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Effects of urban renewal on the mental health of older adults: evidence from China

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Objectives: This study aims to evaluate the impact of urban renewal on the mental health of older adults in China.
Methods: Based on the micro-data from the 2016, 2018, and 2020 waves of the China Longitudinal Aging Social Survey (CLASS) and the macro-data at the city level, nine indicators at the household, community, and city levels were selected and integrated through principal component analysis to reflect urban renewal. Then the study explored the impact of urban renewal on the mental health of older adults in China using the fixed-effects model.
Results: The findings revealed that urban renewal has a positive impact on the mental health of older adults at the 1% significance level. The conclusion was still valid after the instrumental variable regression method (IV) and the propensity score matching method (PSM) were used for robustness analysis. The social adaptability and life satisfaction of older adults played a significant mediating role. The heterogeneity analysis showed that older adults aged 60–69 and 80 years or older, as well as rural residents, benefit more from urban renewal.
Conclusion: This study highlights that urban renewal should be further intensified to increase the renewal of various facilities and services at the household, community, and city levels, thereby expanding the benefits of urban renewal on the mental health of older adults.

KEYWORDS
active aging, health access, mental health, older adults, urban renewal

Introduction

The 21st century has witnessed unprecedented global efforts to enhance population health and quality of life. Achieving optimal health outcomes remains a paramount societal goal worldwide. However, rapid population aging poses significant challenges to this aspiration. Driven by advances in healthcare, rising living standards, and declining fertility rates, the global population has aged at an accelerating pace [1]. According to the United Nations' World Population Prospects 2024, the global population aged 60 years and above reached 606 million in 2024 and is projected to reach 2 billion by 2050 [2]. With advancing age, older adults experience substantial changes in physiological, psychological, and cognitive functioning, rendering health maintenance an increasingly pressing concern in aging societies. The World Health Organization defines health in its Constitution as a state of complete physical, mental, and social well-being—not merely the absence of disease or infirmity [3].

With socioeconomic development, the psychological wellbeing of older adults has gained increasing policy attention [4]. China has prioritized mental health and aged care

services as core components of its active aging strategy. Nevertheless, late-life mental health remains a significant public health concern, with affective disorders exhibiting high prevalence. Recent evidence suggests that depressive symptoms remain prevalent among older adults in China. A meta-analysis of 23 studies involving 75,599 participants estimated the overall detection rate of depression among Chinese older adults at 20.6%. The analysis also identified several associated factors, including advanced age, female gender, lower educational attainment, and rural residence [5]. Collectively, mental disorders constitute a leading contributor to disease burden among older adults [6].

Older adults' mental health is shaped by multiple determinants. Grounded in ecological systems theory, which posits that individuals are inextricably embedded within their surrounding environments [7], the urban community represents a key spatial unit for active aging interventions [8, 9]. In this context, urban renewal-defined as the physical regeneration of central city land, improvement of living environments, and reconstruction of urban communities to enhance livability and economic vitality [10–12], has emerged as a critical environmental determinant. In 2021 alone, China initiated the renovation of approximately 56,000 old urban residential communities, benefiting nearly 10 million households [13]. Recently, this policy has shifted from purely physical infrastructure upgrading toward integrated strategies that combine built environment improvements with the expansion of community-based social and aged-care services [14–17], suggesting that contemporary urban renewal may function as a multidimensional environmental intervention with potential mental health benefits for older adults.

Despite the scale of these investments, empirical evidence linking urban renewal to late-life mental health outcomes remains limited. Existing literature has largely examined urban renewal through the lenses of housing stock renewal, land economics, or built environment aesthetics [18, 19], while its implications for population mental health have received insufficient attention. Moreover, few studies have combined individual-level health data with multidimensional indicators of urban renewal across household, community, and city levels to examine this relationship with older adults' mental health. To address this gap, the study draws on the China Longitudinal Aging Social Survey (CLASS) and macro-data to empirically examine the relationship between urban renewal and mental health among older adults in China. By elucidating how environmental regeneration intersects with psychological wellbeing in later life, this research aims to inform evidence-based urban renewal policy and to advance active aging practice in rapidly urbanizing societies.

Literature review

Under the impact of global aging, research on the mental health of older adults has begun to accelerate. Scholars explore the factors affecting the mental health of older adults from the perspectives of different disciplines, such as medicine, sociology, economics, and management. Studies have pointed out that demographic characteristics such as gender, age, marital status, and religious beliefs are closely related to the mental health of older adults [17]; lifestyle factors such as Internet use, nutrition, exercise, and daily habits also have an impact on the mental health of the older adults [18, 19]; inter-generational support, family relationships, social culture, social security, interpersonal relationships, social support, and social participation as important external factors affect the mental health of the older adults [20, 21].

