysis	Assessment of outcome	Statistical test is appropriate	
Chen et al., 2021 [39], china	*	*	*	**	*		6
Chen et al., 2023 [35], china	*	*	*	*	*	*	6
Liu et al. 2020 [36], china	*	*	*	**	*	*	7
Fang et al., 2019 [38], china	*	*	*	*	*	*	6
Fang et al. 2019 [37], china	*	*		*	*	*	5
Firdaus, 2017 [19], india	*	*	*	*	*	*	6
Qiu et al., 2020 [70], china	*	*	*	**	*	*	7
Kim et al., 2021 [12], South Korea	*	*			*	*	4
Liu et al., 2017 [8], china	*	*	*	*	*	*	6
Sarkar et al., 2013 [50], Uk	*	*		**	*	*	6
Brown et al. 2009 [51], Usa	*		*	*	*	*	5
Evans et al. 2002 [42], Usa	*			*	*	*	4
Oswald et al. 2003 [43], Germany	*	*		*	*	*	5
Oswald et al. 2011 [45], Germany	*	*	*	**	*	*	7
Blay et al. 2015 [71], Brazil	*		*	*	*	*	5

Study (Longitudinal)	Selection Representativeness of the sample	Description of missing data patterns	Comparability control of stability and covariates	Outcome Assessment of outcome	follow-up Time	Attrition rate	Total Score (7)
Li and Zhou, 2020 [40], china	*	*	*	*	*		5
Wang et al. 2018 [48], china	*	*	**	*	*		6
Gan et al. 2022 [44], canada	*		**	*	*	*	6

(*continued on next page*)

Table 3 (*continued*)

Study (cross – sectional)	Selection			Comparability	Outcome		Total score (7)
	Representativeness of the exposed sample	Selection of the non-exposed sample	Ascertainment of exposure	Comparability of outcome groups on the basis of design or analysis	Assessment of outcome	Statistical test is appropriate	
Cheng et al. 2014 [47], Taiwan	*		*	*		*	4
Liang, 2020 [41], china	*	*	*	*	*	*	6
CONSORT	Random Sequence Generation	Allocation Concealment	Blinding	Incomplete Outcome	Selective Reporting	Total Quality	
Breysse et al., 2015 [49], Usa	No	Unclear	No	Yes	No	Low	