In recent years, scholars have begun to pay attention to the impact of the redevelopment environment on the mental health of older adults. Existing studies have increasingly examined the relationship between the built environment and older adults' physical and mental health [22]. Many studies take the relationship between environmental factors and the physical or mental health of older adults as the research content, believing that the built environment has a predictive effect on their physical and mental health [23, 24]. However, research conclusions on the impact of the built or redeveloped environment on the health of older adults have not reached a consensus. Some studies have reported positive associations. They point out that the infrastructure and services related to the living patterns of older adults in the community are an important direction in the construction of age-friendly communities and will have an important impact on the mental health of older adults [25, 26]. Improvements in community infrastructure and public services may facilitate social interaction and strengthen perceived social support, thereby contributing to residents' wellbeing [27]. Other scholars approve of the non-beneficial conclusions. They suggest that redevelopment may also disrupt the original social environment and reduce residents' wellbeing, such as separation from friends and neighbors, discomfort with unfamiliar residents, interference with social networks, disruption of the original pace of life, and concerns about social security, which may have a negative impact on residents' health and wellbeing [28]. In some contexts, redevelopment may disrupt established community networks and weaken place attachment, potentially undermining residents' wellbeing. Moreover, existing studies have confirmed that social adaptability plays an intermediary role in the path through which the environment affects health [19, 29].

As a strategic change in the urban physical environment and social environment, urban renewal has accelerated in recent years. Urban renewal refers to a long-term process of transforming the built environment, local economy, social services, and living conditions of an area through public and private interventions [30]. In the 21st century, the connotation of urban renewal is closely linked to the Age-Friendly Cities and Communities (AFCC) Initiative proposed by WHO [31], which emphasizes the need for society to have inclusive and accessible environments to improve mental health and social participation of older adults. Currently, the literature on urban overall planning and construction, community street reconstruction, and redevelopment of old urban areas is relatively rich. Scholars have made a descriptive summary of the current situation, problems, causes, and countermeasures of urban renewal. [32, 33]. Also, scholars from various countries try to deduce the top-level design of urban renewal from the perspective of the wellbeing of the target object and establish a multi-level and multi-indicator urban renewal framework. Through repeated experiments and evaluations, the Go Well project in the United Kingdom has formed a framework for implementing and measuring urban renewal that covers the

wellbeing of individuals, households, communities, and cities at multiple scales [34]. This framework for guiding urban renewal based on wellbeing and health has provided a basis for subsequent urban renewal.

The ecological systems theory provides an overall explanatory framework for studying human behavior, health, and wellbeing, explicitly focusing on the interaction between the environment and people. Bronfenbrenner's ecological systems theory emphasizes that individual development and wellbeing are shaped by interactions between individuals and multiple layers of their surrounding environments, ranging from immediate settings to broader social and institutional contexts [7]. Moreover, the system itself can be divided into three types of hierarchical systems, namely, the microsystem, mesosystem, and macrosystem, according to the scope of influence. The systems interact with each other, and the communication and exchange of elements such as matter and information occur at all times, jointly having a profound impact on the basic individuals in the system. In the context of healthy aging, as an ecological system that significantly affects the changes in the external living environment of older adults, urban renewal can also be analyzed from different levels based on the ecological systems theory.

Guided by ecological systems theory, this study operationalizes urban renewal across three analytical levels: household, community, and city, corresponding to the three levels of the microsystem, mesosystem, and macrosystem, respectively. As a microsystem of urban renewal, household living conditions are the most important aspect of daily life for older adults, which directly affects their mental health. Some studies have suggested that improving living conditions can significantly reduce depression among older adults [35]. Some studies have also found that living conditions have only an indirect effect on the mental health of older adults [36]. As a meso-system in urban renewal, the community is also an important field for older adults, and they are highly sensitive to the physical environment, such as space and buildings, social support, and healthcare services in the community [37]. The addition of community amenities is also an important aspect of urban renewal at the meso level. Whether the community is equipped with daily care facilities, leisure and recreational facilities, and fitness activities venues is the focus of this study. In addition, as a macro system, the improvement of the overall environment at the city level has become a top priority of urban renewal. The health benefits brought by urban renewal and construction have become a hot spot of attention in recent years for multiple disciplines such as geography, urban planning, and public health. Studies on the impact of urban renewal and construction on the physical and mental health of older adults have pointed out that the implementation of smart city pilot policy has improved the health of older adults and reduced the risk of chronic diseases and depression [38]. Some studies have found that the built-up environment of the city has an impact on the physical activity of older adults due to the low participation rate of older adults in physical activity, but the effect on their mental health is not obvious [39]. However, other studies have found that the blue-green space environment in urban renewal is not related to the mental health of older adults [40].

Although previous studies have examined the relationship between environmental characteristics and older adults' mental health, relatively little attention has been paid to a multidimensional assessment of urban renewal spanning household, community, and city levels. Most of the existing research on urban renewal has focused on the concepts, processes, and current situation of urban renewal. Although a small part of the literature has begun to pay attention to the impact of urban renewal on people's wellbeing, the conclusions of the studies are not yet consistent and do not target older adults as a group. Based on this, from the perspective of the ecological systems theory, this study focuses on the impact of urban renewal on the mental health of older adults, utilizing macro and micro panel data to measure the level of urban renewal, and empirically examining whether and how urban renewal affects the mental health of older adults. The theoretical analysis framework is shown in Figure 1.

The contributions of this study are as follows. First, this study develops a multidimensional measure of urban renewal by combining three waves of individual-level survey data with contextual indicators at the household, community, and city levels. Second, this study examines the relationship between urban renewal and older adults' mental health using a nine-item CES-D measure and explores potential pathways through social adaptability and life satisfaction.Third, this study provides individual-level empirical evidence on the relationship between urban renewal and older adults' mental health, thereby enriching the literature on urban renewal, deepening the comprehensive understanding of its role, and offering a useful reference for better promoting urban renewal.

Theory hypotheses

Based on ecological systems theory, this paper examines the impact of urban renewal on the mental health of older adults at the household, community, and city levels. The current urban renewal is mainly reflected in the following three aspects. Firstly, prior research suggests that the aging adaptation of residential buildings is the foundation of urban renewal [41]. Renovating the bathroom and kitchen, such as installing toilet seats and improving indoor lighting, will enhance the convenience of older adults' lives. Installing elevators, handrails, and other renovations in old residential areas is beneficial for ensuring the safety of older adults [42]. From an ADL perspective, age-friendly improvements to bathrooms, toilets, and indoor accessibility may reduce difficulties in performing daily activities among older adults. It reflects whether the older adults have the basic self-care abilities such as eating, dressing, washing, bathing, using the toilet, and dressing, as well as the functional mobility abilities such as transferring from bed to chair, walking, and going up and down stairs. Therefore, they can be used as three micro-system elements to measure urban renewal at the household level. Secondly, updating community activity facilities and community service projects is an important component for urban renewal [26]. Adding community activity rooms and outdoor activity venues for aging-friendly renovation can help meet the diverse needs of older adults, alleviate their depression and inconvenience in daily life, and promote their mental health. As urban renewal projects covering the aspects of food, clothing, housing, daily use and transportation for the older adults, old-age dining table and daycare stations, old-age activities room and libraries, fitness place or facility and outdoor event venues can be used as the meso-system elements to measure urban renewal at the community level. Thirdly, upgrading the overall livability brand and technological

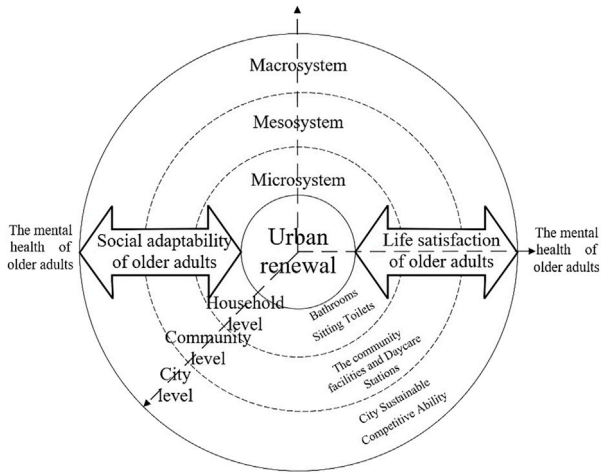


FIGURE 1
Ecological systems analysis framework for urban renewal (China Longitudinal Aging Social Survey, China, 2016, 2018, 2020).

promotion of cities is a key link in urban renewal. Urban renewal takes the creation of an age-friendly society as an important goal [38]. Starting from the actual needs of different groups, urban renewal not only includes the micro aging adaptation transformation of the home environment, old residential areas, and outdoor activity venues but also promotes the improvement of the macro environment of urban governance through the overall livable brand impact index of the city and science and technology, which helps to improve the mental health of older adults. Therefore, China's city brand influence index, city livable brand index, and urban sustainable competitiveness index can be used as macro-system elements to measure urban renewal at the city level, and their data can be obtained from Statistical Data of Cities at Prefecture Level and Above. Based on this framework, the following hypotheses are proposed:

H1: Urban renewal is positively associated with the mental health of older adults.

In addition, urban renewal provides older adults with more social opportunities and activity space by improving the community environment and public service facilities and promotes them to better integrate into society. This improvement of social adaptability will effectively alleviate the loneliness and social anxiety of older adults [43]. Recent research in environmental psychology and urban studies suggests that rapid urban transformation may disrupt older adults' established social routines and networks, thereby challenging their adaptive capacity and, in turn, affecting their mental health [28]. Furthermore, literature on aging and social integration highlights that social adaptability reflects individuals' cognitive and behavioral flexibility in response to environmental shifts, which is closely associated with both life satisfaction and psychological outcomes [23–25]. Based on the theoretical analysis above, this paper proposes the following hypotheses:

H2a: The social adaptability of older adults acts as a mediating variable in the impact of urban renewal on the mental health of older adults.

H2b: The life satisfaction of older adults acts as a mediating variable in the impact of urban renewal on the mental health of older adults.

Of course, due to the differences in geographical location, regional economy, and natural resources, and the endowment characteristics of different groups are different, the impact of urban renewal on the mental health of different older adults may have varying degrees of influence. Therefore, this paper proposes the following hypothesis:

H3: The impact of urban renewal on the mental health of different older adults may be heterogeneous.

Methods

Data sources

The micro-data used in this study comes from the 2016, 2018, and 2020 waves of the China Longitudinal Aging Social Survey (CLASS), conducted by the China Survey and Data Center of Renmin University of China. CLASS employs a multistage stratified sampling method. At the first stage, counties (or urban districts) are stratified by region and urban/rural status. From this frame, primary sampling units (PSUs) are randomly selected. Villages and neighborhood committees are then selected within these PSUs, followed by the random selection of households and ultimately the target respondent aged 60 years and older within each household.