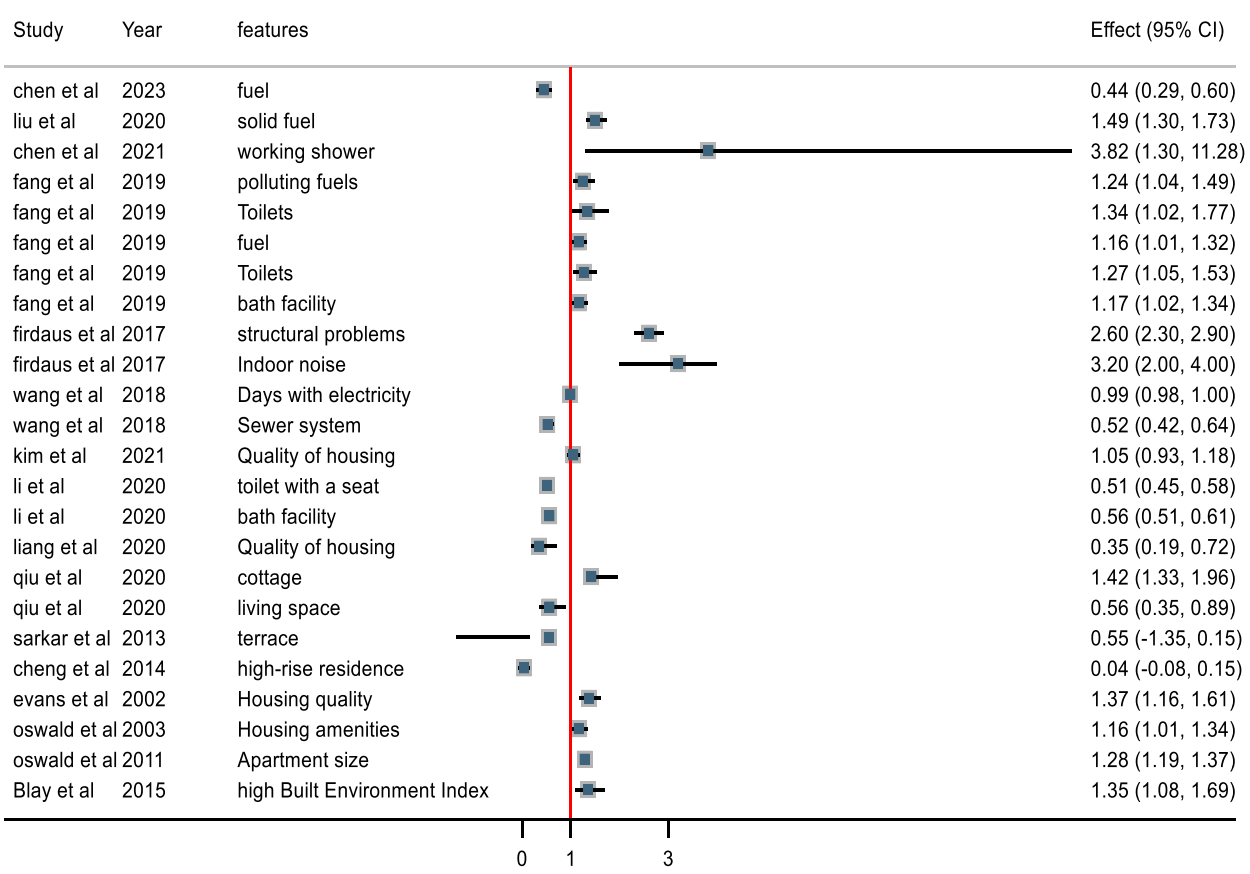

Fig. 2. Dwelling features and mental well-being in older adults. The horizontal navy lines depict the 95 % confidence intervals for these estimates, while the vertical solid red line symbolizes the null effect. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

better mental health outcomes in older adults. The improved indoor air quality associated with using clean fuels, such as natural gas or electricity instead of coal and wood, reduces exposure to harmful pollutants [52]. Older individuals with chronic diseases often have compromised respiratory function, making them more susceptible to the adverse effects of indoor air pollution. This cleaner indoor air can also positively impact respiratory health, subsequently influencing overall mental well-being [53]. Furthermore, it was observed that this relationship is stronger in older persons with chronic diseases, as well as in women, since women traditionally spend more time in household activities and may experience greater exposure to indoor pollutants.

Another feature found to be related to the mental health of older people is the availability and type of bathroom facilities, including the toilet. Research indicates that toilets equipped with seats and flushes are associated with better mental health, along with functional bath facilities such as a working shower. The mechanism underlying this relationship may be linked to the promotion of personal hygiene, positively influencing self-esteem and social interactions [54]. Adhering to good personal hygiene practices can prevent unpleasant odors and infections, leading to improved physical health outcomes [55]. Moreover, the presence of clean and functional toilets can help prevent common issues in older people, such as constipation and urinary incontinence [56]. The negative impact of these issues on mental health should not be underestimated, as studies have shown that urinary incontinence, for instance, can lead to social isolation, depression, and anxiety [57]. Therefore, by providing appropriate bathing facilities and toilets, older people can maintain good personal hygiene practices, prevent the occurrence of unpleasant physical symptoms, and contribute to better mental health outcomes.

One other feature related to the mental health of older adults is the size of the house. In three studies assessing house area and mental health, all consistently indicate that a larger house area is associated with better mental health scores, while a smaller area is correlated with lower mental health scores. One possible reason for this relationship is that spacious living environments provide increased opportunities for physical activity, fostering overall well-being and cognitive function [58]. Additionally, ample space allows for better organization and reduced clutter, promoting a sense of order and control, which can positively influence mental health [59].