The baseline survey of the CLASS was conducted in 2014. In 2016, the survey covered 23 provinces (autonomous regions and municipalities directly under the central government), 293 prefectures, 7 regions, 30 autonomous prefectures, and 3 leagues across the country. The 2018 wave successfully interviewed 11,419 respondents, and the 2020 wave successfully interviewed 11,400 respondents. According to the official documentation, the follow-up response rate (the rate of successful re-interviews with baseline respondents) is approximately 80%.

After excluding observations with missing values in the key variables, the final balanced panel consisted of 7,055 individuals observed in all three waves, yielding 21,165 person-wave observations. In addition, the macro-data at the city level was drawn from the China City Statistical Yearbook and China City Yearbook for the corresponding years of 2016, 2018, and 2020.

Variables

Dependent variables

The dependent variable in this paper is the mental health of older adults. Drawing on existing measurement methods of mental health and combining the variables in the CLASS database [44], this study uses the CES-D scale to measure the mental health of older adults, including the nine items of "Did you feel well in the past week?" "Did you feel lonely in the past week?" "Did you feel sad in the past week?" "Did you feel you had a good time in the past week?" "Did you feel eat less in the past week?" "Did you feel sleepless in the past week?" "Did you feel useless in the past week?" "Did you feel

had nothing to do in the past week?" "Did you feel have a lot of fun in the past week?". Among these nine items, the positive-oriented items include "Did you feel well in the past week?", "Did you feel you had a good time in the past week?", and "Did you feel have a lot of fun in the past week?"; their response options are "rarely or none of the time", "some or a small amount of the time", and "occasionally or a moderate amount of the time", with values assigned as 1, 2, and 3 in sequence. The remaining six items are negative-oriented items, which were reverse-coded in this study. The nine items were summed to produce a composite score ranging from 9 to 27, with higher scores indicating fewer depressive symptoms and better mental health. The Cronbach's alpha based on the used Chinese sample is 0.843, suggesting high reliability.

Independent variables

The independent variable in this paper is urban renewal at the household, community, and city levels. Based on existing policy practices and literature studies [45], the indicators at the household level include whether there is a bathroom, a sitting toilet, and an indoor lavatory in the house. The indicators at the community level include whether there are old-age dining tables and old-age daycare stations, old-age activity rooms and libraries, fitness places or facilities, and outdoor event venues in the community. The indicators at the city level include China's city brand influence index, city livable brand index, and urban sustainable competitiveness index.

To reduce information overlap among various urban renewal indicators and achieve indicator dimensionality reduction while preserving the essential information, this paper employs principal component analysis (PCA) to construct the above nine indicators into a composite index and applies the Promax oblique rotation method to rotate the extracted principal components. PCA was conducted using the pooled observations from the 2016, 2018, and 2020 survey waves to obtain a common factor structure and consistent weights across survey years. All variables were Z-score standardized to eliminate the influence of different measurement scales. The KMO value was 0.78, and Bartlett's test of sphericity was significant (χ^2 = 2,500.00, $p < 0.001$), indicating that the data were suitable for PCA. The results indicate that these nine indicators can be statistically summarized into three interrelated latent dimensions; their corresponding eigenvalues are 2.721, 2.403, 2.392, all of which exceed 1. These eigenvalues account for 30.23%, 26.70%, and 26.58% of the information contained in the original indicators, respectively; the cumulative variance contribution rate amounts to 83.51%, which is considered reasonable [46].

According to Supplementary Table S1, Factor 1 primarily comprises bathrooms, sitting toilets, and indoor laboratories, reflecting the accessibility and basic living amenities at the household level; Factor 2 mainly includes old-age dining tables and old-age daycare stations, old-age activity rooms and libraries, and fitness places or facilities, and outdoor event venues, representing age-friendly assistive facilities at the community level; Factor 3 primarily involves China's city brand influence index, city livable brand index, and urban sustainable competitiveness index, reflecting overall urban environmental improvement at the city level. Finally, the variance contribution rates of principal components 1, 2, and 3 are used as weights for weighted averaging to obtain the comprehensive score of urban renewal.

Mediating variables

The mediating variables in this paper include social adaptability and life satisfaction of older adults. Social adaptability is measured by three items from the CLASS questionnaire: "Do you agree that society is changing too fast and it is difficult for me to adapt to such changes?", "Social changes nowadays are becoming more and more unfavorable to older adults", and "I feel that I am still useful to society." The social adaptability index is constructed as the sum of the scores of these three items, with higher scores indicating a higher level of social adaptability; life satisfaction is measured by "Overall, are you satisfied with your current life?". Responses are coded on a five-point Likert scale, ranging from 1 ("very dissatisfied") to 5 ("very satisfied"). For both mediating variables, higher scores indicate greater levels of social adaptability or life satisfaction.

Control variables

We control for a range of variables including individual and social characteristics that may be correlated with the mental health of older adults. We selected gender, age, educational attainment, residence status, physical health, housing ownership, chronic disease, and for individual characteristics; marital status, number of children, living arrangement, economic security, and Internet access frequency for social characteristics. The specific coding scheme for the control variables is as follows: gender is coded as "1" for male and "0" for female. Educational attainment is coded categorically, with "1" for "illiteracy", "2" for "primary school", "3" for "elemental school", "4" for "middle school", and 5 for "high school and above". Residence status is assigned a value of "0" for rural areas and "1" for urban areas. "Physical health" is coded as "1" for very unhealthy, "2" for fairly unhealthy, "3" for average, "4" for fairly healthy, and "5" for very healthy. "Marital status" is coded as "1" for married and "0" for otherwise. "Living arrangement" is coded as "0" for those living alone and "1" for those not living alone. Finally, internet access frequency is coded as "5" for "every day", "4" for "at least once a week", "3" for "at least once a month", "2" for "a few times a year", "1" for "never online".

Empirical strategy

To evaluate the impact of urban renewal on the mental health of older adults, this study constructs the following model:

$$Y_{it} = a_0 + a_1 C_{it} + \beta X_{it} + \mu_t + \delta_i + \varepsilon_{it} \quad (1)$$

In Equation 1, i represents the individual, t represents the year, the dependent variable Y_{it} is the mental health of older adult i in year t, and the independent variable C_{it} measures the intensity or exposure to urban renewal, the X_{it} represents the set of control

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TABLE 1 Variable definitions and summary statistics (China Longitudinal Aging Social Survey, China, 2016, 2018, 2020).

Variables	Variable definition	2016 wave		2018 wave		2020 wave	
		Mean	SD	Mean	SD	Mean	SD
Dependent variables							
Mental health	9-Item CES-D	18.762	5.138	19.221	4.697	19.167	4.358
Independent variables							
Urban renewal	Indicators for measuring the level of urban renewal using principal component analysis, continuous variables	0.077	1.713	0.065	1.748	0.084	1.77
Control variables							
Gender	Male = 1, female = 0	0.502	0.500	0.503	0.500	0.503	0.500
Age	Continuous variables	68.279	6.327	70.278	6.327	72.285	6.344
Education	Illiterate = 1, primary school = 2, elementary school = 3, middle school = 4, high school and above = 5	2.856	1.299	2.857	1.334	2.852	1.330
Residence status	Urban areas = 1, rural areas = 0	0.438	0.496	0.429	0.495	0.423	0.494
Physical health	Very healthy = 5, fairly healthy = 4, average = 3 fairly unhealthy = 2, very unhealthy = 1	3.321	0.941	3.312	0.877	3.299	0.892
Housing ownership	Own house = 1; else = 0	0.821	0.383	0.814	0.389	0.807	0.394
Chronic disease	Number of chronic diseases	1.212	1.571	1.603	1.587	1.831	1.508
Marital status	Married = 1, otherwise = 0	0.754	0.431	0.715	0.451	0.741	0.438
Number of children	Continuous variable	2.529	1.311	2.490	1.335	2.533	1.359
Living arrangement	Alone = 0, otherwise = 1	0.879	0.321	0.884	0.320	0.912	0.296
Economic security	The total amount of each type of social security benefit, in logarithmic values	5.359	2.730	5.770	3.076	5.173	2.385
Internet access frequency	Every day = 5, at least once a week = 4, at least once a month = 3, a few times a year = 2, never online = 1	1.873	1.303	1.922	1.421	1.216	1.564
Mediating variables							
Social adaptability of older adults	Sum of three questions	8.131	3.265	8.603	2.919	8.559	3.116
Life satisfaction of older adults	Very satisfied = 5, Quite satisfied = 4, fair = 3, Quite dissatisfied = 2, very dissatisfied = 1	3.797	0.828	3.772	0.850	3.687	0.881
Instrumental variables							
Urban-rural financial expenditure on urban renewal and communities	Provincial per capital financial expenditures on public affairs in urban and rural communities as a percentage of the total	0.179	0.184	0.203	0.183	0.172	0.121

N = 21,165. CES-D , Center for Epidemiological Survey, Depression scale.

variables, the a_0, a_1 and β are regression coefficients. μ_t and δ_i represent time-fixed effects, and individual fixed effects, respectively, and ε_{it} is the idiosyncratic error term. All analyses were conducted using Stata 16.0.

In the robustness analysis, this study employs the propensity score matching (PSM) method to construct counterfactual outcomes and reduce selection bias arising from observed characteristics. PSM is widely used to estimate treatment effects by comparing outcomes between treated and control groups that are similar in observed characteristics. The average treatment effect on the treated (ATT) is specified as follows:

$$\begin{aligned} ATT &= E\left\{E\left[Y_{1i} - Y_{0i} \middle| C_i = 1, p(X_i)\right]\right\} \\ &= E\left\{E\left[Y_{1i} \middle| C_i = 1, p(X_i)\right] - E\left[Y_{0i} \middle| C_i = 0, p(X_i)\right]\right\} \end{aligned} \quad (2)$$

In Equation 2, the Y_{1i} and Y_{0i} denote the potential mental health outcomes for individual under high and low levels of urban renewal, respectively; C_i is a binary treatment variable, where $C_i = 1$ indicates exposure to a high level of urban renewal, and $C_i = 0$ otherwise. $P(X_i)$ is the propensity score, representing the probability of being in the treatment group conditional on observed characteristics.