The number of house floors and height has also been found to be associated with mental health outcomes in older adults [60]. Contrary to what was previously thought, living in tall and multi-story buildings is related to better mental health in older adults. This positive association may be attributed to the modern amenities incorporated into tall buildings. Today, such structures are equipped

Table 4
Certainty assessment.

Outcome	Features	No. of studies	Study Design	Risk Of Bias	Inconsistency	Indirectness	Imprecision	Other Considerations	Overall Certainty of evidence
Mental health	Fuel	4	Observational studies	Not serious	Not serious	Not serious	Not serious	Possible publication bias	Moderate (⊕⊕⊕○)
	Bath Facilities	4	Observational studies	Not serious	Not serious	Not serious	Not serious	Possible publication bias	Moderate (⊕⊕⊕○)
	Toilets	3	Observational studies	Not serious	Not serious	Not serious	Not serious	Possible publication bias	Moderate (⊕⊕⊕○)
	House Quality	6	Observational studies	Moderate Risk of Bias	Not serious	Not serious	Not serious	No publication bias	Moderate (⊕⊕⊕○)
	House Height	3	Observational studies	Not serious	Not serious	Not serious	Not serious	Possible publication bias	Moderate (⊕⊕⊕○)
	House area	3	Observational studies	Not serious	Not serious	Not serious	Not serious	Possible publication bias	Moderate (⊕⊕⊕○)

with elevators and various similar devices, mitigating the physical challenges associated with navigating multiple floors [47]. Improved accessibility, coupled with the potential benefits of elevated living, may contribute to the observed positive impact on mental health in older individuals residing in taller buildings.

Regarding house quality, it has been demonstrated that better house quality is associated with better mental health in older people. House quality encompasses supportive equipment and the absence of structural problems. One mediator that has been shown to influence the relationship between house quality and mental health outcomes is social support. This suggests that not only the physical aspects of a home but also the presence of a supportive social network can be pivotal in enhancing positive mental health outcomes among older adults. Additionally, the sense of community and companionship associated with robust social support may contribute significantly to the overall well-being of individuals residing in high-quality housing [61]. Another mediator that has been found is place attachment, emphasizing the emotional connection and sense of belonging individuals feel toward their homes, which may further contribute to the positive impact of house quality on mental health.

These results can be further enriched by considering the broader context of the older adults' living environment. Communication and social interaction within the household are crucial for maintaining mental health, suggesting that homes designed to facilitate such interactions could enhance mental well-being. Physical activities, whether facilitated by indoor spaces conducive to movement or access to gardens for activities like gardening, play a significant role in mental health [62,63]. Similarly, Faraziani and Eken (2024) found that exercise-based health management systems can enhance cognitive abilities and delay cognitive decline in the elderly [64]. These findings underscore the need for dwelling designs that facilitate physical activity, such as adequate space for exercise and easy access to outdoor areas. Moreover, the synchronization of mind and body is vital for well-being, as discussed by Navabinejad and Rostami (2023), who explored the field of psychophysiology in sports [65]. Additionally, dietary habits, influenced by the kitchen environment and accessibility to healthy food, are essential factors. Engaging in activities requiring mobility outside the home, such as marketing and banking, contributes to a sense of independence and well-being. The integration of these aspects into dwelling designs could lead to more holistic approaches in creating age-friendly living environments that support both the mental and physical health of older adults [66].

Also, Therapeutic interventions such as mind-body therapy have been shown to be effective in managing depression among older adults [67]. This highlights the importance of incorporating therapeutic spaces within homes that facilitate such activities. Additionally, income, inappropriate medication, and other stress factors significantly influence mental health [68,69]. Homes designed to reduce stress, such as those with quiet and private spaces, can mitigate the adverse effects of financial and social stressors.

This systematic review highlights several features of the house and interior that have been found to have a positive association with promoting mental health in older adults. Nevertheless, conflicting findings have been reported regarding the relationship between construction materials of the house and the mental health of older adults [40,41]. In light of these findings, future research endeavors should prioritize addressing the existing gaps and discrepancies, conducting more rigorous investigations to provide a clearer understanding of the intricate relationship between construction materials and the mental health of older adults.

While the studies included in this systematic review provide valuable insights into the connection between housing and mental health outcomes in older adults, it is important to acknowledge certain limitations that may impact the generalizability and robustness of the findings. Firstly, the diversity in study designs, ranging from quasi-experimental and longitudinal studies to cross-sectional surveys, poses challenges in establishing causal relationships. The variation in research methodologies makes it difficult to draw definitive conclusions about the causal impact of housing features on mental health, and future research employing more standardized and rigorous intervention study designs is warranted.

Another significant constraint observed in the studies within this systematic review is the overrepresentation of research conducted in China compared to other geographical regions. A substantial portion of the included studies originates from China, potentially introducing a geographic bias that may limit the generalizability of findings to a global context. This prevalence of Chinese studies may reflect specific cultural, economic, or environmental factors unique to China, making it challenging to extrapolate the observed associations between housing and mental health outcomes to populations in different parts of the world. To enhance the external validity of the systematic review's findings, future research should strive for greater geographical diversity in study samples to capture a more comprehensive understanding of the relationship between housing and mental health outcomes across various cultural and environmental contexts.

4.1. Strengths and limitations of the review

This systematic review exhibits several strengths that enhance the robustness of its findings. Notably, the included studies underwent a rigorous quality assessment, and a majority demonstrated a low risk of bias, thereby contributing to the overall reliability of the synthesized evidence. The meticulous evaluation of each study's methodological quality ensures that the results are based on high-quality research, enhancing the internal validity of the systematic review. Furthermore, the review employed a certainty assessment approach, systematically evaluating the quality of evidence across studies. This process provides a transparent framework for appraising the confidence in the observed associations between housing features and mental health outcomes in older adults.

While the systematic review demonstrates strengths, several limitations should be acknowledged. The heterogeneity in study designs and variability in outcome measures precluded a meta-analysis, limiting the ability to provide statistical descriptors like an estimated pooled effect. Additionally, the inclusion criteria for this review were restricted to studies published in the English language. This language restriction may have introduced language bias, potentially excluding relevant research published in other languages. Such exclusion could limit the comprehensiveness of our findings and might overlook significant studies conducted in non-English-speaking regions.

5. Conclusion

In conclusion, this systematic review underscores the significance of various housing characteristics in promoting mental health among older adults. The findings suggest that the use of clean fuel, the presence of bath facilities, toilets with flushable and seated features, high-rise and multi-floor housing, and larger living areas are all significant factors contributing to the mental well-being of older adults. Understanding the impact of these environmental factors on mental health can inform the design of homes and communities that better support the needs of the older adult population. Moreover, this review highlights the imperative for additional research to examine the correlation between construction materials and the mental health of older individuals. Overall, Public health policies should prioritize creating age-friendly living environments that incorporate features such as clean fuel usage, accessible and functional bathing facilities, and spaces that promote physical and social activities. Urban planning should consider the specific needs of older adults, such as designing safe and accessible housing and ensuring proximity to essential services. By integrating these considerations, policymakers and urban planners can better support the mental well-being of the elderly population.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Data availability statement

No data was used for the research described in the article.

Consent for publication

Not applicable.

CRediT authorship contribution statement

Sina Sharifi: Writing – review & editing, Writing – original draft, Visualization, Software, Methodology, Investigation, Data curation, Conceptualization. **Hadis Mosafer:** Writing – review & editing, Writing – original draft, Methodology, Investigation. **Mahmoud Rahmati:** Writing – original draft, Visualization, Methodology. **Kimia Babaei Khorzoughi:** Writing – original draft, Methodology, Investigation. **Akram Parandeh:** Writing – review & editing, Methodology.

Declaration of competing interest

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

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