Results

Descriptive analysis

Descriptive statistics are summarized in Table 1. The average age of the respondents in 2016 was 68.279. From 2016 to 2018, the mental health of older adults increased from 18.762 to 19.221. The mean economic security score increased from 5.359 in 2016 to 5.770 in 2018, before declining to 5.173 in 2020. From 2016 to 2020, the level of urban renewal in China decreased from 0.077 in 2016 to 0.065 in 2018, before increasing to 0.084 in 2020. However, with the growth of age, the Chronic disease of older adults was inclining, with the average value rising from 1.212 in 2016 to 1.831 in 2020. The mean of older adults' social adaptability increased from 8.131 to 8.559, indicating that the social adaptability of this group was significantly improved. But the mean of older adults' life satisfaction decreased from 3.797 to 3.687.

The impact of urban renewal on the mental health of older adults

This study examined the results of the impact of urban renewal on the mental health of older adults based on the fixed-effects models. Model 1 only contains the core explanatory variables. Model 2 adds the individual characteristics variables based on Model 1. Model 3 further introduces social characteristics variables. The coefficient of urban renewal is 0.491 in Model 1 and 0.331 in Models 3 of Table 2. All three estimates are statistically significant at 1% level.

As for the control variables, education, physical health, marital status, housing ownership, economic security, and internet access frequency are significantly associated with the mental health of older adults, whereas residence status is not statistically significant. Specifically, education, physical health, and housing ownership are positively associated with mental health, while chronic disease is negatively associated with mental health. Among the social characteristic variables, marital status, economic security, and internet access frequency are positively associated with mental health, whereas the number of children, and living arrangement are not significantly associated with mental health. In addition, internet access frequency is positively associated with mental health, suggesting that more frequent internet use is associated with better mental health among older adults.

TABLE 2 Effects of urban renewal on the mental health of older adults (China Longitudinal Aging Social Survey, China, 2016, 2018, 2020).

Variable name	Model 1	Model 2	Model 3
Urban renewal	0.491*** (0.063)	0.338*** (0.075)	0.331*** (0.076)
Gender		0.896 (1.617)	1.032 (1.639)
Age		−0.053 (0.171)	−0.039 (0.173)
Education		0.435*** (0.123)	0.409*** (0.125)
Residence status		0.385 (0.415)	0.369 (0.418)
Physical health		1.112*** (0.085)	1.106*** (0.086)
Housing ownership		0.112** (0.052)	0.108** (0.051)
Chronic disease		−0.146*** (0.050)	−0.150*** (0.051)
Marital status			0.504* (0.293)
Number of children			−0.249 (0.183)
Living arrangement			0.113 (0.269)
Economic security			0.035* (0.018)
Internet access frequency			0.708*** (0.135)
Fixed C_{it}	Yes	Yes	Yes
Fixed year	Yes	Yes	Yes
N	21165	21165	21165
R-squared	0.000	0.012	0.016

***, **, * denote 1%, 5%, and 10% significance levels, respectively.

Robustness analysis

The mental health of older adults at the micro level does not affect the level of urban renewal at the macro level, and the reverse causality between the two is relatively weak; however, potential endogeneity caused by omitted variables cannot be completely ruled out [9]. To further examine the robustness of the results, we employ the instrumental variables (IV) method and the propensity score matching (PSM) method. Referring to the practice of Lu et al. [47], we select the urban-rural financial expenditure on urban renewal and communities of each province as an instrumental variable for the urban renewal index. According to the Chinese government's revenue and expenditure classification system, this expenditure category comprises core expenditure items focused on the construction of urban and rural community public facilities, environmental sanitation, and planning and management; it does not include funding for social security, elderly care services, mental health, or medical and health services. This variable is closely related to the level and growth rate of urban renewal and therefore provides a plausible source of variation in the urban renewal index. Table 3 reports the IV regression results. In the first-stage regression, the coefficient of urban-rural financial expenditure on urban renewal and communities is positive and statistically significant at the 1% level, indicating that the instrumental variable is significantly associated with the urban renewal index and satisfies the relevance requirement of the IV strategy. The first-stage F-statistic is 42.18, which exceeds the conventional threshold of 10, providing evidence against the concern that the instrument is weak. In addition, the Kleibergen-Paap rk LM statistic is 38.45 ($p < 0.01$), rejecting the null hypothesis of underidentification and supporting the identification of the endogenous regressor. The Cragg-Donald Wald F statistic is 40.62, which is also substantially higher than the conventional critical value of 10, providing further evidence that the instrument is unlikely to suffer from a severe weak-instrument problem. In the second-stage regression, the coefficient of urban renewal is positive and statistically significant, indicating that the positive association between urban renewal and mental health of older adults remains after instrumenting for urban renewal. These results are broadly consistent with the direction of the main

TABLE 3 Instrumental variable regression results (China Longitudinal Aging Social Survey, China, 2016, 2018, 2020).

	First-stage regression	Second-stage regression
Urban-rural financial expenditure on urban renewal and communities	0.567*** (0.089)	----
Urban renewal	----	0.379*** (0.062)
Control variable	Yes	Yes
Fixed C_{it}	Yes	Yes
Fixed year	Yes	Yes
First-stage F-statistic	42.18	----
Kleibergen-Paap rk LM	38.45***	----
Cragg-Donald Wald F statistic	40.62***	----
N	21165	21165
R-squared	0.061	0.073

***, **, * denote 1%, 5%, and 10% significance levels, respectively. The Cragg-Donald F statistic (40.62) exceeds the Stock-Yogo 10% critical value (16.38), rejecting concerns over weak instruments.

regression results and provide supplementary evidence for the robustness of the baseline findings.

In propensity score matching, this study divided the samples into two groups of "high urban renewal level" and "low urban renewal level" based on the sample median value of urban renewal, with high urban renewal level as the experimental group and low urban renewal level as the control group. The control variables are used as the criteria for matching, and the 1:1 nearest neighbor matching method with put-back is used to match, obtaining Model 1 and Model 2 respectively. The results of the balance test show that the standardized deviation of covariates after matching is less than 5% and the t-tests fail to reject the null hypothesis of equal means between the treatment and control groups after matching, which indicates that the differences between the characteristics of the experimental group and the control group have been eliminated to a greater extent and that the matching effect is good. The results of the matched samples are presented in Model 3 of Table 4. After 1: 1 nearest-neighbor matching, the average treatment effect on the treated (ATT) is 0.336 ($p < 0.01$), indicating that higher levels of urban renewal are positively associated with better mental health among older adults. The estimated effect size is consistent with the main fixed-effects estimates reported in Table 2 (Model 3), confirming the robustness of our findings. Balance tests show that all standardized biases are below 5% after matching, suggesting that the matching procedure effectively eliminated observed differences between the treatment and control groups.

Mechanism analysis

To further examine the potential mediating pathways through which urban renewal is associated with the mental health of older adults, this study draws on existing research to conduct mediation analyses [48]. The results are presented in Table 5.

TABLE 4 Results of propensity value matching (China Longitudinal Aging Social Survey, China, 2016, 2018, 2020).

	Before matching	After matching	After matching with controls
Urban renewal	0.453*** (0.084)	0.378*** (0.092)	0.336*** (0.087)
Control variable	No	No	Yes
N	21165	21165	21165
R-squared	0.032	0.045	0.028

Nearest-neighbor matching is done on a 1:1 basis.
***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

The results of Model 1 show that urban renewal was positively associated with the social adaptability of older adults at the 1% significance level, indicating that the higher the level of urban renewal, the better the social adaptability of older adults. Model 2 shows that the increase in social adaptability of older adults was positively associated with the mental health of older adults. Meanwhile, urban renewal was still positively associated with the mental health of older adults, indicating that social adaptability may serve as a potential positive mediating pathway in the relationship between urban renewal and older adults' mental health. Model 3 shows that urban renewal was positively associated with the life satisfaction of older adults at the 1% significance level, which indicates that greater urban renewal progress is significantly associated with older adults' life satisfaction. Model 4 shows that life satisfaction was positively associated with the mental health of older adults.

Heterogeneity analysis

To further explore whether the association between urban renewal and mental health varies across different subgroups, we conducted subgroup analyses by residence and age group. The results are presented in Supplementary Table S2. For rural residents, the level of urban renewal was positively associated with mental health of older adults (coefficient = 0.381, $p < 0.01$). For urban residents, urban renewal was not significantly associated with the mental health of older adults. We also test this implication by running a subgroup analysis across the age group. The Model 2 results showed the implementation of urban renewal was positively associated with the mental health of older adults aged 60–69 and 80 years or older, while it was not significantly associated with the mental health of older adults aged 70–79.

Discussion

Based on the panel data from the 2016, 2018, and 2020 waves of the China Longitudinal Aging Social Survey (CLASS), this study selects nine indicators at the household, community, and city levels, and constructs a comprehensive indicator reflecting urban renewal through principal component analysis methods. Then, it empirically analyzes the impact of urban renewal on the

TABLE 5 Intermediary mechanism test(China Longitudinal Aging Social Survey, China, 2016, 2018, 2020).

	Model 1 Social adaptation of older adults	Model 2 The mental health of older adults	Model 3 Life satisfaction of older adults	Model 4 The mental health of older adults
Urban renewal	0.158*** (0.041)		0.310*** (0.074)	
Social adaptation of older adults		0.678*** (0.032)		
Life satisfaction of older adults				1.095*** (0.086)
Control variable	yes	yes	yes	yes
Fixed Cit	yes	yes	yes	yes
Fixed year	yes	yes	yes	yes
N	21165	21165	21165	21165

Nearest-neighbor matching is done on a 1:1 basis.

mental health of older adults by the fixed-effects model. The findings show that urban renewal was positively associated with the mental health of older adults, and this conclusion was still valid after using instrumental variables to overcome endogeneity bias and the propensity score matching method (PSM) for robustness estimation. These findings suggest that age-friendly household facilities, community amenities, and broader urban environmental conditions are positively associated with older adults' mental health [49]. This is similar to the results of the urban built environment and people's health [50], community neighborhood environment and people's health [51], and urban green spaces and people's health [52].

Furthermore, the results of the study show that urban renewal was positively associated with the mental health of older adults by increasing their social adaptability and life satisfaction. What can be found is that the effect of life satisfaction may outweigh social adaptability in mediating mental health. According to the stress-coping model, the life satisfaction of older adults can be regarded as a process in which individuals interact with the social environment and achieve inner harmony through self-adjustment [53]. Urban renewal initiatives, including age-friendly improvements to household facilities and the provision of barrier-free community infrastructure enhance the older adults' perception of environmental control and further reduce the load of older adults' life through the allocation and supply of urban public resources [54]. This is similar to the research results on life satisfaction and the mental health of older adults [55]. Compared with life satisfaction, social adaptation ability depends more on long-term emotional accumulation. Finally, the heterogeneity analysis shows that older adults living in rural areas or aged 60–69 and 80 years or older benefit more than those living in cities or other ages.

Policy implications

In recent years, China's urban renewal projects have changed from the market-driven incremental expansion mode to the stock improvement mode with connotation improvement as the core. High-quality development has received extensive attention from the Chinese government and all sectors of society. In 2024, China's Ministry of Housing and Urban-Rural Development issued the "Notice on Promoting Urban Renewal in a Solid and Orderly Manner", aiming to promote the fine and high-quality development of urban renewal. The empirical results of this study make the following recommendations:

1. Taking the needs of older adults as the goal orientation, we should promote the urban renewal project related to the wellbeing of older adults in a multi-dimensional way from the household, community, and city levels. Along with urban renewal shifting from bulldozing and clearing under-resourced areas to a stage focusing on humanistic and sustainable development [56], the urban renewal of various countries has entered the stage of high-quality development, gradually evolving from focusing only on physical space to focusing on the multidimensional process of urban preservation, restoration, and reuse. The renewal mode has also shifted from single-dimensional hardware transformation to a multi-dimensional direction of focusing on the quality of the human environment, improvement of social services, and upgrading of urban connotation [57]. In the new era, urban renewal, which is centered on the reorganization of urban elements, urgently needs to construct a new form of livable cities from the perspective of the wellbeing of the target objects. At the same time, in the face of the increasing aging of the population, urban renewal should be actively adapted to the strategy of active aging, strengthen the aging-adapted renovation of facilities such as residence conditions and activity venues, and promote the aging-adapted adjustment of services such as daily care, culture, and recreation, to ensure that urban renewal work is more closely related to the actual needs of older adults.
2. Taking health equity as the outcome orientation, the top priority of the urban renewal project is to popularize healthy life, balance

health services, improve health security, and build a healthy environment. In urban renewal, it is necessary to implement a more detailed and scientific regional differentiation strategy, gradually reduce the urban-rural differences brought about by household registration through the optimal allocation of resources, and lead the development of equalized public services through urban renewal, to eliminate the "Matthew effect" caused by the uneven allocation of resources for the older adults. Accelerate the progress of urban renewal from home to community and from rural to urban areas, so as to narrow the gap in facility sharing of older adults. Given the gap between local economic development and urban materialization level, the allocation of urban renewal resources should prioritize areas with lower economic levels and incomplete infrastructure. For example, the establishment of special online activity rooms for older adults in communities can meet their Internet use needs and narrow the gap between urban and rural areas in digital infrastructure. Considering that older adults have difficulty getting up and need to rely on desktop support, we can design armrest positions at the edge of the dining table. For older adults with visual impairments or mobility limitations, installing night lights and appropriately positioned grab bars may improve nighttime mobility and reduce fall risks.

Limitations

There are some shortcomings in this study. Urban renewal is an extremely complex project involving a wide range of projects. Although this study has accounted for the diversity and differences of relevant projects and selected indicators at the household, community, and city levels, the nine indicators adopted in this paper still have limitations in capturing the full picture of urban renewal levels, due to data availability constraints. While the fixed-effects framework and controlled observed time-varying variables help alleviate concerns about confounding bias, they cannot fully eliminate endogeneity bias caused by unobserved time-varying factors, heterogeneous urban development trajectories, and different degrees of exposure to the COVID-19 pandemic. In addition, the impact of urban renewal on the mental health of older adults may have a lag effect, and short-term data do not fully reflect the external effects of this project. Future research can further optimize the selection of indicators and research methods to pinpoint the level of urban renewal and its impact on the mental health of older adults and even on other people's wellbeing.

Conclusion

This study provides evidence of a positive association between urban renewal and the mental health of older adults in China, with social adaptability and life satisfaction playing a mediating role, and that older adults in different regions and ages benefit differently from urban renewal. Our study emphasizes the need to further increase urban renewal efforts in the future to improve the adaptability of facilities and services at the household, community, and city levels, thereby expanding the benefits of urban renewal on the mental health of older adults.

Data availability statement

The datasets generated and/or analyzed during the current study are available in the China Longitudinal Aging Social Survey (CLASS) repository, http://class.ruc.edu.cn/index.php? r=index/index &hl=en.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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Conflict of interest

The authors declare that they do not have any conflicts of interest.

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.ssph-journal.org/articles/10.3389/ijph.2026.1609984/full#supplementary-material

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